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Polycyclic Aromatic Hydrocarbons (PAHs) Metabolism by White Rot Fungi *Agaricomycetes sp* AGAT and Its Microcosm Study

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Abstract Hydrocarbon pollution is a perennial problem not only in India but throughout the globe. A plethora of microorganisms have been reported to be efficient degraders of these recalcitrant pollutants. In the present study the Basidiomycetous a fungal isolate *Agaricomycetes sp.* AGAT was isolated from wood bark collected from Anand, Gujarat India. The isolate was screened for production of ligninolytic enzyme by primary and secondary screening. The isolate *Agaricomycetes sp.* AGAT is also able to degrade the polycyclic aromatic hydrocarbons (PAHs) present in the contaminated soil. The basidiomycetous fungal *Agaricomycetes sp.* AGAT was able to grow on 100 ppm Pyrene, Phenanthrene, Fluorene and Fluoranthene as a sole source of carbon in minimal medium. Maximum degradation of 78.53%, 85.05%, 20.5% and 70.49% of Phenanthrene, Pyrene, Fluoranthene and Fluorene respectively. The depletion in the residual PAHs in the culture medium was determined by HPLC. By GC-MS analysis metabolites were identified as 1-hydroxypyrene and phthalic acid from Pyrene, 9H- Fluoren-9-ol from Fluorene, Fluorene, 4-[1,2-dihydroxethyl] from Fluoranthene and 9,10-dihydro-9,10-dihydroxyphenanthrene from Phenanthrene. Further effect of surfactants, mediator were also studied. Phytotoxicity study of degraded metabolite was also studied.

Keywords: *Agaricomycetes sp. AGAT, polycyclic aromatic hydrocarbons (PAHs), phytotoxicity*

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1. Introduction

Basidiomycetes group are regarded as most interesting group of fungi with their ability to grow under detrimental environment condition constantly acting as natural degraders of lignocellulose [1]. They are further classified into brown rot fungi and white rot fungi according to the way they degrade wood. Brown rot fungi have ability to degrade wood polysaccharides while white rot fungi have ability to decompose all wood polymers including lignin. White rot fungi are known for actively degrading lignin because of presence of extracellular enzyme complex containing lignin peroxidase (LiP, E.C. 1.11.1.14), manganese peroxidase (MnP, E.C. 1.11.1.13) and laccase (Lac, E.C.1.10.3.2). These enzymes are involved in oxidation of lignin present in wood and in oxidation of xenobiotic compounds including synthetic dyes and polycyclic aromatic hydrocarbons (PAHs).

Contamination of environment by aromatic compounds has become one of the global problem. Polycyclic aromatic hydrocarbons (PAHs) contamination is serious and increasing problem for human and ecosystem because of spill in soil, water and other natural resources. Polycyclic aromatic hydrocarbons (PAHs) are a group of organic compound having two or more fused benzene ring which have been identified as persistent organic pollutants and are of great concern due to the characteristics of toxicity, mutagenicity and carcinogenicity. The US Environmental Protection Agency (US EPA) has listed 16 PAHs as priority pollutants [2,3]. PAHs are formed due to incomplete pyrolysis of organic materials such as petroleum, coal and wood.

Various potential techniques are being developed now-a-days to overcome these problems. Microbiological process of degradation of organic pollutants is considered as a promising method for environmental problem. Use of microbial resources for remediation of PAH contaminant has been important 'green solution' [4,5,6]. Bioremediation is the technique using microbes (bacteria, fungi and algae) which degrade or transform and mineralize contaminants to carbon di oxide and water. Bioremediation is simple process that is economical, versatile, ecofriendly and efficient as compared to chemical technique that produce toxic intermediate and have lower bioavailability for contaminants. The extracellular ligninolytic enzymes secreted by white rot fungi oxidize PAHs via a non-specific, radical-based reaction with corresponding quinones [7]. Catalysis reaction by laccase depends on the monoelectronic oxidation transforming the substrate to reactive radicals with the help of mediator [8]. Use of various mediators (ABTS, HBT and Phenol) for enhancement of PAH degradation have being reported by [9,10,11]. PAHs bioavailability can be enhanced by

addition of surfactants which increase its surface tension and increase its solubilization through formation of micelles in solution. This phenomena is observed at its critical micellar condition (CMC) [12].

The main objective of the present work was to study degradation of Pyrene, Phenanthrene, Fluoranthene and Fluorene by white rot fungi *Agaricomycetes sp* AGAT. Attempts were made for enhancing the degradation of PAHs by addition of surfactants and mediators to the medium. The potential isolate *Agaricomycetes sp* AGAT was explored for its interaction with indigenous microflora present in the soil through microcosm study. Degraded metabolites were analyzed using HPLC and GC-MS analysis.

2. Materials and Method

2.1. Microorganisms and Culture Conditions

Agaricomycetes sp AGAT (Genbank accession no. KT153994) was grown on 2% Malt extract agar (MEA). MEA contained (g/l) Malt Extract 30.0, Peptone 5.0, and Agar 25.0 (pH: 5.4) at 30℃.

2.2. Chemicals

ABTS (2, 2-Azino-bis (3-ethylbenzthiozoline-6-sulphonic acid), Phenol and HBT (1-hydroxybenzotriazole) was purchased from Sigma Aldrich (Sigma St. Louis, MO, USA). Malt Extract Agar (MEA), glucose, sodium acetate, KH_2PO_4, H_3BO_3, $NaNoO_4$, Alk $(SO_4)_2$, yeast extract, sodium dedecyl sulphate (SDS), sodium sulphate, thiamine were purchased from Hi-Media Labs (Mumbai, India). Ammonium tartrate, copper (II) sulphate pentahydrate, manganese (II) sulphate monohydrate, magnesium sulphate heptahydrate, calcium chloride dihydrate, zinc sulfate were procured from S D Fine chemicals (Mumbai, India). Tween 80, Triton X-100, Ethyl acetate, Acetone, Acetonitrile, HCl and HPLC grade water were purchased from Merck (Mumbai, India).

Polycyclic aromatic hydrocarbon (PAHs) Pyrene, Phenanthrene, Fluorene and Fluoranthene were procured from Sigma Aldrich (Sigma St. Louis, MO, USA).

2.3. Enzyme Assays

Laccase (E.C.1.1.03.2) activity was determined by measuring the oxidation of 2, 2'-azino-bis 3-ethylbenzothiazoline-6-sulphoric acid (ABTS) as increase in absorbance for 3 minutes was measured spectrophotometrically at 420nm ($\varepsilon = 36000 cm^{-1} M^{-1}$) [13]. The reaction mixture contained 100µl of 50 mM ABTS and 800 µl of 20 mM Sodium Acetate buffer (pH 4.5) and 100 µl of appropriately diluted enzyme extract. One unit of enzyme activity was defined as the amount of enzyme that oxidized 1 µM of corresponding substrate per min.

2.4. Isolation, Screening and Identification of Isolated Fungal Strain

Various mushroom samples, decayed wood and barks of trees were collected from the nearby regions of Vadodara (22°19'18.64" N 73°09'19.19" E) and Anand (22°33'08.87" N 72°55'38.68" E) Districts, Gujarat, India. Samples collected were screened for the presence of ligninolytic enzymes. Surface sterilization of collected samples was performed by suspending in 0.01 %(v/v) mercuric chloride solution for 2-3 minutes followed by washing. The samples were placed on 2% (w/v) malt extract agar (MEA) plates containing streptomycin (25µg/ml) and the plates were further incubated at 28℃ for 8-10 days. Isolated cultures were repeatedly sub cultured to obtain a pure culture. Microscopic studies were performed to study the characteristic of white rot fungi. Further samples were screened for the phenol oxidase activity. The presence of laccase enzyme (primary screening) was studied using various chromogenic substrates like ortho-dianisidine; guaiacol and gallic acid at a concentration of 0.01% (w/v) supplemented in 2% (w/v) malt extract agar plates. The actively grown culture (agar plugs) were placed on the plates and incubated at 28℃ for 10 days. Fungal isolate showing positive Bevandamm's reactions were further explored for the quantitative detection of ligninolytic enzymes. Cultures were maintained on MEA plates at 30℃ and stored at 4℃.

Quantitative detection (secondary screening) of ligninolytic enzyme was performed using 5.0 gm of wheat bran as a solid substrate with Asther's medium as a moistening agent under solid state fermentation.

The molecular identification of the new isolate AGAT was done by using ITS4 (TCCTCCGCTTGATATGC) and ITS5 (GGAAGTAAAAGTCGTAACAAGG) gene sequencing by Agarkhar Research Institute (ARI) Pune, India.

2.5. PAHs Degradation

Degradation studies were conducted in 250ml Erlenmeyer flasks containing 100 ml of degradation medium prepared according to Tien & Kirk [14] containing (g/l) glucose 10, ammonium Tartrate 0.2, sodium acetate 3.28, thiamine 2, KH_2PO_4 2; $MgSO_4.7\ H_2O$, 0.53; $CaCl_2$, 0.1; $CuSO_4$, 0.001, $MnSO_4$, 0.005; H_3BO_3, 0.001; $NaMoO_4.\ 2H_2O$, 0.0001; $ZnSO_4.\ 7H_2O$, 0.0001; $AlK\ (SO_4)_2.\ 12H_2O$, 0.0001; and yeast extract 0.5. The pH of the medium was adjusted to 5.0 with 2N HCl. Flasks were sterilized at 121℃ for 20 min. Thiamine was separately filter sterilized and added thereafter. All the flasks were inoculated with fungal agar disc of 9 mm diameter from the edge of the actively growing culture. All the flasks were incubated at 28℃ at 100 rpm for 6 days. Stock solution of PAHs were prepared in acetone, filter sterilized with help of 0.2 µm filter and added to 6 day old culture at a final concentration of 100 ppm. All the flasks were re-incubated at 28℃ at 100 rpm for 25 days.

2.5.1. Effect of Surfactants on PAHs Degradation

Surfactants plays an important role in degradation of PAHs in order to study the effect of surfactant the degradation medium was seeded with surfactants like SDS, Triton X-100 and Tween 80 at a concentration of 0.1,1 and 2mM. Control flask was without surfactant.

2.5.2. Effect of mediator on PAHs degradation

Mediator plays an important role in degradation of PAHs in order to study the effect of mediator the degradation medium was seeded with mediator like ABTS,

Phenol and HBT at a concentration of 0.1,1 and 2mM. Control flask was without mediator.

2.6. Extraction of Residual PAHs

The entire content of the flask (100ml) were extracted for determination of residual PAHs.

After addition of PAHs to six day old culture extraction was done on 5th, 10th, 15th, 20th and 25th day of incubation. The mycelia was filtered using Whatman filter paper No1. The liquid was extracted in double volume of ethyl acetate, kept at 30℃ at 150 rpm for 30 mins. The mixture was separated using separating funnel. The organic phase was collected and saved.

The extract obtained was dried using anhydrous sodium sulphate to remove aqueous phase.

2.7. Calculations for PAHs Degradation Rate

Degradation rate of PAHs was calculated by subtracting the amount of PAH extracted from the abiotic control from the other samples. The rate of degradation was calculated as:

PAH degradation rate (%) = Abiotic control extraction (100%) - Sample extraction

Sample extraction means filtrate obtained.

2.8. Microcosm Study

Microcosm preparation was planned in four different sets of soil model systems were prepared as:

- (Set A)-Sterile soil containing PAH which served as abiotic control
- (Set B)-Sterile soil supplemented with PAH (100ppm) was inoculated by *Agaricomycetes sp* AGAT to determine the PAH degradation efficiency by *Agaricomycetes sp* AGAT in absence of indigenous organisms
- (Set C)-Non sterile Soil with native or indigenous organisms and PAH, to evaluate the intrinsic ability of soil to degrade PAH
- (Set D)-Non sterile soil supplemented with PAH and inoculated with *Agaricomycetes sp* AGAT to check the degradation rate by *Agaricomycetes sp* AGAT in presence of indigenous flora.

2.9. Analytical Procedures

2.9.1. Determination of residual PAHs:

The residual PAHs were analyzed by reverse-phase HPLC (Shimadzu, Japan) equipped with Nuclosil 100-5 Column (C-18 PAH Column, 250mm X 4.6mm) series 200 pump. Detection was done using D2 detector set at 254 nm. Dried samples were re-extracted in 1 ml of mobile phase (Acetonitrile: Water, 70:30), filtered through 0.2µM filter and 20µl was injected to HPLC Column.

2.9.2. Detection of Metabolites

The residual metabolite was extracted from the sample with equal volume of ethyl acetate. Further 2ml of sample was transferred to GC vial for GC-MS analysis carried out by using Shimadzu Gas Chromatograph Mass Spectrophotometer GC-MS (Shimadzu). The total sample injected was 2µl.

2.9.3. Phytotoxicity Analysis

The method of testing of Phytotoxicity of PAHs and its metabolites was performed according to Kalme *et al.*, [15]. The test was carried out for standard and the extracted metabolites on the seeds of *Triticum aestivum*, common Indian agricultural crops. Ten seeds were supplied daily with 10ml of standard and extracted metabolites dissolved in water for 7-10 days in small pots, maintaining light and temperature (30℃) in a controlled environment. Toxicity effect was measured in terms of percent germination, lengths of root and shoot of the plant after 7-10 days.

2.9.4. Data Analysis

The data in subsequent sections represent arithmetic mean values of three experimental repetitions (each one was made in duplicate).

3. Results

3.1. Isolation and Primary Screening

Table 1. Response of different fungal isolates on MEA plates containing different chromogenic substrates

Strain No	Isolate code	Primary screening Chromogenic substrates (0.01%w/v) ODA	Guaiacol	Gallic Acid	Secondary screening Laccase (U/gm)
1	AGAT	++++	++++	++++	117653.8
2	AGAT - 1	+++	+++	+++	60166.6
3	AGAT - 2	ND	ND	ND	ND
4	AGAT - 3	+	+	+	10077
5	AGAT - 4	++	++	++	52250.7
6	AGAT - 5	ND	ND	ND	ND
7	AGAT - 6	ND	ND	ND	ND
8	AGAT - 7	ND	ND	ND	ND
9	AGAT - 8	+	+	+	5145.8
10	AGAT - 9	++	++	++	20250.6
11	AGAT - 10	ND	ND	ND	ND
12	AGAT - 11	ND	ND	ND	ND
13	AGAT - 12	++	++	++	28520
14	AGAT - 13	+	+	+	2053
15	AGAT - 14	ND	ND	ND	ND

++++ - Excellent producer, +++ - Good producer, ++ - Moderate producer, + - poor producer, ND- No detection of colored zone on MEA plates containing chromogenic substrates

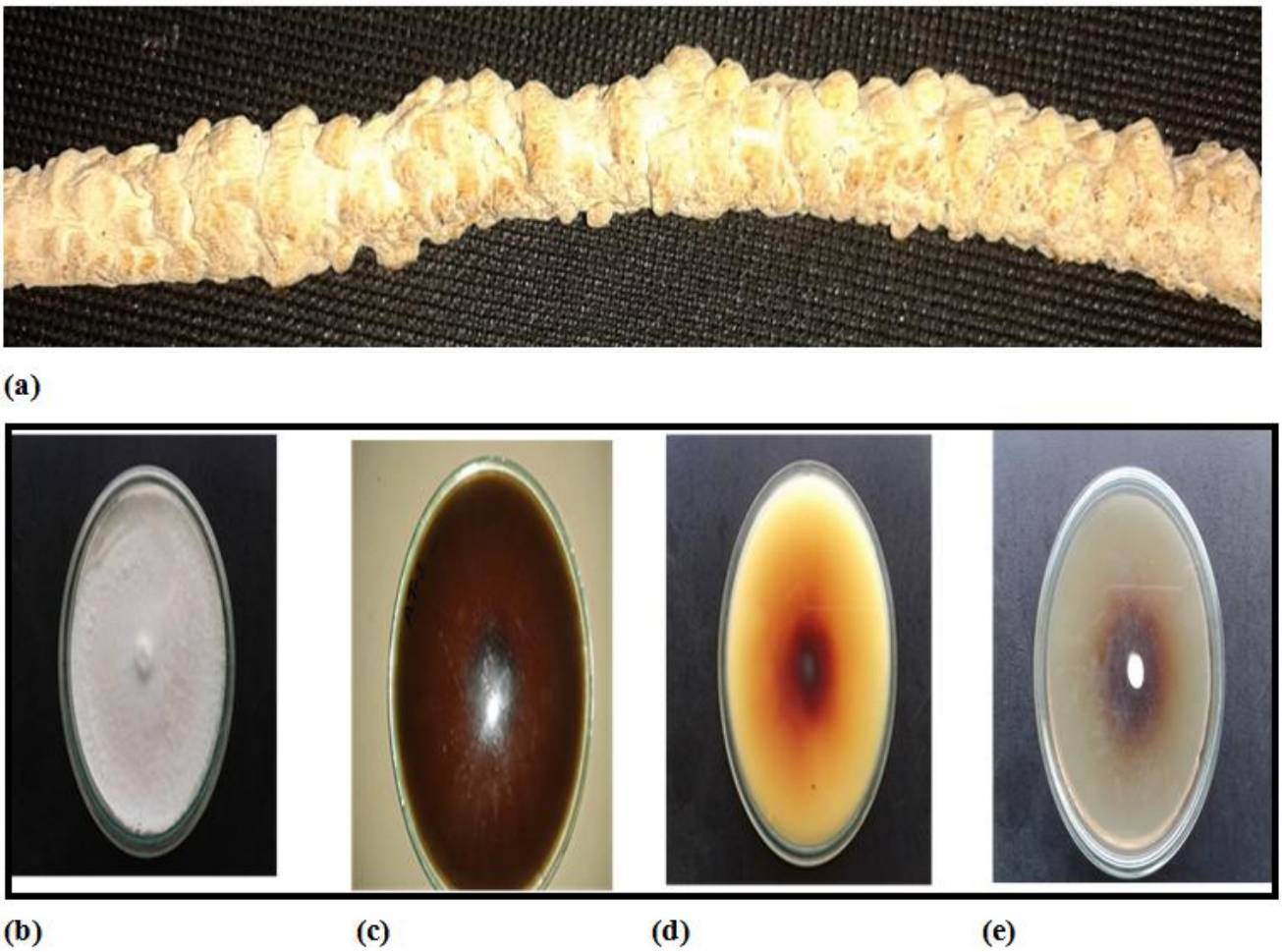

Figure 1. (a) Fruiting Body of AGAT. (b) Growth pattern of AGAT on 2%MEA, (c) - (e) Plate assay for Laccase on MEA plate containing different chromogenic substrates viz. orth-dianisidine, Guaiacol and Gallic acid

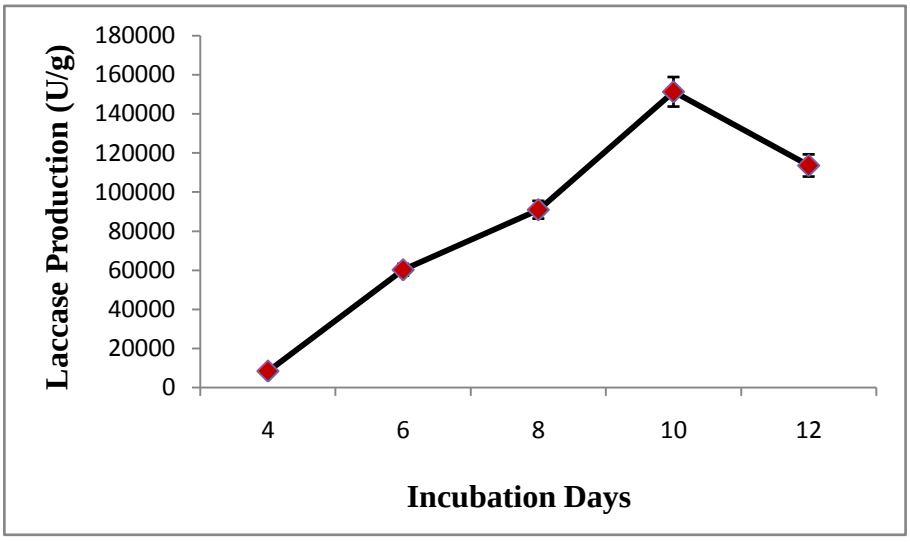

Figure 2. Secondary screening for laccase production

In the present study out of 15 isolates only 8 isolates were potential to produce ligninolytic enzyme by plate assay method. Dark brown zone surrounding the growth of mycelial disc on MEA plate containing o-dianisidine and gallic acid. Reddish brown colour zone was observed with plate containing guaiacol at concentration of 0.01% w/v (Figure 1). This is a characteristic of phenol oxidase which indicates of positive bevandamm's reaction for laccase activity. Further the isolate were classified as poor, moderate, good and excellent producer of laccase (Table 1).

Secondary screening of laccase was done using wheat bran as solid substrate and Asther's medium as moistening agent under solid state fermentation (SSF) (Figure 2). Maximum production of 1.65 X 10^5 U/g of dry substrate was obtained on 10th day of incubation for wheat bran. Hence, on the basis of primary and secondary screening isolate AGAT was selected and explored for PAHs degradation.

3.2. Identification of the Fungal Isolate

3.2.1. Macroscopic Characteristics

Isolate AGAT fruiting body was found to be grown on bark of wood of mulberry tree with fleshy white mat like growth. Strain grew well on MEA covering the entire plate in 8-10 days incubated at 28℃.

3.2.2. Microscopic Characteristics

Microscopic examination of fruiting body revealed the presence of Basidiospores and gleopleros hyphae and binding hyphae as shown in Fig 3.sp Spore observed were size of around 12.56 X 7.75 µm. The molecular identification of the new isolate AGAT was confirmed by isolation of genomic DNA followed by amplification of ITS region of rDNA using universal fungal primers ITS4 and ITS5 (Agharkar Research Institute, Pune). Similarity of the DNA sequence in Genbank Database was found to be same with *Agaricomycetes sp.* with 99% similarity. The isolate was identified as *Agaricomycetes sp.* AGAT with Genbank Accession No KT153994 (Figure 4).

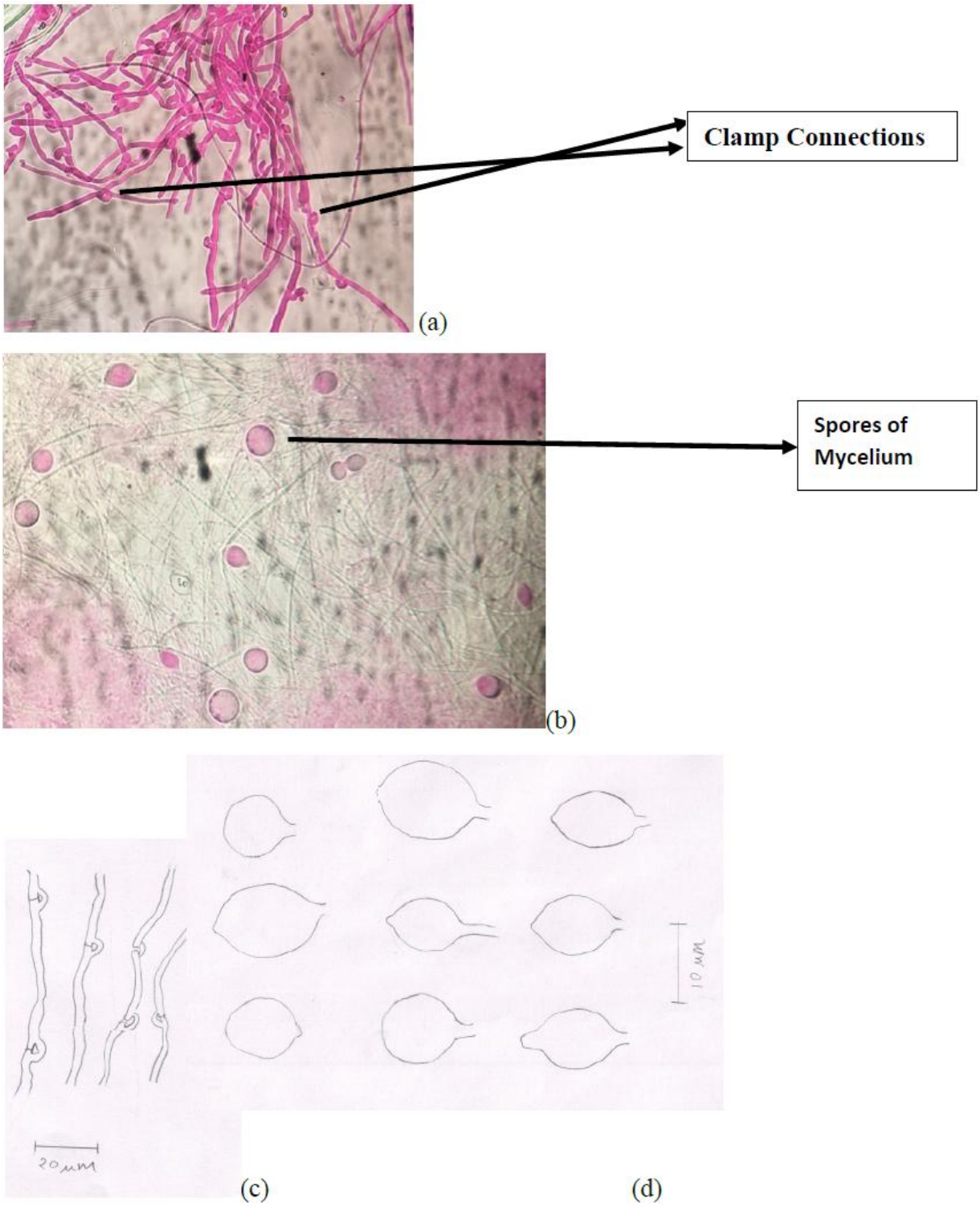

Figure 3. (a) Clamp connection observed in mycelium (b) Spores of mycelium (c) generative hyphae with clamp connection (d) Spores of mycelium

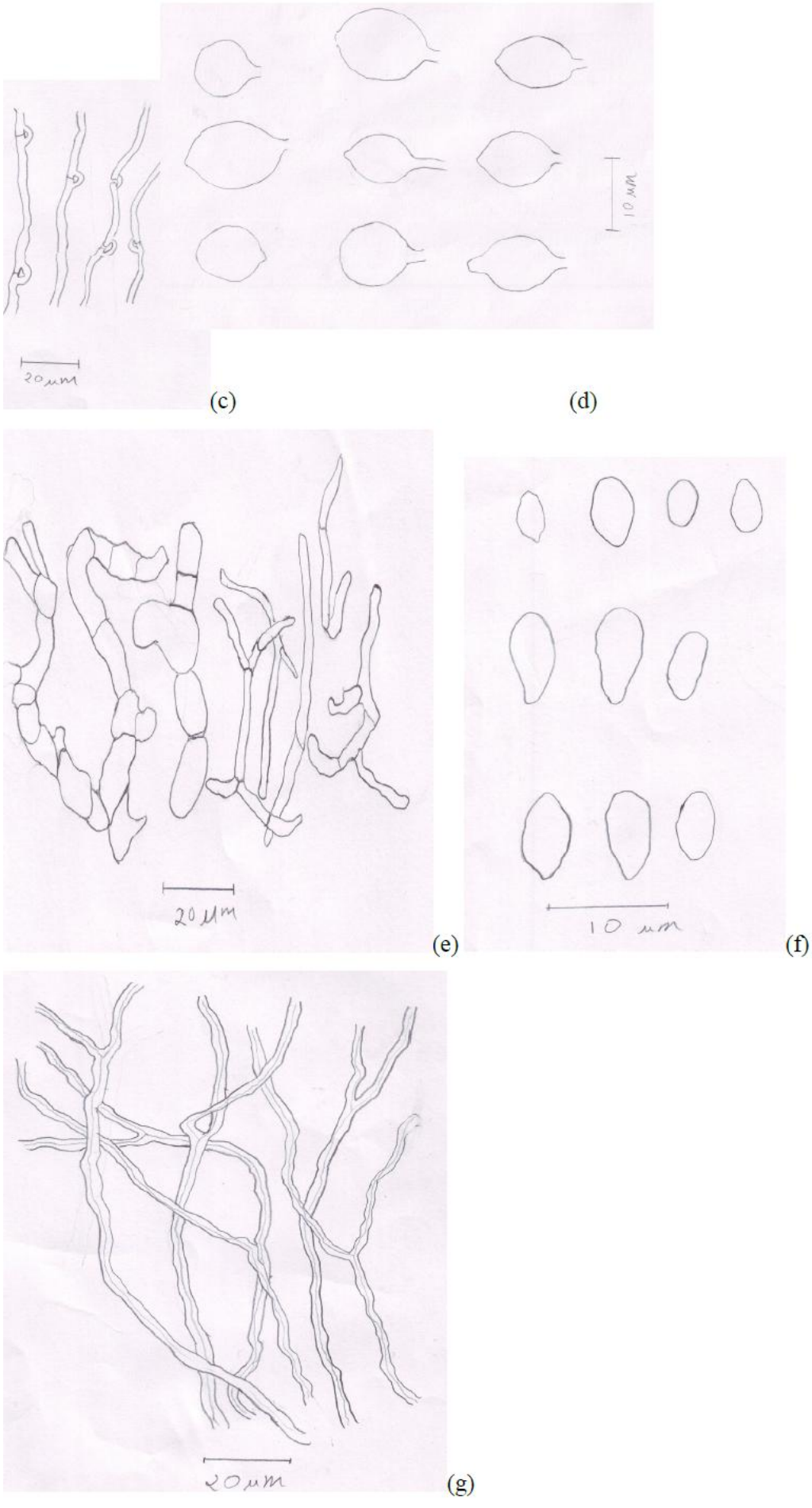

Figure 3. (e) Gloeopleros hyphae (f) Basidiospores observed in fruiting body (g) Binding hyphae.

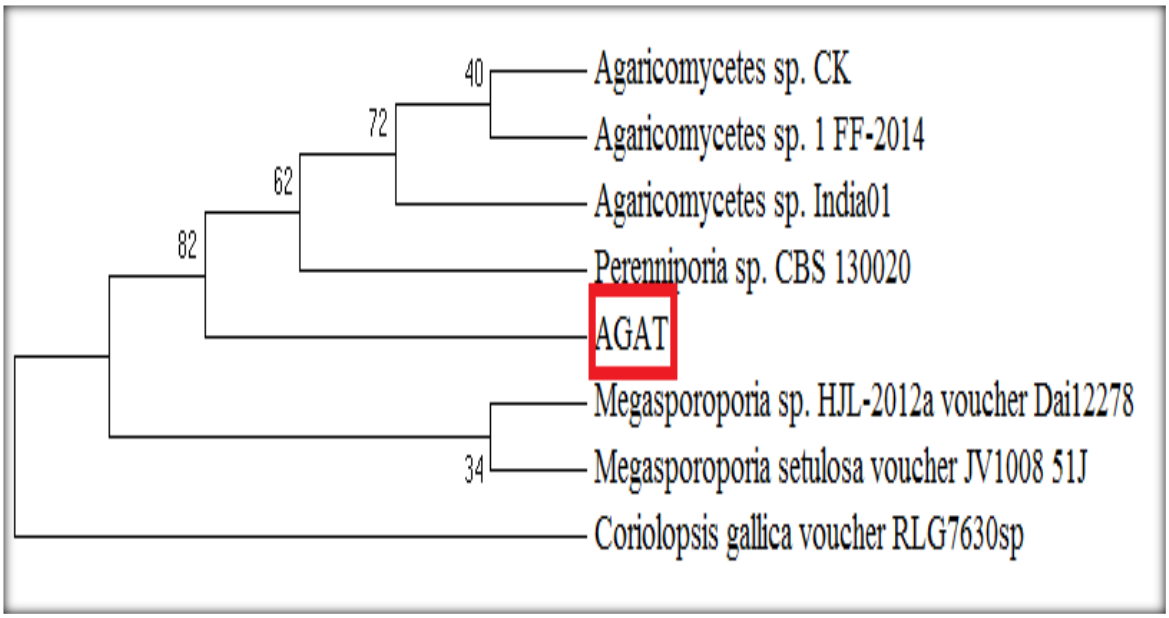

Figure 4. The bootstrapped unrooted tree of AGAT by NJ analysis

3.3. Growth of Fungal Culture *Agaricomycetes sp* AGAT on PAHs

The isolate *Agaricomycetes sp.* AGAT was grown on MEA plate containing 100 ppm of each PAH (Benzo (a) Anthracene, Fluorene, Pyrene, Acenaphthene, Anthracene and Phenanthrene).the isolate *Agaricomycetes sp.* AGAT was able to grow and utilize PAH as a sole source of carbon and energy as shown in Figure 5. Table 2 shows the growth in terms of zone of proliferation of isolate *Agaricomycetes sp.* AGAT on 8th day of incubation.

3.4. Degradation of PAHs by *Agaricomycetes sp* AGAT

The isolate *Agaricomycetes sp.* AGAT was grown in degradation medium (Minimal Salt medium) by spiking with different PAHs as sole source of carbon and energy. Degradation study using LMW PAH like Phenanthrene and Fluorene while HMW PAH like Pyrene and Fluoranthene was done. *Agaricomycetes sp.* AGAT was able to degrade 30.5% Phenanthrene in 20 days with 1250 U/ml of enzyme activity. Degradation of PAHs was dome more efficiently in presence of co-substrate such as glucose (Figure 6).

Table 2. Growth of Fungal Culture on MEA Plate with different PAHs (100 ppm) on 8th day of incubation period

PAHs	Diameter (cms)
Malt Extract (Control)	9.0
Pyrene	8.25
Anthracene	8.5
Fluorene	7.25
Fluoranthene	9.0
Phenanthrene	3.9
Acenaphthene	4.0

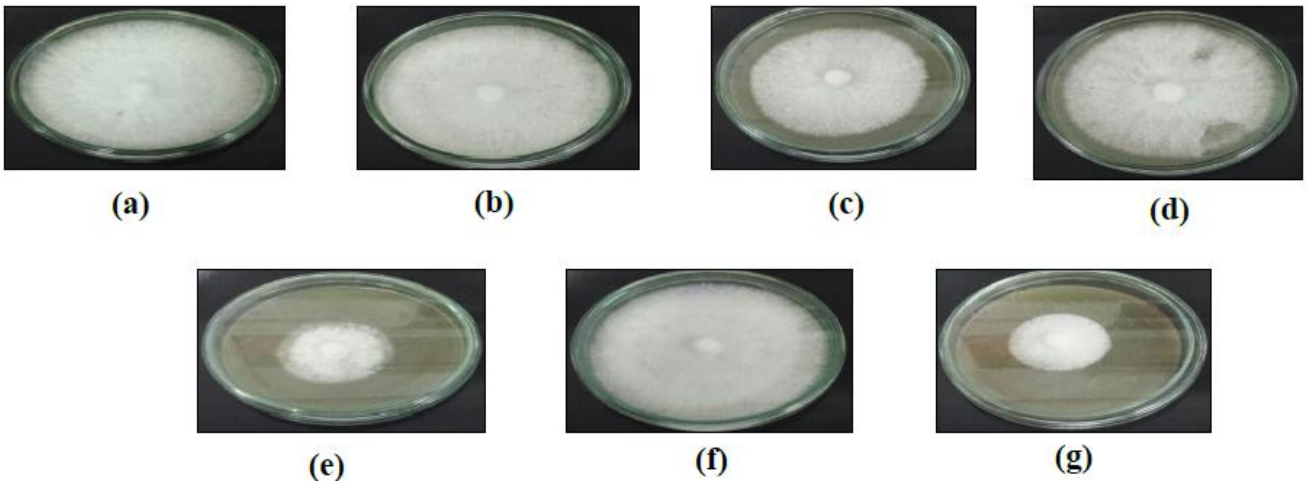

Figure 5. Fungal culture grown on different PAH used as sole source of carbon: (a). Control (b) Benzo(a) Fluoranthene (c) Fluorene (d) Pyrene (e) Acenaphthene(f) Anthracene (g) Phenanthrene

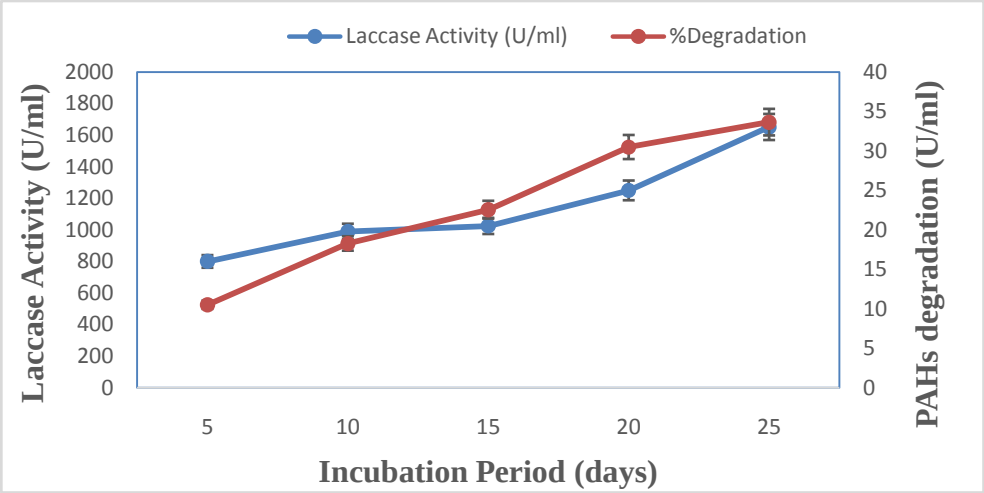

Figure 6. Phenanthrene degradation by *Agaricomycetes sp* AGAT as a sole source of carbon and energy

With addition of glucose as co-substrate in degradation medium the degradation of Phenanthrene increased to 78.53% with 3394.16U/ml on 20th day of incubation. Amongst the various co-substrates glucose was found to be best. Therefore, glucose was used in our further studies for the degradation of PAHs (Figure 7).

The degradation profile of various PAHs were studied with respect to laccase activity, incubation period and % degradation. In the present study 100 ppm of different PAHs were used for degradation study by fungal culture *Agaricomycetes sp* AGAT. Pyrene showed maximum degradation of 85.05% on 15th day of incubation with 2650.2 U/ml of enzyme activity and Fluoranthene reported 20.5% degradation on 25th day of incubation with 3580.2 U/ml enzyme activity (Figure 8 - Figure 11).

No further significant PAHs degradation was observed. The growth of fungus in liquid medium with PAHs can be observed by comparing it with control flask (Figure 12).

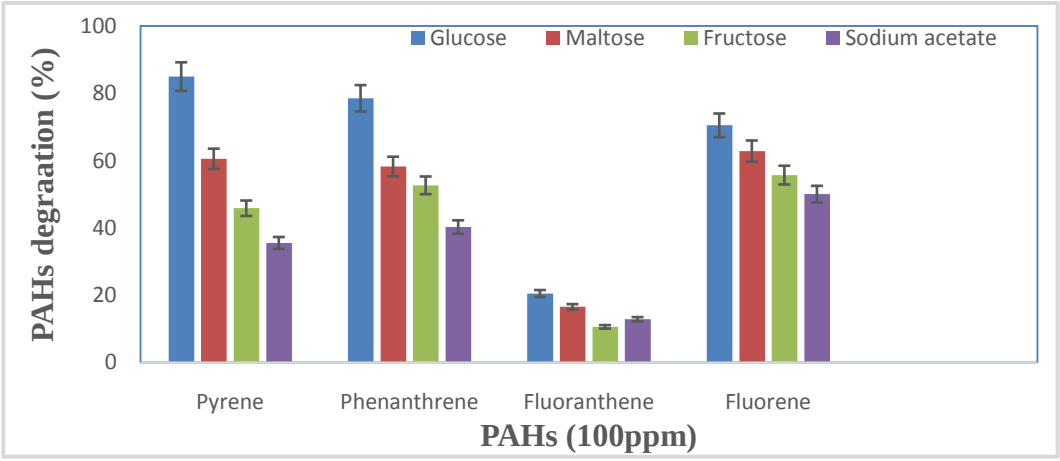

Figure 7. Different co-substrate used for PAH degradation

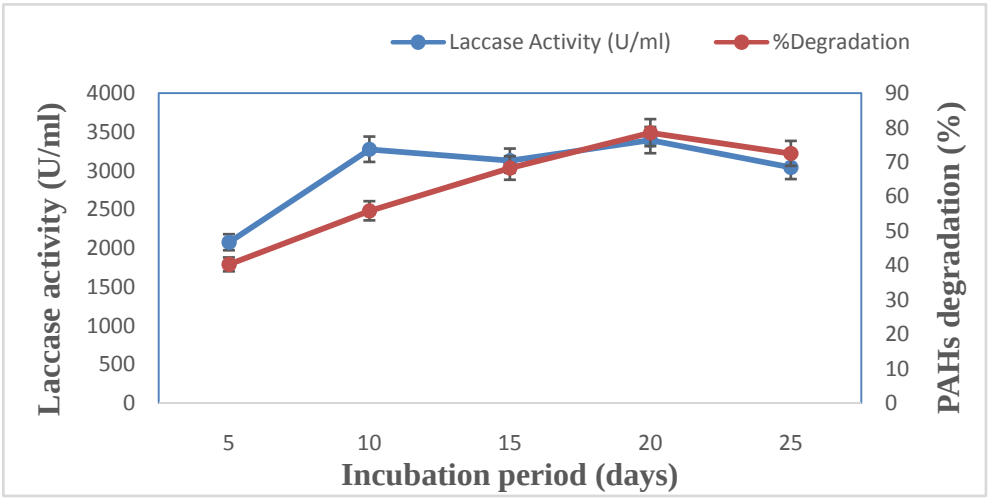

Figure 8. The co-metabolic degradation of Phenanthrene by *Agaricomycetes sp* AGAT

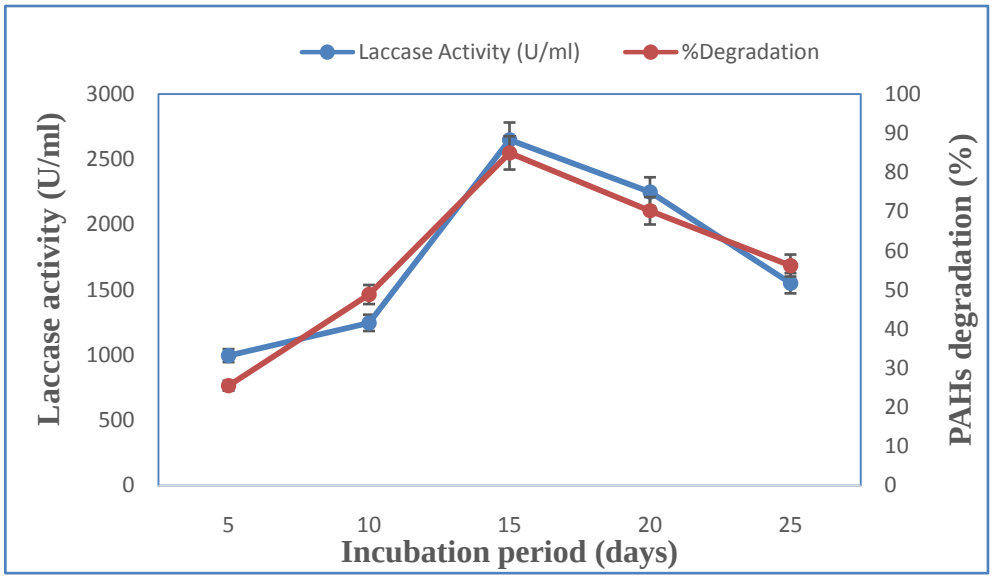

Figure 9. The Pyrene (100ppm) degradation profile by *Agaricomycetes sp* AGAT

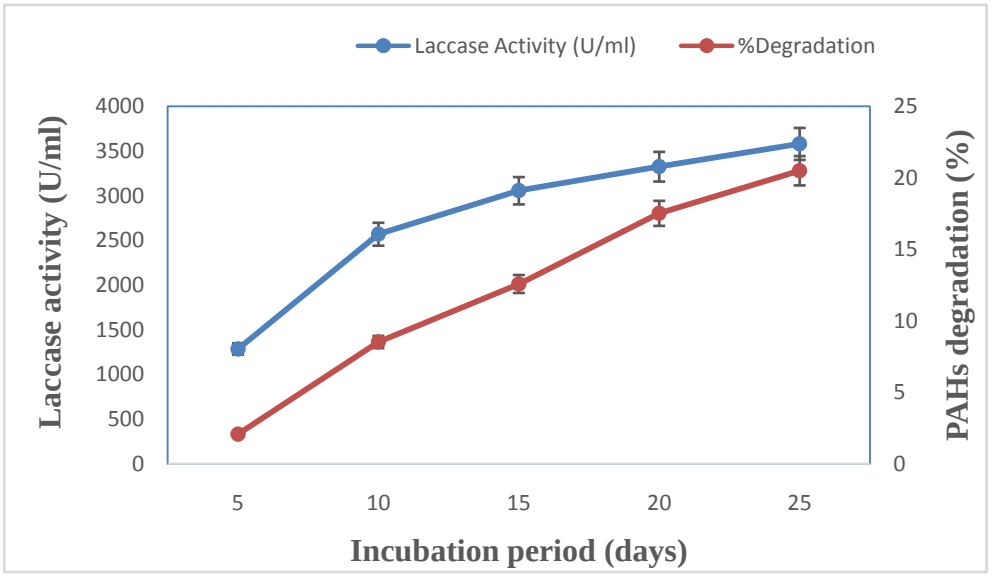

Figure 10. The Fluoranthene (100ppm) degradation profile by *Agaricomycetes sp* AGAT

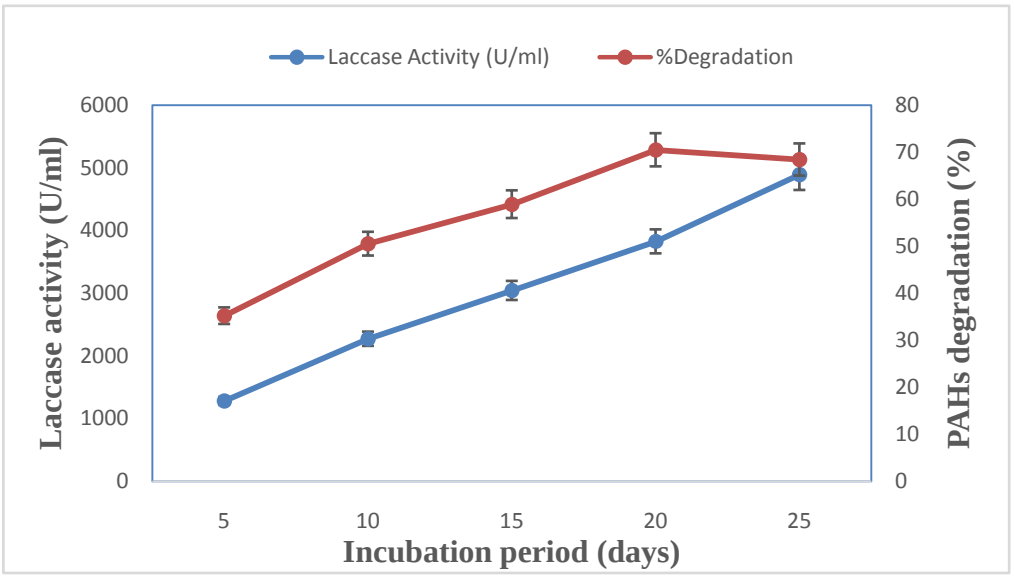

Figure 11. The Fluorene (100ppm) degradation profile by *Agaricomycetes sp* AGAT

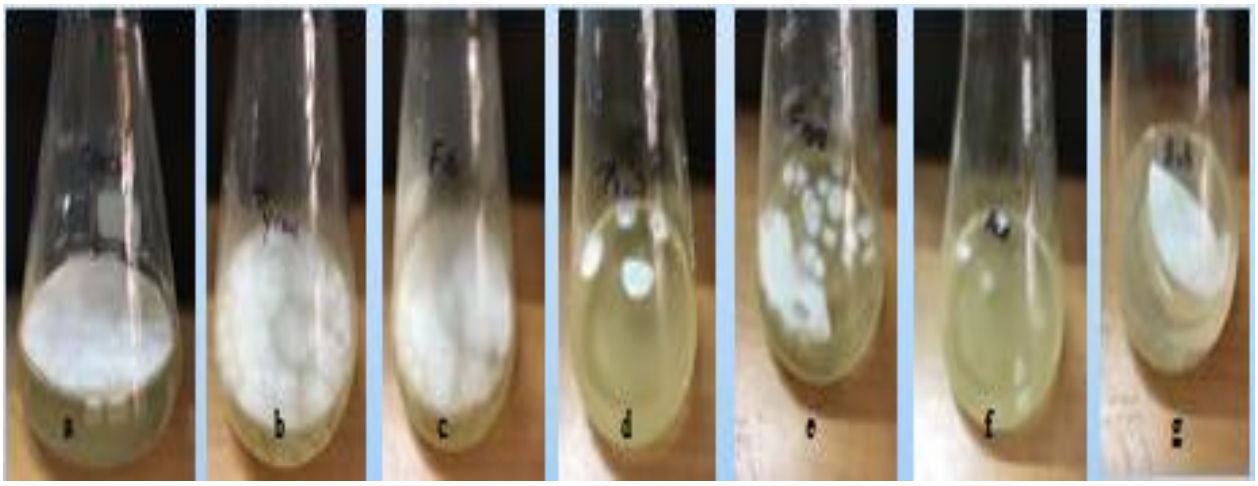

Figure 12. Growth of *Agaricomycetes sp.* on different PAHs. (100ppm): (a) Control (b) Pyrene (c) Fluoranthene (d) Phenanthrene (e) Fluorene (f) Acenaphthene (g) Anthracene

3.5. Effect of Different Surfactants on Degradation of PAHs

All the surfactants (SDS, Tween 80 and Triton X-100) were incorporated in medium. At concentration of 1mM were found to enhance the degradation of PAH as compared to control and other two concentration i.e. 0.1mM and 2 mM. When the surfactants used at different concentration then considerable difference in degradation was observed (Figure 13 - Figure 15).

Whereas Figure 13 shows a significant increase in degradation of Fluoranthene from 20.35% to 88.09%. Further increase in concentration of Tween 80 reduced the degradation as high concentration of surfactant may affect the growth of fungi in medium.

Similarly SDS was also found to be effective in increasing PAHs degradation as Tween 80. Maximum degradation of around 99% of Pyrene, Fluoranthene, Phenanthrene and Fluorene at concentration of 0.1mM, 1mM and 2mM was obtained.

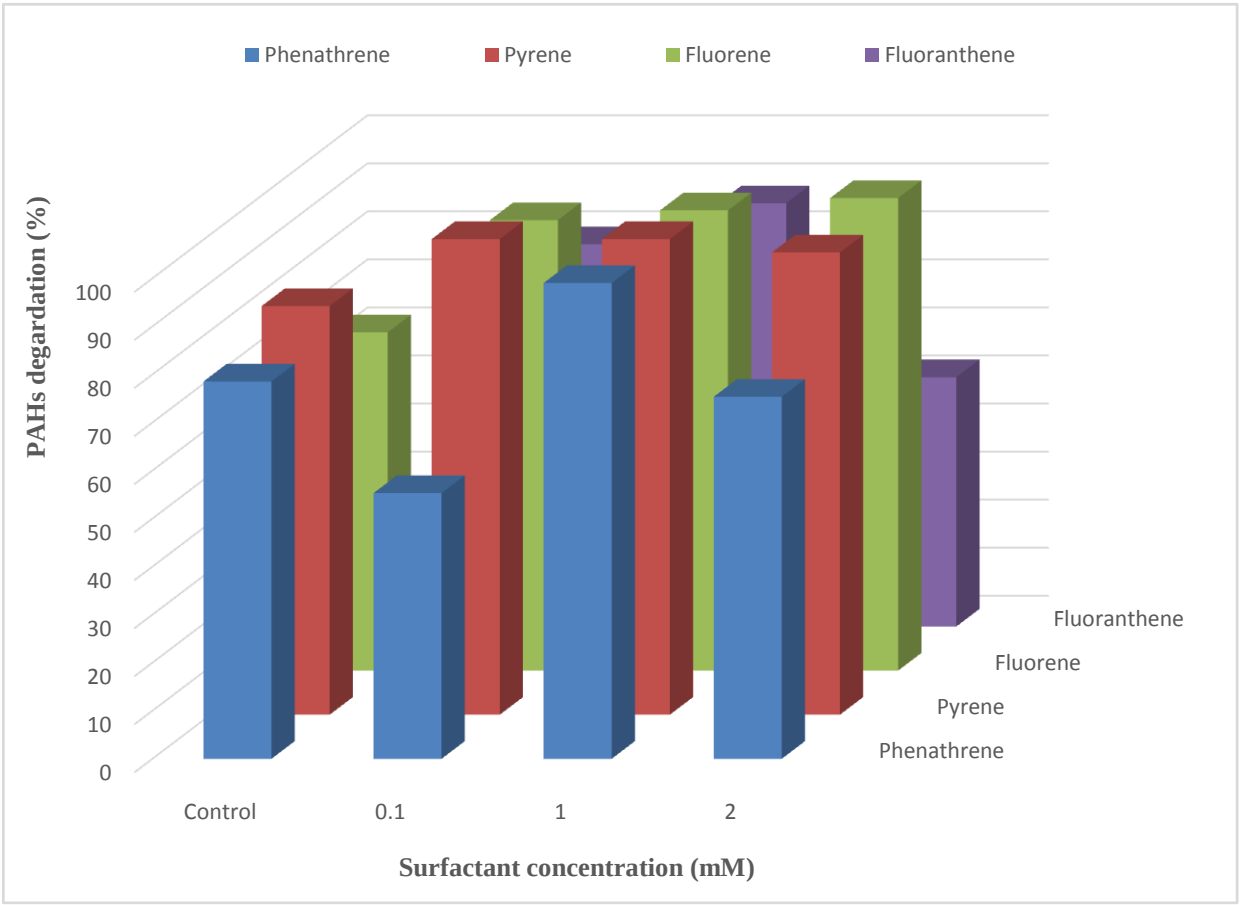

Figure 13. Degradation of PAHs in the presence of different concentrations of Tween 80 on 15th day of Pyrene, 20th day of Phenanthrene and Fluorene and 25th day of Fluoranthene

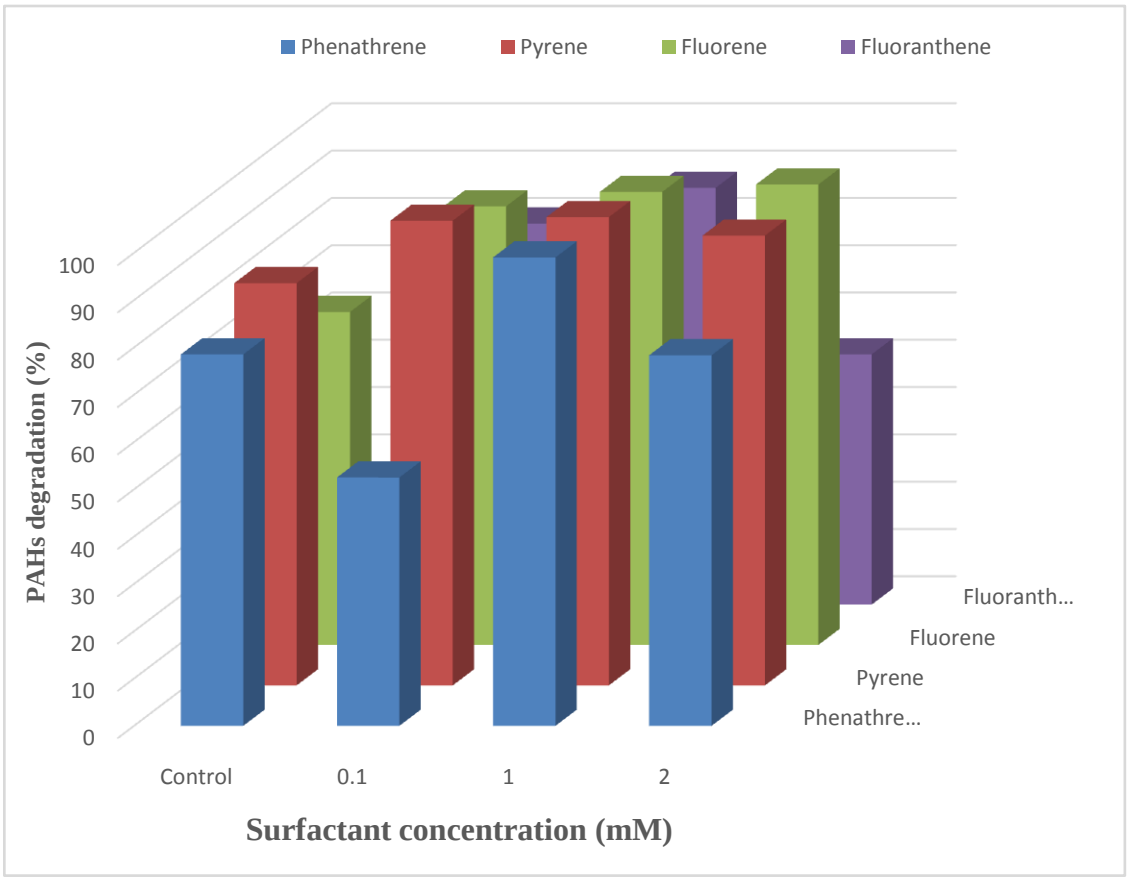

Figure 14. Degradation of PAHs in the presence of different concentrations of SDS on 15th day of Pyrene, 20th day of Phenanthrene and Fluorene and 25th day of Fluoranthene

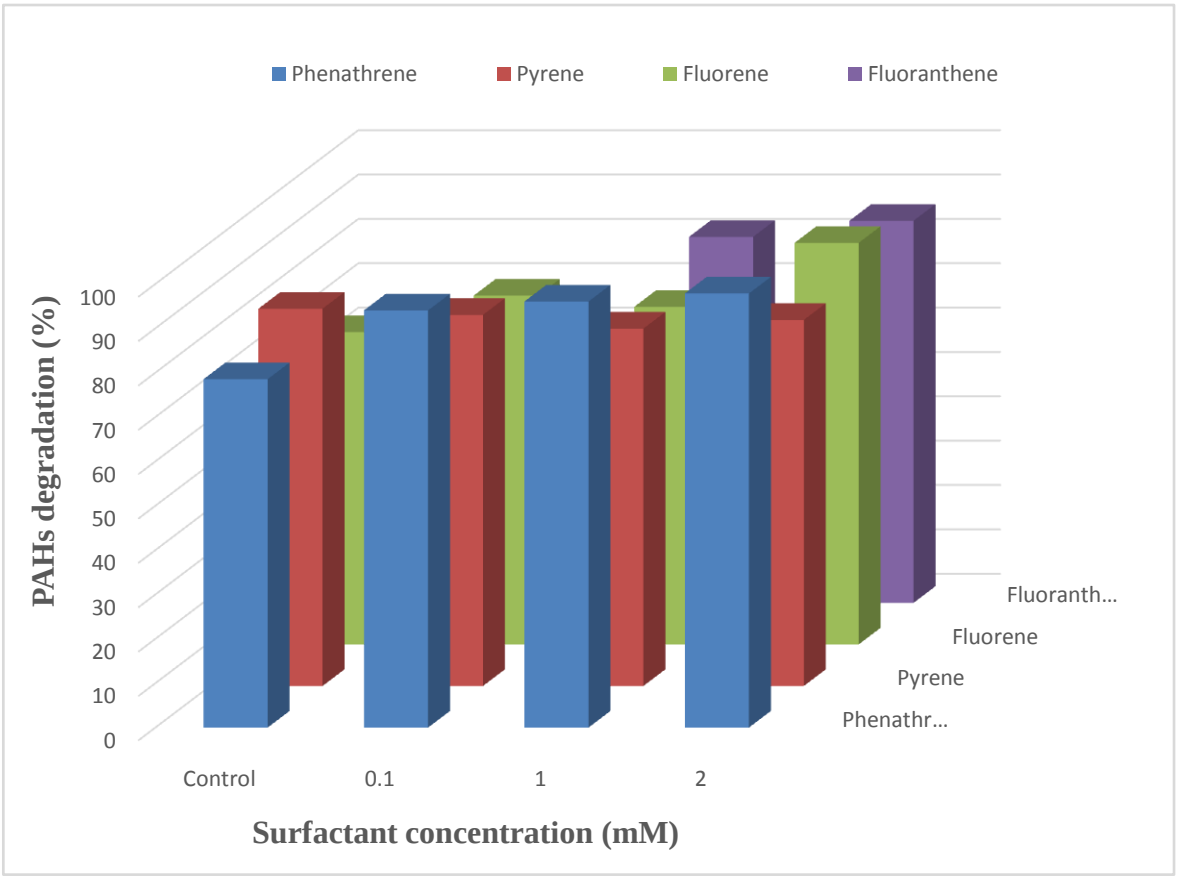

Figure 15. Degradation of PAHs in the presence of different concentrations of Triton X-100 on 15th day of Pyrene, 20th day of Phenanthrene and Fluorene and 25th day of Fluoranthene.

3.6. Effect of Different Mediator Compounds on Degradation of PAHs

In the present study 3 mediator used were ABTS, HBT and Phenol at concentration of 0.1mM, 1mM and 2mM. Amongst all HBT was found to be best and powerful mediator in PAH degradation. Around 99.1% of Pyrene removal was observed on 15th day of incubation. HBT showed 95.25%, 94.74% and 75.25% removal of Phenanthrene, Fluorene and Fluoranthene on 20th and 25th day of incubation respectively at 2mM concentration. Even at low concentration of 0.1mM HBT showed effective enhancement in PAH degradation (Fig 16).ABTS showed 98% elimination of Pyrene and Phenanthrene at concentration of 2mM. Around 90.21% degradation of Fluorene and 86.98% degradation of Fluoranthene were obtained at 2mM concentration of ABTS (Figure 17). Phenol also used mediator showed almost 90% removal of all PAHs in system at concentration of 2mM (Figure 18).

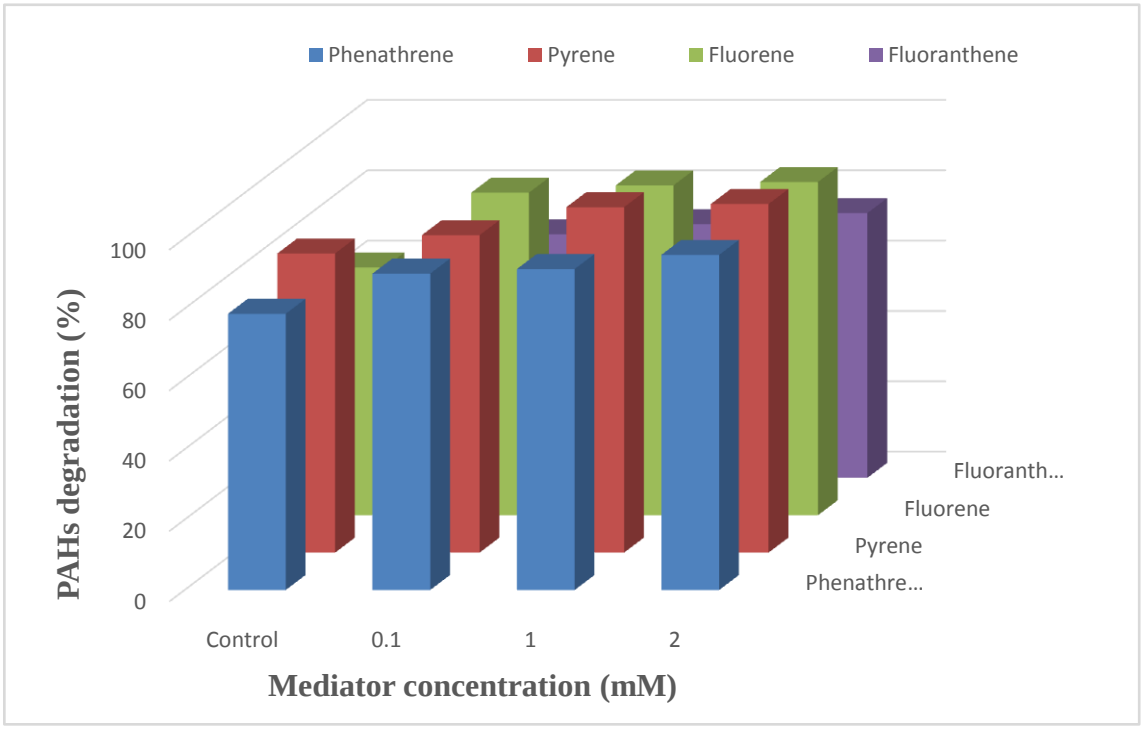

Figure 16. Effect of different concentrations of mediator compound HBT on degradation of PAHs

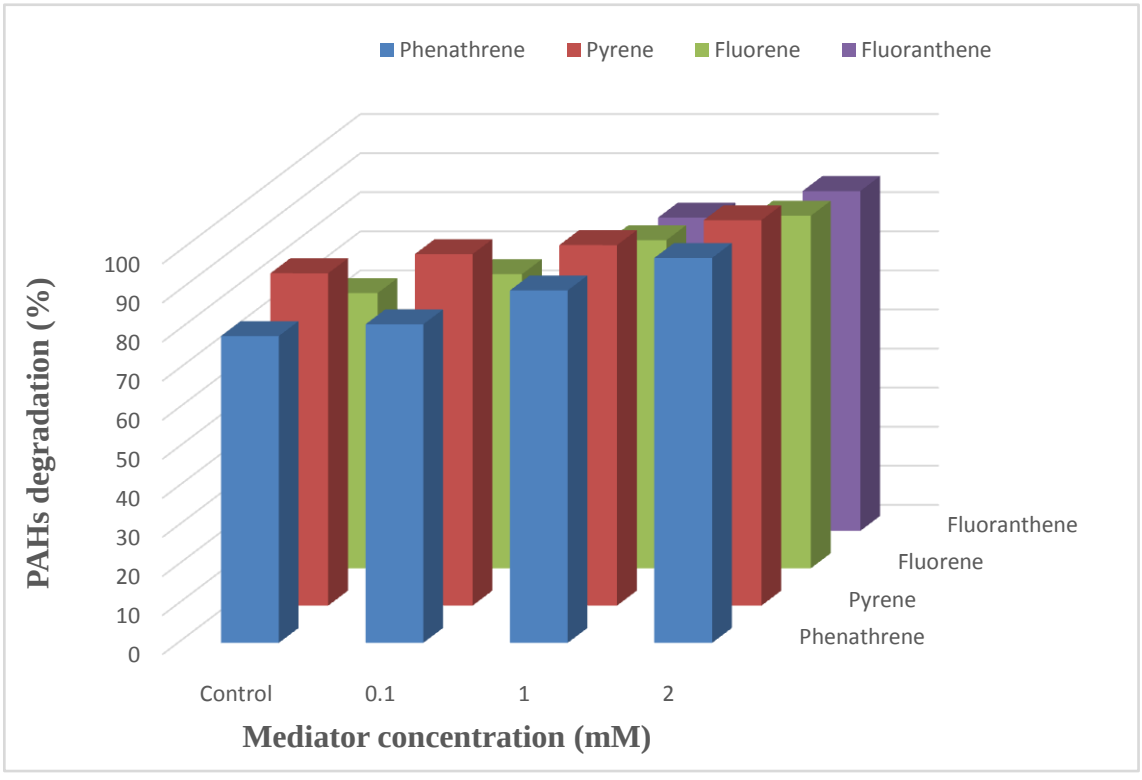

Figure 17. Effect of different concentrations of mediator compound ABTS on degradation of PAHs

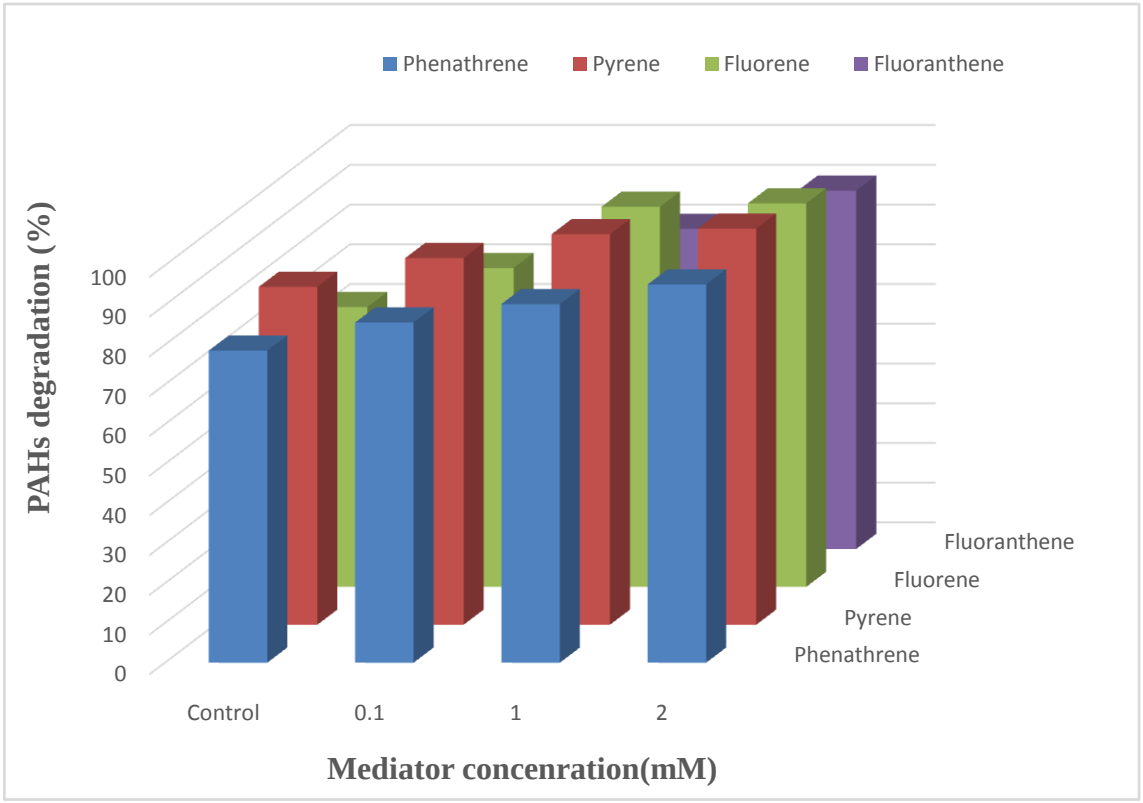

Figure 18. Effect of different concentrations of mediator compound Phenol on degradation of PAHs

3.7. Microcosm Study to Explore the Bioremediation Potential of *Agaricomycetes sp* AGAT

Microcosm study of PAHs such as Phenanthrene, Fluoranthene, Fluorene and Pyrene at concentration of 100 ppm using different sets of experiments were studied. The study shows the abiotic loss of Phenanthrene i.e. set A without microorganisms was about 25% i.e. control set (Set A). In set B 76.63% Phenanthrene degradation was observed by *Agaricomycetes sp* AGAT without the presence of indigenous flora. Presence of microbes in soil showed 45.50% (set c) degradation while set D showed maximum degradation of 96.66% with presence of both micro-flora and isolate AGAT (Figure 19). Present study showed that the maximum degradation in presence of Fluorene (93.88%) was achieved in set B i.e. having only presence of isolate *Agaricomycetes sp* AGAT as compared to set D which showed 46.20% degradation in presence of both indigenous flora along with isolate *Agaricomycetes sp* AGAT as shown in Figure 20. Pyrene and Fluoranthene also showed maximum degradation of 90.25% and 35.74% by *Agaricomycetes sp* AGAT present in sterile soil i.e. Set D. (Figure 21- Figure 22).

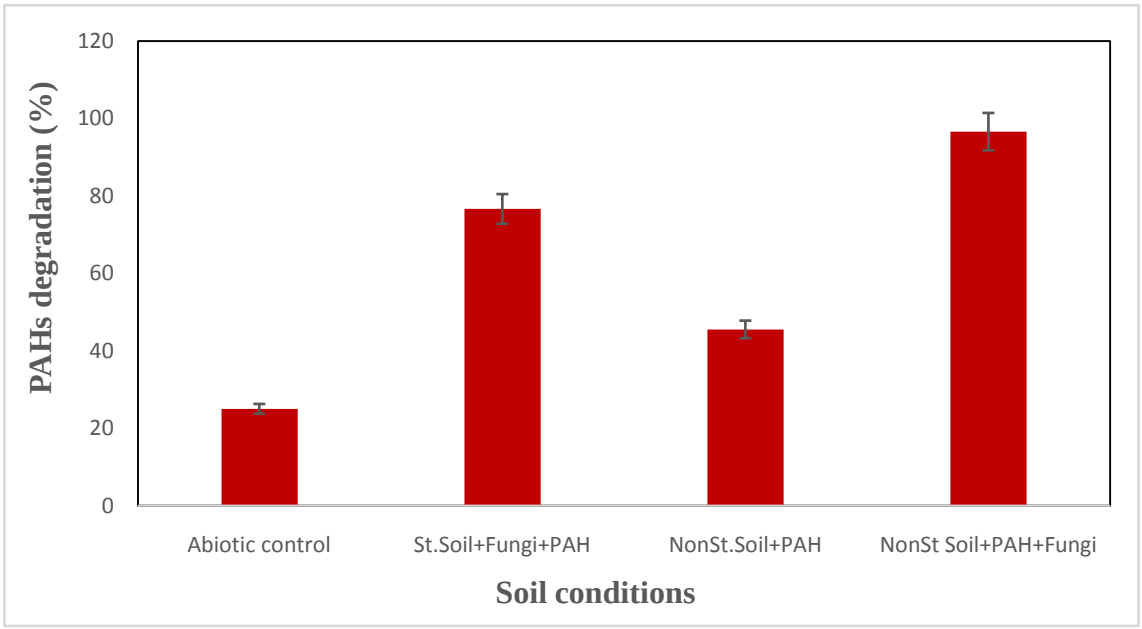

Figure 19. Microcosm study for Phenanthrene degradation

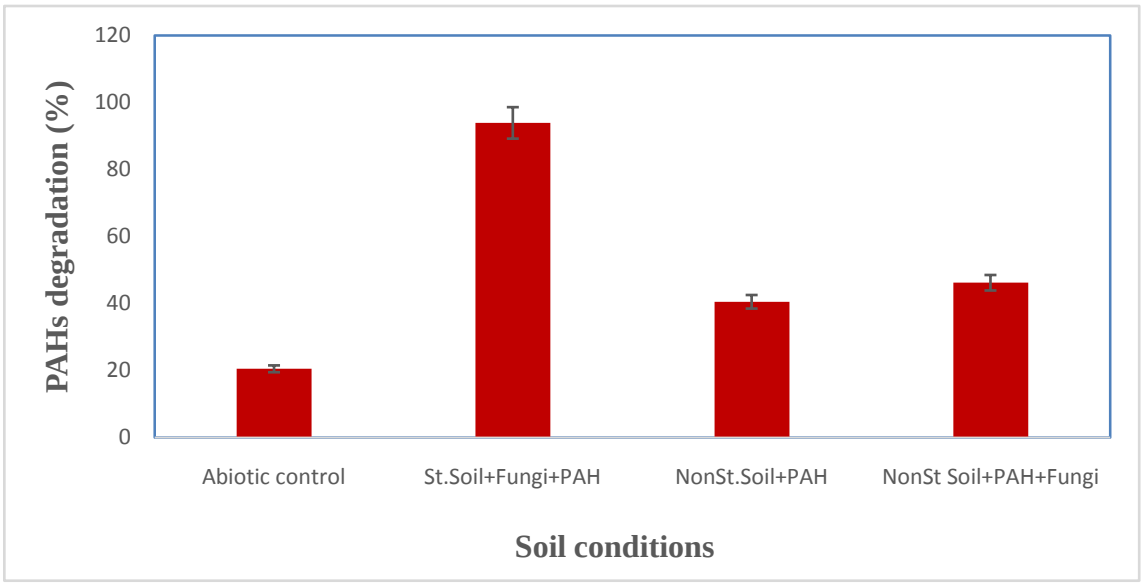

Figure 20. Microcosm study for Fluorene degradation

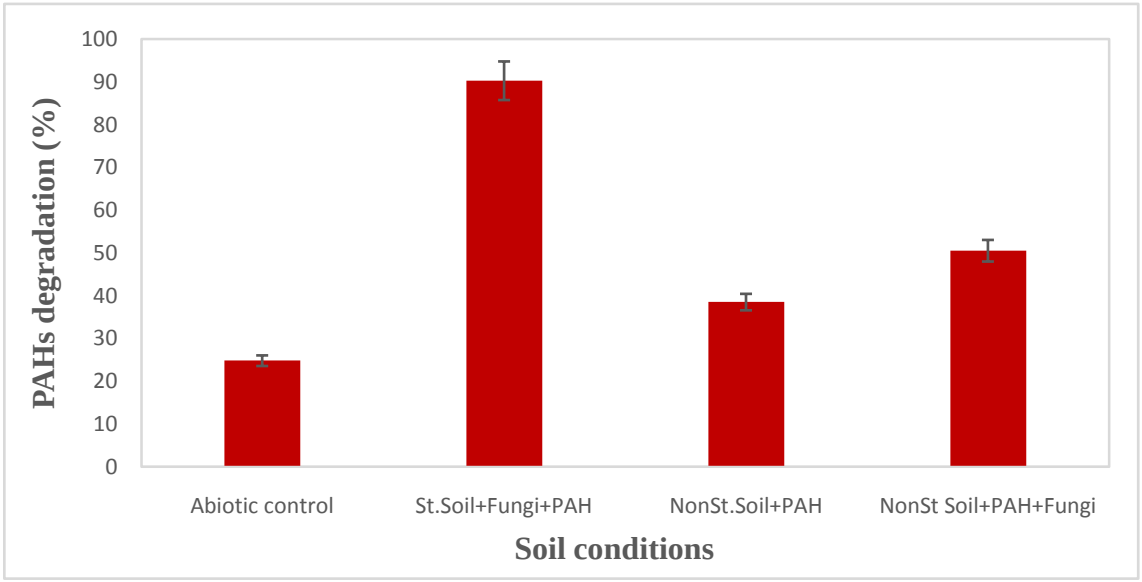

Figure 21. Microcosm study for Pyrene degradation

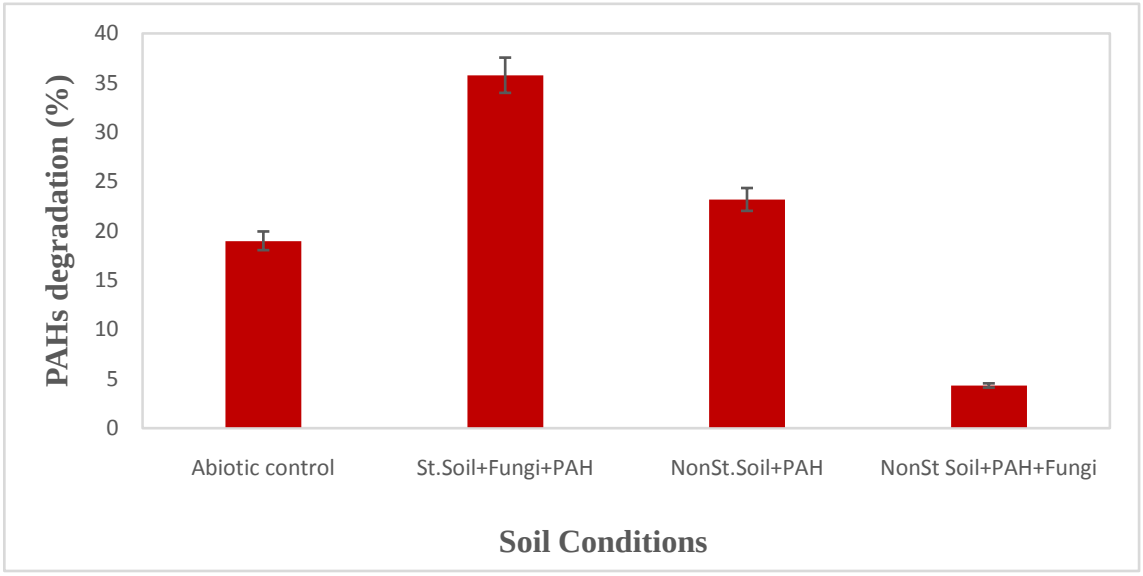

Figure 22. Microcosm study for Fluoranthene degradation

3.8. Detection of PAH Degradation Metabolites

For detection of degraded metabolite GC-MS analysis was performed. GC-MS analysis showed one peak as compared to control sample which was identified as 1-hydroxypyrene and phthalic acid with 218.5 m/z and 166.3m/z ratio respectively (Figure 23). Proposed pathway is shown in Figure 24.

GC-MS spectra of Phenanthrene showed presence of one peak as compared to control as shown in Figure 25. Peak corresponds to formation of 9,10-dihydroxy Phenanthrene it's an intermediate compound formed due to ring cleavage of cytochrome P-450 and epoxide hydrolase enzyme. Proposed pathway for degradation of Phenanthrene is shown as in Figure 26.

GC-MS analysis of Fluorene was Fluoren-9-ol as intermediate product after degradation on 20th day of incubation (Figure 27 - Figure 28). Fluorene 4- [1,2-dihydroethyl] is the intermediate detected by mass spectra of Fluoranthene (Figure 29 - Figure 30).

3.9. Phytotoxicity Study of Degraded Metabolite

The results of phytotoxicity studies using PAHs and its degraded metabolite on *Triticum aestivum* are shown in Table 3. Length of plumule and root length (in cms) of germinated seeds were recorded after 10 days. Maximum shoot length observed in degradation metabolite of Pyrene (21 cms) Figure 31.

% germination of seeds was affected after addition of PAH at concentration of 100 ppm to pot as compared to degraded metabolite as shown in Table 3. It is observed that Fluorene is most toxic for seed germination as compared to other PAHs.

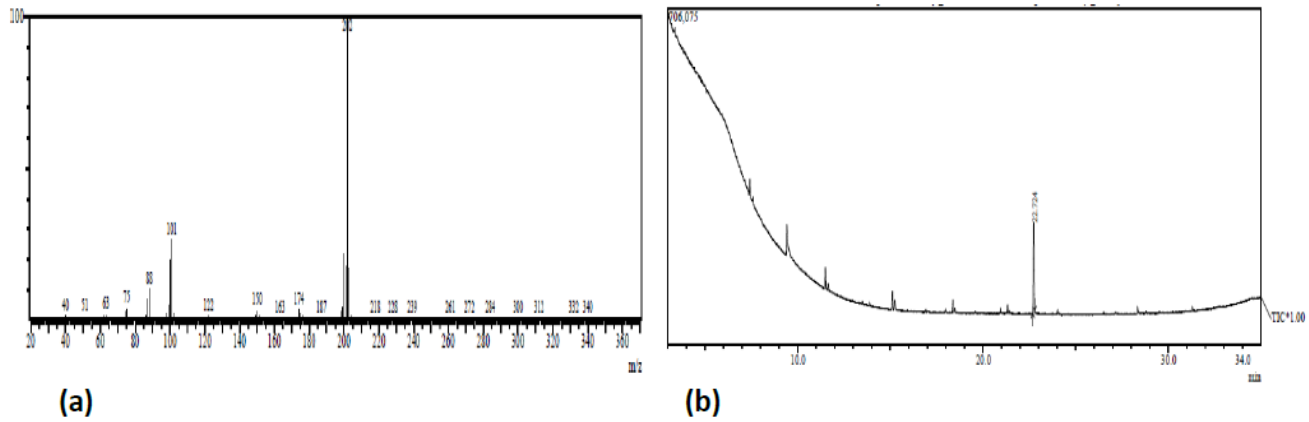

Figure 23. (a) & (b): Shows the mass spectra of control and experimental pyrene

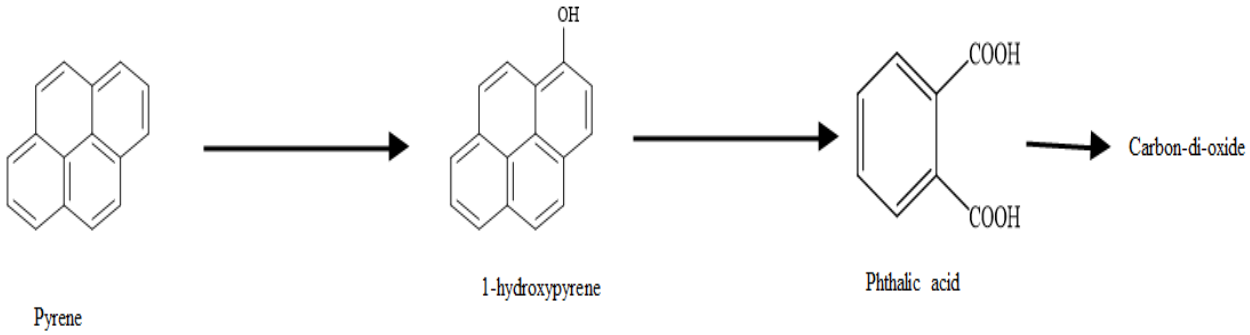

Figure 24. Proposed pathway of pyrene

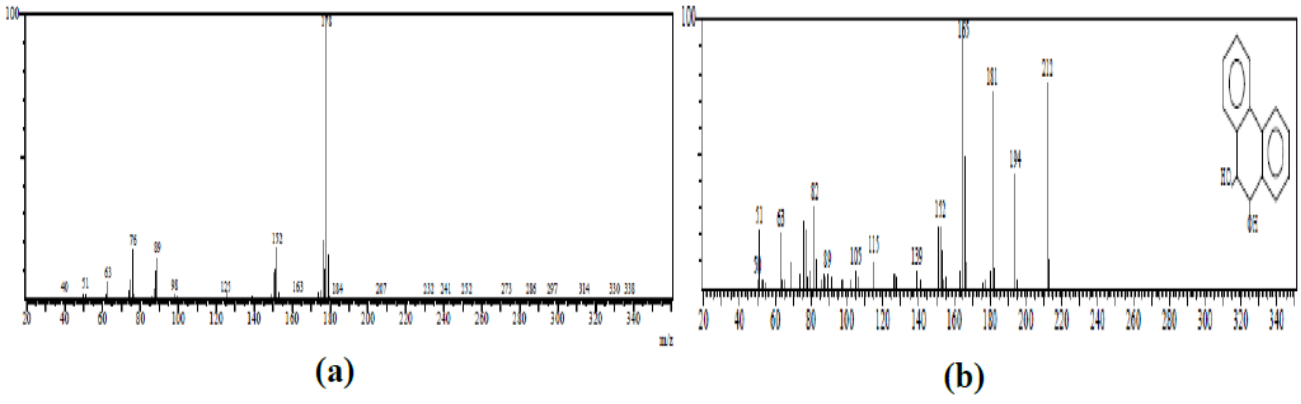

Figure 25. (a) & (b): Mass spectra of control and experimental Phenanthrene

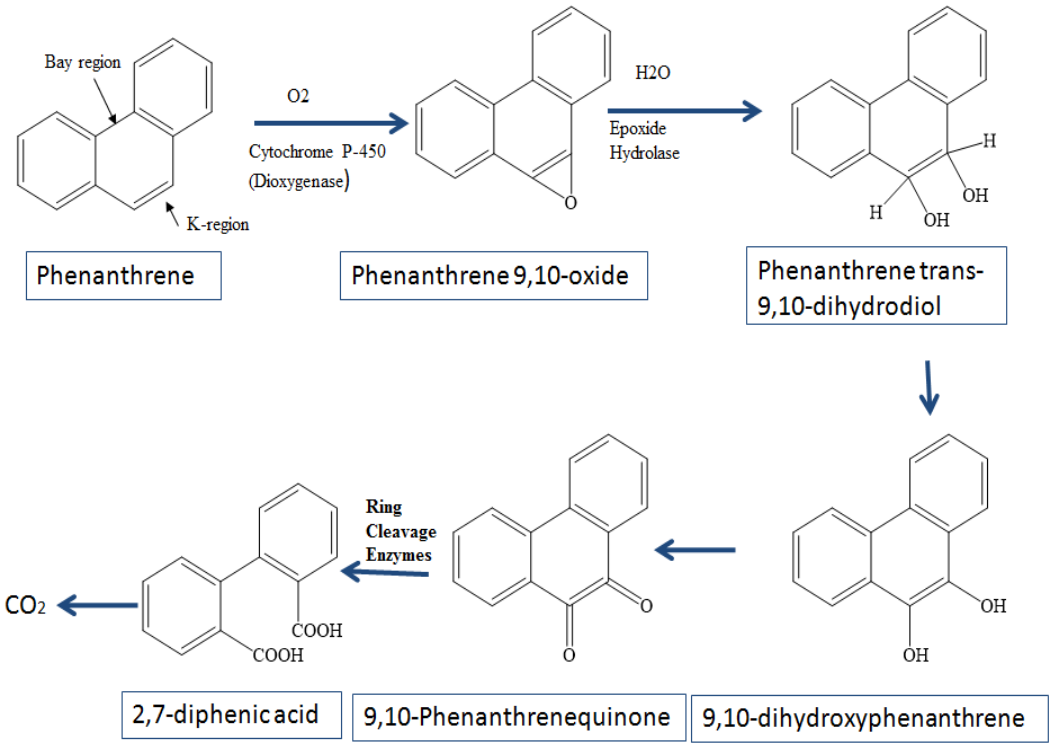

Figure 26. Proposed pathway for Phenanthrene degradation

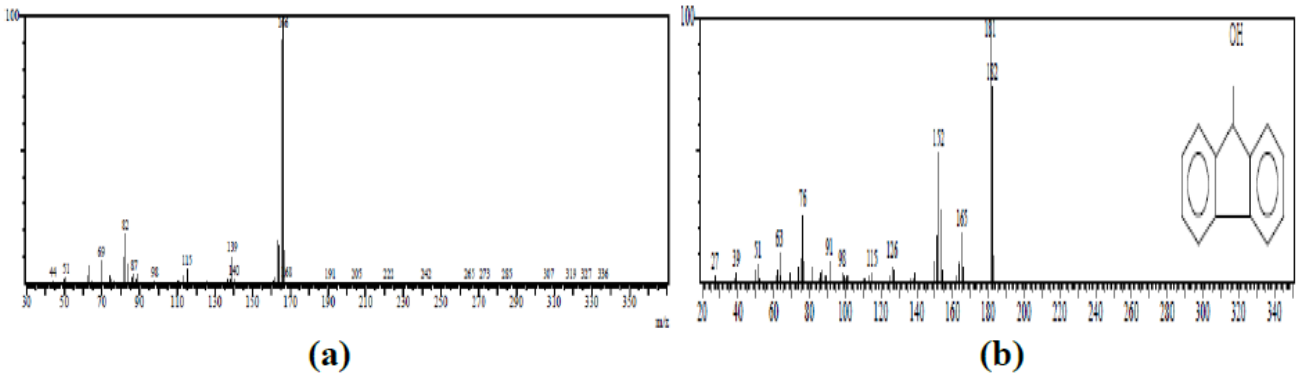

Figure 27. (a) & (b): Mass spectra of control and experimental Fluorene

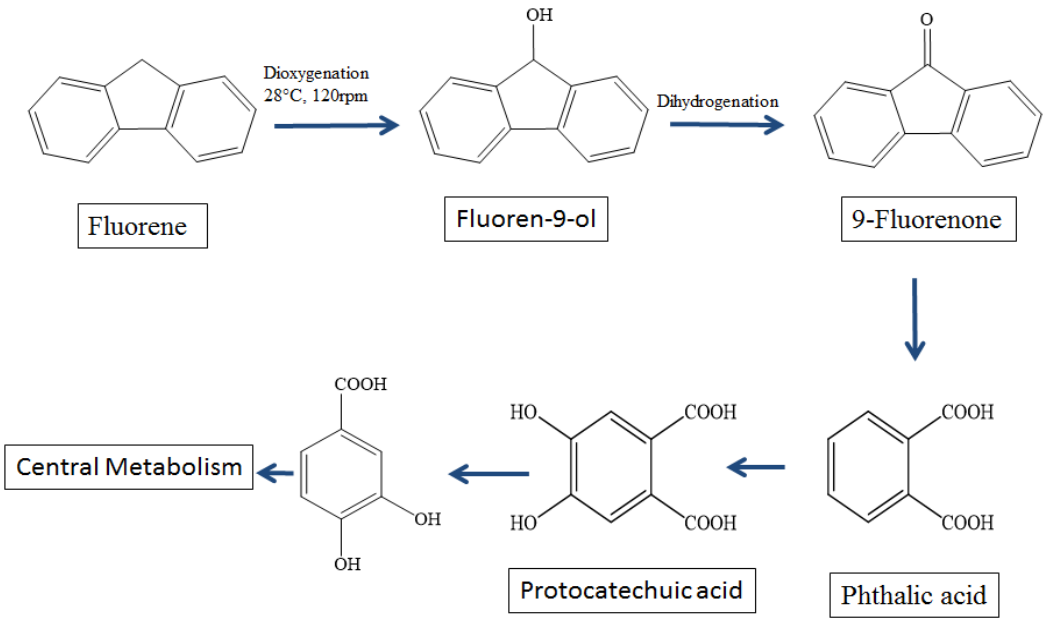

Figure 28. Proposed pathway for Fluorene

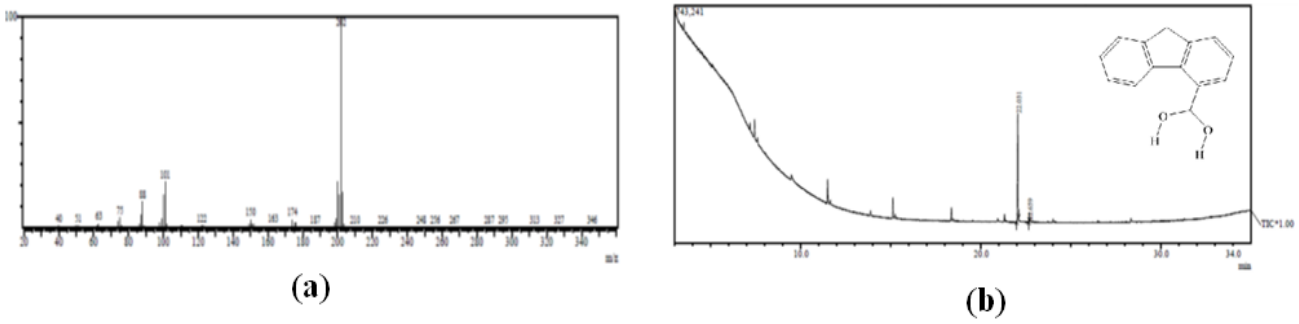

Figure 29. (a) & (b) Mass spectra of control and experimental Fluoranthene

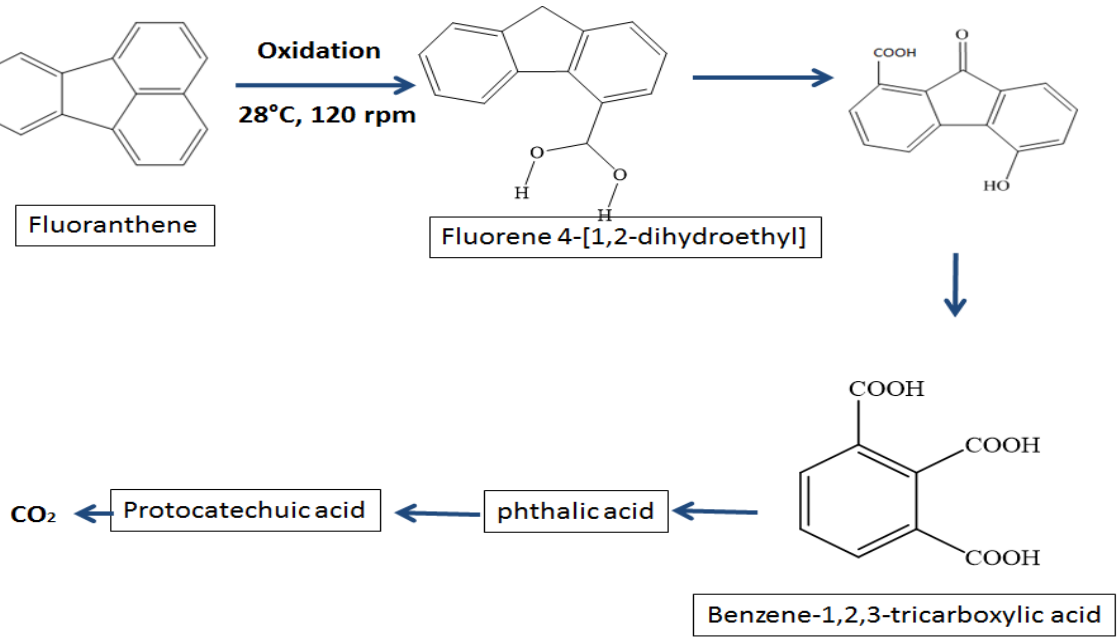

Figure 30. Proposed pathway for Fluoranthene

Table 3. Phytotoxicity study of different PAHs and its degraded metabolite on lengthe of plumule of *Triticum asetivum* seeds

Sr.No.	No.of seeds**(%)**		Root length (cms)		Shoot length (cms)	
	Control	Expt	Control	Expt	Control	Expt
Phenanthrene	50	70	± 0.75	9±1.7	18±0.6	18.5±1.1
Fluoranthene	40	80	5 ± 0.6	10±1.6	17 ± 0.35	19.5±0.9
Fluorene	20	60	4 ± 0.35	10±0.81	14.5 ± 0.45	20±1.2
Pyrene	50	90	6 ±0.45	8±0.9	15± 0.25	21±0.85

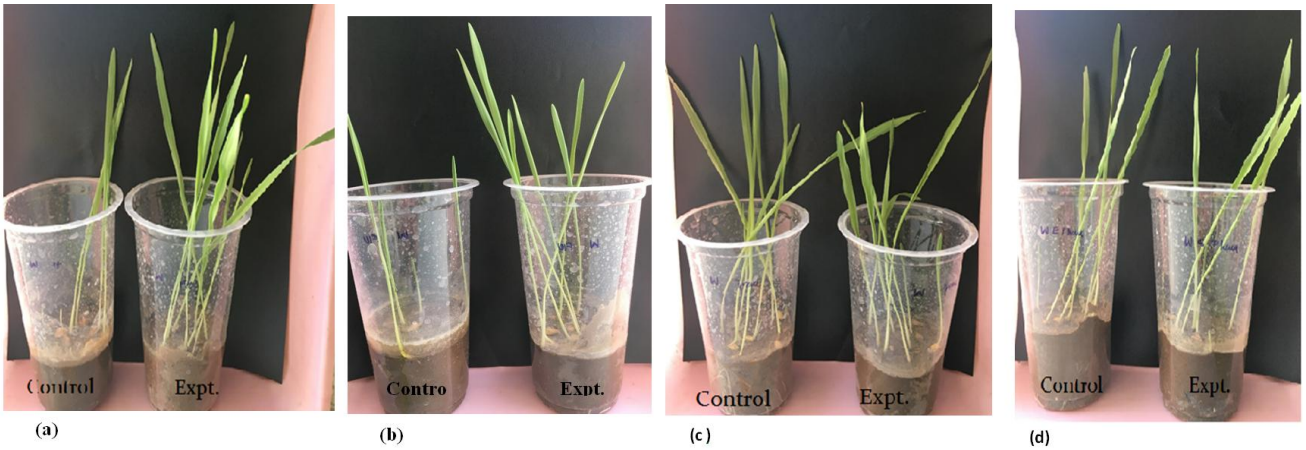

Figure 31. Phytotoxicity of degraded metabolite on *Triticum asetivum* (a) Fluoranthene (b) Fluorene (c) Pyrene and (d) Phenanthrene

4. Discussion

By plate assay method isolate were screened for ligninolytic enzyme production using o-dianisidine, guaiacol and gallic acid. Positive Bevandamm's reaction observed for laccase activity. Chhaya and Gupte [16] reported the similar results with litter dwelling fungi for screening of laccase producers using ABTS and guaiacol as a substrate. Gao *et al.,* [17], Patel *et al.,* [18] and Agrawal *et al.,* [19] reported the similar results for the screening of presence of laccase enzyme in the fungi by plate assay. Primary screening method is a very rapid for detection of the presence of the laccase enzyme by comparing the intensity of color and time required for development of colour due to oxidation of chromogens.

Solid state fermentation is one of the best process which have been used for ligninolytic enzyme production using agro-industrial residues. As agro-industrial residues are produced world-wide in abundance as a waste/ by product of crop cultivation and food processing industry. Secondary screening of laccase production was carried out using wheat bran as a solid substrate and Asther medium as a moistening agent under solid state fermentation. The Asther's medium [20] was used as a moistening agent to maintain the moisture level of the substrates. Maximum laccase production of 1.65 X 10^5 U/g of dry substrate for wheat bran was reported on 10th day of incubation. Vares *et al.,* [21] and Gupte *et al.,* [22] reported higher laccase production with *Phlebia radiata* and *Pleurotus ostreatus* respectively under SSF using wheat straw as substrate. Kapoor *et al.,* [23] also reported maximum laccase production with *Lentinus edodes* from peanut meal supplemented wheat straw. On the basis of primary and secondary screening the isolate *Agaricomycetes sp.* AGAT was selected for further studies as it was considered as an excellent producer of laccase.

PAHs are considered to be environmental pollutants which having the ability to affect plants, animals and humans. PAH are mainly degraded by biological transformations thus the use of microbes represents the potential route for the removal of PAH from the environment. White rot fungi are the choice of organisms used widely in bioremediation. They are known to actively degrade wide range of recalcitrant and xenobiotic compounds. It has been assumed by many researchers that the degradation of these compounds is catalyzed by the enzymatic machinery of these fungi [24,25,26]. Fungi like Pleurotus *eryngii* [27], *Pleurotus pulmonaris F043* [25], *Scopulariopsis brevicaulis [28], Pycnoporus sanguineus H1* [2] and Phanerochaete chrysosporium [29] has been used for PAHs degradation.

The isolate *Agaricomycetes sp* AGAT showed degradation in degradation medium. The % degradation was enhanced in presence of co-substrate glucose present in medium. Mao and Guan [28] reported enhanced degradation of PAH by *Scopulariopsis brevicaulis.* using glucose as co-substrate. Hwang *et al*., [30] and Tekere *et al*., [31] also reported using other co-substrates enhanced the degradation. It has been reported by Wang *et al*., [32]; Swamy and Ramsay [33]; that the degradation of organic pollutants is faster when glucose is used as a co-substrate for growth.100% removal of Fluorene within 23 days was reported by Hadibarata and Kristanti [27] at a concentration of 10 ppm by fungal isolate *Pleurotus eryngii* F032 while 100% Fluoranthene was eliminated in 30 days at 10ppm concentration by *Pleurotus pulmonarius* F043 [25]. Mao and Guan [28] using *Scopulariopsis brevicaulis* reported removal of Pyrene (64.3%), Fluoranthene (61.9%) and Phenanthrene (60%) after 30 days. The decline in PAHs removal probably occurs in nitrogen limiting conditions. This can attributed as ligninolytic enzymes are also produced in nitrogen-limiting condition which decrease the PAHs available in the system. The present study shows the involvement of laccase in the degradation process.

Bioavailability for PAH degradation was enhanced by addition of surfactant to the medium. Surfactants have been known to increase surface area of the PAHs and the subsequent flux in an aqueous medium [34]. The solubility of the PAHs studied were as Phenanthrene 1.3mg/l; Fluoranthene 0.26 mg/l; Pyrene 0.14mg/l and Fluorene 1.992 mg/l [35]. The rate of degradation depends on the mass transfer rate of PAHs from solid phase to water phase [36]. Surfactants become intermediate between immiscible phases because of their hydrophobic and hydrophilic moieties. By addition of surfactants it increases the concentration of hydrophobic compounds in water phase by solubilization or emulsification. Solubilization occurs only above a specific threshold concentration, critical micellar concentration (CMC) after which surfactants molecules will aggregate to micelles. 72% degradation could be achieved by Hadibarata and Tachibana [37] with Tween 80 as surfactants after 30 days of incubation. Tween 80 enhance both uptake and release of compounds from the cells through modification of cell membrane permeability. Zhao *et al*., [38] found that Tween 80 is best for the degradation of Phenanthrene. Rate of degradation increased from 68.8% to 87.4% in the presence of AOT with Tween 80 within 10 days by *Pleurotus ostreatus* D1 [11]. Higher concentration of SDS may inhibit the growth of fungi. It may be attributed due to change in physico-chemical interactions between fungus and surfactants or limited bioavailability of micellar PAH due to low exit rates from the micelles [39]. Degradation of PAHs has been investigated by using Triton X-100 and SDS with *P.chrysogenum, M.racemosus, L.theobromae* [40]..

In the present study *in vivo* system is used where whole of fungal culture is used for degradation of PAHs. The PAHs selected for the present study is LMW-PAH and HMW -PAH with two or more benzene rings. The reaction catalyzed by laccase depends on monoelectric oxidation which transforms substrates to corresponding reactive radicals. The small molecule which act as single electron donor and activator of enzymes known as mediators enhances the rate of oxidation of the enzyme. The synthetic mediators like ABTS and HBT are mainly used in degradation studies. In our study three mediator used were ABTS, HBT and phenol at varying concentration of 0.1mM, 1mM and 2mM. ABTS when used as a mediator in a system the rate of degradation of Pyrene increased to 92% by *Pyconoporus sanguineus* H1 [2]. HBT has been used widely as mediator because of its high redox potential and its ability to stimulate PAHs oxidation by laccase [41]. Higher concentration resulted in complete removal of PAH due to production of coupling

products with oxidized mediators in a nonstoichiometric production of the quinone [42].

Bioaugmentation technique has been proposed as a strategy for enhancement of the bioremediation of contaminated soils. For *in-situ* bioremediation of the contaminated sites, addition of microorganisms has been a valuable tool in order to increase the rate and extent of biodegradation of organic pollutants. Various physico-chemical parameters affect the efficiency of organisms as compared to native microbial population present in contaminated sites. The use of organism depends on survival and performance in natural ecosystem. Therefore, to ensure the organism need to be studied for its survival and degradation efficiency in soil and also in the presence of the ingenious microbial populations [43,44]. Microcosm study provides an insight towards the competition between culture and indigenous microflora present in the environment. Bioaugmentation by *Paracoccus sp* increased Phenanthrene degradation as reported by Teng *et al*., [45]. Jain and Bajpai [46]; Singh and Ward [47] reported that in natural environment various processes have been studied in order to understand the role of microorganisms and microbial communities in bioremediation. The degradation of Fluorene, Fluoranthene and Pyrene in soil was 0, 6.2% and 7.5% respectively within 10 days [8]. Degradation of PAHs Fluorene, Fluoranthene, Phenanthrene and Pyrene was increased from 98 to 100%, 73 to 98%, 99 to 100% and 26 to 94% by inoculation of *P.velutina* to soil sample which shows that the degradation rate enhanced together by *P.velutina* together with indigenous microbes [48]. *Anthracophyllum discolor* degraded Phenanthrene (62%), Fluoranthene (54%) and Pyrene (60%) from soil sample after 60 days of incubation [49].

For detection of degraded metabolite GC-MS analysis were performed of all PAHs. 1-hydroxypyrene and phthalic acid with 218.5 m/z and 166.3 m/z ratio respectively were reported from degradation of Pyrene. Bezalel *et al*., [50] reported that initially pyrene was metabolized at the 4, 5 bond (K region) which forms an epoxide, which was hydrated to form pyrene trans-4, 5-dihydrodiol using *Pleurotus ostreatus.* Sack *et al*., [51] reported 1-pyrenol as degraded metabolite using wood decaying fungi.

It has been reported by various researchers that the ring metabolite 2, 2'-diphenic acid is from Phenanthrene via Phenanthrene trans9,10-dihydrol or Phenanthrene 9,10-quinone. This dead end product formed 2, 2'-diphenic acid is produced due to activity of ligninolytic enzymes from various white rot fungi [26,50,51,52].

Further decarboxylation reaction leads to formation of dead end product phthalic acid which leads to central metabolism pathway. The GC-MS of all four PAHs compound showed the presence of phthalic acid as an intermediate compound. Phthalic acid formation is one of the ring fission products formed after degradation of PAHs by white rot fungi, further derivatization of phthalic acid to carbon-di-oxide and highly polar metabolites takes place [53].

The toxicity of the degraded product can be defined as phytotoxicity assay. The PAH and its degraded metabolite were used for phytotoxicity study using *Triticum asetivum* seeds. The rate of germination can be used as an indicator for pollutant contamination because this process is very sensitive to various kinds of pollutants [54]. The toxic effects of PAHs depends on various factors. Chemical structure and chemical properties of the pollutants are main reason for affecting PAH toxicity. Phytotoxicity study of various PAHs has been reported by Somtrakoon and Chouychai [55] on economic crops.

In conclusion, large number of isolate were screened for ligninolytic enzyme production by plate assay method. The isolate showing positive Bevandamm's reactions by oxidation of phenolic compounds were screened for secondary screening. The isolate AGAT was identified as *Agaricomycetes sp AGAT* by ITS4 & ITS5 sequencing and further explored for PAHs degradation study. In present study a varied rate of degradation of various PAHs (Pyrene, Fluorene, Fluoranthene and Phenanthrene) were observed using *Agaricomycetes sp* AGAT. Rate of degradation depends upon their molecular weight and structure. There is correlation observed between ligninolytic enzyme and PAHs degradation. *In-situ* bioremediation techniques i.e. microcosm study has been performed which showed the importance of the indigenous flora present by increasing the degradation of PAH. Phytotoxicity study was performed on *Triticum asetivum* to check the effect of degraded metabolites obtained after degradation. GC-MS analysis was performed for identification of metabolites formed. A proposed pathways for PAHs degradation has been given depending upon the intermediate obtained in our study.

Acknowledgements

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Conflict of Interest

The authors declare that they have no conflict of interest.

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RESEARCH ARTICLE OPEN ACCESS

Isolation of α-Amylase Producing Microorganisms from Soil of Kachchh, Gujarat

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Abstract

The purpose of this study is to explore the soil of the Gujarat, Kachchh region to identify amylase-producing bacteria and characterize them using molecular methods. The unique ecological characteristics of the Kachchh region may facilitate the isolation of these bacteria. Samples were collected from multiple locations within the Kachchh District, including Gandhidham, Rapar, Bhuj, Nakhatrana, Mandvi, and Mundra Talukas. These samples were then screened to isolate amylase-producing bacteria. A total of 27 different types of colonies were identified, out of which 16 exhibited amylase production (M1-M16). Out of 27 colonies identified, 16 showed amylase production. Strains M2, M7, and M13 exhibited high amylase activity, with M2 showing a consistent increase over 72 hours, making it a strong candidate for amylase production. Further identification of M2 stain identified M2 as a Gram-positive, spore-forming, capsulated, and motile bacillus, specifically *Bacillus licheniformis*. This was confirmed through DNA sequencing and analysis in the NCBI database, which showed a 99.15% similarity with *Bacillus licheniformis*. The study concludes that Soil in Kachchh is rich with microorganisms that produce amylase, an enzyme with diverse industrial applications. These organisms are valuable for sectors like food, textiles, paper, detergents, pharmaceuticals, and biofuel production.

Keywords: α-amylase, *Bacillus licheniformis,* Amylase Production

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INTRODUCTION

Alpha-amylase, an enzyme that breaks down starch into simple sugar components, plays a pivotal role in various industries such as starch processing, brewing, sugar manufacturing, textiles, and detergents. In 1894 amylase enzyme produced from a fungal source, was used as a pharmaceutical aid for digestive diseases. Alpha-amylases are among the most critical enzymes, contributing to approximately 30% of the global enzyme production.[1]

These enzymes are ubiquitous, found in animals, plants, and bacteria. Microorganisms, including bacteria, fungi, and yeast, are known sources of amylase, and their properties have been extensively studied. Among these, Bacillus strains are noteworthy for their ability to produce significant amounts of amylase, accounting for about 60% of commercially available enzymes. Specifically, *Bacillus subtilis* and *Bacillus mesentericus* produce the most widely used thermostable amylase in the starch industry.[2]

Amylase is a key player in the carbon biogeochemical cycle and finds extensive applications in biotechnological food, detergent, and pharmaceutical industries. It can break down glycosidic bonds in polysaccharides. Interestingly, amylase is present in human saliva and initiates the chemical process of digestion in starchy foods like rice and potatoes. This enzymatic conversion of starch into sugar imparts a mildly sweet taste when these foods are consumed. The pancreas also produces alpha-amylase, which hydrolyzes dietary starch into disaccharides and trisaccharides, which are subsequently converted into glucose by other enzymes.[3]

The use of alpha-amylase extends to various industrial processes, including those in the food, fermentation, and pharmaceutical industries. The selection of the appropriate organism is crucial to ensure a high yield of useful enzymes. The development of new microbial strains for industrial enzyme synthesis using low-cost carbon and nitrogen sources is a constant endeavor. In microorganisms, two primary types of amylases have been identified: alpha-amylase and glucoamylase.[4,5]

The commercial applications of alpha-amylase have expanded to several domains, including clinical, pharmaceutical, and analytical chemistry, among other extracellular enzymes. Industries such as food, textile, fermentation, and paper heavily rely on starch-degrading bacteria. In the realm of biotechnology, the isolation and manipulation of pure cultures of starch-degrading microorganisms from soil are crucial. The extraction and manipulation of pure culture from various waste materials are vital for several biotechnology sectors.[6,7]

Significant amylase-producing microbes include *Bacillus subtilis, Bacillus licheniformis, Bacillus amyloliquefaciens, Bacillus cereus,* and *Bacillus megaterium,* as well as fungi such as *Aspergillus niger, Penicillium, Rhizopus, Cephalosporium,* and *Neurospora*. Microbial alpha-amylases have been demonstrated to be a viable alternative to chemical hydrolysis, although the enzyme's low yield has always been a challenge in commercial amylase production.[8]

Amylase-producing bacteria can be found in soil, and exploring various regions can be helpful in finding potent amylase-producing bacteria. The unique nature of the soil may harbor a more diverse range of bacteria. The Kachch soil could be checked for amylase production.

MATERIALS AND METHODS

Sampling

The research initiative collected soil samples from six distinct Talukas (namely Gandhidham, Rapar, Bhuj, Nakhatrana, Mandvi, and Mundra) in the Kachchh District of Gujarat, India, (GPS coordinates of 23° 44' 1.4352'' N and 69° 51' 35.0676'' E) targeting a diverse range of soil characteristics and microbial ecosystems (Figure 1). The extraction process focused on the subsurface strata at depths of 3 to 4 centimetres, using aseptic techniques to prevent contamination and preserve the indigenous microbial populations. The samples were sealed in sterile plastic bags and transported under strict aseptic conditions to the Mayur Laboratory in Adipur, Kachchh, where they were stored at 4 degrees Celsius to maintain microbial viability. The primary focus was to identify and isolate amylase-producing microorganisms.[9]

Primary screening

A 10 g soil sample was prepared for amylase isolation, suspended in 90 ml of sterile saline solution containing 0.85% sodium chloride. This isotonic environment maintains the physiological conditions of the microorganisms and prevents osmotic shock. Serial dilutions (10^{-1} to 10^{-10}) were prepared from the sample and 100 µL suspensions from each dilution were spread on starch agar plates.[10,11]

The inoculated plates were incubated at a constant 37°C for 72 hours, allowing bacterial colonies to proliferate and express amylase activity. Post incubation, the plates were visually examined for bacterial growth. The presence of amylase activity was confirmed using the Gram's iodine test. This involved flooding the agar plates with a solution of Gram's iodine, leading to a blue-black complex formation in the presence of residual starch. This served as an indirect indicator of starch hydrolysis by amylase-producing bacteria.[11,12]

Secondary screening

After the initial screening identified bacteria capable of producing amylase, the focus shifted to isolating the strain with the highest amylase activity. The transition from primary screening to selecting the most potent strain aims to maximize amylase production efficiency. This involves a thorough evaluation of the amylase's enzymatic properties and cultivation aspects, paving the way for advancements in industrial and biotechnological applications. The secondary screening selected the isolate with the highest enzyme activity for further applications.[13,14]

Post-incubation, the crude enzyme was purified by adding 50 ml of a phosphate buffer (50 mM, pH 7.4) to the media. The resulting slurry was strained using a damp cheesecloth and then centrifuged at 11648 RCF for 15 minutes in a cooling centrifuge. This process separated cells, small particles, and spores. As amylase is an exoenzyme, the cell-free supernatant was used as the enzyme. This purification process is crucial for obtaining a clean sample of the enzyme for further analysis.[15]

Amylase activity was assessed using the 3,5-dinitrosalicylic acid (DNSA) method,[16,17] which measures reducing sugars produced during the enzyme-substrate reaction. The amylase assay was conducted with a reaction mixture containing 1% soluble starch in a 50 mM phosphate buffer at pH 7.2. The mixture was incubated for 10 minutes at 37°C, and the reaction was terminated by adding 2 ml of DNSA reagent.

The reaction mixture was then heat-treated at 100°C for 10 minutes and cooled to stop the enzymatic reaction and stabilize the products. The optical density of each sample was measured at 540 nm using a spectrophotometer, allowing for the quantification of the colored reaction product, and providing a direct measurement of amylase activity. Enzyme activity was quantified in units, where 1 unit/ml represents the amount of enzyme that releases 1 µl mole of glucose under the specified assay conditions. This comprehensive methodology reliably assesses the amylase-producing capabilities of bacterial strains.

Identification of amylase producing bacterial strains

The identification of the most potent amylase-producing bacteria involved key steps: Colony Morphology characterization, Microscopic characterization, Biochemical characterization and Molecular characterization.[18]

Figure 1. Sampling and Isolation of Amylase producing bacteria

Colony morphological characterization

Colony Morphology Analysis provided a comprehensive characterization of bacterial isolates, examining color, shape, size, colony nature, and pigmentation. These parameters offered insights into the bacteria's nature, growth patterns, structural characteristics, physiological attributes, and environmental adaptations.[19]

Microscopic characterization

Microscopic Observation revealed specific structural features of the bacterial cells. Techniques such as Gram staining, capsule staining, endospore staining, and the motility test provided a detailed view of the structural and functional attributes of the bacterial isolates. These methods collectively contributed to a nuanced understanding of the isolates, laying the groundwork for further investigations into their physiological and ecological characteristics. This systematic approach was crucial in identifying the most potent amylase-producing bacteria.[20]

Biochemical characterization

Biochemical characterization of bacterial isolates was performed both manually and using the VITEK system. The VITEK system, with its comprehensive library of biochemical profiles, facilitated a thorough analysis of the isolates' unique biochemical traits.

The process involved preparing bacterial isolates for testing, setting up the VITEK system, and conducting various biochemical tests. The VITEK system automated the analysis of the biochemical reactions, comparing the observed reactions with the patterns stored in its database. This resulted in outputs based on the unique biochemical characteristics of each isolate, aiding in the classification, and understanding of the microbial community. The extensive biochemical library ensured a high level of accuracy and precision in the identification process. The VITEK system covered a broad spectrum of biochemical reactions, providing a comprehensive analysis of the isolates' metabolic and enzymatic activities. This contributed to a more detailed understanding of the bacterial community.[21]

Molecular characterization

Molecular identification by DNA sequencing is the most precise tool for identifying microbial strains. The DNA sequencing of the isolated strain was carried out in several steps[20,22]

DNA Purification: A ready-to-use kit was used to purify DNA from bacterial cells. The purification process involved a spin column-based nucleic acid purification method, utilizing solid-phase extraction to rapidly purify nucleic acids. The method consisted of four main stages: lysing, binding, washing, and eluting.

DNA amplification

PCR primers were used for the amplification of DNA. The primers used were 16S rRNA FP: 5'-AGAGTTTGATCCTGGCTCAG-3' and 16S rRNA RP: 5'-ACGGCTACCTTGTTACGACTT-3'.

Quality test of PCR product

After the completion of the PCR reaction, the resulting products were visualized through 2.5% agarose gel electrophoresis under ultraviolet (UV) light.

DNA sequencing

The procedure for DNA sequencing was done by Sanger sequencing. The sequencing was performed using a Thermo Fisher DNA sequencer (Model No: 3730xl DNA Analyzer).

DNA sequencing data analysis

Data obtained from DNA sequencing were analysed in the NCBI database. The BLAST Web Interface was accessed as per the procedure. This comprehensive approach allowed for the identification of the most potent amylase-producing bacteria.

RESULT AND DISCUSSION

Isolation of amylase producing bacteria

Primary screening

Post-incubation, different colonies were counted from six sampling sites: Gandhidham, Nakhtrana, Bhachou, Mundra, Mandavi, and Rapar. A total of 27 different types of colonies were identified. For instance, Gandhidham yielded

8 bacterial isolates, Nakhtrana had 4, Bhachou had 5, Mundra had 3, Mandavi had 1, and Rapar had 6 (Figure 2).

The Gram's iodine test was applied to each plate for primary screening of amylase-producing bacteria. Out of the 27 colonies, 16 showed a clear zone around them, indicating amylase production. For example, out of the 8 bacteria isolated in Gandhidham, 5 exhibited amylase production. Similarly, Nakhtrana yielded 2 amylase-producing isolates out of 4. A similar pattern was observed for Bhachou, Mundra, Mandavi, and Rapar. This systematic approach was crucial in identifying the most potent amylase-producing bacteria.

The colony characteristics of the 16 amylase-producing strains were analysed across multiple parameters, including size, shape, colour, elevation, texture, margin, and optical properties. Each strain exhibited unique features, contributing to a nuanced understanding of their visual attributes.

The primary screening for amylase production involved measuring the clear zones formed after the application of iodine on starch agar plates. These clear zones indicate the extent to which the 16 isolated strains, labelled as M1 to M16, are capable of hydrolysing starch. A larger clear zone generally suggests higher amylase activity and more potent amylase production.

The clear zone measurements exhibited notable variability among the strains, ranging from 0.4 mm (M9) to 3.5 mm (M2). This diversity suggests differences in the amylase-producing capabilities of the isolates. Strains M2, M6, M7,

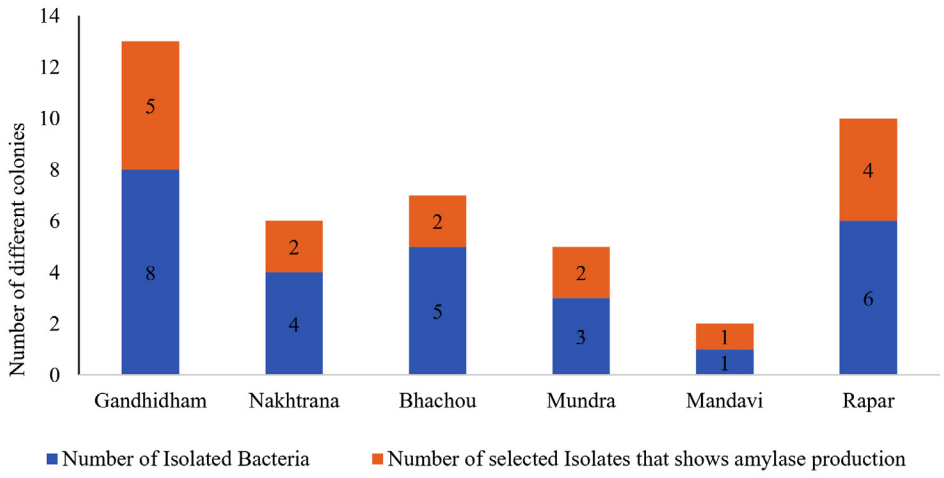


Figure 2. Results of Isolation and primary screening of amylase producing bacteria

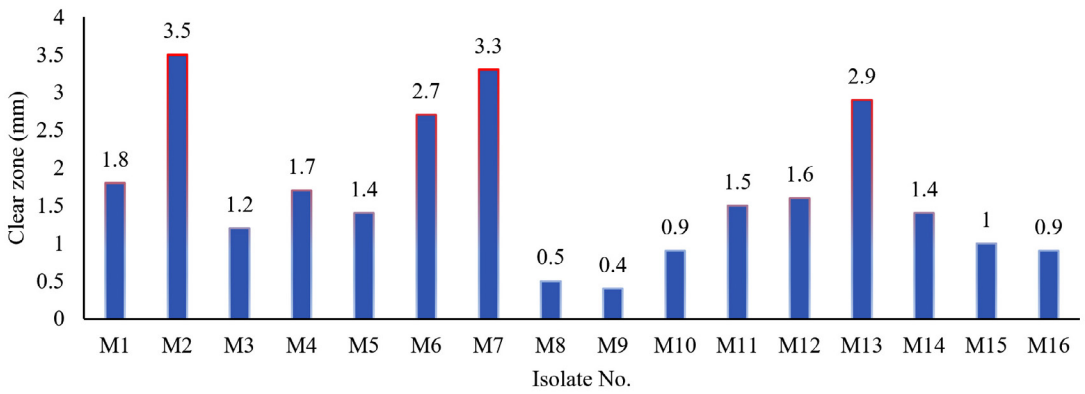


Figure 3. Results of Starch hydrolyzing zone of amylase producing bacteria

and M13 stood out as potentially potent amylase producers, showcasing clear zones of 3.5 mm, 2.7 mm, 3.3 mm, and 2.9 mm, respectively (Figure 3).

The distinct clear zone sizes for each strain indicate that amylase production is not uniform across the microbial isolates. This information is crucial for selecting specific strains with desirable amylase-producing capabilities.

Secondary screening

Following the initial screening, 16 amylase-producing bacterial strains underwent a secondary screening to evaluate their specific amylase activity across different time intervals (24 hours, 48 hours, and 72 hours). The results provided comprehensive insights into the temporal dynamics of amylase production.

Notably, strains M2, M7, and M13 consistently demonstrated elevated amylase activity, suggesting their potential as robust amylase producers. However, M2 at 48 hours and M7 at 72 hours recorded unusually low amylase activity values, indicating biological variability within these strains.

An ascending trend in amylase activity was observed from 24 hours to 72 hours across many strains, with particularly pronounced time-dependent increases in M2, M6, M7, M11, M13, and M14. Conversely, strains M8 and M9 consistently exhibited relatively low amylase activity across all time points (Figure 4).

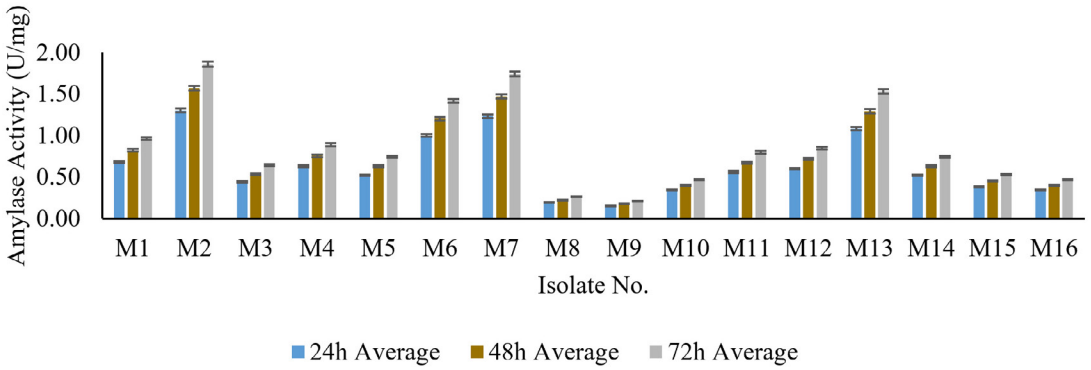


Figure 4. Amylase activity of produced amylase from amylase producing bacteria at different time interval

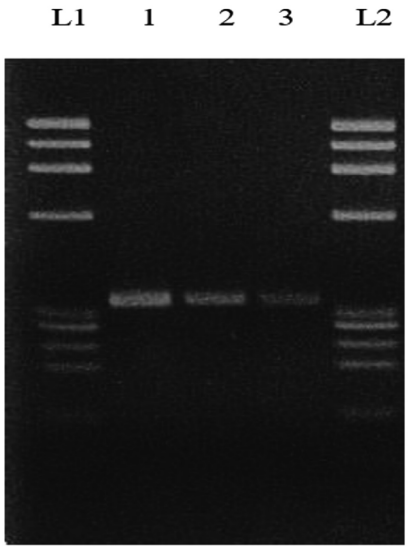


Figure 5. Electrophoresis of DNA (4th sample)
L1: Leader 1, 1: Replicate 1, 2: Replicate 2, 3: Replicate 3, L2: Leader 2

Upon closer examination, certain strains, notably M2, showed an incremental trend in amylase activity over the 72-hour period, positioning M2 as a robust and persistent amylase producer. These findings aid in identifying promising bacterial strains for further exploration or potential industrial applications. Strains demonstrating both elevated overall amylase activity and temporal stability, such as M2, merit careful consideration for their suitability in practical applications. Following the secondary screening process, the M2 strain was specifically chosen for subsequent phases of identification.

Identification of amylase producing bacterial strains

The M2 strain, identified as the most potent amylase-producing bacteria, was characterized by several distinctive features.

Colony morphology

The colony of the M2 strain is medium-sized, irregular, and powdery in nature. It displays a spectrum of colours, ranging from white to beige and cream. The colony is flat or slightly convex in terms of elevation, and its texture is described as powdery. The margin of the colony is irregular and undulate, exhibiting a wavy pattern. Notably, no specific optical properties were identified for the M2 colony.

Microscopic observation

The M2 strain, based on microscopic examinations, is identified as a Gram-positive bacillus capable of forming endospores and capsules. Furthermore, the rod-shaped bacteria occur in chain formations, indicating a particular structural arrangement. The motility test confirmed the ability of the M2 strain to exhibit movement. These detailed observations provide valuable insights into the morphological diversity of the isolates, aiding in the identification of the most potent amylase-producing bacteria.

The M2 strain underwent a comprehensive biochemical characterization, performed both manually and using the VITEK system (Table).

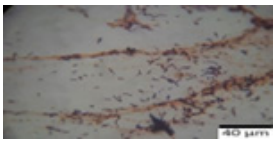
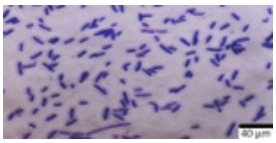
Manual biochemical tests

The results provided valuable information about the biochemical profile of the organism. The organism exhibited a negative response for the Indole test, indicating the absence of indole production. Conversely, it demonstrated positive reactions for various tests, including Methyl Red, Citrate Utilization, Sugar Fermentation (both glucose and sucrose), Catalase, Oxidase, Starch Hydrolysis, Nitrate Reduction, and Glucose Fermentation. These positive reactions suggest the organism's ability to metabolize certain substrates or produce specific enzymes.

Biochemical test with VITEK analysis

The VITEK analysis of the M2 strain yielded a wealth of biochemical results, providing a detailed overview of its metabolic capabilities. Key observations from the VITEK analysis include positive results for tests such as Beta-Xylosidase, Phenylalanine Arylamidase, Beta-Galactosidase, L-Pyrrolydonyl-Arylamidase, Alpha-Galactosidase, Tyrosine Arylamidase, Cycloheximide utilization, Glycogen, Myo-Inositol, Methyl-α-D-glucopyranoside, Ellman reduction, Maltotriose, D-Mannitol, D-Mannose, N-Acetyl-D-Glucosamine, Palatinose, Beta-Glucosidase,

Table. Microscopic observation of amylase producing bacteria

Gram staining		Gram-positive bacilli
Endospore staining		Spore forming bacilli
Capsule staining		Capsulated bacilli
Motility		Motile

Alpha-Glucosidase, D-Tagatose, D-Trehalose, Inulin, D-Glucose, D-Ribose, Growth in 6.5% NaCl, Kanamycin resistance, Oleandomycin resistance, Esculin hydrolysis, Tetrazolium red, and Polymyxin B resistance. The results also indicate negative outcomes for tests such as L-Lysine-Arylamidase, L-Aspartate Arylamidase, Leucine Arylamidase, L-Proline Arylamidase, Alanine Arylamidase, Beta-N-Acetyl-Glucosaminidase, Ala-Phe-Pro Arylamidase, Methyl-D-Xyloside, Alpha-Mannosidase, Glycine Arylamidase, D-Melezitose, L-rhamnose, Beta-Mannosidase, Phosphoryl Choline, Pyruvate, and Putrescine assimilation.

The culmination of these comprehensive biochemical tests and the VITEK 2 data analysis confidently identified the M2 strain as *Bacillus licheniformis*. This taxonomic classification provides essential information for understanding the strain's physiological and biochemical characteristics. The positive outcomes in various enzymatic assays suggest the strain's potential utility in industrial applications, particularly in enzyme production. These findings contribute not only to the taxonomic knowledge of the M2 strain but also have implications for potential biotechnological and industrial applications in areas such as enzyme production and microbial processes.

Molecular characterization

The M2 strain was further confirmed by a molecular method, specifically DNA sequencing. After the purification of DNA from the isolate, it was multiplied using the PCR method to increase the quantity. The purification and amplification of DNA were confirmed by electrophoresis (Figure 5).

The DNA sequencing results were analysed in the NCBI database to identify the most suitable microorganisms through BLAST. The results showed that *Bacillus licheniformis* had a 99.15% similarity with the test microorganisms. Specifically, the *Bacillus licheniformis* strain DLSB-13 16S ribosomal RNA gene partial sequence (Accession: MK795391.1) scored 2124, with a 100% query cover and an E-value of 0.0. This confirms the identification of the M2 strain as *Bacillus licheniformis*, providing essential information for understanding the strain's physiological and biochemical characteristics. These findings have implications for potential biotechnological and industrial applications in areas such as enzyme production and microbial processes.

Study's revelation of the rich microbial diversity within the soil samples from the Kachchh region is a significant contribution to our understanding of the area's ecological dynamics. The identification of amylase-producing microorganisms as a prominent group within this diversity underscores their potential role in the region's biogeochemical cycles and industrial applications.

Our findings are in harmony with the research conducted by Joshi and Trivedi, which also highlighted the microbial richness of Kachchh soil. Their work, which isolated 48 bacterial types with 36 identified as amylase producers, provides a broader context for our study. It suggests that the Kachchh region may be a hotspot for microbial diversity, particularly for strains capable of producing industrially relevant enzymes like α-amylase.[23] It also emphasizes the need for further research into the specific conditions that foster such high levels of microbial diversity and enzyme production. Understanding these factors could lead to more efficient exploitation of these resources for industrial purposes, such as in the production of biofuels, bioplastics, and other value-added products.

Another study conducted in the unexplored Nasinuan Forest of Thailand has led to the discovery of 13 bacterial isolates capable of producing the amylase enzyme. These isolates were identified using 16S rRNA sequencing on 1% starch agar, revealing a diverse group of bacteria with amylase-producing potential.[24]

The study's findings are noteworthy as they mirror our research where the M2 strain was identified as *Bacillus licheniformis* through DNA sequencing and 16S rRNA gene analysis. This consistency in results underscores the reliability of these molecular techniques in identifying bacterial strains with specific enzymatic activities.

The implications of such discoveries are significant, particularly for industries that rely on amylase enzymes, such as food and agriculture.[1] The ability to harness these enzymes from natural sources can lead to more sustainable and cost-effective production methods.[6]

The study conducted in Sudan, which focused on the isolation and characterization of α-amylase producing microorganisms, has yielded results that are noteworthy for their implications in both scientific research and industrial applications. The identification of Bacillus cereus and *Bacillus licheniformis* as starch hydrolyzing bacteria with amylase activity is particularly significant. This finding is consistent with our current study, where *B. licheniformis* was observed to produce a clear zone indicative of amylase activity.[20]

The presence of these bacteria in Sudanese soil samples suggests a potential for harnessing their enzymatic capabilities for various biotechnological processes. The ability of *B. licheniformis* to produce amylase is not only crucial for the natural degradation of starch but also holds promise for industrial applications such as the production of bioethanol, where amylase plays a key role in breaking down starch into fermentable sugars.[14]

Moreover, the similarity between the findings of the Sudanese study and our own underscores the global nature of microbial diversity and its potential for enzyme production. It highlights the importance of cross-regional studies in identifying and utilizing microbial resources for sustainable development.[17]

CONCLUSION

In conclusion, our study has isolated and identified *Bacillus licheniformis* from Kachch soil as a potent amylase producer. The comprehensive morphological, microscopic, and biochemical characterization of the strain, coupled with DNA sequencing confirmation, has provided a robust identification of this microorganism.

The amylase activity of *Bacillus licheniformis* holds significant promise for industrial applications, particularly in the field of enzyme production. This discovery not only enriches the existing knowledge base but also opens new avenues for research into the sustainable exploitation of microbial resources in the Kachchh region.

Future research should focus on exploring the genetic and environmental factors that contribute to the prevalence of amylase-producing bacteria in this ecosystem. Such studies could lead to optimized conditions for enzyme production and contribute to the development of sustainable biotechnological processes. The potential of Kachchh soil as a reservoir for industrially relevant microorganisms is immense, and continued investigation will undoubtedly yield further valuable insights.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

AUTHORS' CONTRIBUTION

All authors listed have made a substantial, direct and intellectual contribution to the work, and approved it for publication.

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None.

DATA AVAILABILITY

All datasets generated or analyzed during this study are included in the manuscript.

ETHICS STATEMENT

This article does not contain any studies on human participants or animals performed by any of the authors.

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Production of Amylase by Solid State Fermentation Using Agricultural Waste

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ABSTRACT

This study presents a comprehensive investigation into the production of amylase, a crucial enzyme with wide-ranging industrial applications, using locally sourced substrates from Kachchh, Gujarat. The research employed the *Bacillus licheniformis* strain and substrates such as coconut, rice husk, wheat bran, paddy straw, and maize straw. The study found paddy straw to be the most promising substrate for amylase production. The research also systematically optimized various process parameters for amylase production in Solid-State Fermentation (SSF) using the One Variable at a Time (OVAT) method. These parameters included incubation period, temperature, inoculum level, additional carbon sources, starch concentrations, additional nitrogen sources, initial pH, different mineral salt ions, initial moisture level, and surfactants. The results showed that the optimal conditions for maximum amylase yield were an incubation period of 48 hours, an incubation temperature of 35°C, an inoculum level of 10%, starch as the additional carbon source, a starch concentration of 2.5%, yeast extract as the additional nitrogen source, an initial pH of 7, NaCl as the mineral salt, an initial moisture level of 75%, and Tween 80 as the surfactant. This research provides a reliable and sustainable approach to enzyme production, offering valuable insights for the optimization of the solid-state fermentation process for maximum amylase production.

INTRODUCTION

Enzymes play a pivotal role in numerous industrial applications, catalyzing biochemical reactions with remarkable specificity and efficiency. Among these enzymes, amylase holds a significant position due to its wide-ranging applications in various industries, including food, textiles, and biofuel production. Solid-state fermentation (SSF) has emerged as an environmentally friendly and economically viable approach for amylase production, using agricultural waste as a substrate (Souza & Magalhaes 2010).

Amylase, an enzyme that hydrolyzes starch into simpler sugars, is crucial for many industrial processes. Traditionally, amylase has been produced using submerged fermentation; however, SSF offers distinct advantages, such as reduced water consumption, higher enzyme stability, and the use of solid substrates, particularly agricultural waste. This shift towards SSF aligns with the global efforts to develop sustainable and eco-friendly processes in the biotechnological industry (Saxena & Singh 2011).

Agricultural waste, a substantial byproduct of farming activities, poses environmental challenges when not effectively managed. The utilization of these agricultural residues as substrates for SSF not only addresses the issue of waste disposal but also transforms these residues into valuable resources for enzyme production. The incorporation of agricultural waste into the SSF process adds an extra layer of sustainability to the bioprocess, contributing to the concept of a circular economy (Sadh et al. 2018).

In this context, this research paper aims to investigate the production of amylase through solid-state fermentation, using agricultural waste as a cost-effective and sustainable substrate. The study focuses on optimizing the fermentation conditions to enhance amylase yield and activity, thereby contributing to the development of efficient and environmentally friendly enzymatic processes. The utilization of agricultural waste not only aligns with the principles of sustainable biotechnology but also addresses the dual challenges of enzyme production and waste management in the agricultural sector.

Through a comprehensive exploration of the potential of solid-state fermentation using agricultural waste, this research looks to provide insights into the optimization of amylase production, offering a sustainable alternative to traditional enzyme production methods. The findings

of this study could have far-reaching implications for the biotechnological industry, fostering a greener and more efficient approach to enzyme production.

MATERIALS AND METHODS

Selection of Microbial Culture

The research initiative involved the meticulous collection of soil specimens from six distinct Talukas, namely Gandhidham, Rapar, Bhuj, Nakhatrana, Mandvi, and Mundra, situated within the Kachchh District of Gujarat, India. For isolation and screening purposes designated 24-72-h incubation period on the starch agar plates was subjected to meticulous visual examination for growth.

Selection of Substrate

This study used locally sourced substrates like coconut, rice husk, wheat bran, paddy straw, and maize straw from Kachchh, Gujarat, for amylase production. Their abundant availability ensures a steady supply for enzyme production. Using these agricultural residues promotes sustainability by repurposing waste and economically utilizing local resources.

Pretreatment of Substrate

The substrate was pretreated through several steps. It was washed with tap water and distilled water, treated with 1% NaOH to remove impurities, and dried at 80°C for two days. After being ground into fine particles, it was autoclaved at 121.6°C for 20 min (Mushtaq et al. 2023).

Preparation of Bacterial Inoculum

A 500 mL flask was filled with 250 mL of nutrient broth and autoclaved at 121.6°C for 20 min. After cooling, 1 mL of a 24-h-old broth was added and incubated at 37°C with 150 rpm agitation. Post -24hour incubation, 1 mL of the broth culture was added to the dry substrate for enzyme production (Saxena & Singh 2011).

Effect of Various Substrates on Enzyme Production

Four substrates-coconut, rice husk, wheat bran, paddy straw, and maize straw-were selected based on their starch content. After preparing the substrates, each underwent Solid-State Fermentation as per the below procedure.

Solid-state Fermentation (SSF)

SSF was conducted in 500 mL flasks, each containing 5 g of substrate. The moisture content was kept at 50%. After autoclaving at 121.6°C for 20 min and cooling, 1 mL of bacterial inoculum was added. The setup was then incubated for 48 h at 37°C (Cerda et al. 2016).

Purification of Crude Enzyme

Post-incubation, 50 mL of pH 7.4 phosphate buffer was added for crude enzyme extraction. The slurry was strained using a damp cheesecloth and centrifuged at 10000 rpm for 15 min to separate cells and particles. The cell-free supernatant, having the exoenzyme amylase, was used as the crude enzyme (Ramapriya et al. 2018).

Amylase Activity

Amylase activity was assessed using the 3,5-dinitrosalicylic acid (DNSA) method (Elyasi Far et al. 2020), which measures reducing sugars produced in the enzyme-substrate reaction. This systematic approach, from determining amylase activity to purifying the crude enzyme and conducting detailed assays, provided a reliable method for evaluating the amylase production of bacterial strains.

The amylase assay was conducted using a reaction mixture with 1% soluble starch in a 50 mM phosphate buffer at pH 7.2. The mixture was incubated for 10 minutes at 37°C, and the reaction was stopped by adding 2 mL of DNSA reagent. The mixture was then heat-treated at 100°C for 10 min and cooled. The optical density of each sample was measured at 540 nm using a spectrophotometer. Enzyme activity was quantified in units, with 1 unit.mL^{-1} represents the enzyme amount that releases 1 µ mole of glucose under the assay conditions. The substrate with the highest amylase production was identified for further study.

Optimization of Amylase Production Using the One Variable at A Time (OVAT) Method

This study systematically optimized various process parameters for amylase production in solid-state fermentation (SSF) (Table 1). Physicochemical parameters like fermentation period, initial pH, moisture level, and inoculum concentration were adjusted to study their effects on α-amylase production. Nutritional parameters like carbon and nitrogen sources, surfactants, and metal ions were also fine-tuned. The goal was to maximize enzyme production in SSF, enhancing the efficiency and yield of α-amylase, which is crucial for practical applications of SSF processes (Dike et al. 2022).

RESULTS AND DISCUSSION

Selection of Microbial Culture

Among various pure cultures, the *Bacillus licheniformis* was utilized for the production of amylase enzyme. *Bacillus licheniformis* was screened out as a potent one and identified (16 S rRNA) from a soil sample.

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Effect of Various Substrates on Enzyme Production

Four substrates-coconut, rice husk, wheat bran, paddy straw, and maize straw-were evaluated for amylase production. Paddy straw showed the highest enzyme activity at 1.002 IU.g^{-1}, making it a promising substrate for amylase production. Wheat bran also showed good results with an activity of 0.812 IU.g^{-1}. Coconut substrates and rice husk had lower activities at 0.513 IU.g^{-1} and 0.612 IU.g^{-1}, respectively, while maize straw had a moderate activity of 0.849 IU.g^{-1}. (Fig. 1).

Optimization of Amylase Production Using The One Variable at A Time (OVAT) Method

Effect of incubation period on enzyme production: The effect of the incubation period on enzyme production was investigated by varying the duration of fermentation at 24, 48, 72, and 96 h. The enzyme production, measured in IU.g^{-1}, varied at different incubation times, as outlined in Fig. 2.

The results show that amylase production varies across different incubation periods. The highest yield was observed at the 48-h mark, reaching 1.40 IU.g^{-1}, indicating that this is the optimal duration for enzyme production in this process. The lower yield at 24 hours (0.07 IU.g^{-1}) suggests that the fermentation process might not have reached peak efficiency in this short duration. The decline in enzyme production at 72 h (0.36 IU.g^{-1}) and 96 h (0.10 IU.g^{-1}) could be due to factors like substrate depletion, accumulation of by-products, or other inhibitory factors. Dike et al. (2022) also found a similar kind of pattern during the production of amylase enzyme.

Effect of incubation temperature on enzyme production: The study found that incubation temperature significantly affects amylase production. The highest yield was observed at 35°C, with an enzyme production of 0.20 IU.g^{-1}, suggesting this is the optimal temperature for this process. At 30°C and 40°C, the production was relatively high (0.18 IU.g^{-1} and 0.15 IU.g^{-1}, respectively), indicating these temperatures are also favorable for amylase synthesis. However, a decrease in enzyme production was noted at 45°C (0.10 IU.g^{-1}) and

Table 1: Optimization parameters for amylase production.

Parameter	Levels
Incubation Period	24, 48, 72, 96 h
Incubation Temperature	30, 35, 40, 45, 50, 55°C
Inoculum Level *(Bacillus licheniformis)*	5%, 10%, 15%, 30%
Additional Carbon Sources [1%]	Starch, lactose, glucose, and fructose
Starch Concentrations	0.5, 1, 1.5, 2, and 2.5%
Additional Nitrogen Sources [1%]	NH_4Cl, $(NH_4)_2SO_4$, NH_4NO_3, Yeast extract, and peptone
Initial pH	4, 5, 6, 7, and 8
Different Mineral Salts Ions [100 µM]	NaCl, KH_2PO_4, $FeCl_2$, $CaCl_2$, and $MgSO_4$
Initial Moisture Level	25%, 50%, 75%, and 100%
Surfactants	Tween 20, Tween 80, SDS, and PEG

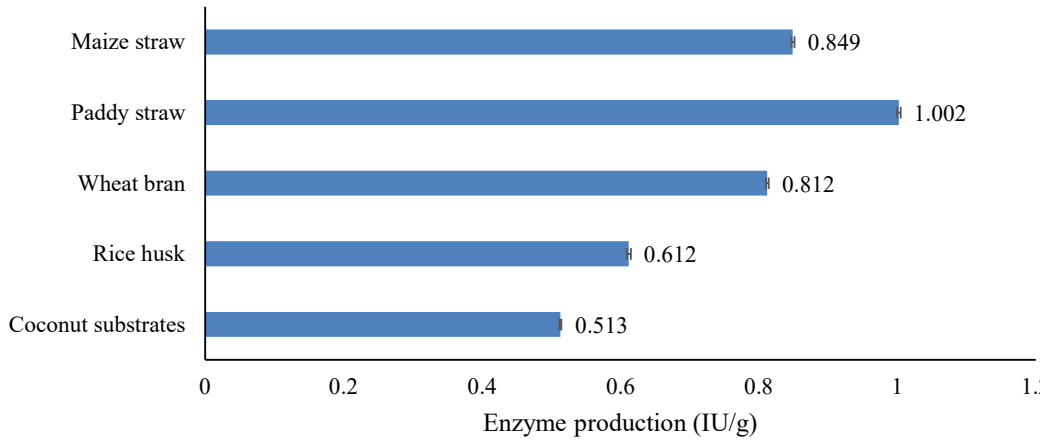

Fig. 1: Amylase production with different substrates.

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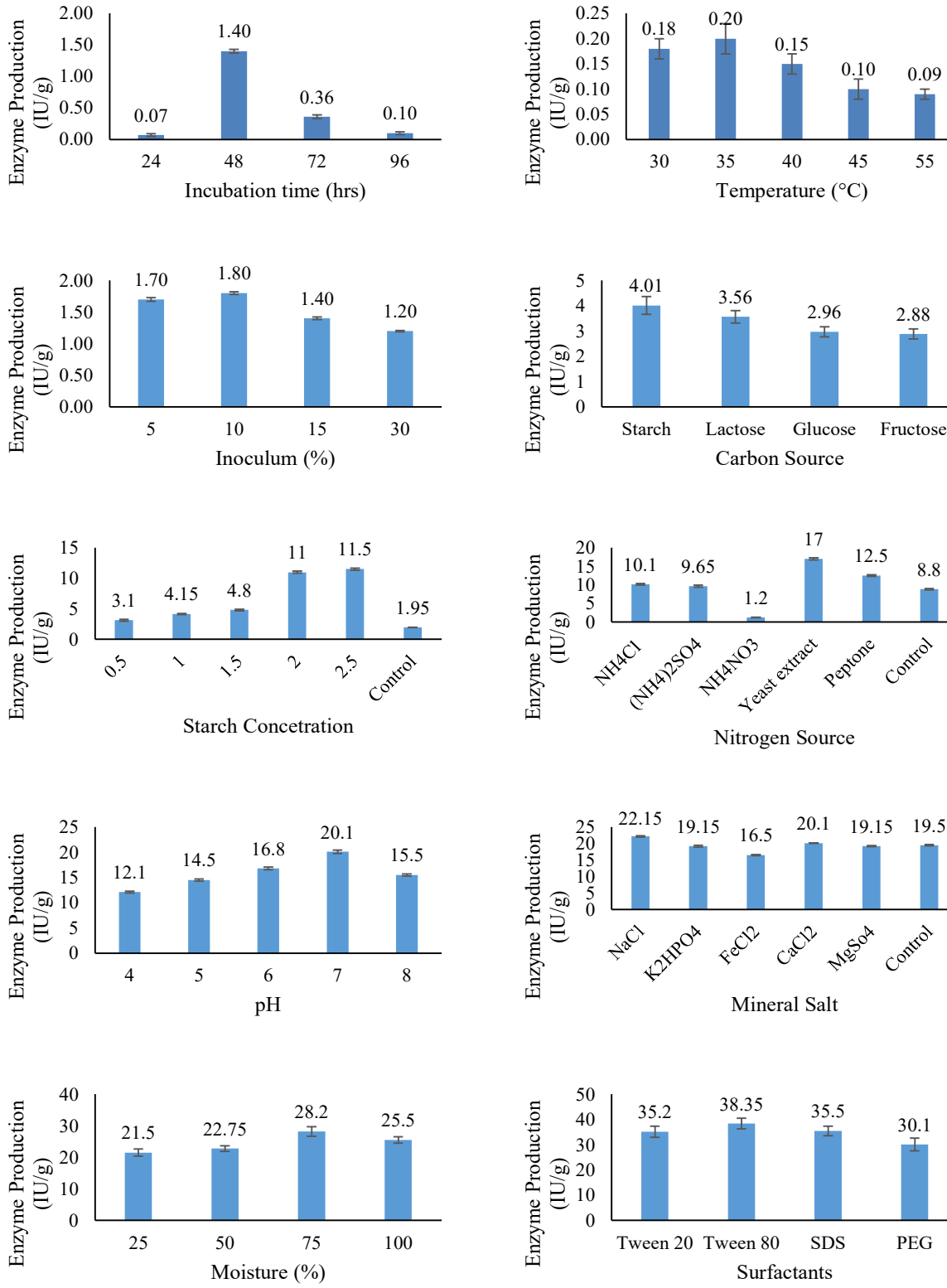

Fig. 2: Results of optimized parameters for amylase production.

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55°C (0.09 IU.g^{-1}), implying reduced enzymatic activity at higher temperatures. Notably, at 50°C, no measurable amylase production was observed, indicating a temperature beyond the optimal range for enzymatic activity under these conditions (Fig. 2).

In a study on amylase production by *Bacillus subtilis*, it was found that the optimal activity temperature was 40°C. However, the enzyme yield dropped down more quickly with the increase in incubation period at 50°C (Salman et al. 2016). It is important to note that the optimal incubation temperature can vary depending on the specific strain of microorganisms used, the substrate, and the specific conditions of the fermentation process.

Effect of inoculum level on enzyme production: The study found that the inoculum level of isolated *Bacillus licheniformis* significantly impacts amylase production. The highest yield was observed with a 10% inoculum, reaching 1.80 IU.g^{-1}, suggesting this is the optimal level for this process. At lower inoculum levels of 5% and 15%, the production remained relatively high (1.70 IU.g^{-1} and 1.40 IU.g^{-1}, respectively), indicating these levels are also favorable for amylase synthesis. However, a slight decrease in enzyme production was noted at a higher inoculum level of 30% (1.20 IU.g^{-1}), implying that an excessively high inoculum may not be conducive to maximum amylase yield (Fig. 2).

Amylase is an enzyme that hydrolyses starch to glucose units. The production of amylase is influenced by several factors, including the inoculum level (Ozdemir et al. 2012).

In a study on amylase production by Aspergillus awamori under solid-state fermentation, an inoculum level of 10% (volume per mass) was found to be optimum for α-amylase production (Kalaiarasi & Parvatham 2015).

Effect of additional carbon sources on enzyme production: The investigation into the effect of additional carbon sources on amylase production revealed varying outcomes based on different carbon supplements (Starch, lactose, glucose, and fructose) with paddy straw. The enzyme production, measured in IU.g^{-1}, in the presence of different carbon sources, is summarized in Fig. 2.

The study found that the type of carbon source significantly impacts amylase production. Starch was the most effective, yielding the highest enzyme production at 4.01 IU.g^{-1}, suggesting that it, along with paddy straw, creates an optimal environment for amylase synthesis. Lactose also showed substantial effectiveness, yielding 3.56 IU.g^{-1} of amylase, indicating its potential as a supplementary carbon source. However, glucose and fructose resulted in lower amylase production (2.96 IU.g^{-1} and 2.88 IU.g^{-1}, respectively), suggesting they might not be as conducive to amylase synthesis as starch and lactose under these experimental conditions.

In a study on amylase production by *Trichoderma viride*, it was found that the different commercial carbon substrates significantly affected the concomitant syntheses of amylase (Juwon & Emmanuel 2012).

Effect of different starch concentrations on enzyme production: The exploration of different starch concentrations for amylase production revealed varying outcomes, emphasizing the importance of starch concentration in optimizing enzyme yield. The enzyme production, measured in IU.g^{-1} at different starch concentrations, is presented in Fig. 2.

The study found a clear concentration-dependent effect on amylase production. As the starch concentration increased, so did the enzyme yield. Specifically, at starch concentrations of 2% and 2.5%, amylase production significantly increased, reaching 11 IU.g^{-1} and 11.5 IU.g^{-1}, respectively, suggesting that higher starch concentrations are favorable for maximizing amylase synthesis.

At lower concentrations (0.5%, 1%, and 1.5%), a progressive increase in enzyme production was also observed, indicating a positive correlation between starch concentration and amylase yield. However, the most substantial enhancement was observed at higher concentrations.

The control experiment with a starch concentration of 0% yielded an amylase production of 1.95 IU.g^{-1}, serving as a baseline for comparison. This reinforces the notion that starch is a critical substrate for amylase production and its absence results in significantly lower enzyme yields.

A study on amylase production by *Bacillus licheniformis* ZB-05 under solid-state fermentation found that as additional carbon sources, 2% soluble starch enhanced α-amylase production (Karatas et al. 2013).

Effect of additional nitrogen sources on enzyme production: The investigation into the effect of additional nitrogen sources on amylase production revealed distinct outcomes, highlighting the influence of different inorganic nitrogen sources. The enzyme production, measured in IU.g^{-1}, with various nitrogen sources at a 1% concentration, is summarized in Fig. 2.

The study found that nitrogen sources significantly impact amylase production. Yeast extract was the most effective, yielding the highest enzyme production at 17 IU.g^{-1}, suggesting it provides optimal conditions for amylase synthesis. Peptone also showed substantial effectiveness, producing 12.5 IU.g^{-1} of amylase.

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Ammonium chloride and ammonium sulfate resulted in moderate amylase production (10.1 IU.g^{-1} and 9.65 IU.g^{-1}, respectively), indicating their suitability as nitrogen sources, albeit with a lower impact compared to yeast extract and peptone.

However, ammonium nitrate led to lower amylase production (1.2 IU.g^{-1}), suggesting it might be less conducive to amylase synthesis under these experimental conditions.

The control experiment with no added nitrogen yielded an amylase production of 8.8 IU.g^{-1}, serving as a baseline for comparison. This reinforces the notion that the presence of specific nitrogen sources positively influences amylase production.

In a study on amylase production by *Brevibacillus borstelensis* R1, it was found that the addition of different nitrogen sources greatly affected the production of amylase (Suribabu et al. 2014).

Effect of Initial pH on Enzyme Production

The investigation into the effect of initial pH on amylase production revealed distinct outcomes, emphasizing the significance of pH in optimizing enzyme yield. The enzyme production, measured in IU.g^{-1} at different pH levels, is summarized in Fig. 2.

The study found that the initial pH significantly impacts amylase production. The optimal pH was found to be 7, yielding the highest enzyme production at 20.1 IU.g^{-1}, suggesting a slightly acidic to neutral pH environment is conducive for maximum amylase synthesis.

At pH 6 and 8, substantial amylase production was observed (16.8 IU.g^{-1} and 15.5 IU.g^{-1}, respectively), indicating that the enzyme is still active and efficient at these pH levels.

However, lowering the pH to 5 and 4 resulted in decreased amylase production (14.5 IU.g^{-1} and 12.1 IU.g^{-1}, respectively), suggesting that excessively acidic conditions may adversely affect amylase synthesis.

A published study emphasized the of pH influence the production of alpha-amylase (Kalaiarasi & Parvatham 2015, Suribabu et al. 2014)

Effect of different mineral salt ions on enzyme production: The investigation into the effect of different mineral salts on amylase production provided insights into the influence of specific metal ions on enzyme yield. The enzyme production, measured in IU.g^{-1}, with various mineral salts at a concentration of 100 μM is summarized in Fig. 2.

The study found that the addition of specific mineral salts significantly impacts amylase production. Here are the results:

- NaCl (Sodium Chloride): The presence of NaCl resulted in the highest yield at 22.15 IU.g^{-1}, suggesting that sodium ions play a positive role in promoting amylase synthesis.
- K_2HPO_4 (Potassium Hydrogen Phosphate): The addition of K_2HPO_4 yielded 19.15 IU.g^{-1}, indicating that potassium ions contribute to the enhancement of amylase synthesis.
- $FeCl_2$ (Iron (II) Chloride): Iron ions resulted in an α-amylase production of 16.5 IU.g^{-1}, demonstrating a positive impact on amylase synthesis.
- $CaCl_2$ (Calcium Chloride): Calcium ions positively influenced α-amylase production, yielding 20.1 IU.g^{-1}, suggesting that calcium plays a role in enhancing amylase synthesis.
- $MgSO_4$ (Magnesium Sulphate): Magnesium ions resulted in an α-amylase production of 19.15 IU.g^{-1}, indicating that, like potassium and calcium, magnesium ions contribute to the positive regulation of amylase synthesis.

The control experiment, without the addition of specific mineral salts, produced α-amylase at 19.5 IU.g^{-1}, serving as a baseline for comparison. A Published study shows a significant effect on the production of amylase enzyme (Saxena & Singh 2011).

Effect of initial moisture level on enzyme production: The investigation into the effect of different levels of initial moisture on amylase production elucidated the impact of varying substrate moisture content on enzyme yield. The enzyme production, measured in IU.g^{-1} at different moisture levels, is summarized in Fig. 2.

The study found that the initial moisture level of the substrate significantly impacts amylase production. Here are the results:

- 25% Moisture: A moisture level of 25% resulted in an amylase production of 21.5 IU.g^{-1}, suggesting that lower moisture levels still support significant amylase synthesis.
- 50% Moisture: Increasing the moisture level to 50% positively impacted amylase production, yielding 22.75 IU.g^{-1}, indicating that a moderate increase in substrate moisture enhances enzyme yield.
- 75% Moisture: The highest amylase production was observed at a moisture level of 75%, reaching 28.2 IU.g^{-1}, suggesting that the fermentation process

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is particularly efficient when the substrate has a higher moisture content.

- 100% Moisture: A further increase to 100% moisture resulted in a slight reduction in amylase production to 25.5 IU.g^{-1}, indicating that excessively high moisture levels may not be optimal for enzyme synthesis.

This information is crucial for optimizing the solid-state fermentation process for maximum amylase production. It shows the importance of carefully controlling the moisture level of the substrate to achieve the best results (Gangadharan et al. 2007).

Effect of various surfactants on enzyme production: The investigation into the effect of various surfactants on amylase production provided insights into the impact of different surface-active agents on enzyme yield. The enzyme production, measured in IU.g^{-1}, with various surfactants is summarized in Fig. 2.

The study found that different surfactants significantly impact amylase production. Here are the results:

- Tween 20: The addition of Tween 20 enhanced amylase production, yielding 35.2 IU.g^{-1}, suggesting it positively influences amylase synthesis.
- Tween 80: Tween 80 was the most effective, yielding the highest enzyme production at 38.35 IU.g^{-1}, indicating it's particularly effective in promoting amylase production.
- SDS (Sodium Dodecyl Sulphate): The addition of SDS also positively influenced amylase production, yielding 35.5 IU.g^{-1}, suggesting it contributes to the enhancement of amylase synthesis.
- PEG (Polyethylene Glycol): PEG resulted in slightly lower amylase production at 30.1 IU.g^{-1} compared to the other surfactants, indicating its impact on amylase synthesis is less pronounced under these experimental conditions.

This information is crucial for optimizing the solid-state fermentation process for maximum amylase production. It shows the importance of carefully selecting the surfactants to achieve the best results (Singh & Kumar Brahman 2013).

CONCLUSION

The comprehensive study we conducted aimed to optimize amylase production through a systematic exploration of a range of factors and conditions. The final set of media identified to maximize enzyme yield includes:

- Substrate Composition: Paddy straw (5 g) and Starch (3%).
- Mineral Salt and Additives: NaCl (100 µM), Tween-80 (1%), and Yeast Extract (1%).
- Moisture Content: Initial Moisture (75%).
- Incubation Conditions: Incubation Time (48 hours), Temperature (35°C), and pH (7).

This optimal combination ensures significant enzymatic activity and provides insights for process scalability and industrial applications. The established parameters serve as a valuable foundation for further studies and applications in the field of enzyme production. This research offers a systematic and tailored approach to maximize amylase yield, contributing to the advancement of biotechnological processes and applications.

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Unique Identities of Neighbourhood in Asian Countries

Prof. Shweta Kapoorr

Principal I/C, Swarrnim Institute Of Design

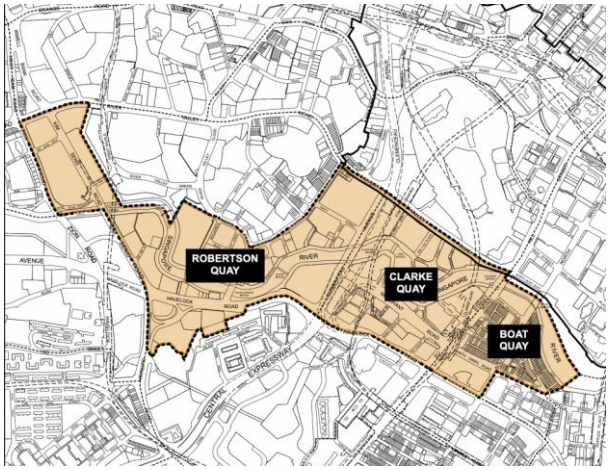
Abstract:
How do we create a unique modern and architectural urban design languages of aneighborhood/city which also makes it livable, sustainable,attaching and visually unique today and for the future?

Keywords: Unique, Urban Design Guidelines, Neighbourhood

How do we create Unique identity exists essentially in an organic and evolutionary manner?
How do we create a unique modern and architectural urban design languages of a neighborhood/city which also makes it livable, sustainable,attaching and visually unique today and for the future?
Key Layers of Neighborhood scale Design.

https://www.hdb.gov.sg/cs/infoweb/-/media/doc/Press Releases/corppr04092018annex-final.ashx

Singapore river one Planning area**:-**(Residential,Mixed-use, Heritage)
Riverfront living, buzzing Night life, Activities in historic buildings, analysis on waterfront destinations.



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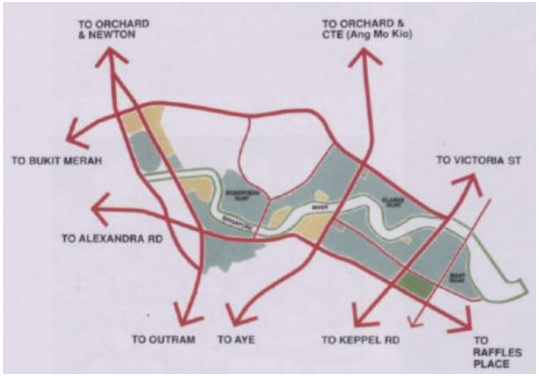
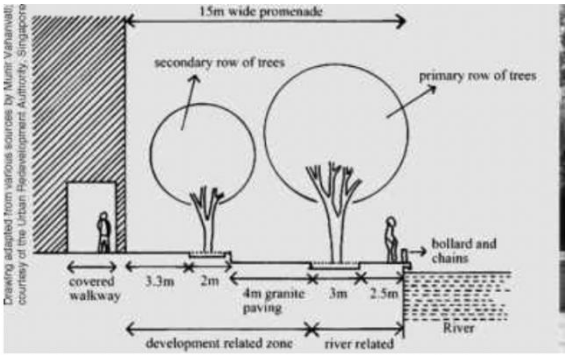
New Development Urban design Guideline.

Aims to guide the physical development of the area to ensure that individual buildings contribute to, & strengthen planning vision for the respective zones & create an attractive pedestrian friendly physical environment.

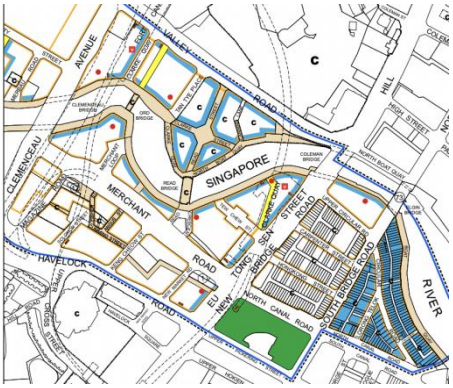
Implementation of tree lined pedestrian promenade on bridges along the banks of the river, connecting the above 3 quays.Activity corridor that capitalizes on the river frontage and reflects its unique historic character.



Bridges connecting bank of Singapore river



15 mts setback from riverfront to development



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Zones of Singapore river planning area:-Total 3kms long

Robertson Quay- Waterfront Residential living Art related Facilities

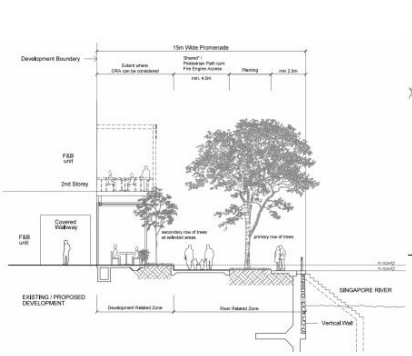
Clarke Quay -Conserved Mixed used Building ,Commercial, Residential & Hotel

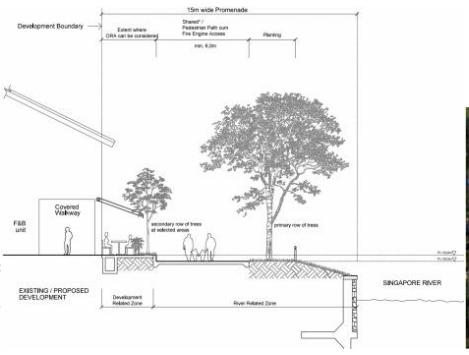
Boat Quay-Conserved 100 shop buildings ,Commercial activities

AGU

To create vibrant precincts attractive, pedestrian-friendly streets, AGU (Activity generating uses) like retail,food& beverages at

- Riverfront promenade,
- pedestrian malls,
- block links,
- key streets &
- public spaces.





ORA

Outdoor Refreshment Area are allowed at:

- Along riverfront promenade
- Public areas or open spaces
- ORA defined by different floor finishes or planters etc.
- Structures (scale & design) compliment the adjacent developments.

Robertson Quay

- Abutting within the boundary
- Maximum height -4mts related to 1st storey of development/adjacent covered walkway to a maximum height of 4mts.
- Market styled umbrellas ,not anchored to the promenade.

Clark Quay

Standalone ORA structures near river related zones

- Light weight & not exceed 4m height.

Form & Massing

- Scale form & architectural expression of the surrounding buildings.
- Buildings should be designed to contribute skyline profile of city & pedestrian experience along the riverfront promenade.
- Design of building form & massing with architectural treatment depends upon how it is viewed form different places.

1. Major approaches/landmarks
2. Promenades
3. Pedestrian malls.

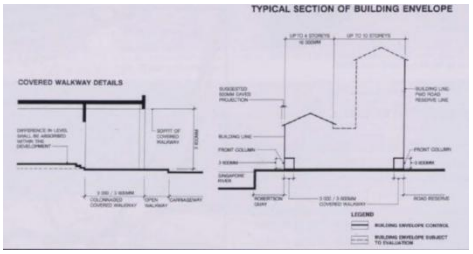
- Robertson Quay blocks were of former warehouse styles lined the river to be retained.
- Existing Buildings
- Roof profiles & solid & void expressions.

Location- Front to next to F & B Unit.(as shown in section above)

The riverfront promenade, pedestrian malls and public spaces (covered walkways,courtyards,within the setbacks).

Boat Quay

- Umbrellas are allowed.
- Tent structures allowed.
- Existing trees are not pruned.
- Tree aeration and plantation are kept open.



Building Height

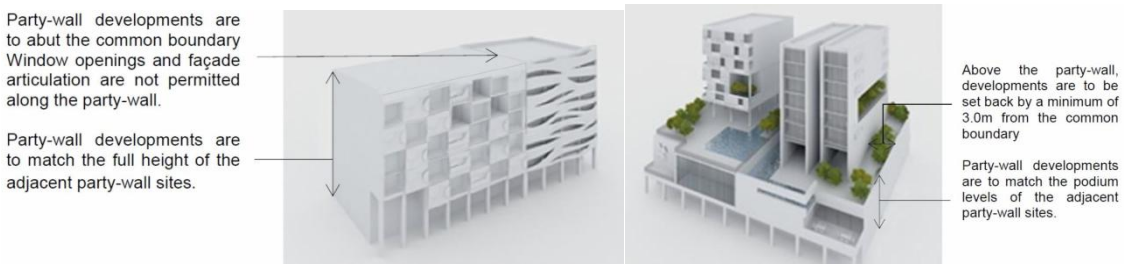
- Specified to create 3 dimensional skyline profile.
- Lower Height for pedestrian friendly scale :

1. River front promenade.
2. Low rise conserved buildings.

- Higher building heights in non-river fronting portion.
- Higher building heights assigned for focal points & variety in built environment
- Robertson Quay & Clarke Quay has 2.8 plot ratio.
- Boat Quay has 4.2 Plot Ratio.

Building Edge

- Creative distinctive well defined streets.
- 40% per building frontage, between the corners of development for bu;ding form articulation.
- Create distinctive well defined streets developments built to the lines of road reserves /promenade reserves to a minimum of 2 storeys.



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Party Wall

- Party wall developments -to abut the common boundary with the Lower Height for pedestrian friendly scale :

1. River front promenade.

2. Low rise conserved buildings.

- Higher building heights in non-river fronting portion.

Building Edge

- Creative distinctive well defined streets.
- 40% per building frontage, between the corners of development for building form articulation.
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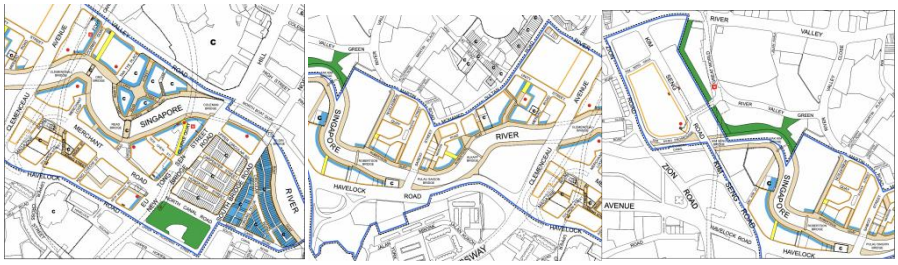

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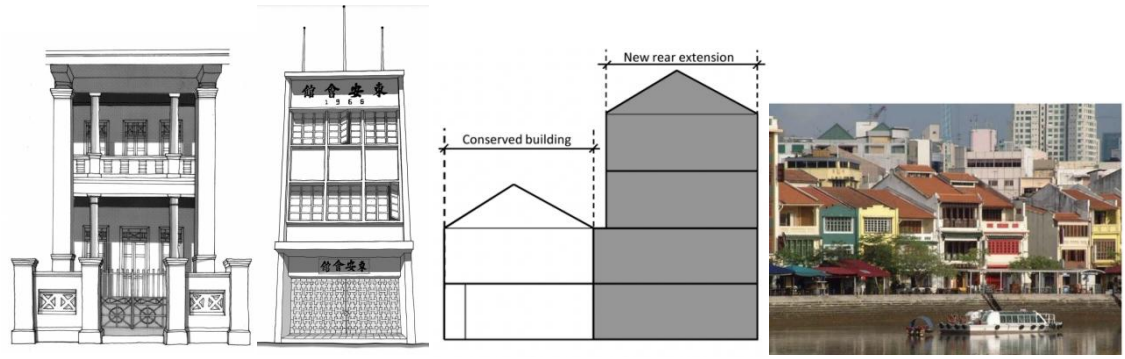
Public Spaces

- Developments fronting the riverfront promenade or pedestrian malls or nodes-provision of public open spaces within the site.
- Landscaping in these open spaces for visual and physical porosity.
- Well connected to river promenade open and covered walkways and accessible from underground and elevated 2nd storey.

Roofscape

- Roofs of both high rise and low rise parts of developments are to be considered which contributes the distinctive and coherent character of Singapore river.
- Relating to the conserved buildings,development at Robertson Quay have terracotta clay tiled pitched roofs as the predominant roof form.

Conservation Development Urban Design Guidelines



Art Deco Modern Shop house

Boat Quay Historic Districts Shop-houses conservation guidelines:

A new Jack roof .Skylight at the rear slope of main roof & on rear secondary roofs.

A cover over the air well.A cover over the rear court.New windows on rear facade & gable end wall.

Addition of secondary doors & windows.

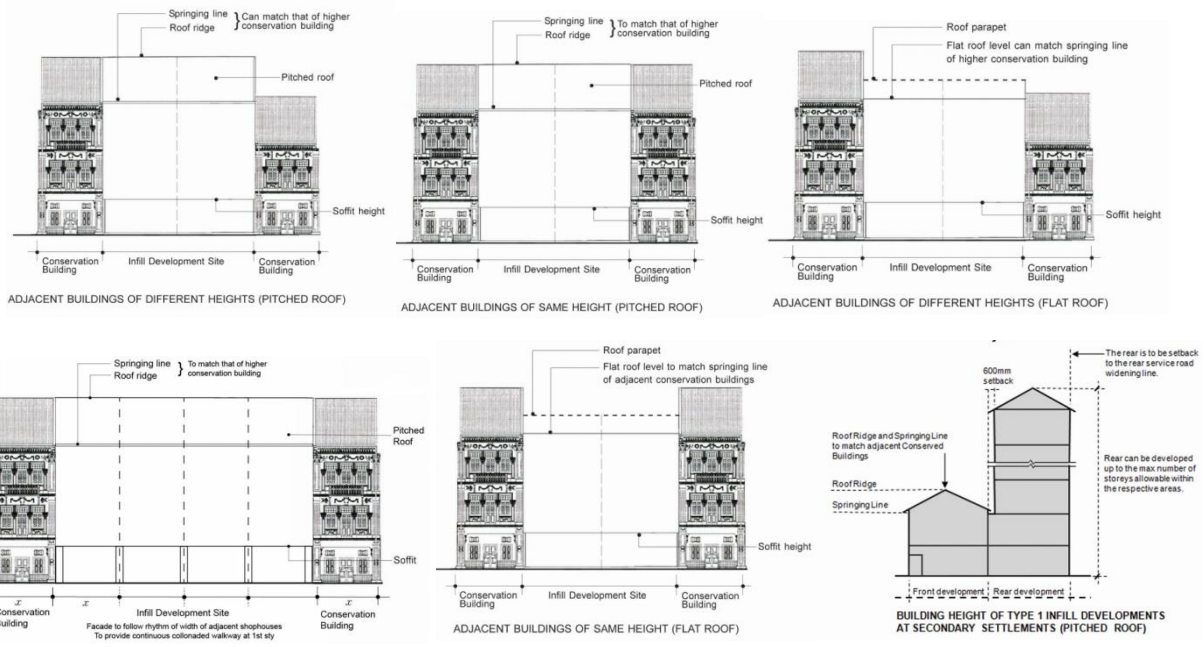
Art Deco

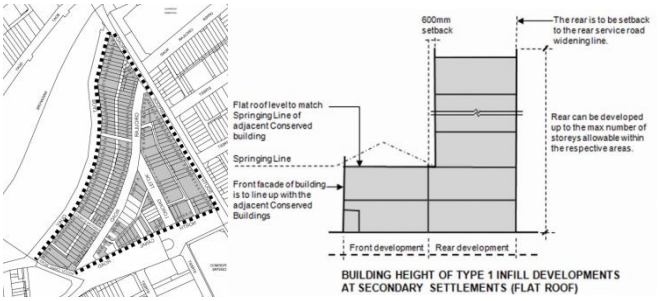
Streamlining columns,arches, orders, keystones & pediments, into geometric design. No clay tiles .

Proportional beauty & elevation composition.

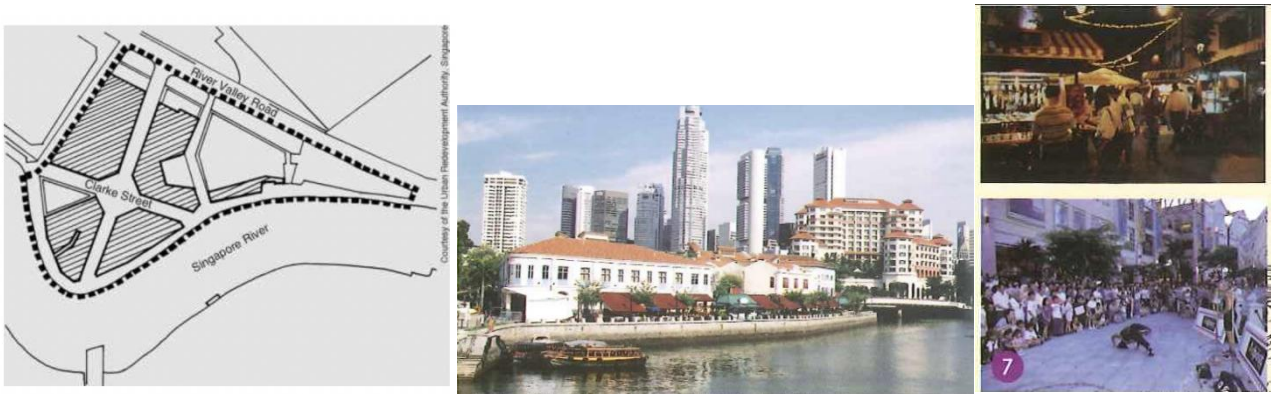
Modern Shop house

Thin air fins & air vents which are functional & decorative. Well proportioned windows to compliment with geometric design. Functionalism moving towards modernism approach. Representation of Post war economic situation





Clarke Quay conserved ware houses (Mixed use developments) guidelines:



60 go-downs at Clarke quay converted into 200 & more shops, restaurant,bars,etc.

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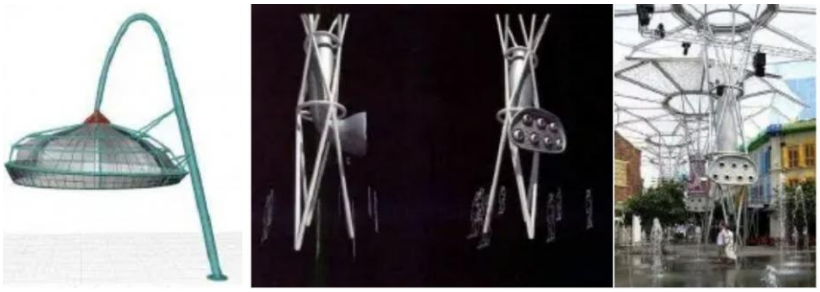


Blue bells figures showing Clarke quay revival plans.

The Clarke quay after revival in 2003 created a promenade with chairs,kiosks, trees & steps along the bank . However, the new installations of lilypads& bluebells in 2003 weakened the visibility of the river while narrowed the pedestrian space. The facade of the whole area also changed.

Facade Transformation of Clarke Quay

Facade Transformation of Clarke Quay

Regeneration of shop houses made the Clarke quay increase the economy of people

Heritage precinct is continuously reinventing itself from family oriented festival market to retail centre& warehouses into night clubs. Heritage structures modifications done many times.

Conclusion:

The riverfront was developed in a way to attract more people to it.

Appropriate relations between the government & private companies lead to the development of the

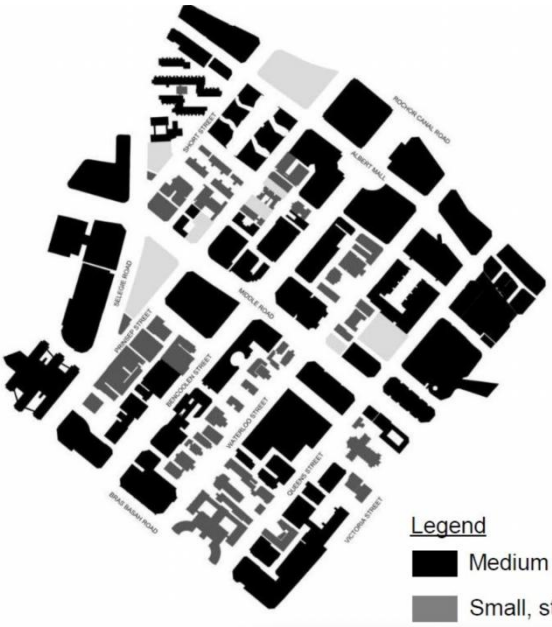
riverfront to be the centre of tourist attractions.

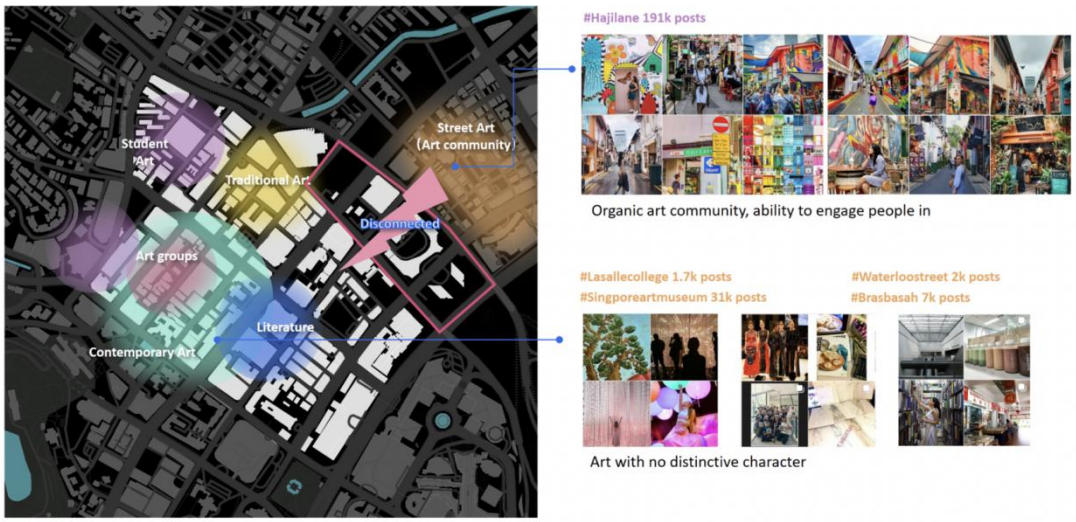
The efficiency of links between spaces,encourages pedestrian movement & makes all places adjoining the river easily accessible.

The movement along the river is development such that each pocket of area has a different experience to offer with its environment, along with buffer spaces in between, allowing users to gain better clarity of the space.

Urban Design Guidelines

Rapid development in 1980s improved the quality of life in Singapore but changes also led to a loss of vibrancy to formerly bustling districts. To inject life back into the Bras Basah Bugis precinct, the URA embarked on a 20 yr plan, with a focus on encouraging walking, to being back life to the streets.





Rochor Planning Urban Design guidelines-

Land Use

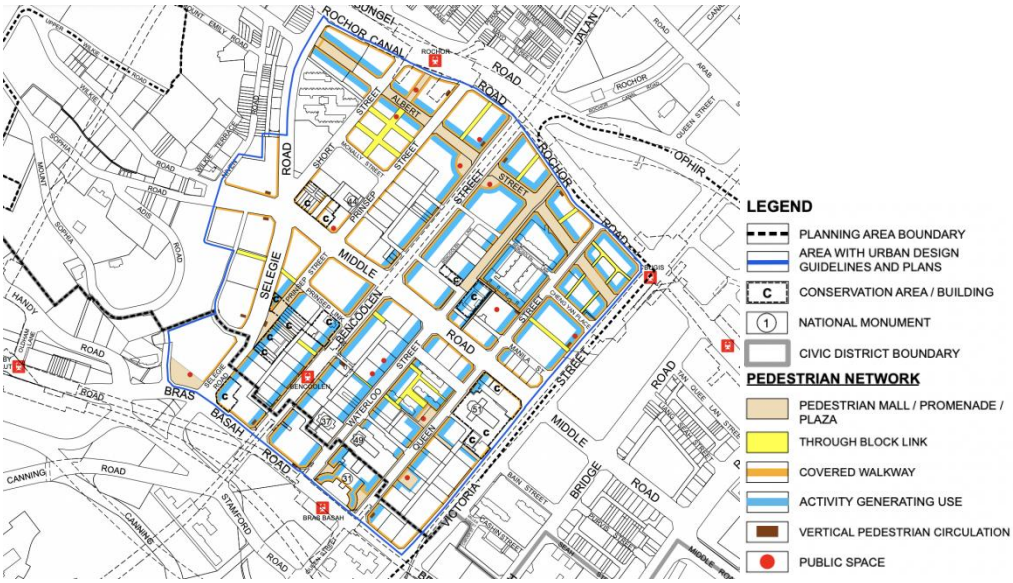
- The Bras Basah Bugis (BBB) Museums, shopping belt, Learning and heritage enclave.
- Guidelines ensures the individual development contributes to strengthen the planning vision for the area, while retaining BBB'S eclectic character.
- Standalone religious buildings, schools, medium to large scale commercial buildings and public housing.

Differentiated urban design guidelines for different streets wrt the character of each street.

Varied Street scapes Innovative & varied building forms & scale, as well as shop fronts with high level of transparency enhances the street experience.Pedestrian Friendly District

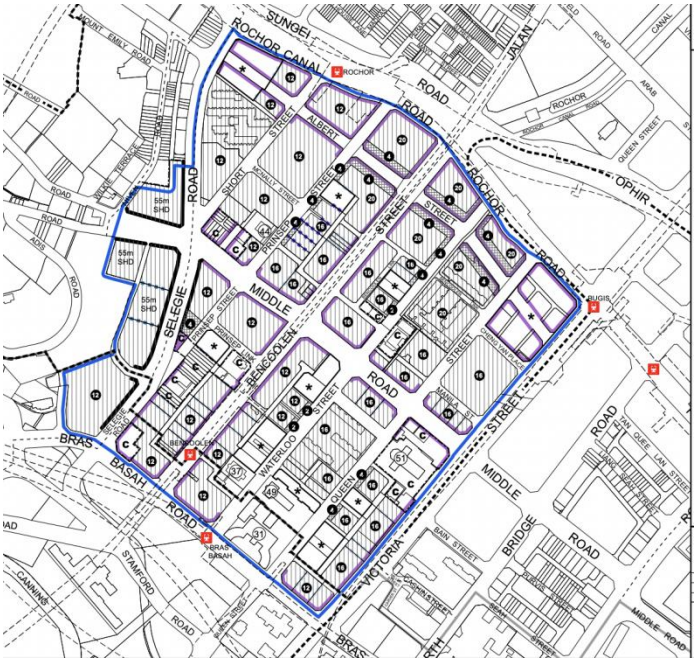
Connectivity between developments via a comprehensive network of pedestrian malls,covered walkways & laneways in between buildings will make the area more walk-able. For large scale development permeability in ground level is important to allow pedestrians to walk through the buildings.Active Vibrant streets Many public spaces are connected by pedestrian malls & walkways are safeguarded for the public enjoyment & for organized events & spontaneous activities.

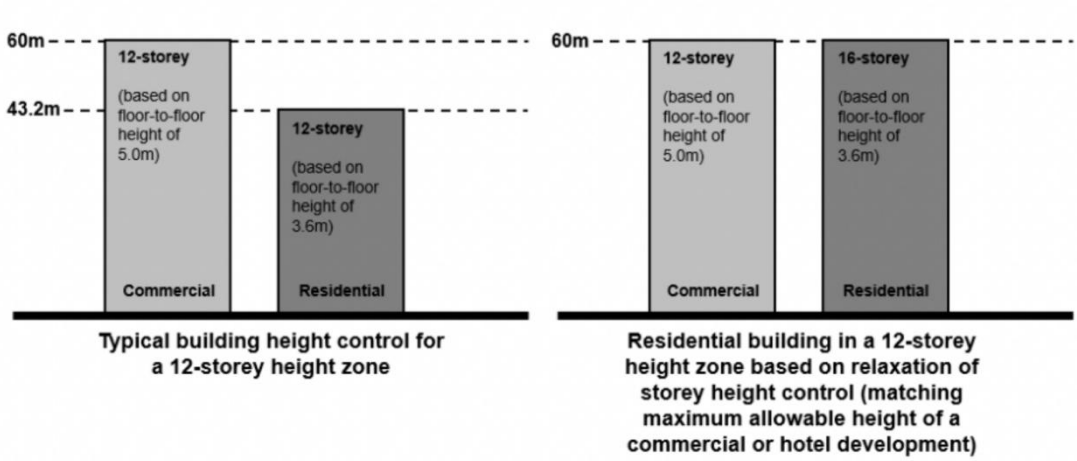
ORA



- ORA & ODA (Outdoor Display Area) can be allowed in selected locations.
- GFA for ORAs are to be computed as part of maximum GFA for the development & subject to the prevailing Development Control Guidelines.

Building Form & Massing





Typical building height control for a 12-storey height zone

Residential building in a 12-storey height zone based on relaxation of storey height control (matching maximum allowable height of a commercial or hotel development)

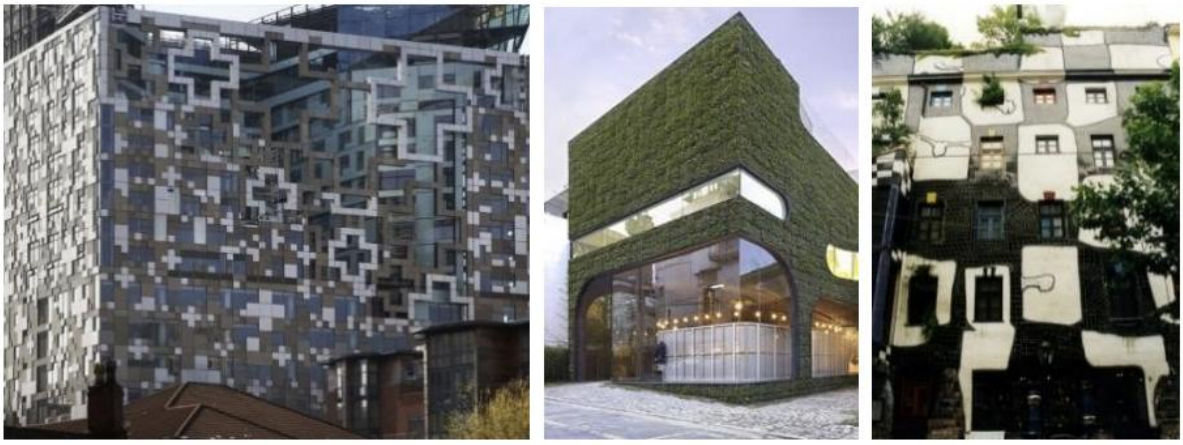
- Looking at scale form & architectural expressing of the surrounding buildings, to enhance the varied character of the different streets in BBB.
- Building heights are specified to respond to the site context and to reinforce the character of the district.
- Lower height near Mount Sophia to retain lower-rise character around the hill.
- Residential development with BBB an equivalent building height to the maximum allowable height for a commercial building can be considered to give greater design flexibility.

Building Edge

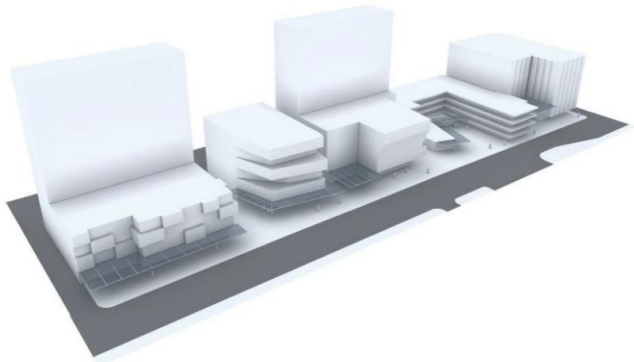
- Building edge of developments helps to define the streetscape & urban spaces within the city.
- Creative expression of the overall building form & architectural treatment is highly encouraged, with a variety of building materials & textures.
- Integrated facade lighting & landscaping, to provide interest & variety to the street scape.

- A high level of transparency & porosity is also encouraged at the street level.

Examples of Variety of Building Edge treatment.



Different architectural expressions on facade are encouraged to prevent uniform quality of evelopments. Give variety to the building edge &streets-cape. The development along other streets-should not to be built up to the Road Reserve.Developments having setbacks from the Road Reserve, the area fronting the developments is to be landscaped as attractive & accessible public spaces. Open car parks, as well as gates & boundary walls that obstruct public access will not be allowed withinbuilding setback.

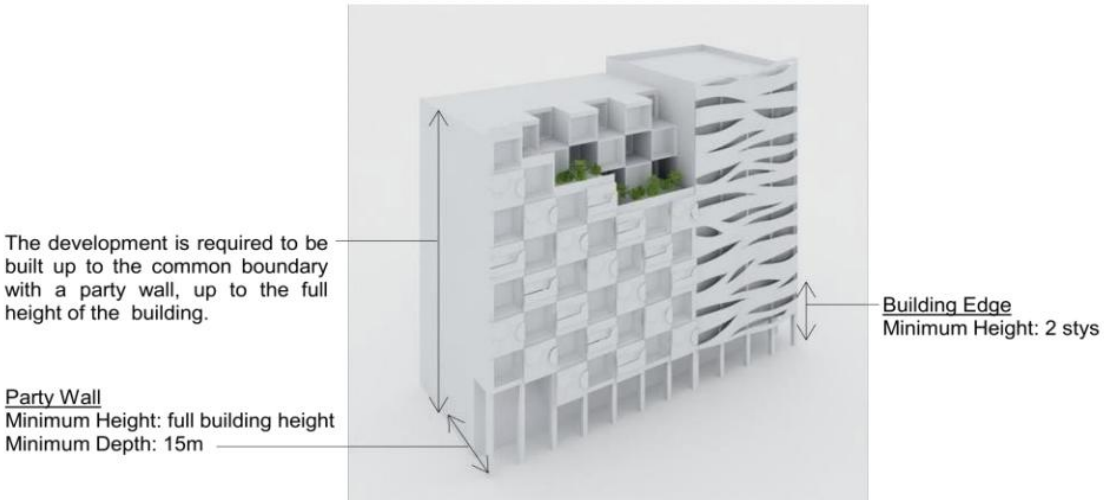


Mix of buildings of different typologies. Ranging from traditional shop-houses to small & medium scale modern developments.Buildings that are set back from the line of Road Reserve to provide public spaces

in front of the developments.Existing are built up to the common boundary with the adjacent developments with a party-wall. This maximize building footprint & creates a continuous pedestrian walkway between developments. Developments within these street-blocks are to be built up to the common boundaries as party wall developments. No windows are allowed along party walls, as these will be constructed by the future adjacent party wall development.Standalone buildings are with setback of 3m (minimum) from the common boundary.

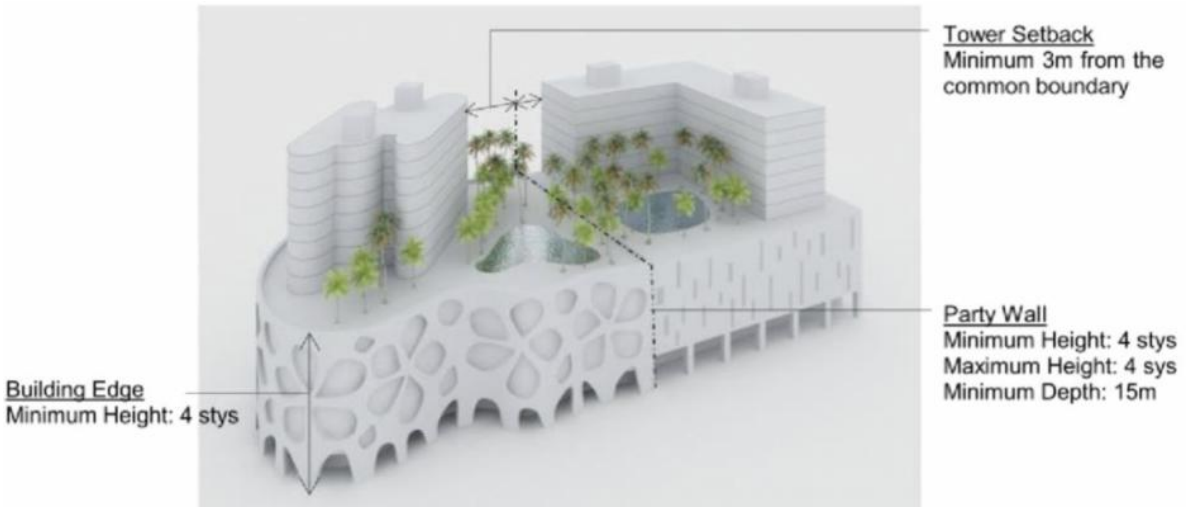
Guidelines for commercial street blocks

Party wall with full height of the building with common boundary.



Guidelines for Residential street blocks

Party-wall developments are to be built up to a minimum 2 storeys& not exceeding 4 storeys. Beyond the height of 4 storeys, the building is to be set back minimally 3m from the common boundary, & 7.5 m from the Road Reserve. This allows openings in the residential development



Guidelines for Mixed use development.

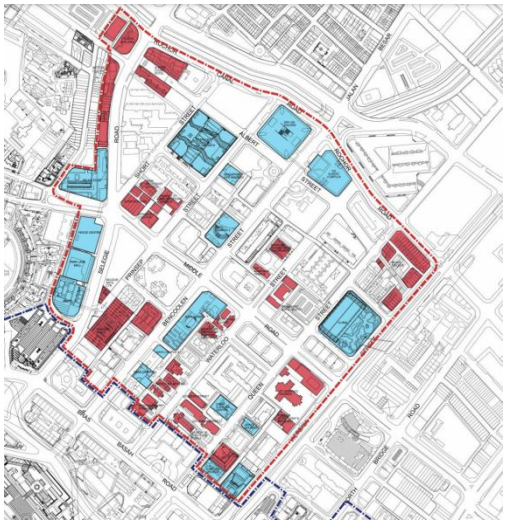
The mixed-use developments along Seleige Road are to be built up to the common boundary upto 4 storeys. In view of the relatively large building footprint, the tower blocks above the podium are to be set back 3m (minimum) from the common boundary. This prevents wall-like developments &provide opportunities for more window openings within the mixed-use development.

Public Spaces

It is important to provide spaces within private developments for users to enjoy. Selected developments fronting key pedestrian malls or nodes are required to provide public open spaces within the development site. Public spaces are well connected pedestrian mall, adjacent open & covered walkways, thru block links & where applicable, are encouraged to be linked & designed to be well integrated and easily accessible from the underground & elevated 2ndstorey pedestrian networks within the development.
https://www.ura.gov.sg/-/media/User-Defined/URA-Online/circulars/2013/nov/dc13-16/dc13-16-Annex-A.pdf

Greenery Replacement & Landscaping

To create a green & sustainable city, all new developments will be required to incorporate landscaping in the form of sky terraces & roof gardens according to Landscape Replacement Area.

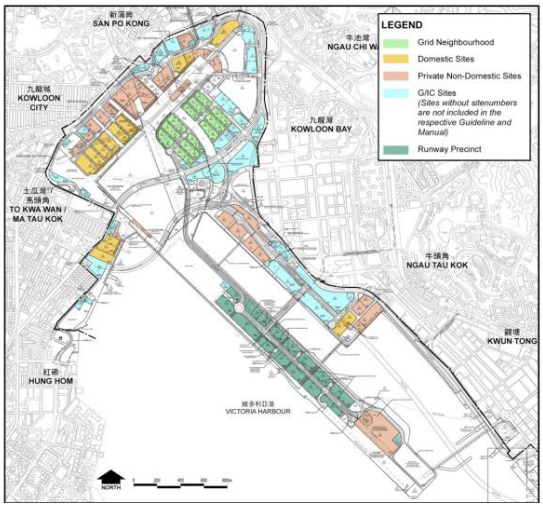


Night Lighting

Various arts,culture& heritage developments, as well as key commercial buildings are to provide night lighting to enhance the district character at night.Buildings with unique & attractive luminous facades will enhance vibrant street life & can be allowed for Contemporary buildings that suit the context of their locations. Luminiuos facades are not allowed for Classic Buildings.

https://development.asia/case-study/enhancing-urban-spaces-pedestrian-friendly-mixed-use-development

Urban Design Guidelines for Grid Neighborhood of Kai Tak Hong Kong.



Kait tak urban design guidelines for Grid Neighborhood

Overall Urban Design Framework for Kai Tak

Following are Key Urban Design & Landscape principles:-

- Connecting Neighborhoods
- Creating Nodes
- Activating the Harbour-front
- Creating a Pedestrian Friendly Environment.
- Creating Dynamic Skyline
- Celebrating Views.
- Celebrating Gateways.
- Creating "A Green Web for Sustainable Development.

Principal Function is to achieve coherent overall design of high quality.

Parameters that are specifically applicable are:-

- Relating to Proposed residential Low blocks.
- High Blocks
- A retail belt from the Station Square.

Introduction

To create Visual identity.Adistinguished,vibrant, attractive and people oriented community.increase of Visual permeability across site by Southeast & Northwest axis.

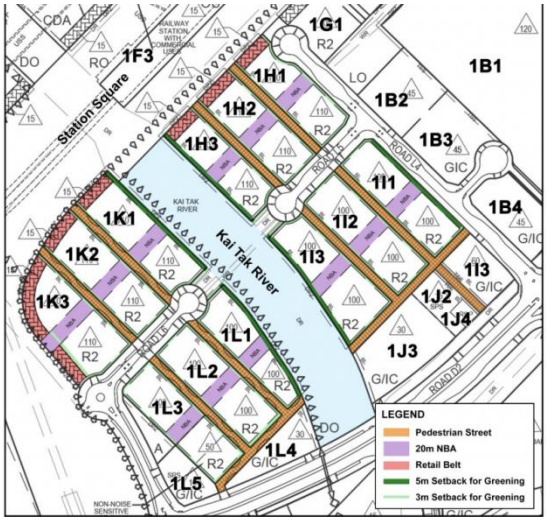
Public Creative framework

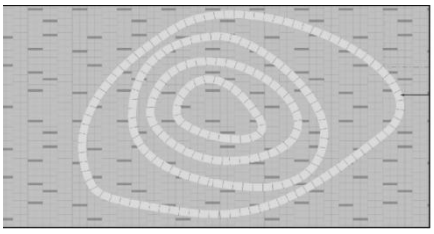
Color scheme- features 8 main color and 6 highlight color. Colors- core values of Kai Tak-Connecting, Natural, Healthy, Future Driven,Strong

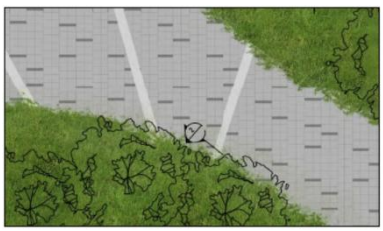
Colors are in harmony with society and Urban structures (architectural constructions,park and leisure environment, and business areas etc)

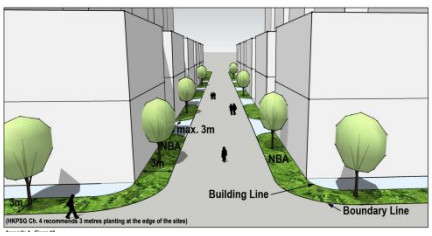
Ambient Tone and Color

Defines building or an area. Applied in building facade, furniture,street pavements. Sense of place, improves visual quality of neighborhood, soften visual impact of buildings.Visually appealing pedestrian circulation.Connection with public realm.









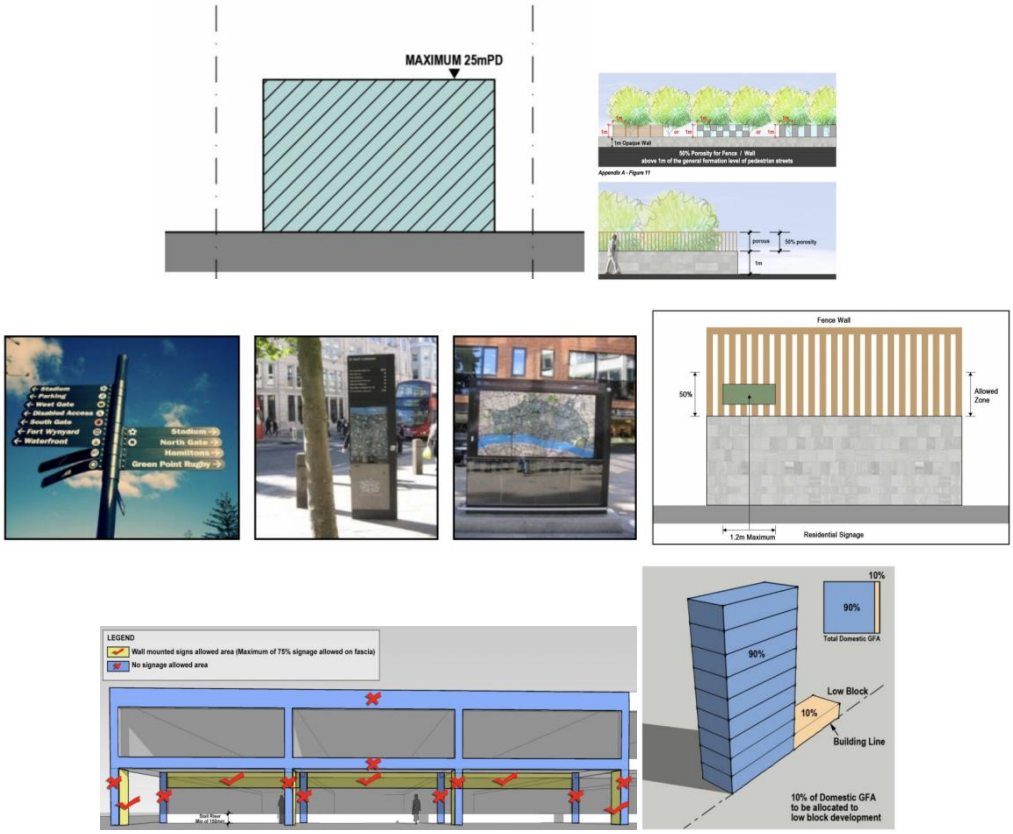
Streets-cape Design:

Historic Street Pattern: Efficient, effective design and pedestrian movement.Increase of Visual permeability across site by Southeast and Northwest axis. Riverine edge- 5 mts setback forgreening.3mts wide NBA (non building area)10 mts wide Pedestrian streets.20mts wide Visual corridor with organized trees , plants .For points and routes of access and circulation to define spaces character and function with visual order.Enhance legibility there should be change of paving material at

the junction of pedestrian street and visual corridor.

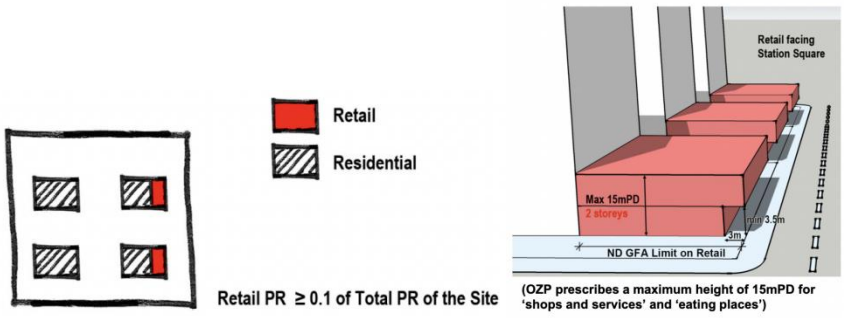
Residential Facade Treatment

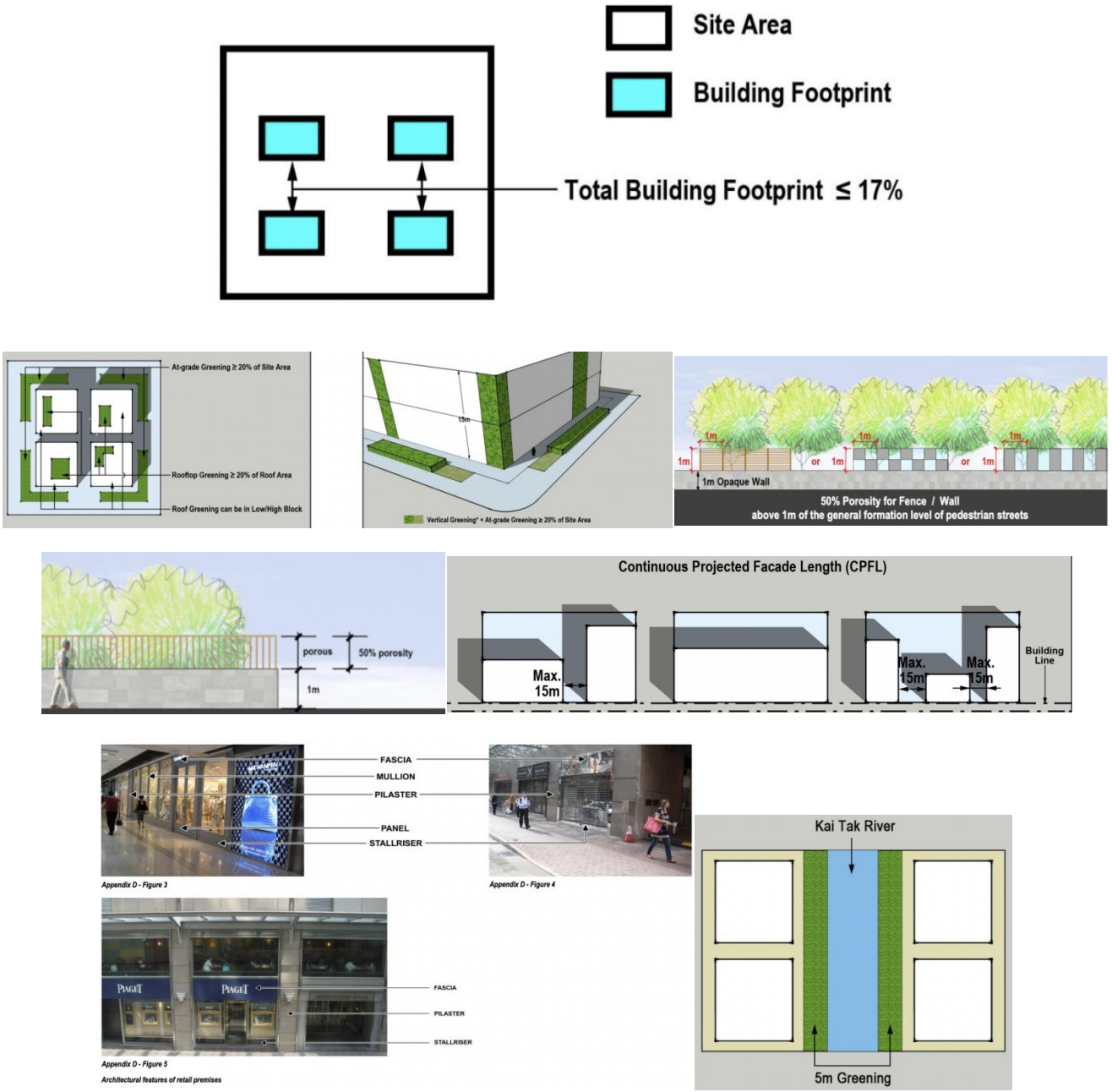
Continuity of facade treatments at ground level. Building frontages with balconies, bay windows, clearly defined windows &windows.Quality edge in the neighborhood, and interest in public realm created by the texture and exterior detailing which is related to human scale.Also foster a sense of lightness and subtlety in the development.Soft materials like recycled wood/natural materials to be used.Wood and glass - express the character, architecture and form of the buildings with enhancing the quality of built environment.Modern low maintenance material brick and stone soften the visual appearance of the buildings.Excessive long facade should also be avoided.Windows,doors and balconies located in street face of building help to add visual variety and depth to a building.



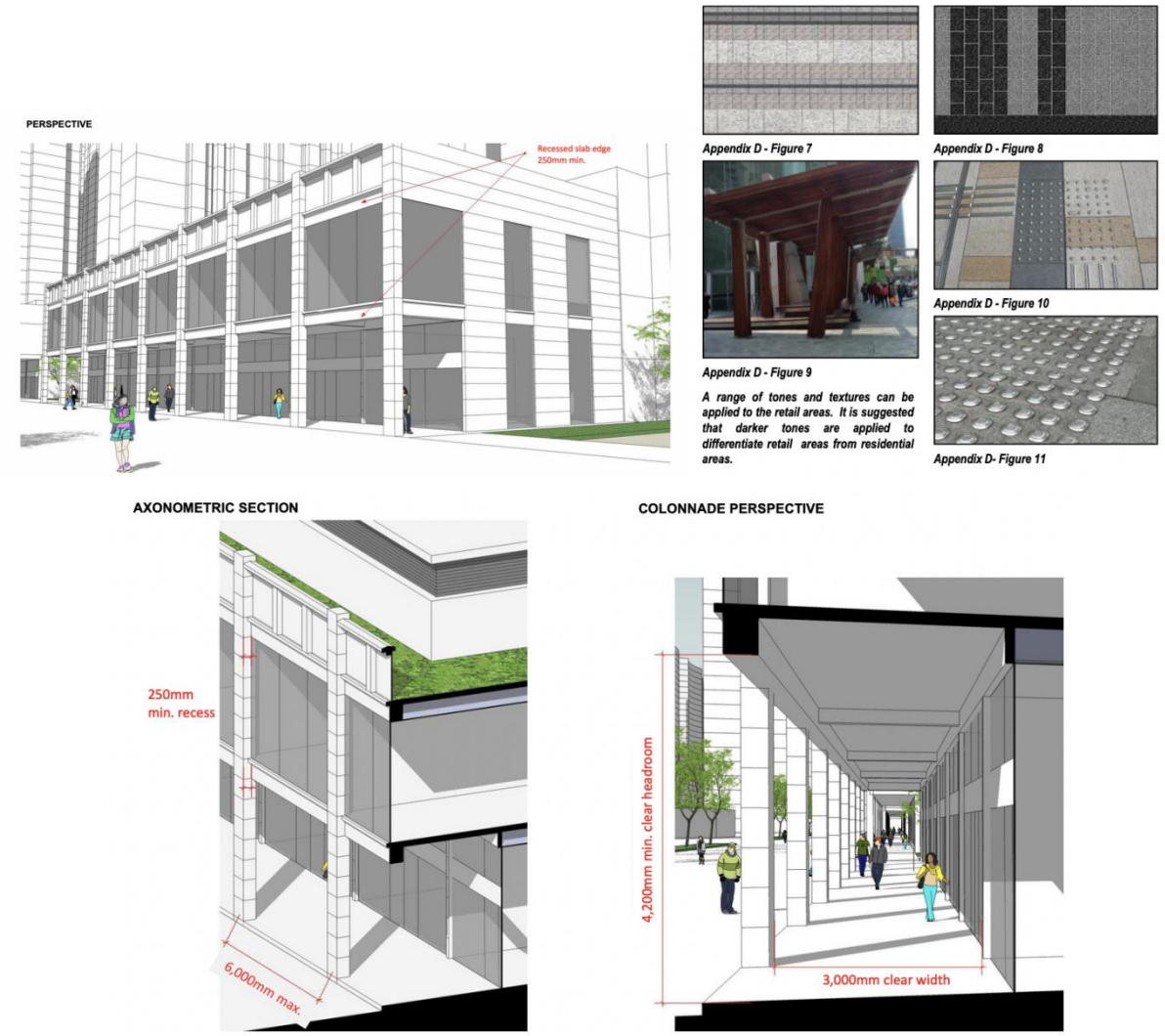
Greater permeability of fence walls to enhance interaction between neighborhood and pedestrian street.Use of polished metal surfaces incorporated into building design.Highly reflective to be avoided as they produce glare.Directional signage, retail signage, street name signage & residential name signage with regard to certain building and dimension constraints.Residential signage locations.

Low rise resiential blocks-BH 25m pd.A minimum of 10% of GFA -Low rise Residential block.





Facade length dot exceeds 40m.Retail development should not be more than 15 mts.Overall greening ratio-30%.Pedestrian greening ratio-20% Roof area greening ratio-20%.



Form Based Code at Chandigarh

Form based Code are used to create visual identity and maintaining the desired character of a building by :-

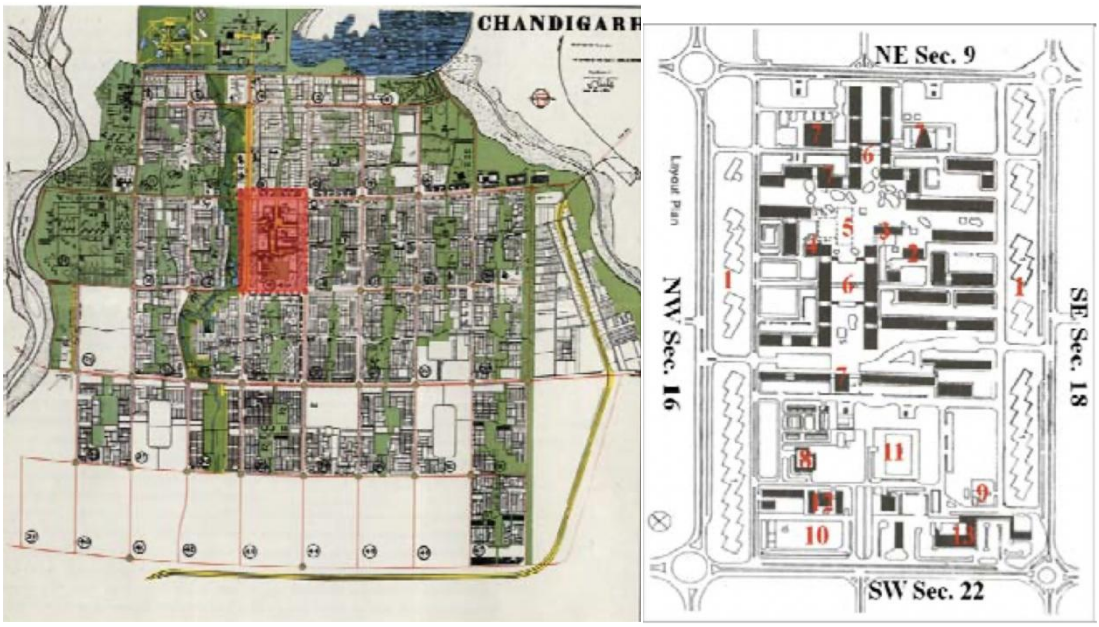
Building Height & bulk.

Facade treatment.

Location of Parking.

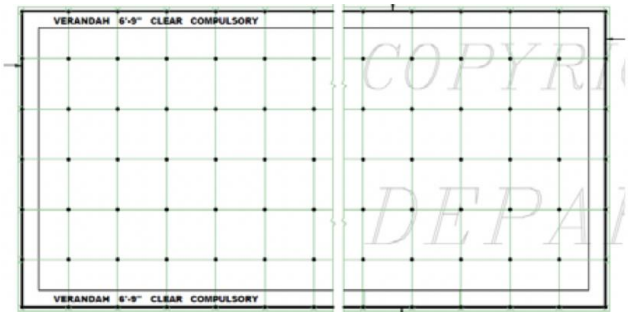
Location of building.

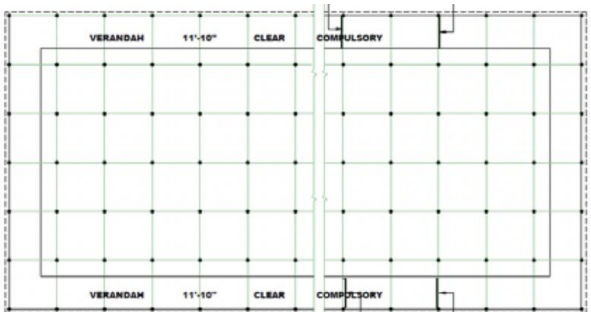
Appearance and Quality of Public Realm.

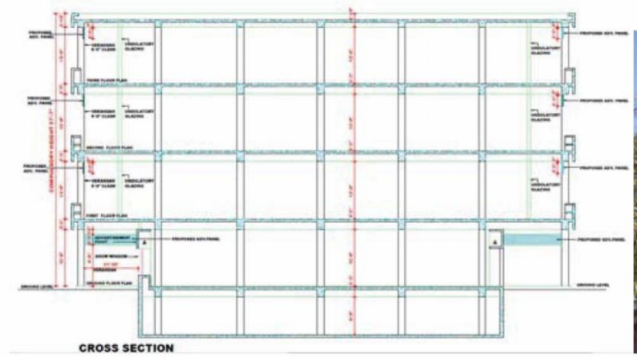


Form Based Code in Sector 17 is a Commercial activity Hub.

These Codes are specified for 4 storeyed, 5 storeyed R.C.C Building blocks, Brick faced building blocks, peripheral blocks, cinemas and petrol pumps.4-storeyed Shop cum Office buildings:

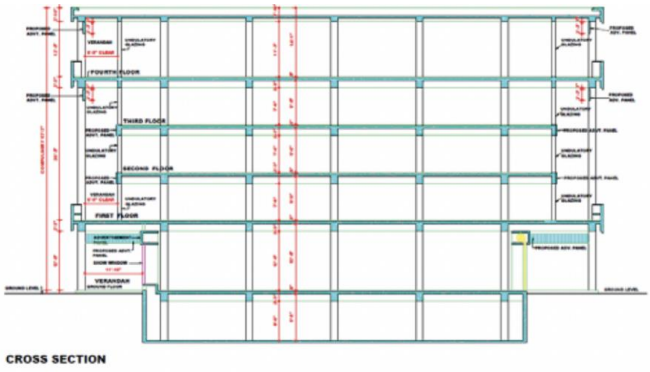






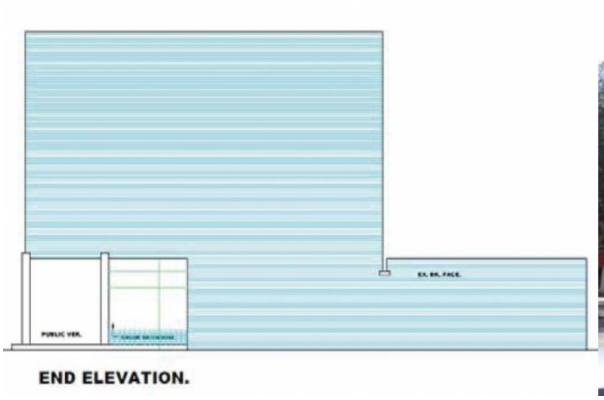
Architectural Controls:

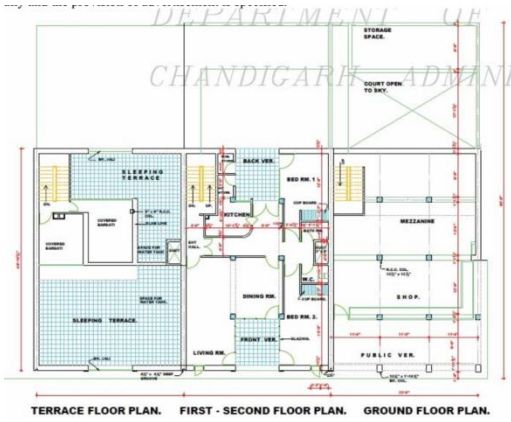
Verandah in ground floor 11’ wide, first,second and third floor 6’ wide.Height restricted to 57’7”.Space for Advertisement Panels as shown in the figure Basement -services like machine rooms, store rooms, cycle rooms, strong rooms for banks etc.In a commercial complex -Main door entry of the shop for an extra entry size of door is same as the existing door, that to at the rear side.Party wall should be till the ceiling height.



5 storeyed Shop and Office Building:-

Height remains the same 57'7" internal heights of floors changed.





Shops cum Office (Brick faced)

Height remains 48'9". Upper floors with recessed balconies or windows for play of solid and void. No basement, provision of Mezzanines.1/2" of groove to separate the shops visually.Peripheral blocks are designed for a better view from the main road.

Cinemas having almost similar character.

Facade violation

Texture on concrete, paint on concrete and colour on exposed brick facade.

New cinema block with glass facade, and old on the right side. The city center is governed by architectural controls of "System of Construction and Architectural Treatment of Exterior Controls". http://ijiet.com/wp-content/up loads/2016/08/10.pdf

Are The Urban Design Guidelines Similar To Form Based Codes.

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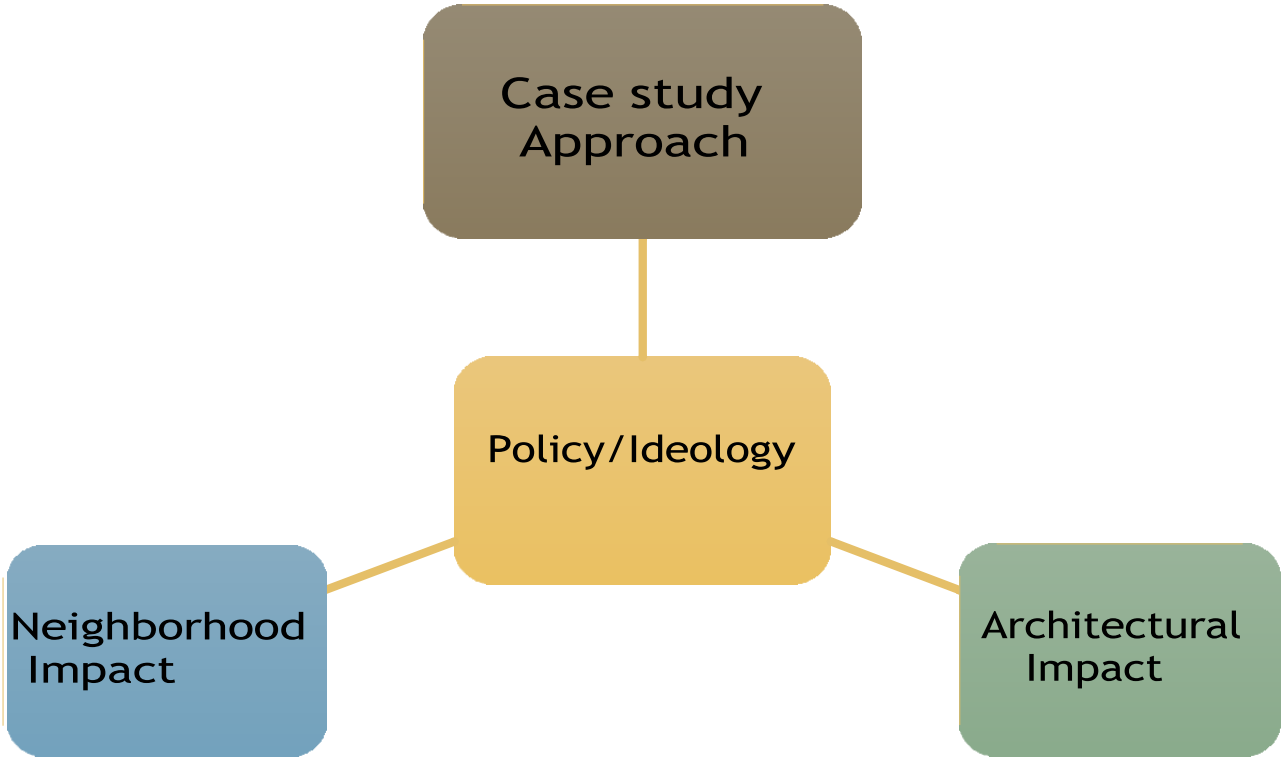
[1,* 2,] Principal I/C Department of Architecture, Design & Planning Swarrnim Startup and Innovation University,Gujarat,India Shweta.kapoor@swarrnim.edu.in,

***Corresponding Author:-** AR.Shweta Kapoor
*Principal I/C Department of Architecture, Design & Planning Swarrnim Startup and Innovation University,Gujarat,India Shweta.kapoor@swarrnim.edu.in,

An Ideal Place

Many countries have started to take initiative in planning and designing places that are livable sustainable and forms identity of that place.
Many planners and philosophers have tried to achieve that vision of an ideal place for over decades now. In the last century Conventional planning or use based planning or we can also call it as Euclidean zoning have been the most common one.
Factors comprising to make a place ideal Source : Shweta Kapoor 2023

Approach:



New Urbanism

'New Urbanism is a planning and development approach based on the principles of how cities and towns had been built for the last several centuries: walkable blocks and streets, housing and shopping in close proximity, and accessible public spaces. In other words: New Urbanism focuses on human-scaled urban design'. According to the Congress of the New Urbanism,[CITATION CNU22 \l 16393]

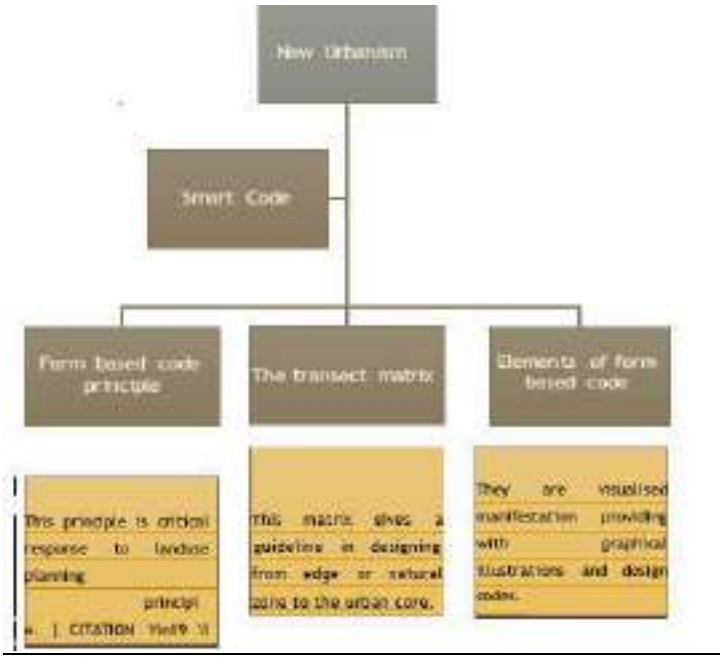


Table 1- New Urbanism Heirerchy Source : 2023

Form - Based Code

What is form based Code?

According to [CITATION For16 \l 16393] 'A form-based code is a land development regulation that fosters predictable built results and a high-quality public realm by using physical form (rather than separation of uses) as the organizing principle for the code. A form-based code is a regulation, not a mere guideline, adopted into city, town, or county law.'

Conventional zoning

- *In conventional zoning the city or town is divided in different landuse typessuch as residential, commercial, industrial, recreational, etc.[CITATION Pla \l 16393].*
- *Conventional zoning also known as Euclidean zoning was formulated keeping public health in mind, by separating residential and industrial zones.*
- *This planning guideline gained popularity in early 20th century and was practiced far and wide.*
- *But rapid urbanisation gave rise to urban sprawl and due to division of landuse dependency on automobile increased manifold times. [CITATION Yin19 \l 16393]. Thus, there was a need of a new planning methodology to replace this traditional zoning.*

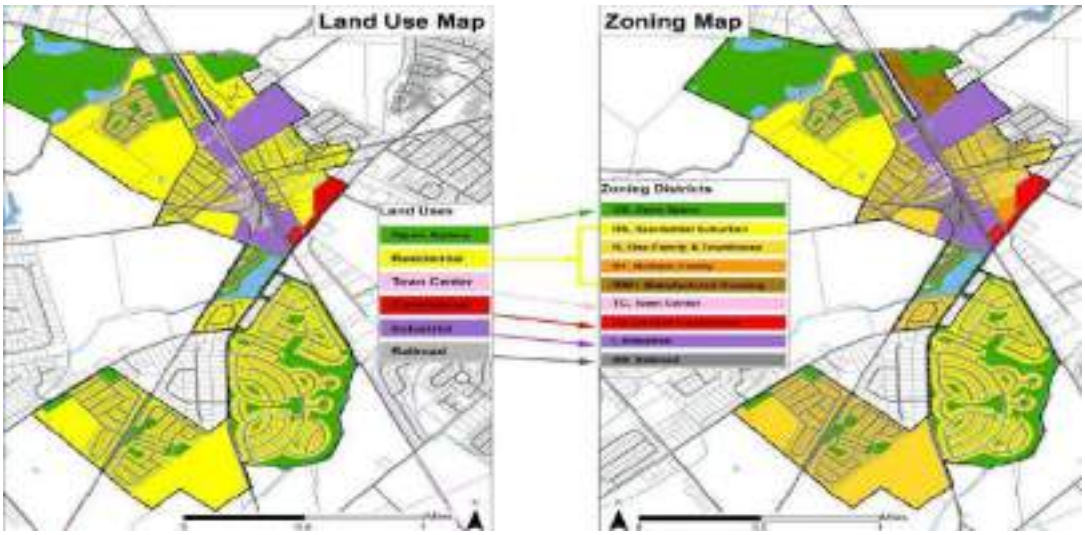


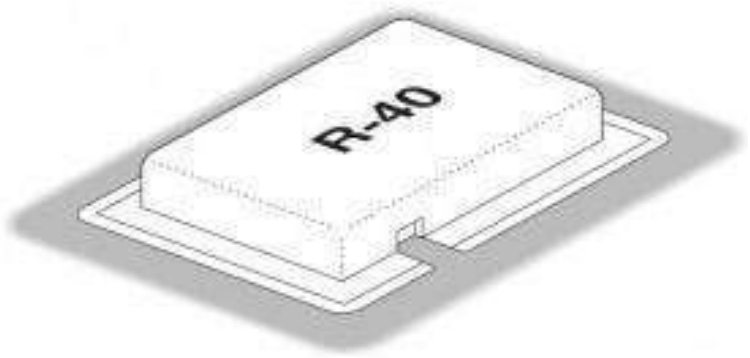
***Figure 1** - Land use map vs zoning map*

Source [CITATION Lan \l 16393 CITATION Lan \l 16393] : [CITATION Lan \l 16393 CITATION Lan \l 16393]

Form Based Code Principle

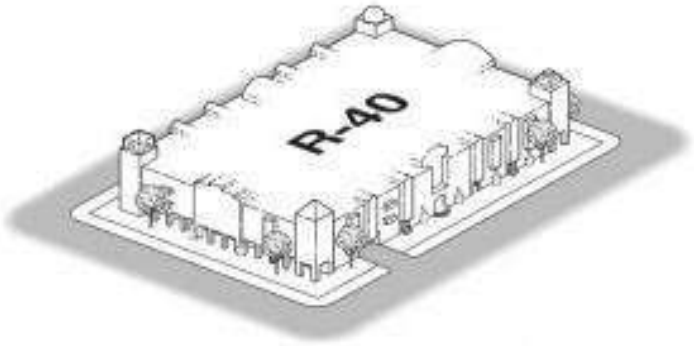
How conventional zoning designs a block or area?

- Density Use
- FAR (Floor Area Ratio)
- Building setbacks
- Parking requirements
- Maximum building heights



How Zoning design guidelines, define a block?

- Density Use
- FAR (Floor Area Ratio)
- Building setbacks
- Parking requirements
- Maximum building heights
- Frequency of Openings
- Surface Articulation



How Form- based code, defines a block

Street and building types

- Build-to lines
- Number of floors
- Percentage of built site frontage specified
- .

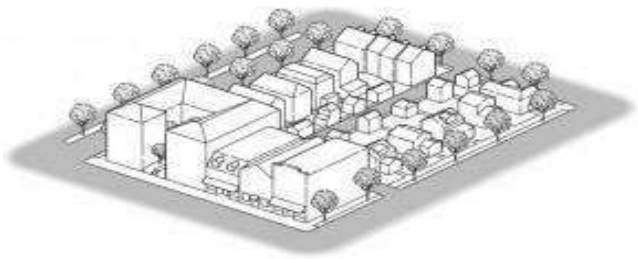


Figure 2 - Comparison between convention zoning, zoning design guildelines and form-based code

Difference between conventional/ Euclidean zoning and Form based code

	Euclidean Zoning	Form based code (FBC)
1	Giving an area or landmass certain Land use is a primary factor in Euclidean zoning.	Understanding the Physical form and the contextual need of the place are primary factors in Form based code planning.
2	District plan	Neighbourhood plan
3	Dependency on automobiles increased for eg. local business were placed outside residential zone.	Self sustaining neighbourhood led to increased walkability and reducing dependency on automobiles.
4	Landuse specific planning principle.	Mixed land use planning principle including walkability, easy access and compact plan.
5	Housing discrimination and racial segregation increased. [CITATION Pla \l 16393]	Mixed landuse planning decreased housing discrimination.[CITATION Pla \l 16393]
6	Plot ratio, density is taken into consideration in terms of the landuse whose outcomes can be quite unpredicatable for different plot. [CITATION Yin19 \l 16393]	While setting standards and parameters such as frontage, building line, etc. the form is taken into consideration rather than generalised landuse rules. [CITATION Yin19 \l 16393]

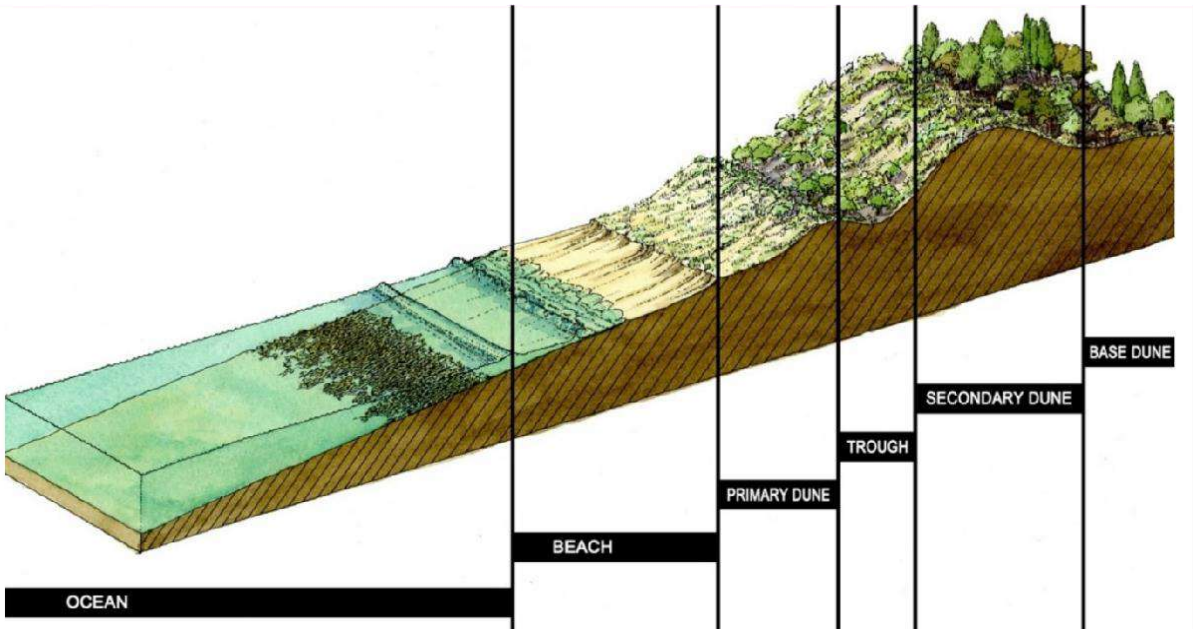
Conventional zoning model vs Form based zone model

Figure 3 3 - Conventional Zoning Source : [CITATION Yin19 \l 16393]

Figure 4 4 - Form-based code Source : [CITATION Yin19 \l 16393]

The Transect Matrix

According to ecologists, the transition of ecosystem from one habitat to another depending on the characteristics of that ecosystem can be described as



Transect [CITATION Ste09 \l 16393].

Figure 5 - Transect from ocean to dune in ecosystem Source :[CITATION The \l 16393]

Similarly, there is a transition from rural – to - urban settlement patterns. This transect gives rise to different zone types depending on the urban characteristics and hierarchical development of that zone [CITATION The \l 16393]. Thus, in 2003, Duany Plater Zyberk & Company, wrote standards for Transect based matrix which further formed the framework for Form based code.

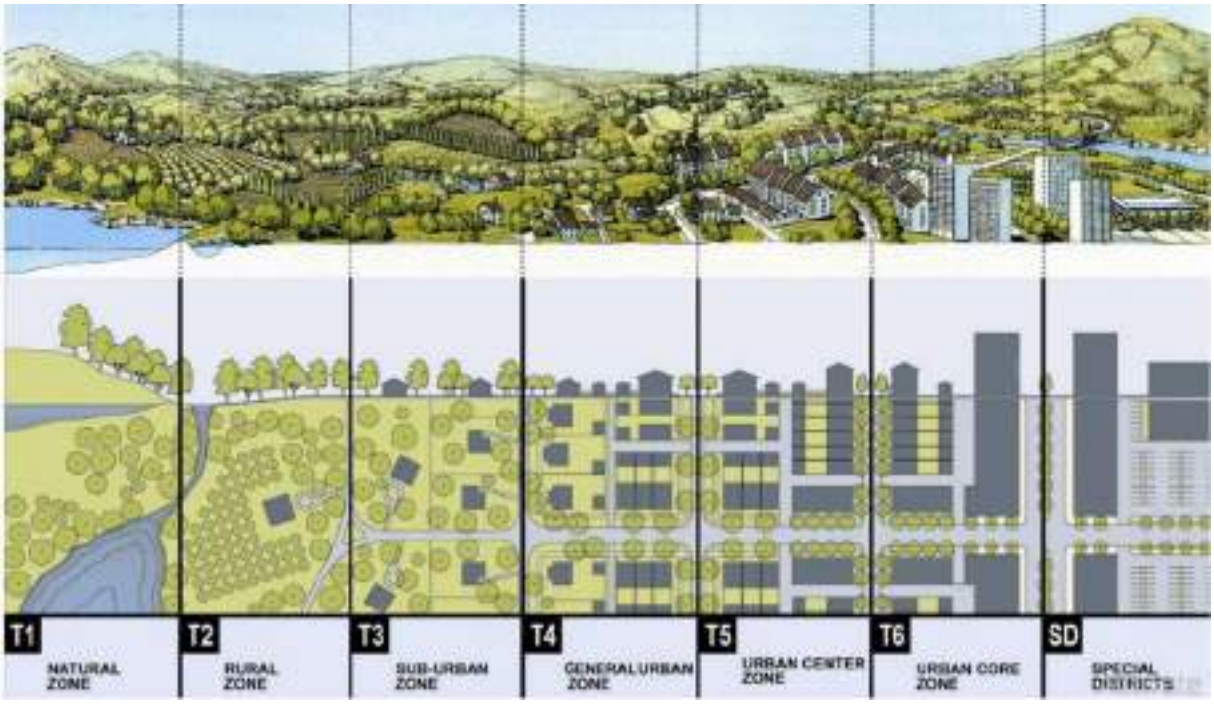
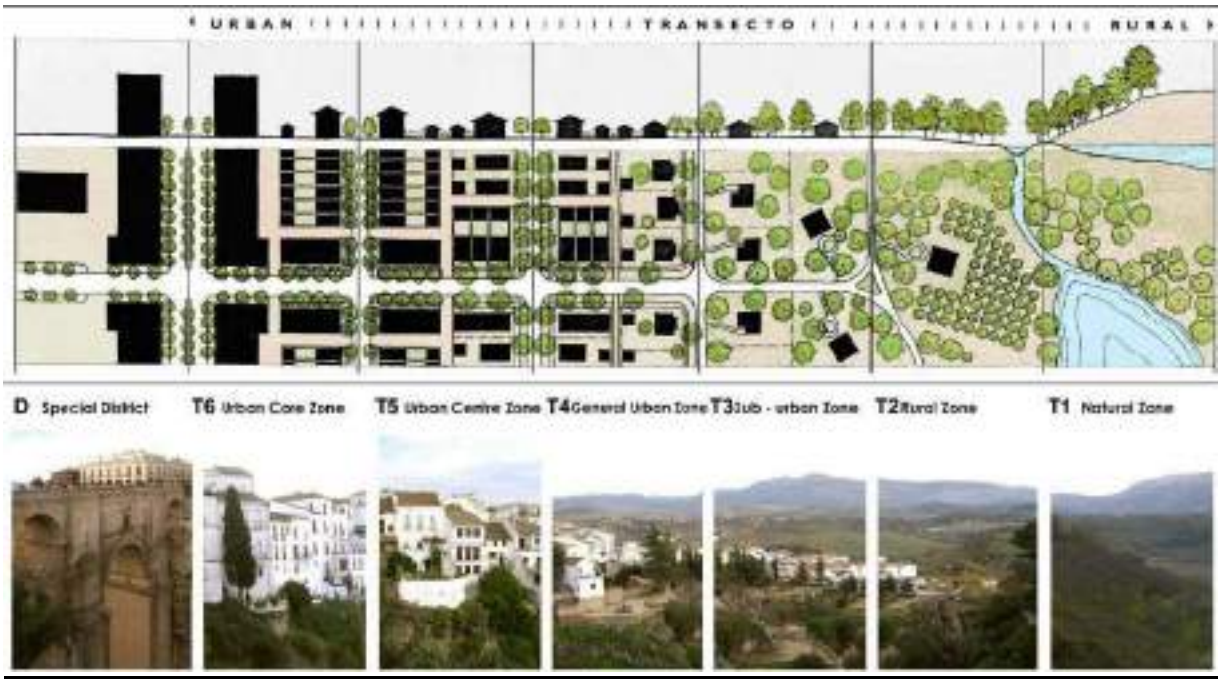


Figure 6 - Standard Transect Matrix of Form based code Source : [CITATION Yin19 \l 16393]

Transect Matrix zone application in Europe



Ronda Spain

Figure 7 - Transect matrix zone of Ronda, Spain Source : [CITATION Cen \l 16393]

Pienza Italy

The figure below shows a gradual transect section of Pienza, Italy. The left side shows a gradual transition from T-2 zone to T-5 zone. But on the right side there is a drastic transition from T-5 zone to T-2 zone which at the city wall. Such transitions are quite intriguing and are very much similar to the central park in New York city. [CITATION Cen \l 16393]

Figure 8 - Transect section of Pienza Italy Source : [CITATION Cen \l 16393]

Hammonton, New Jersey

The figure below shows the Plan of Hammonton in New Jersey adopting form based code where they used transect matrix zoning, but changed the nomenclature of T- zones to district zones according to the city's need. Their transect zones are as follows.

- Gateway Crossroads (G3),
- Gateway Boulevard (G2),
- Gateway Avenue (G1),
- Near Town (D1),
- In Town Railway (D2),
- In Town (D3), and
- Main Street (D4),

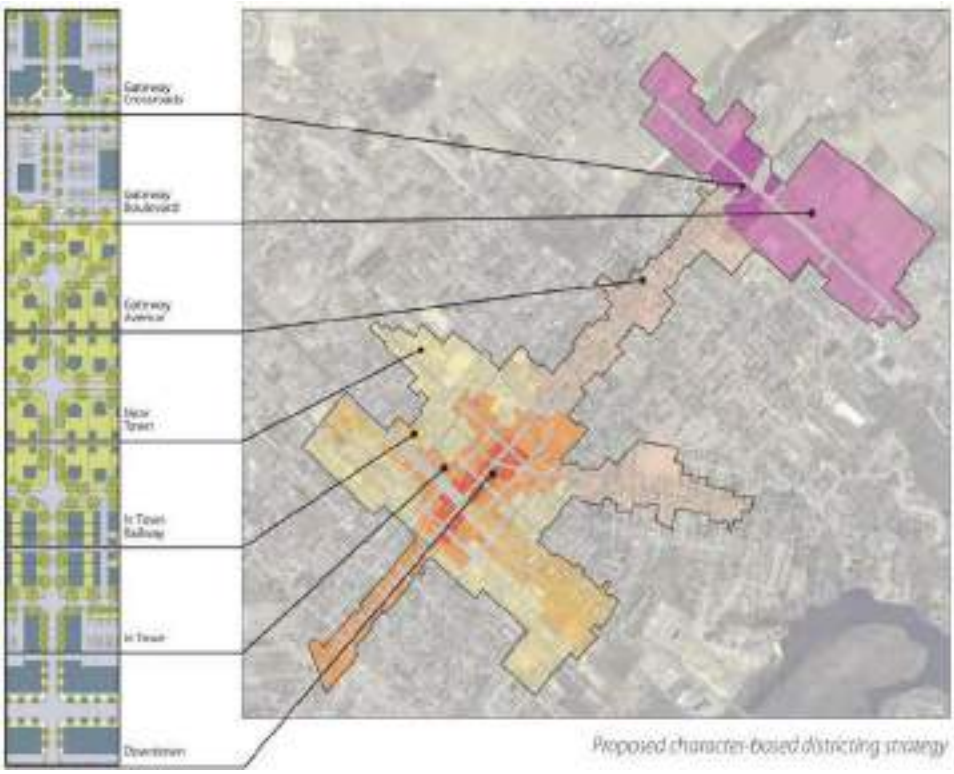


Figure 9 - *Form based code, Regulating plan of Hammonton Source : [CITATION Sli12 \l 16393]*

Elements of form based Code

Conventional zoning included standards mostly in text format on contrary to form based code which emphasizes more on graphical and pictorial representation while setting regulations & standards.

1. *Regulating Plan*

   'A regulating plan is essentially a fine – grained zoning map combined with a street plan, keyed to a set of standards….Each street, block, or parcel must comply with illustrated standards in the FBC.' [CITATION Mar14 \l 16393]

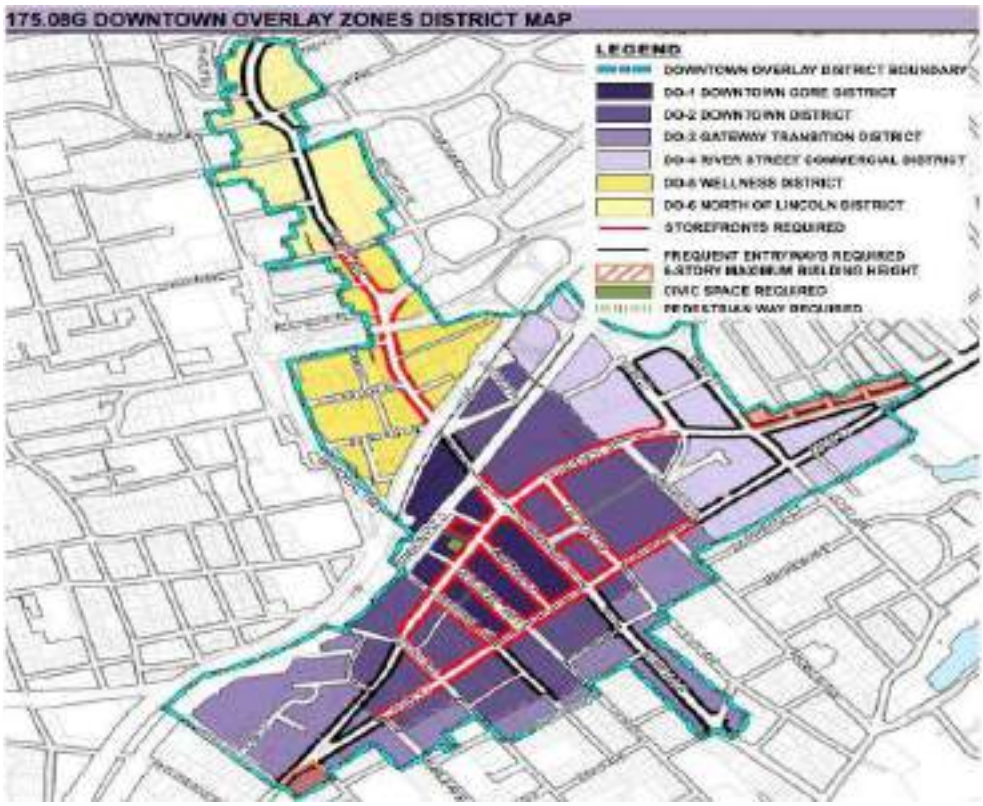


Figure 10 - *Regulating Plan of City of Rochelle as a form based code, Source : [CITATION For20 \l 16393]*

1. **Public Standards**

Public standards are generally applied to the designated regulating plan that encompasses everything that comes in public realm. The codes are generally applied to sidewalks, travel lanes, on-street parking, street trees, and street furniture. [CITATION For16 \l 16393]

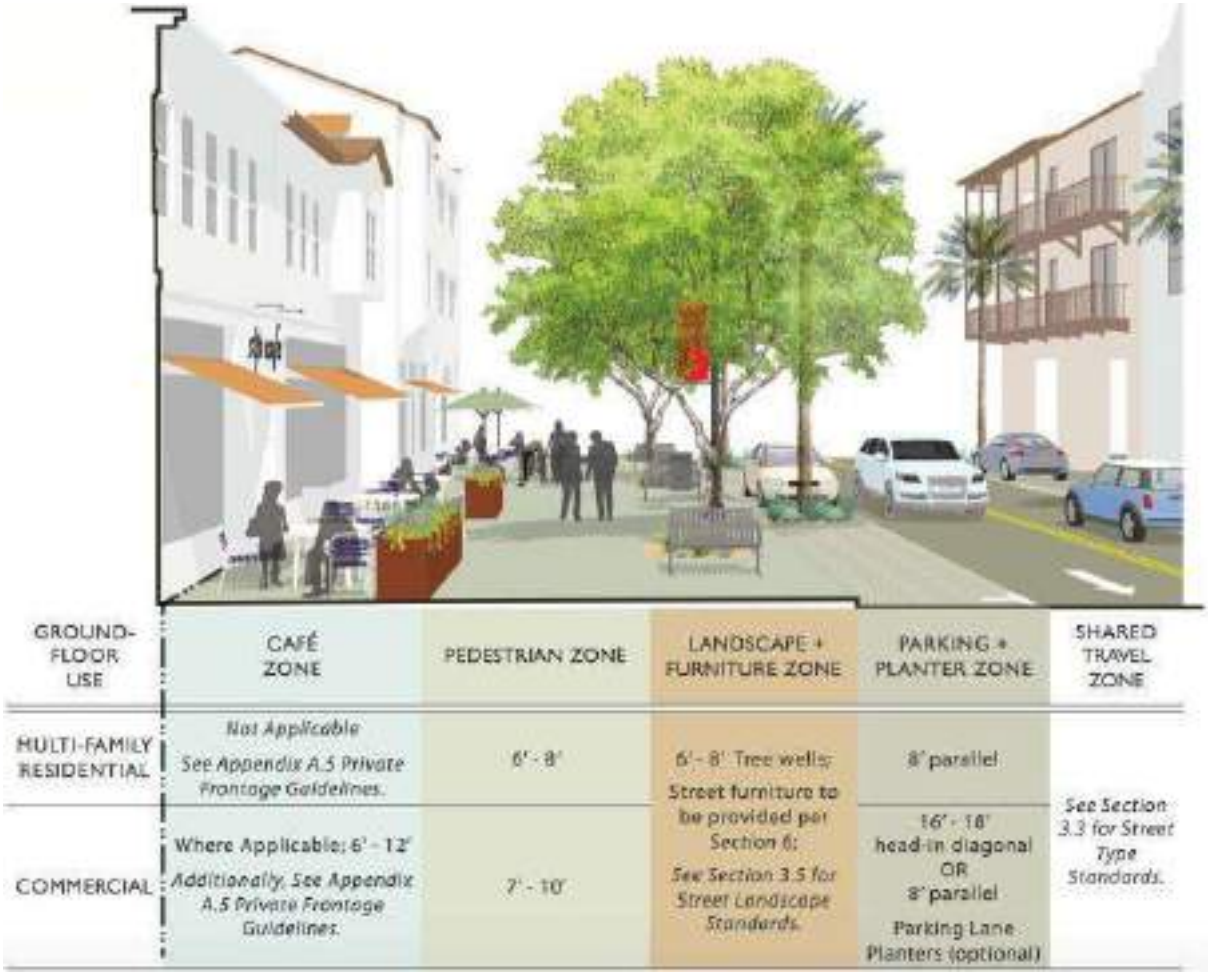
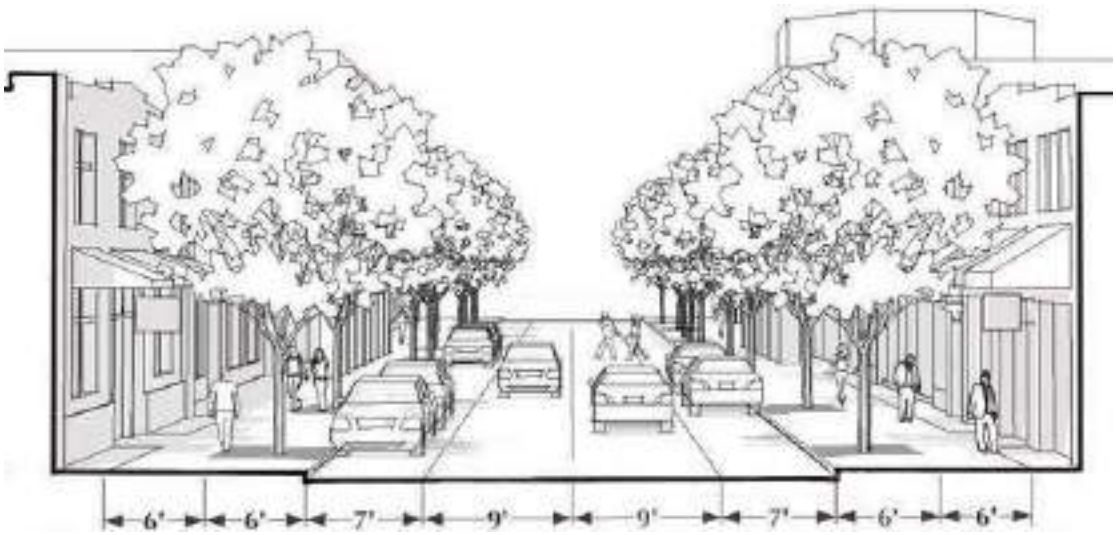


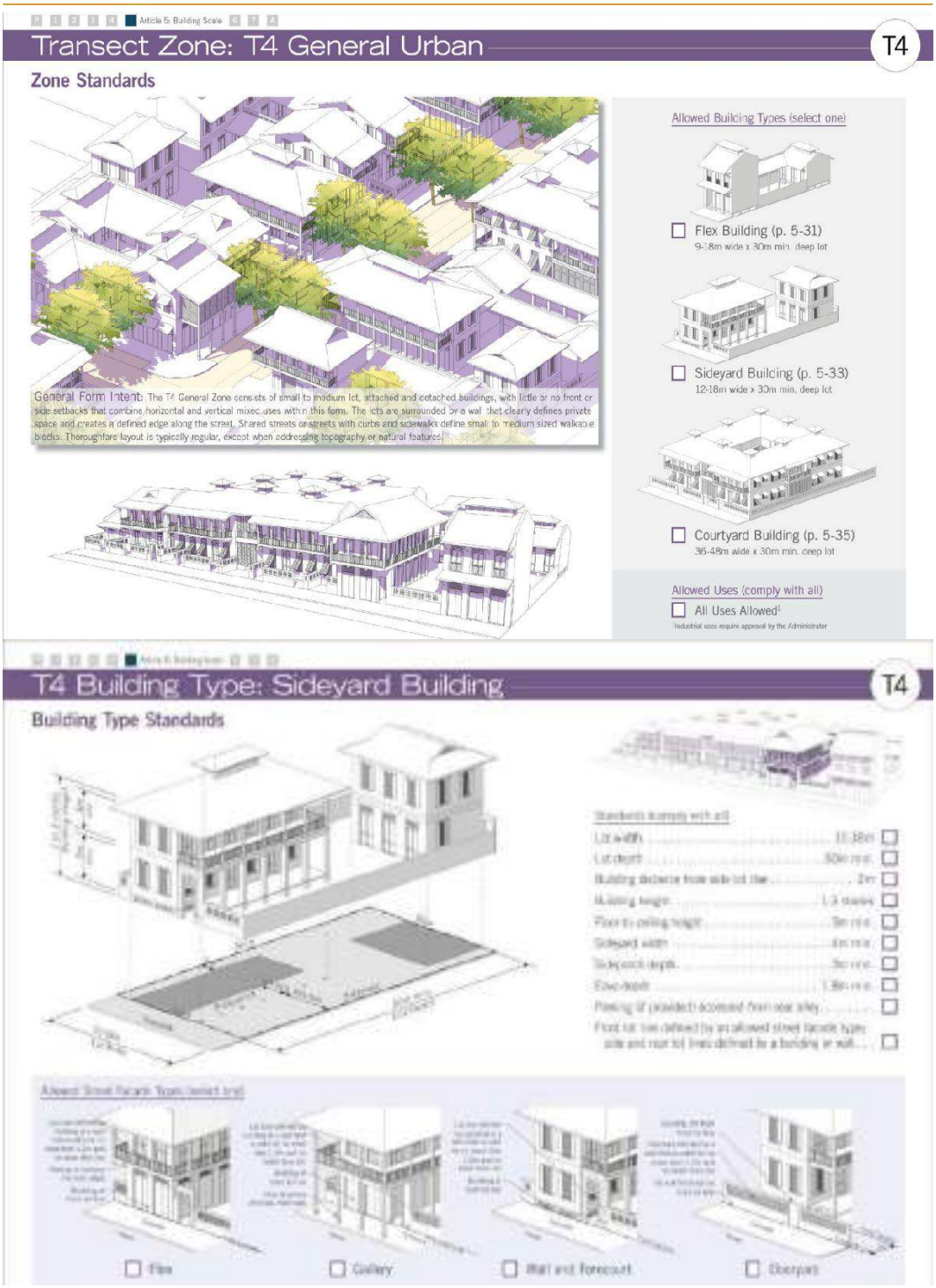
Figure 11 - Public standards in form based code,



Source : [CITATION Sma19 \l 16393]

Figure 12 - Schematic cross section of a mixed landuse street in florida, Source : [CITATION Mar14 \l 16393]

2. **Building Standards**



[CITATION Yin19 \l 16393]

Figure 135 - Building Standards forAkanda Source :[CITATION Opt21 \l 16393]

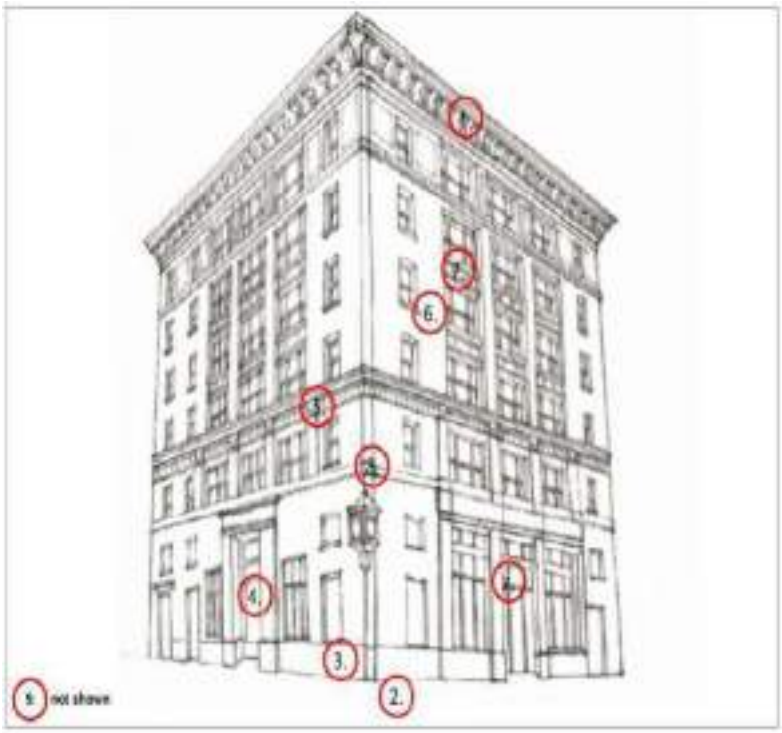
The standards set for the form and configuration of the building is regulated in building standards. These standards may also include parking standards and their placements, allowed encroachments as well as building typologies too.

3. Administration
   Administration outlines clearly defined application, project reviews and spells out how the process will occur.[
4. Definitions
   The glossary consists of definitions of all technical terms contained in the code. [CITATION For16 \l 16393]

5. Other optional Cases

- Architecture

Architectural standards include guidelines drawn for exterior of a building where material and designs are provided as well. They can be applicable to most heritage towns, but they are not compulsory. Mostly architectural standards depends on the scope of the project as well as objectives laid by the community.



Key Characteristics

1. **Roof** - flat roof with projecting cornice or parapet.
2. **Floor Plan/Elevation** - simple, rectangular plans with L-shaped or U-shaped variations.
3. **Base** - articulated base by change in material, change in plane, or both.
4. **Shading** - recessed arcades & entries, balconies, or fabric awnings.
5. **Form/Massing** - 1 to multiple stories, with base, middle, and top. Vertically proportioned with corner towers common.
6. **Walls** - flat planes of stone, brick, or plaster, punctuated by deep openings.
7. **Openings** - large storefront openings at ground, vertically proportioned, with transoms arranged in rhythmic pattern. Upper floors include combinations of small and large openings relating to ground level openings. Serial or symmetrical composition are typical.
8. **Articulation** - base, middle and top of facade are clearly defined by changes in material and horizontal banding. Ground floor and/or build-to/scaled base receive most detailed attention. Other details include cornices, balconies, awnings.
9. **Colors** - public buildings are more reserved, with muted colors. Otherwise, the palette is open to interpretation.

- ***Landscape***

'Some form-based codes include requirements to control the character and quality of the landscape within private spaces as it affects the public realm and the public good, such as requiring native species to address water usage, as well as screening parking lots from the street, buffering more or less intensive uses, and greening parking lots.'[CITATION Chi12 \l 16393]

Case study 1 – Miami 21 Code

Project details:

- Project size/area – 35,514 acres
- Client – City of Miami
- Date of Design – 2004
- Location – Florida, U.S.A.

Figure 15 *- Location of Miami,Florida Source : (2023)*

Figure 6 *- Fisher Island, Miami Source :[CITATION ADE19 \l 16393]*

'Miami was the first large American city to adopt SmartCode' [CITATION THE10 \l 16393].
Who wrote the Code?
Transect/Form based code was prepared by Duany Plater – Zyberk for the entire city of Miami which includes 37 square miles of land area. The document prepared for SmartCode provides both regulatory guidelines as well as solves liveability concerns which were difficult to achieve by old Euclidean zoning. [CITATION DPZ20 \l 16393]
How was the Code Adopted?
Miami adopted the Code in 2010 with a vision of smart growth and new urbanism. The city staf f and code prepares held more over 100s of public hearings and review meeting before replacing the Ordinance 11000. [CITATION Yin19 \l 16393]
Why was the Code prepared?

- *The code was in response to rapid urbanisation and clash between development along corridors and preservation of low to moderate intensity or single family housing.*
- *This lack of planning provision resulted in physically incompatible, out of scale developments with no provision for reinvestment. [CITATION DPZ20 \l 16393]*
- *There was a need of transition in approach as the city started to lose its identity.*

Transect Matrix Plan of Miami 21 Code
Transect Planning within Form-Based Code

The transect matrix of Miami contains more zones due to its high density morphology. Designers have further sub divided T6 zone into T6-8,T6-12,T624, etc. The customised Transect matrix also specifies landuse. But unlike Euclidean these are workplace, Industrial & waterfront industrial.

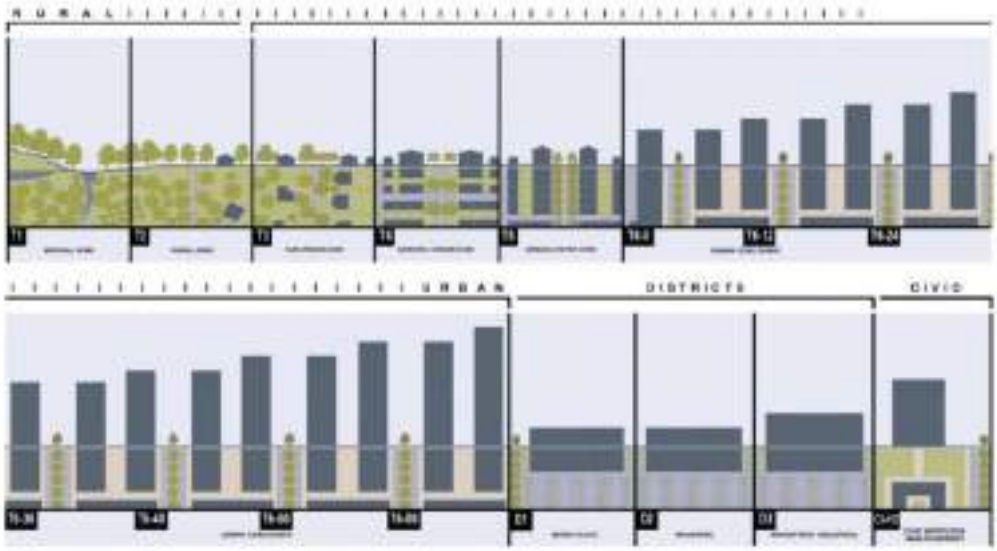


Figure 7 - *Transect zone plan of Miami, Source : [CITATION The10 \l 16393]*

Regulating Plan – Miami 21 code

- *neighbourhood conservation district,*
- *waterfront design guidelines,*
- *a midtown overlay district,*
- *Miami world centre,*
- *Brickell city centre,*
- *design district,*
- *river landing,*
- *ransom everglades,*
- *Miami river*
- *Wynwood NRD -1*
- *MANA Wynwood*
- *Miami Jewish health*

Figure 8 - *Miami Transect Zone Plan, Source : [CITATION Yin19 \l 16393]*

Building Standards

[CITATION The10 \l 16393] has provided with a detailed standards guide with respect to its transect zone. Below is the example of guidelines provided in T6-24 zone

ILLUSTRATION 5.6 URBAN CORE TRANSECT ZONES (T6-24)

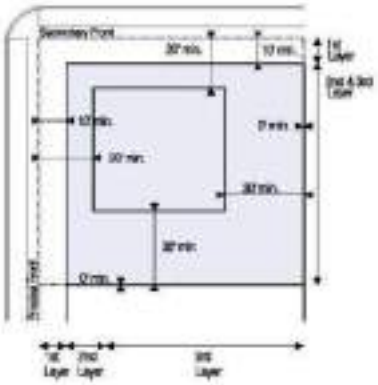
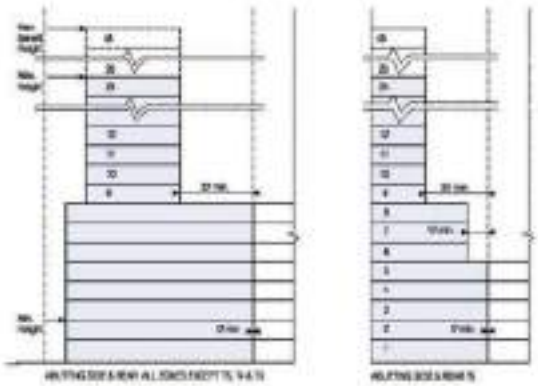
BUILDING DISPOSITION		BUILDING PLACEMENT
LOT OCCUPATION		
a. Lot Area	5,000 s.f. min.; 100,000 s.f. max.	
b. Lot Width	50 ft min.	
c. Lot Coverage		
- 1-8 Stories	80% max.	
- Above 8th Story	15,000 sf. max. Floorplate for Residential & Lodging 30,000 sf. max. Floorplate for Office & Commercial	
d. Floor Lot Ratio (FLR)	T6-24a: 7 / 30% additional Public Benefit T6-24b: 16 / 40% additional Public Benefit	
e. Frontage at front Setback	70% min.	
f. Open Space	10% Lot Area min.	
g. Density	150 du/ac max.*	
BUILDING CONFIGURATION		**BUILDING HEIGHT**
FRONTAGE		
a. Common Lawn	prohibited	
b. Porch & Fence	prohibited	
c. Terrace or LC	prohibited	
d. Forecourt	permitted	
e. Stoop	permitted	
f. Shopfront	permitted (T6-24-L and T6-24-O only)	
g. Gallery	permitted by Special Area Plan	
h. Arcade	permitted by Special Area Plan	
BUILDING HEIGHT		
a. Min. Height	2 Stories	
b. Max. Height	24 Stories	
c. Max. Benefit Height	24 Stories Abutting all Transects Zones except T3	

Table 2 - *Building Standards for T6-24 zone*

Source : [CITATION The10 \l 16393]

Public Standards

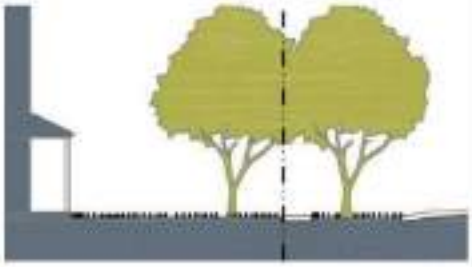
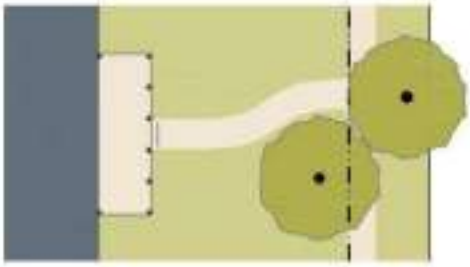
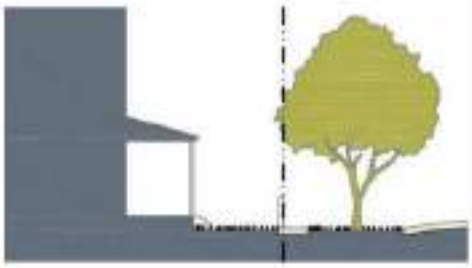
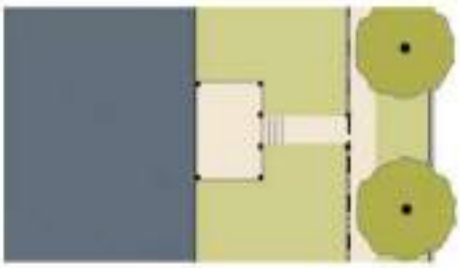
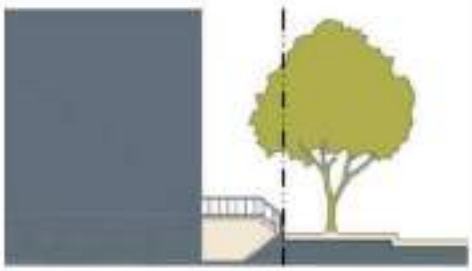
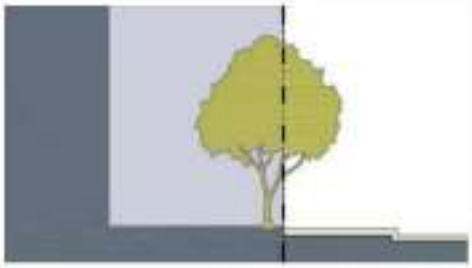
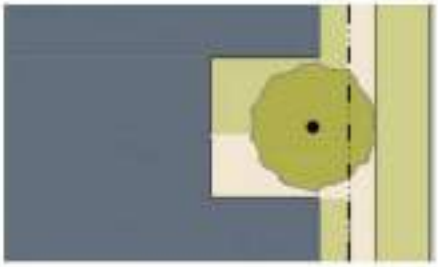
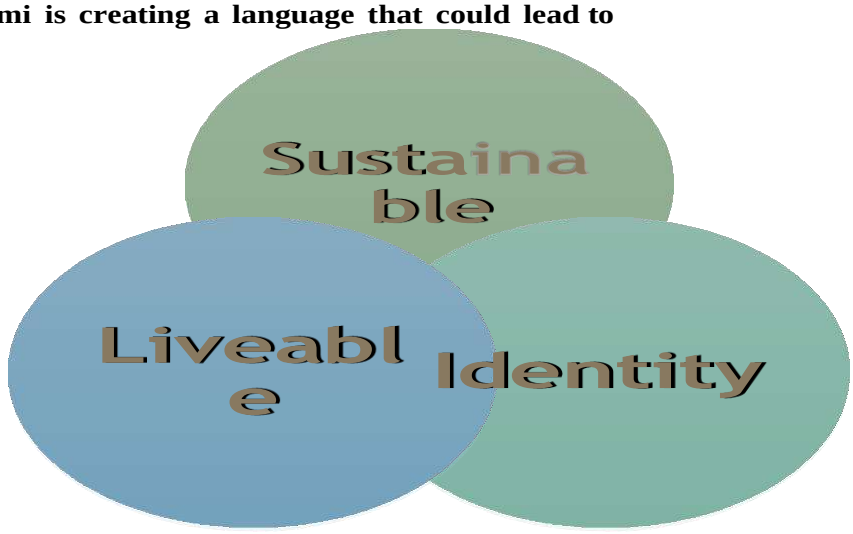
	SECTION LOT PRIVATE Frontage | R.O.W. ◄ PUBLIC Frontage	PLAN LOT PRIVATE Frontage | R.O.W. ◄ PUBLIC Frontage
a. Common Lawn Frontage wherein the Façade is set back substantially from the Frontage Line. The front yard created remains unfenced and is visually continuous with adjacent yards, supporting a common landscape. The Setback can be densely landscaped to buffer from higher speed Thoroughfares.		
b. Porch & Fence Frontage wherein the Façade is set back from the Frontage Line with an attached Porch permitted to encroach. A fence at the Frontage Line maintains the demarcation of the yard while not blocking view into the front yard.		
c. Terrace or Light Court Frontage wherein the Façade is set back from the Frontage Line by an elevated terrace or a sunken light court. This type buffers residential use from urban sidewalks and removes the private yard from public encroachment. The raised terrace is suitable for outdoor cafes.		
d. Forecourt Frontage wherein a portion of the Façade is close to the Frontage Line with a portion set back. The forecourt with a large tree offers visual and environmental variety to the urban Streetscape. The		

Table 3 - Few examples of Public standards Source : [CITATION Cit16 \l 16393]

How Form-Based Code in Miami is creating a language that could lead to



Sustainability –

- Incorporation of LEED building standards for buildings that are 50,000 square feet and above
- Energy substitutes and initiatives like Green Corridor Property Assessed Clean Energy (PACE) program and renewable energy resources have been incorporated for areas that are already developed.
- Miami Green Lab is an inititive started by the council under FBC ordinance where it serves as a green building resource center for community, it also imparts education on energy conservation, urban agriculture and green buildings.
- The FBCs also have made a code of ordinances where the city has adopted Tree masterplan to increase the overall health of trees, that set a goal of achieving 30% tree canopy.

Livability –

- Due to incorporation of FBCs the standard of living has been increased manifold times. Rick Bernhardt the former executive director mentioned that after adopting FBCs the economy of the place have also increaseddue to development and mixed use planning.
- Car dependency increases due to Form based code planning and zoning as it keeps the community convenience in mind.
- Sustainable cities also increases the livability of a place. And Miami has recently earned LEED Gold certification.

Identity –

Transect matrix planning helps to retain the character of the place and gives experiential identity to a place.

Before

Figure 9 - Transforming Blank wall (Before) Source : [CITATION The10 \l 16393]

Transforming Blank Wall

Figure 10 - Transforming Blank wall

(After) Source : [CITATION The10 \l16393]
Figure 7 shows how the blank walls and open parking areas which were abutting to the main roads have been completely transformed into a residential area. FBCs also promotes reconstruction of area that has a potential in transforming a neighbourhood.

Urban Infill Redevelopment

Figure 11 - Urban Infill Redevelopment, Source : [CITATION The10 \l 16393]

Figure 12 - Urban Infill Redevelopment, Source :[CITATION The10 \l 16393]

Green Corridors and urban infrastructural development helps in increasing the livability of the place.

Turning Development Outward

Figure 13 *- Turning Development Outward, Source : [CITATION The10 \l 16393]*

Figure 14 *-- Turning Development Outward, Source : [CITATION The10 \l 16393]*

The ordinances also mentions of designing a commercial place that is more welcoming and not leaving any place between road and the property. There are different by-laws that helps understand the frontages of lots and buildings.

Mixed-Use Corridors with Transit

Figure 15 *- Mixed-Use Corridors with Transit, [CITATION The10 \l 16393]*

Figure 16 - Mixed-Use Corridors with Transit, [CITATION The10 \l 16393]

Building Communities

Figure 17 - Building Communities, [CITATION The10 \l 16393]

Figure 18 *- Building Communities, [CITATION The10 \l 16393]*

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Case Study 2 – Downtown Code for Nashville

Project details:

- ***Project size/area – 388 acres***
- ***Client – City of Nashville***
- ***Date of Design – 2010***
- ***Location – Tennessee, U.S.A.***

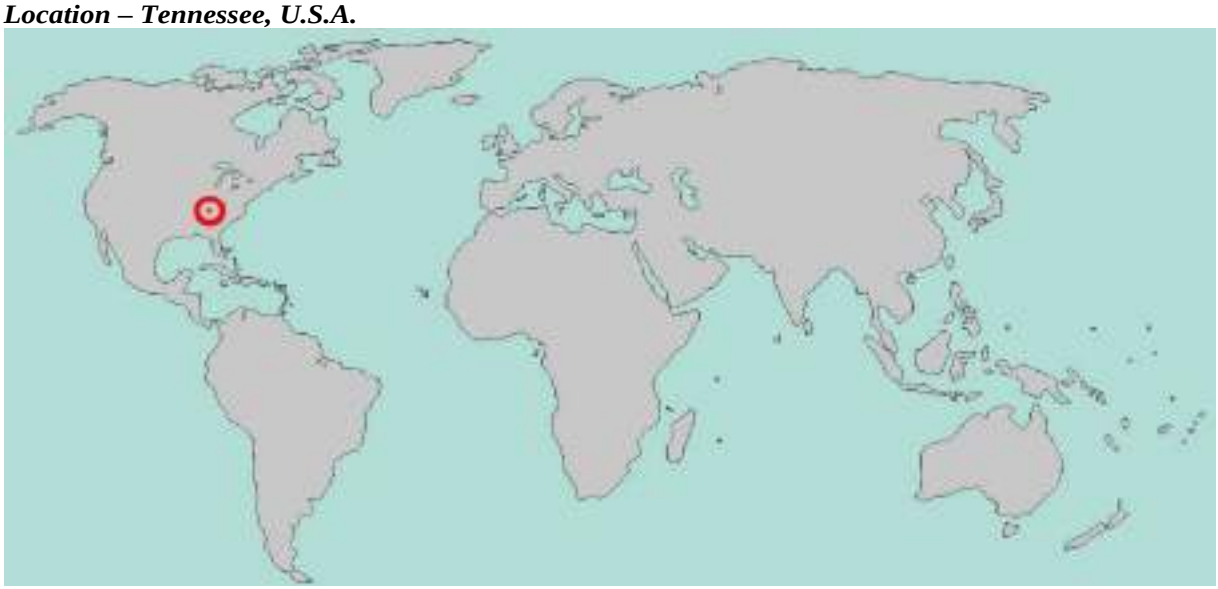


Figure 33 - Location of downtown Nashville, U.S.A. *Source : (2023)*

Why this case study?

case study is done to give an example on how a form based code can be applied only to a small part or the Regulating Plan**.**

Figure 34 - Downtown Nashville, U.S.A. Source: [CITATION Cve00 \l 16393]

Who wrote the Code?

Rick Bernhardt, former executive director, Planning Department, Metropolitan Nashville and Davidson County. He is also one of the board members of Form –ased Code institute as well as he was a chair member of planners force task for the Congress of New Urbanism.[CITATION Ros181 \l 16393].

How was the Code Adopted?
The Code was adopted in 2010, by means of community involvement and making them as key stakeholders and the city planning department. [CITATION Met \l 16393]

Why was the Code prepared?
- The cities wheel – to – spoke planning pattern led to create a good connectivity to the the neighbouring cities.
- This pattern also led to increased dependency on vehicles.
- Nashville being one of the oldest music town it always faced the issue of urbanisation which led to sprawl development and the traditional zoning was being incompetent to the growing needs of the city.

Transect Matrix of Nashville

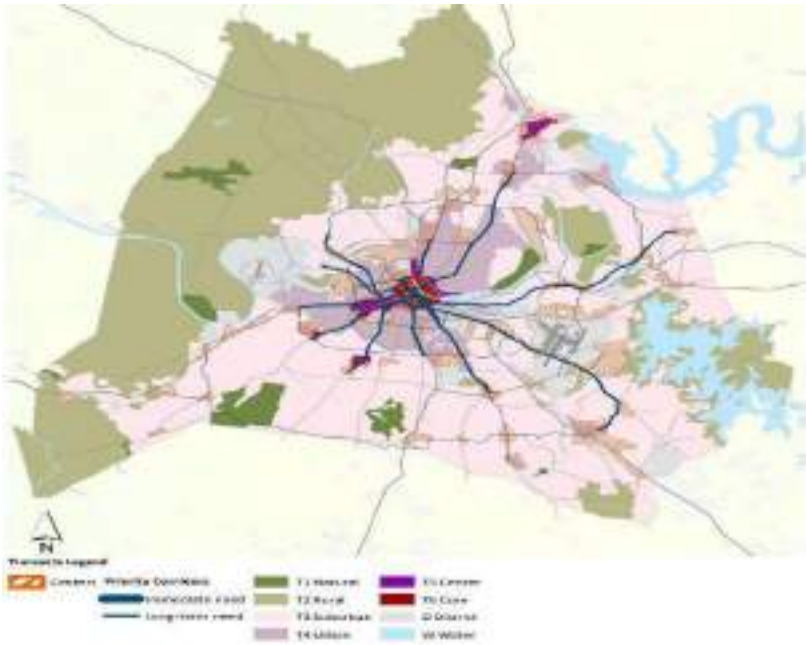
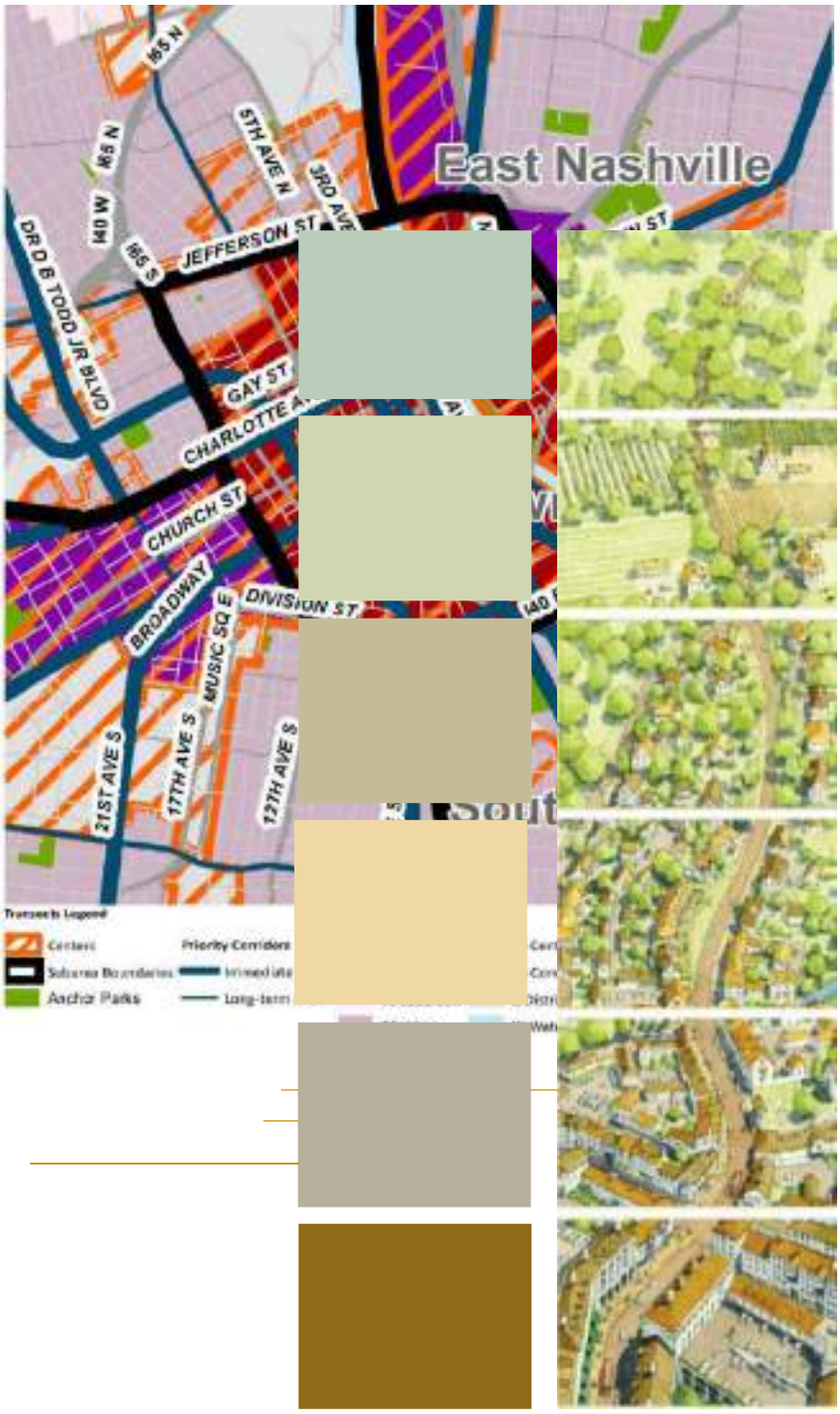


Figure 35 - Transect plan for Nashville Source : [CITATION Met \l 16393]

The transect plan was adopted only for the core downtown area as shown below in Figure 36 - Transect Matrix for Downtown Nashville

Figure 36 - Transect Matrix for Downtowndraw guidelines and code Source : [CITATION Met22 \l 16393



.

T6 – Downtown Encompasses all the downtown region.

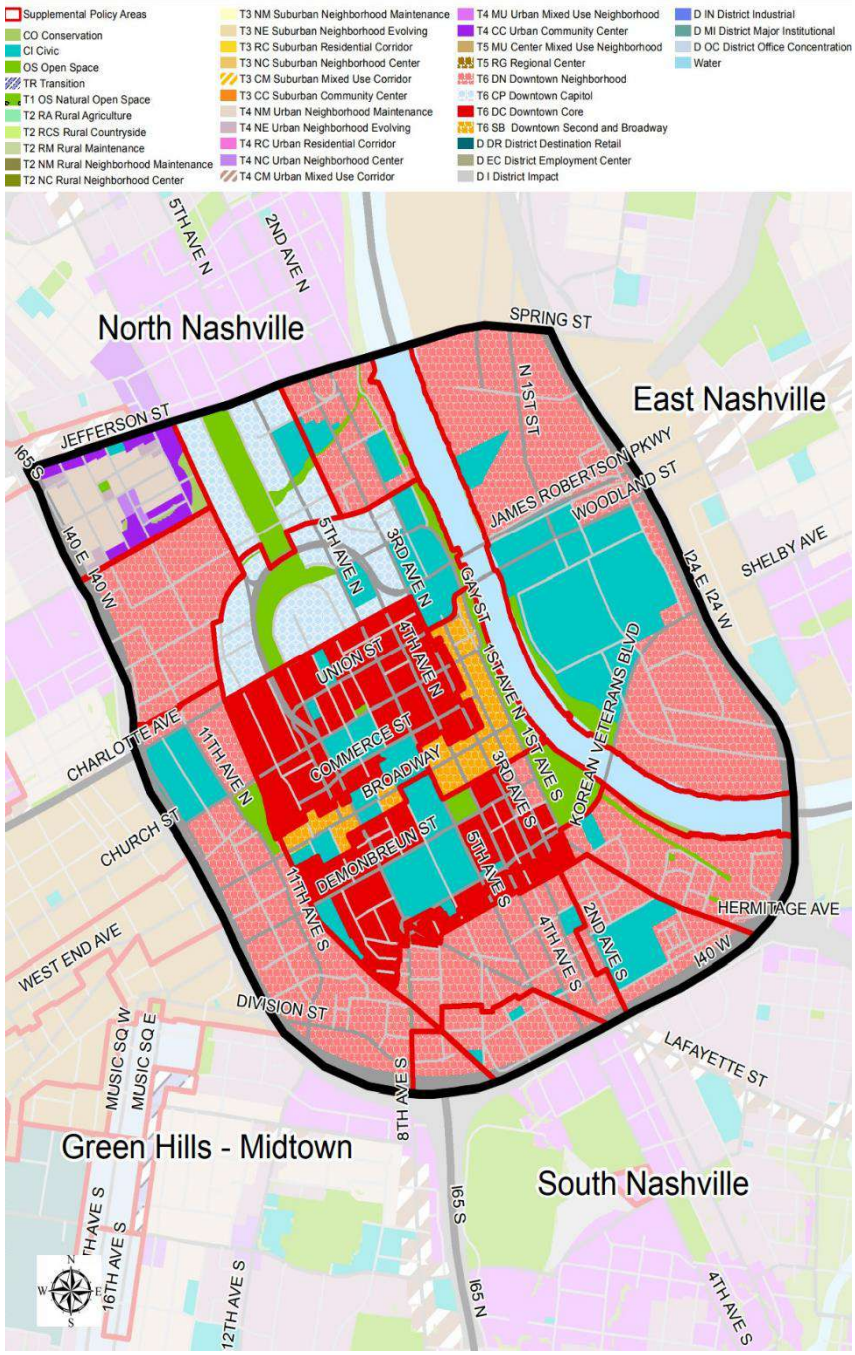
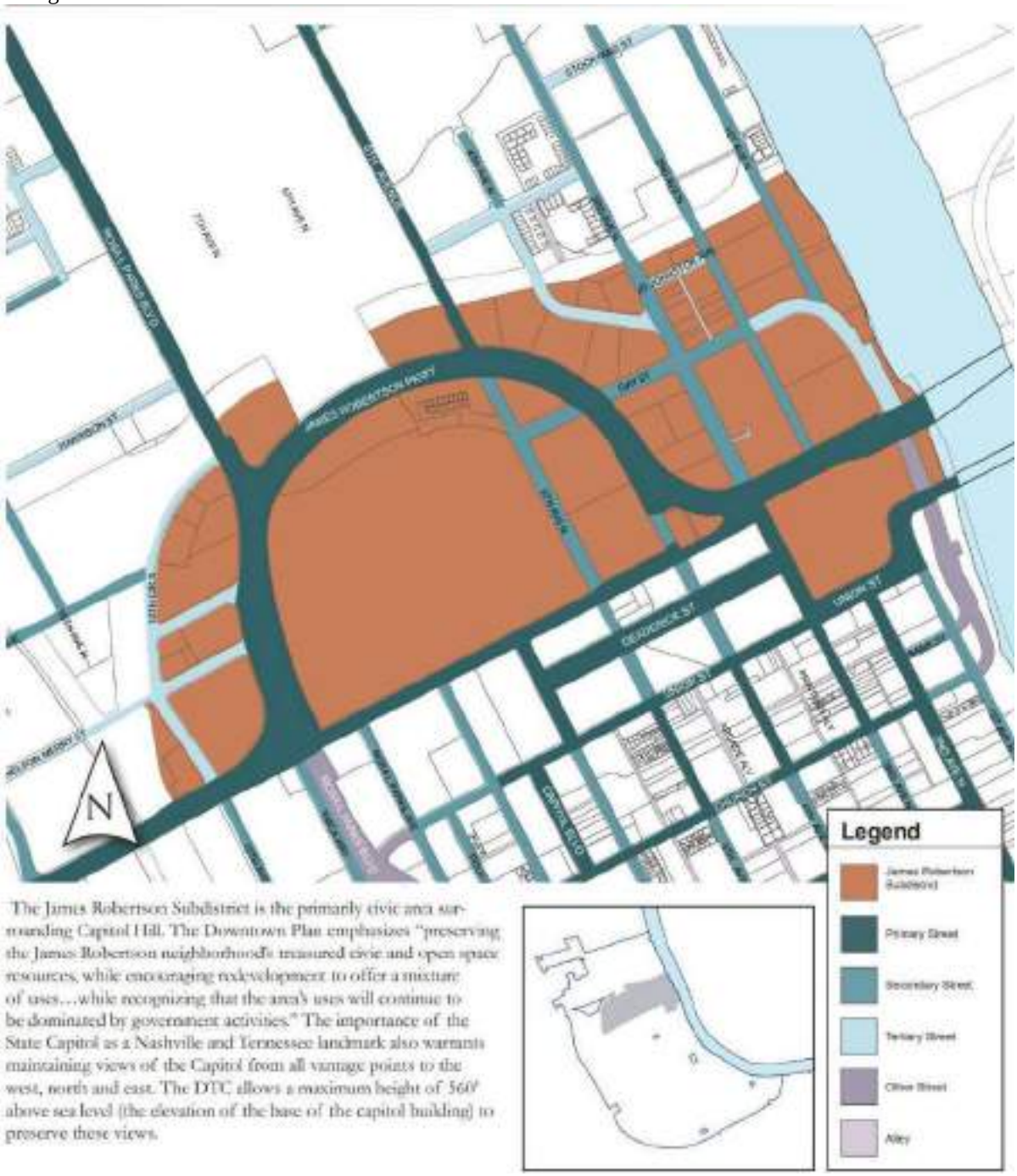


Figure 38 *– Regulating Plan of Subdistrict Boundaries Source : [CITATION Nas17 \l 16393]*

Regulating Plan – James Robertson Subdistrict



The James Robertson Subdistrict is the primarily civic area surrounding Capitol Hill. The Downtown Plan emphasizes "preserving the James Robertson neighborhood's treasured civic and open space resources, while encouraging redevelopment to offer a mixture of uses…while recognizing that the area's uses will continue to be dominated by government activities." The importance of the State Capitol as a Nashville and Tennessee landmark also warrants maintaining views of the Capitol from all vantage points to the west, north and east. The DTC allows a maximum height of 560' above sea level (the elevation of the base of the capitol building) to preserve these views.

Figure 39 - *James Robertson Subdistrict Regulating Plan*

Building Standards

Frontage

A Allowed Frontage Types with Required Build-to Zone

Primary Street
- Storefront Frontage
  - James Robertson Boulevard
    - West of 3rd Ave 20'-30'
    - East of 3rd Ave 0'-10'
  - Charlotte Avenue 0'-10'
- Stoop Frontage
  - James Robertson Boulevard
    - West of 3rd Ave 20'-30'
    - East of 3rd Ave 5'-10'
  - Charlotte Avenue 5'-10'

Secondary Street
- Storefront Frontage 0'-10'
- Stoop Frontage 5'-10'

Tertiary Street
- Storefront Frontage 0'-10'
- Stoop Frontage 5'-10'

B Facade width

Primary Street	80% of lot frontage min.
Secondary Street	60% of lot frontage min.
Tertiary Street	60% of lot frontage min.

Remaining lot frontage may be used for pedestrian amenities and shall not be used for parking.

C Min. building depth 15' from building facade

A building liner is required surrounding parking structures on the all floors facing James Robertson Blvd.

Height

D Max. elevation of 560'

Step-back *

Step-back required for all buildings 8 stories or greater on all public streets and Open Space

E Step-back between 4th and 8th stories

F Min. step-back depth 15'

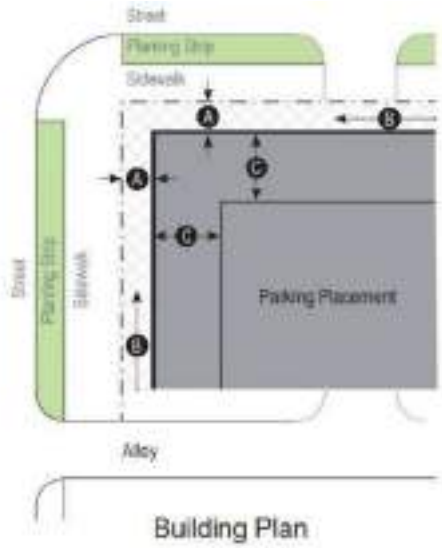
* see page 61 for full description

Sidewalk & Planting

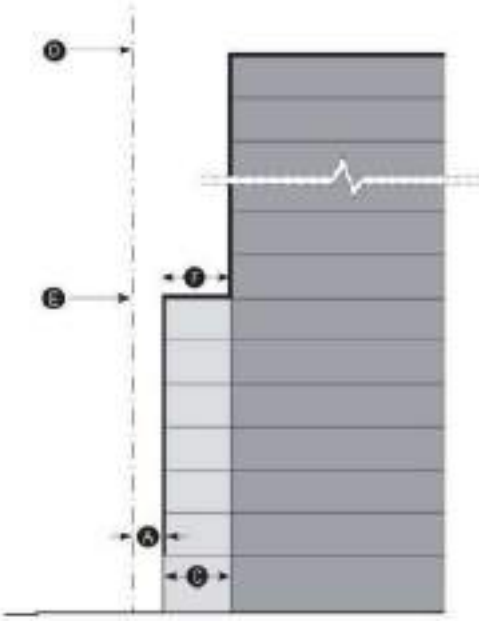
Improvements to the sidewalk corridor according to the General Standards and the Major and Collector Street Plan.

Notes

Uses: page 55; General Standards: page 59



Building Plan



Building Section

Figure 40- *Building standards of James Robertson Subdistrict Source : [CITATION Nas17 \l 16393]*

Public Standards

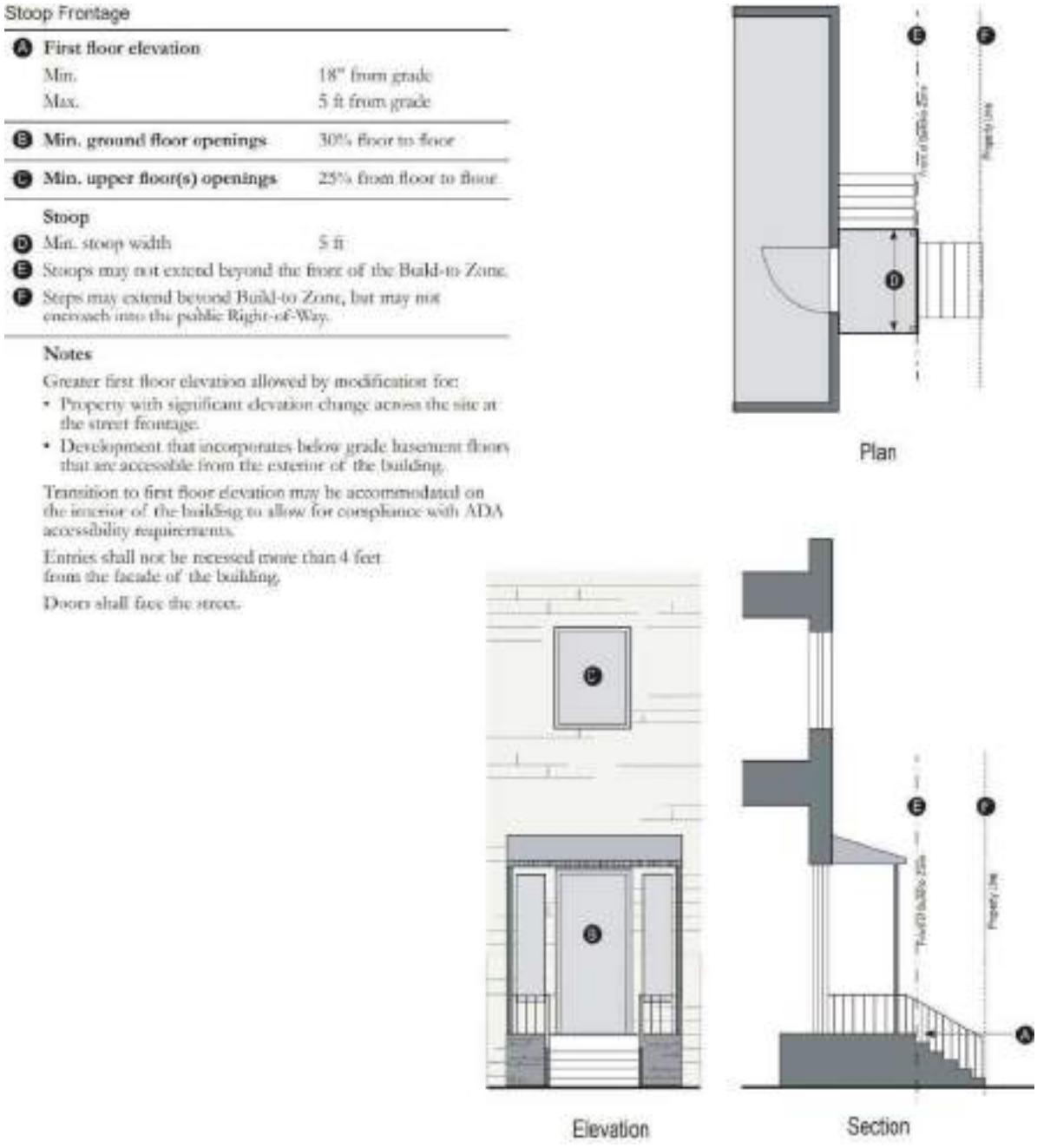


Figure 41 - *Public standards for frontages and lots Source : [CITATION Nas17 \l 16393]*

CC BY

Vision plan of Nashville Downtown in 2040

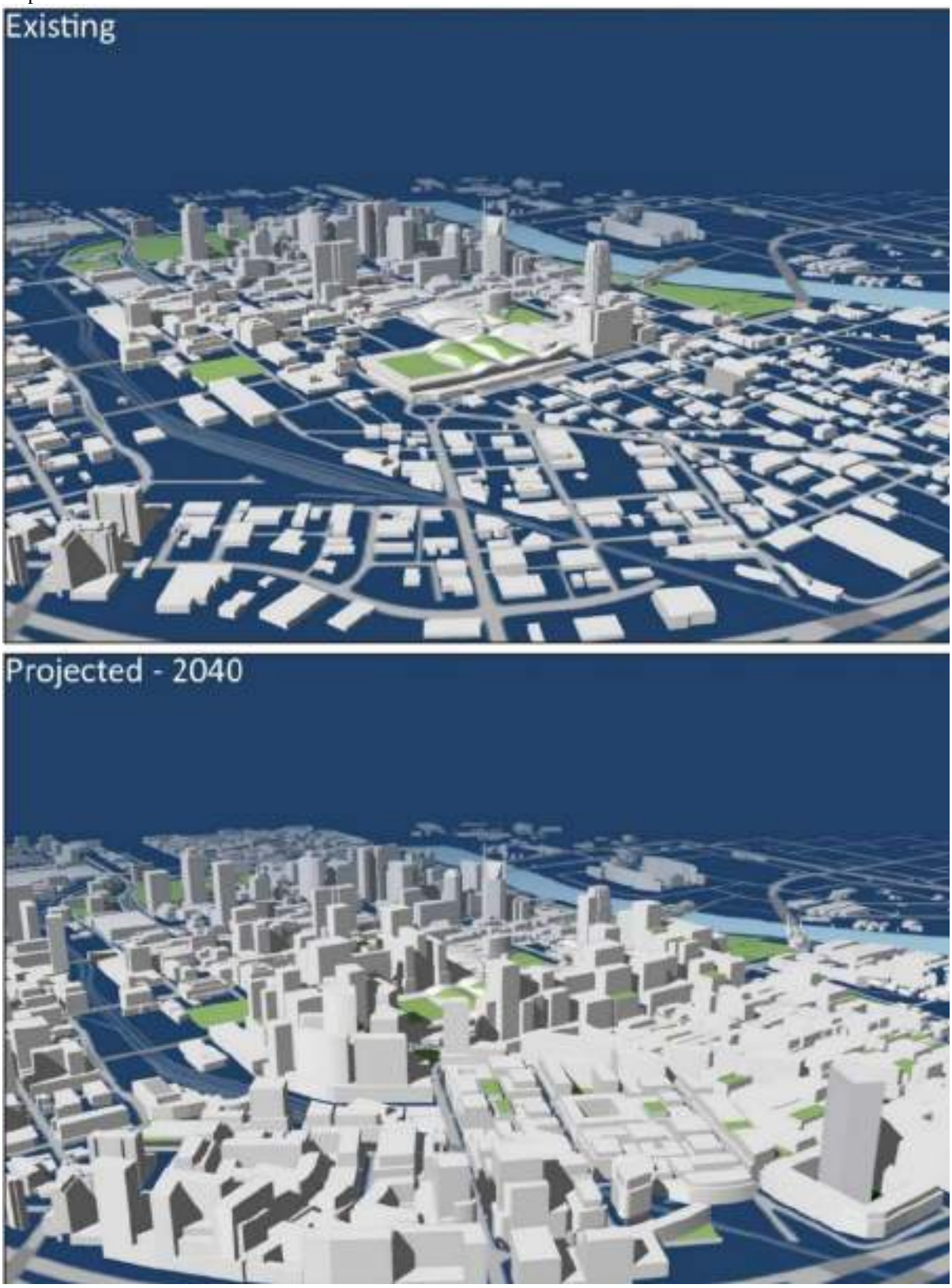


Figure 42 - Vision Plan of DTC 2040 Source : [CITATION Yin19 \l 16393]

Overview.

Miami – Architectural evolution

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"IMPACT OF AWARENESS PROGRAM ON KNOWLEDGE REGARDING COMMON BOTTLE-FEEDING PROBLEMS IN INFANTS AMONG MOTHERS"

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ABSTRACT
The current study has been undertaken to assess knowledge score regarding common bottle-feeding problems among mothers by awareness program in selected community area of Gandhi Nagar, Gujrat. The research design used for the study was pre-experimental in nature. The tool for study was self-structured knowledge questionnaire which consists of 2 parts- PART- I consisted of questions related to Socio-demographic data; PART-II consisted of self -structured knowledge questionnaire to assess knowledge score regarding common bottle-feeding problems among Mothers. The data was analyzed by using descriptive & inferential statistical methods. The most significant finding was that 25.0% of Mothers were having average knowledge regarding common bottle-feeding problems whereas 75.0% had good knowledge after post-test. It was suggested that nurses must educate mothers regarding common bottle-feeding problems.
Keyword- Awareness program, common bottle-feeding problem, mothers.

Introduction

Most often mothers find problems when bottle feeding their infants. Some of these problems are minor and can be rectified easily and with not much fuss and hassle. However, for major and health problems, your doctor should be the first one to be contacted. It is good to get educated before you start bottle feeding your child and this should be from a reliable and good source.

Do not forget that although breast feeding is said to be natural and good since many years, it lacks some important ingredients for the right growth of mind and body of the infant. These are added to the formula feed as they are prepared scientifically and contain measured ingredients. **Common types of bottle-feeding problems**

- Turning away from the bottle.
- Gagging or fussing as the bottle's nipple nears their mouth.
- Being unable to latch/compress the bottle's nipple and express milk.
- Chewing on the bottle's nipple.

Sputtering or coughing while feeding.

Objective of the study

1. To assess the pre-test & post-test Knowledge score regarding common bottle-feeding problems among Mothers.
2. To assess impact of awareness program on knowledge regarding common bottle-feeding problems among Mothers.
3. To find out association between pre-test knowledge score regarding common bottle-feeding problems among Mothers with their selected demographic variables

Hypotheses:

RH_0: There will be no significant difference between pretest & post-test knowledge score on common bottle-feeding problems among Mothers.

RH_1: There will be significant difference between pretest & post-test knowledge score on common bottle-feeding problems among Mothers.

RH_2: There will be significant association between pre-test score on common bottle-feeding problems among Mothers with their selected demographic variables.

Assumption

1. Mothers may have deficit knowledge regarding common bottle-feeding problems.
2. Awareness program will enhance knowledge of Mothers regarding common bottle-feeding problems.

Methodology

An evaluative approach was used and pre-experimental one group pre-test post-test research design was used for the study. The samples consisted of 44 Mothers selected by Non probability convenient sampling technique. The setting for the study was selected community area of Gandhi Nagar, Gujrat. Data was gathered with help of demographic variables & administering a self-structured knowledge questionnaire by analyst prior & after awareness program. Post-test was done after seven days of pre-test. Data were analysis using descriptive & inferential statistics.

Analysis and interpretation

SECTION-I Table -1 Frequency & percentage distribution of samples according to their demographic variables.

n = 44

S. No	Demographic Variables	Frequency	Percentage
1	**Age in Years**		
a.	18-22	11	25.0
b.	23-27	26	59.1
c.	28-32	6	13.6
d.	More than 32	1	2.3
2	**Educational Status**		
a.	No formal education	5	11.4
b.	Primary	6	13.6
c.	Secondary	15	34.1
d.	Higher secondary	17	38.6
e.	UG & PG	1	2.3
3	**Family income**		
a.	10000-15000	12	27.3
b.	150001-20000	19	43.2
c.	Above 20000	13	29.5
4	**Type of family**		
a.	Nuclear	29	65.9
b.	**Joint**	10	22.7
c.	Extended	5	11.4
5	**Previous knowledge related to common bottle-feeding problems**		
a.	Yes	37	84.1
b.	No	7	15.9

SECTION-II- Table- 2.1.1- Frequency and percentage distribution of Pre-test scores of studied subjects:

Category and test Score	Frequency (N=44)	Frequency Percentage (%)
POOR (1-10)	37	84.1
AVERAGE (11-20)	7	15.9
GOOD (21-30)	0	0.0
TOTAL	44	100.0

The present table 2.1.1 concerned with the existing knowledge regarding common bottle-feeding problems among Mothers were shown by pre-test score and it is observed that most of the mothers 37 (84.1%) were poor (01-10) knowledge & some Mothers have 7 (15.9%) were from average category.

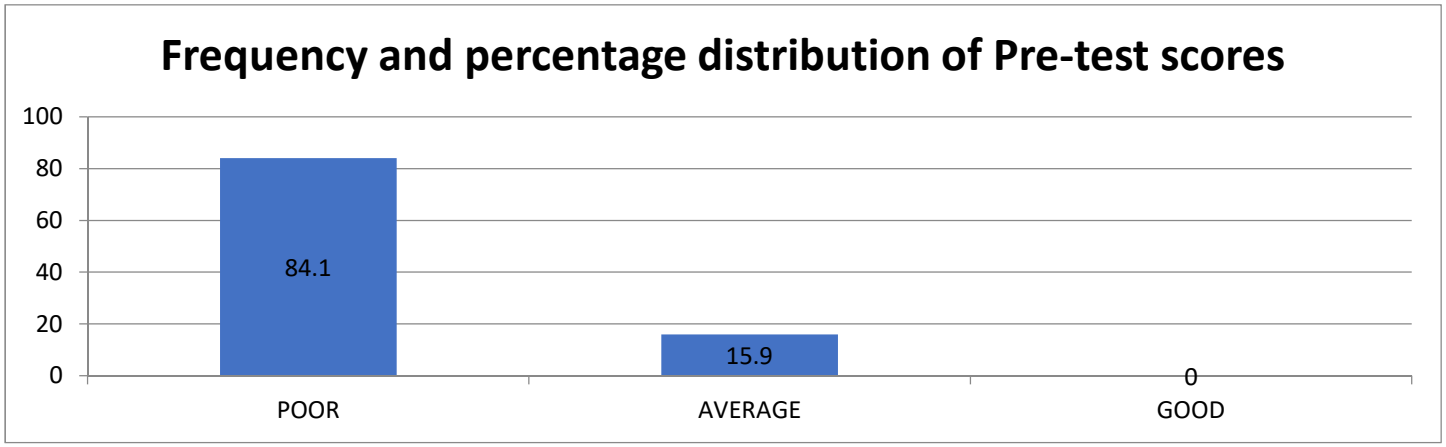

FIG.-2.1.1- Frequency and percentage distribution of Pre-test scores of studied subjects

Table-2.1.2. - Mean ($\overline{X}$) and standard Deviation (s) of knowledge scores:

Knowledge Pre –test	Mean ($\overline{X}$)	Std Dev (S)
Pre-test score	**8.09**	**2.90**

The information regarding mean, percentage of mean and standard deviation of test scores in shown in table 2.1.2 knowledge in mean pre-test score was 8.09± 2.90 while in knowledge regarding common bottle-feeding problems among Mothers in in selected community area of Gandhi Nagar, Gujrat.

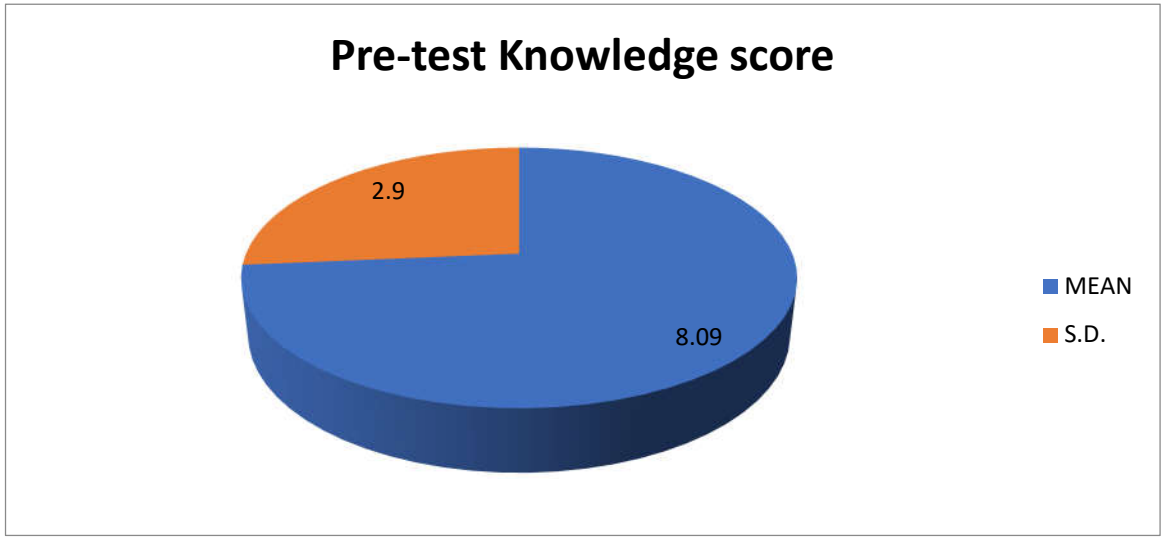

FIG.-2.1.1. - **Mean ($\overline{X}$) and standard Deviation (s) of knowledge scores**

Table-2.2.1- Frequency and percentage distribution of Post test scores of studied subjects:

Category and post-test Score	**Frequency (N=40)**	**Frequency Percentage (%)**
POOR (01-10)	0	0.0
AVERAGE (11-20)	11	25.0
GOOD (21-30)	33	75.5
TOTAL	44	100%

The present table 2.2.1 concerned with the existing knowledge regarding common bottle-feeding problems among Mothers was shown by post test score and it is observed that most of the mothers 33 (75.0%) were **GOOD** (21-30) knowledge & other Mothers have 11 (25.0%) category which are **AVERAGE** (11-20) posttest knowledge score in present study.

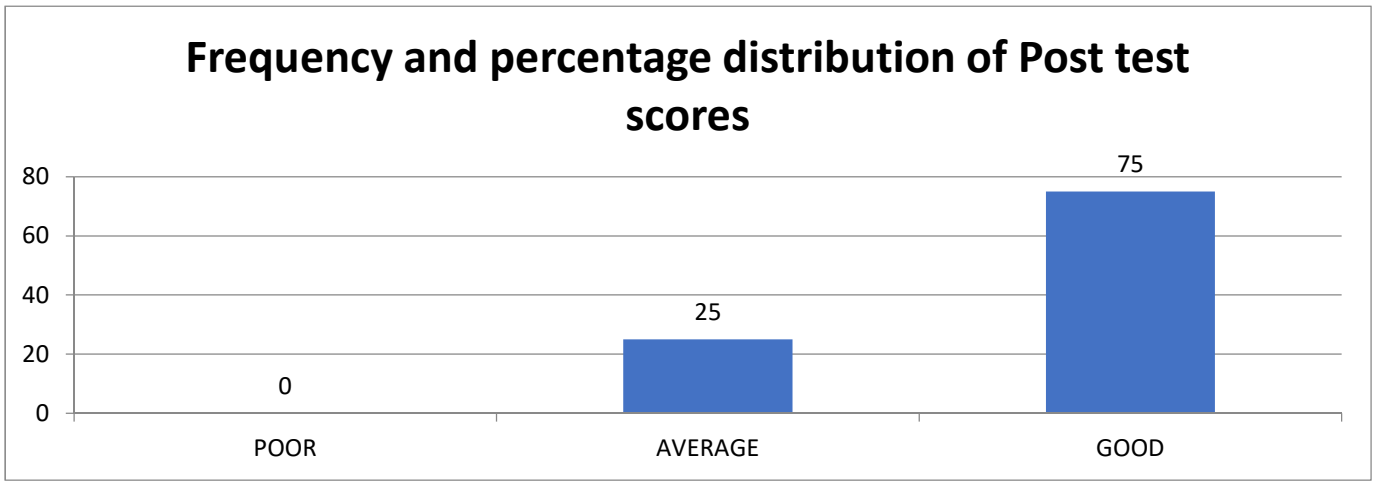

FIG.-2.2.1- Frequency and percentage distribution of Post test scores of studied subjects

Table-2.2.2. - Mean ($\overline{X}$) and standard Deviation (s) of knowledge scores:

Knowledge Test	**Mean ($\overline{X}$)**	**Std Dev (S)**
Post-test score	**21.50**	**3.75**

The information regarding mean, percentage of mean and SD of post test scores in shown in table 2.2.2 knowledge in mean post test score was 21.50 ± 3.75 while in knowledge regarding common bottle-feeding problems among Mothers in in selected community area of Gandhi Nagar, Gujrat.

Hence, it is confirmed from the tables of section-II that there is a significant difference in mean of test scores which partially fulfill 2nd objective of the present study.

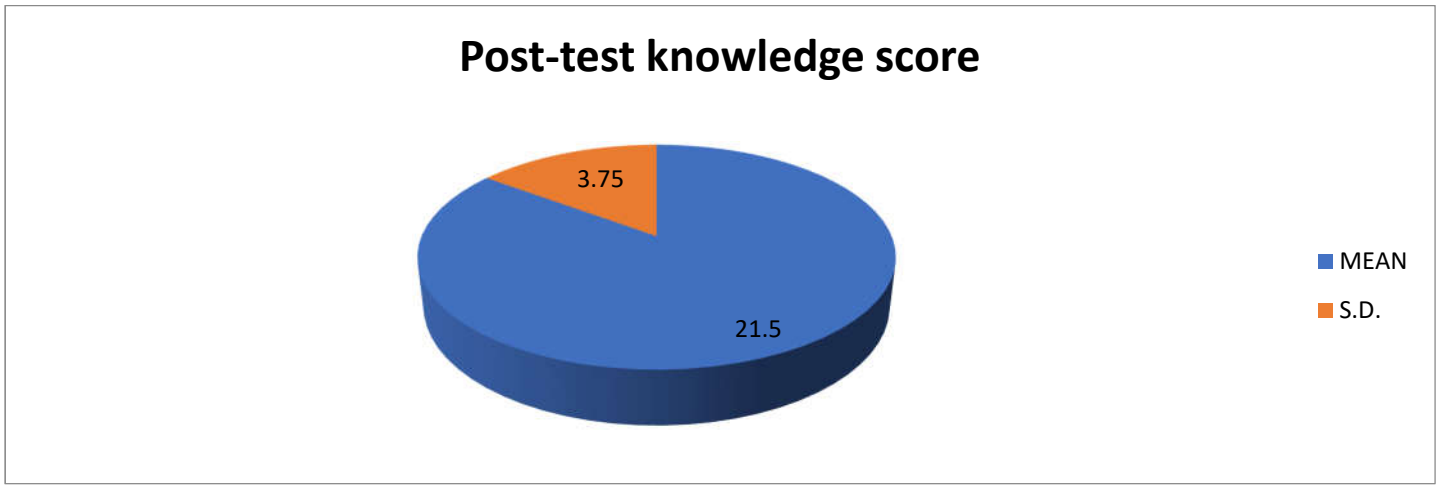

FIG.-2.2.2. - Mean ($\overline{X}$) and standard Deviation (s) of knowledge scores:

TABLE 2.2.3: Impact of awareness program by calculating Mean, SD, Mean Difference and 't' Value of Pre-test and Post-test knowledge.

Knowledge Score of Mothers	Mean ($\bar{X}$)	S. D. (s)	Std. Error of Mean	D. F.	t-value	Significance
Pre-test	**8.09**	**2.90**	0.71	43	**-19.05**	P<0.05
Post-test	**21.50**	**3.75**				

When the mean and SD of pre-test & post-test were compared & 't' test was applied. It can be clearly seen that the 't' value was -19.05 and p value was 0.05 which clearly show that awareness program was very effective in enhancing the knowledge of Mothers.

SECTION-III Association of knowledge scores between test and selected demographic variables:

Table- 3.1 Association of age of Mothers with pre-test scores:

Age	Test scores			Total
(in years)	**POOR (1-10)**	**AVERAGE (11-20)**	**GGOD (21-30)**	
18-22	10	1	0	**11**
23-27	20	6	0	**26**
28-32	6	0	0	**6**
Above 32	1	0	0	**1**
Total	**37**	**7**	**0**	**44**
X= 2.70	p>0.05 (Insignificant)			

The association of age & test scores is shown in present table 3.1. The probability value for Chi-Square test is 2.70 for 3 DF which indicated insignificant value (p>0.05). Hence, it is identified that there is insignificant association between age & test scores. Moreover, it is reflected that age isn't influenced with current problem.

Table- 3.2 Association of educational status with pre-test scores:

Educational status	Test scores			Total
	POOR (1-10)	**AVERAGE (11-20)**	**GOOD (21-30)**	
No formal	5	0	0	**5**
Primary	4	2	0	**6**
Secondary	12	3	0	**15**
Higher sec.	15	2	0	**17**
UG & PG	1	0	0	**1**
Total	**37**	**7**	**0**	**44**
X= 2.90	p>0.05 (Insignificant)			

The association of educational status & test score is shown in present table 3.2. The probability value for Chi-Square test is 2.90 for 4 degrees of freedom which indicated educational status and test scores. Moreover, it is reflected that educational status isn't influenced with present problem.

Table- 3.3 Association of family income with pre-test scores:

Family income	**Test scores**			**Total**
	POOR (1-10)	**AVERAGE (11-20)**	**GOOD (21-30)**	
10000-15000	10	2	0	**12**
15001-20000	16	3	0	**19**
Above 20000	11	2	0	**13**
Total	**37**	**7**	**0**	**44**
X=0.008	p>0.05 (Insignificant)			

The association of family income & test score is shown in present table 3.3. The probability value for Chi-Square test is 0.008 for 2 degrees of freedom which indicated family income and test scores. Moreover, it is reflected that family income isn't influenced with present problem.

Table- 3.4 Association of types of family with pre-test scores:

Types of family	**Test scores**			**Total**
	POOR (1-10)	**AVERAGE (11-20)**	**GOOD (21-30)**	
Nuclear	25	4	0	**29**
Joint	7	3	0	**10**
Extended	5	0	0	**5**
Total	**37**	**7**	**0**	**44**
X= 2.52	p>0.05 (Insignificant)			

The association of types of family & test score is shown in present table 3.4. The probability value for Chi-Square test is 2.52 for 2 degrees of freedom which indicated types of family and test scores. Moreover, it is reflected those types of family isn't influenced with present problem.

Table- 3.5 Association of previous knowledge related to common bottle-feeding problems with pre-test scores:

Previous Knowledge	Test scores			Total
	POOR (1-10)	**AVERAGE (11-20)**	**GOOD (21-30)**	
Yes	3	2	0	**5**
No	34	5	0	**39**
Total	**37**	**7**	**0**	**44**
X= 2.44	p>0.05 (Insignificant)			

The association of previous knowledge & test scores is shown in present table 3.5. The probability value for Chi-Square test is 2.44 for 1 degrees of freedom which indicated previous knowledge & test scores. Moreover, it is reflected that previous knowledge isn't influenced with current problem.

Results

The result of this study indicates that there was a significant increase in post-test knowledge scores compared to pre-test scores of common bottle-feeding problems. The mean percentage knowledge score was observed 8.09± 2.90 in pre-test & after implementation of awareness program post-test mean percentage was observed with 21.50± 3.75.

Conclusion

Thus, after the analysis and interpretation of data we can conclude that the hypothesis RH1 that, there will be significance difference between pre-test knowledge score with post-test knowledge score among Mothers at ($P<0.05$) is being accepted. Furthermore, awareness program related to common bottle-feeding problems among Mothers may consider as an effective tool when there is a need in bridging & modifying knowledge.

Limitations

- This was limited to in selected community area of Gandhi Nagar, Gujrat.
- This was limited to 44 Mothers.

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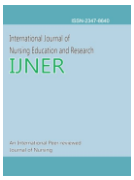

RESEARCH ARTICLE

A Descriptive Study to Identify Perceived Performance Obstacles Faced by the Staff Nurse's working in Psychiatry Department in Government Hospital of Gujarat State

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ABSTRACT:

Background: Nurses constitute the largest group of health care professionals who care for mental health care users in the psychiatric services field. This places them at the crucial junction of providing quality care while trying to manage the challenges that arise with this patient group. Part of dealing with this requires that nursing education be aware not only of the multifaceted roles of psychiatric nurses but the unique and sometimes daunting challenges involved in nursing mentally ill patients. While the roles of psychiatric nurses have received growing attention; little research exists on the roles and challenges associated with psychiatric nursing at mental health care facilities. The current study explored the challenges associated with perceived perform duties obstacles of staff nurses working in psychiatric department. **Objectives:** The study's objectives are :- (1) To assess perceived performance obstacles faced by staff nurses working in government hospital of Gujarat state. (2) To identify the obstacles that affect in perform duties of staff nurse's working in government hospital of Gujarat state. (3) To associate demographic data of staff nurse's with perceived performance obstacle faced by staff nurse's working in government hospital of Gujarat state. **Material and methods:** The study was conducted among 150 staff nurses working in psychiatric department in government hospital of Gujarat state using Convenient Sampling Techniques. Descriptive survey approach was used as a research design. A collection of the data, investigator has used Self-Structured Dichotomous Questionnaire to assess perceived performance obstacles faced by staff nurses working in psychiatric department in government hospital of Gujarat state with a view to develop an information booklet. Descriptive and inferential statistics were used to calculate the analysis from the samples. The reliability of tool was determined by testing test retest method before data collection whereas the association was determined by using Chi square formula. **Results and findings:** The study revealed that majority of samples has Perceived Performance Obstacles where fully present is 44.7% and moderately present is 52.7% hence it is seen that Perceived Performance Obstacles is truly faced by staff nurse working in psychiatric department in Government hospital of Gujarat state. Significant association was found between Gender, and Type of family and perceived performance obstacles score. There was non-Significant association was found between Age, Marital Status, and Educational Status and perceived performance obstacles score. Information booklet has been developed for the nurses to help in managing and understanding of perceived performance obstacles and own mental health needs. We should try to reduce the Perceived Performance Obstacles, to achieve promotion of mental health of staff nurses to prevent stress and encourage coping, to upgrade the standard of their performed duties.

KEYWORDS: Perceived performance obstacles, Staff nurse, Psychiatric department.

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INTRODUCTION:

Mental health is a level of psychological well-being, or an absence of a mental disorder; it is the "psychological state of someone who is functioning at a satisfactory

level of emotional and behavioral adjustment". From the perspective of positive psychology or holism, mental health may include an individual's ability to enjoy life, and create a balance between life activities and efforts to achieve psychological resilience.

The Performance obstacles can be defined as the work factors in the work setting that increase their workload beyond what is expected that negatively affect their quality of work life. Performance obstacles may be related to one or more elements of the work system, such as those related to tasks which include, dealing with many professional issues, and performance obstacles related to tools as unavailability of necessary equipment in a timely manner were considered among the categories of performance obstacles that prevent staff nurses from accomplishing their tasks.

Additionally, The effect of stress has been considered an important cause of decreasing health and reduction in the level of self-efficiency of nurses, decreasing nursing personnel in long-term psychiatric facilities, have displayed higher levels of stress, lower job satisfaction, and a higher propensity to quit than providers working in other types of health care settings. Caring for both the mental and physical health of the psychiatric patient is especially important for psychiatric nurses; thus, their roles have continued to expand over the years, in association with increases in the mental health services supplied by psychiatric departments. Self-efficacy is a key factor in nursing that may lead them to feel confident to perform well in complex situations.

NEED FOR STUDY:

Nursing stress is considered a problem that affects the practice worldwide. Job stress is a harmful response physically and emotionally when the nurses' skills, resources, and needs could not fulfill the requirement of the job**.** This study was aimed to assess job stress and self- efficacy among psychiatric nursing working in mental health hospitals at Cairo, Egypt. The study was conducted in mental health hospital and institute of Psychiatry affiliated to Ain shams university hospitals**.** [3]

Association between Performance Obstacles And Quality Of Work Life among Intensive Care Nurses. Performance obstacles domains as reported by the study subjects: Shows the domains of performance obstacles as reported by nurses in the two studied hospital. MGH was higher in the following domains: Physical work environment, work organization, technology and tools, nursing tasks (55.5%, 37.0%, 33.3%, 74.1% respectively) than MUCH (43.3%, 20.3%, 30.0%, 36.8% respectively).With highly statistically significance. [1]

Job Stress and Self- Efficacy among Psychiatric Nursing Working in Mental Health Hospitals at Cairo, Egypt Shows the socio-demographic characteristics of psychiatric nurses: and found that more than half of nurses were ranged from 20 to <35years and had experience between 5- 10 years constituting (53.1%). Regarding their sex, it was found that more than two-third of them (69.4%) were female. Concerning marital status (77.5%) were married. In addition to there was no one of them had master or doctorate degree, while about two third of them were a diploma nurse and working as a staff nurse constituted (64.3%) and (61.2%) respectively. [4]

Staff Nurses' Performance Obstacles and Quality of Work Life at Benha University Hospital. Frequency distribution of studied staff nurses according to their general characteristics shows:_clarifies that more than three fifths (63.9%) of the studied nurses were in age group less than 25 years and the majority of them (93.3%) were females. As regards to marital status of studied staff nurses; near to two thirds (65.5%) were married, as well as more than two thirds (67.2%) of them were graduates of technical institute of nursing. In relation to years of experience more than half (60.5%) of studied staff nurses had less than or equal 5 years of experience. [2]

OBJECTIVES:

The study's objectives are :-

(1) To assess perceived performance obstacles faced by staff nurses working in government hospital of Gujarat state.

(2) To identify the obstacles that affect in perform duties of staff nurse's working in government hospital of Gujarat state.

(3) To associate demographic data of staff nurse's with perceived performance obstacle faced by staff nurse's working in government hospital of Gujarat state.

MATERIAL AND METHODS:

The study was conducted among 150 staff nurses working in psychiatric department in government hospital of Gujarat state using Convenient Sampling Techniques. Descriptive survey approach was used as a research design. A collection of the data, investigator has used Self-Structured Dichotomous Questionnaire to assess perceived performance obstacles faced by staff nurses working in psychiatric department in government hospital of Gujarat state with a view to develop an information booklet. Descriptive and inferential statistics were used to calculate the analysis from the samples. The reliability of tool was determined by testing test retest method before data collection whereas the association was determined by using Chi square formula. Research setting was Govt. Hospital for Mental Health,

Gujarat State. The data was analyzed by using Descriptive and Inferential Statistics.

RESULT AND DISCUSSION:

Section-I:-Demographic Variables:

The demographic variable of the samples regarding level of perceived performance obstacles faced by staff nurses. In the present study data revealed that samples. Out of 150 samples, 97 samples were distributed between 21-30 years of age (64.7%), 33 samples belong to 31-40 years (22.0%), 14 samples belong to 41-50 years of age (9.3%) and 6 samples belongs to 51-60 years of age (4.0%). As regard to Gender all 150, 43 samples were Male (28.7%) and 107samples were Females (71.3%). According to Marital status of all 150 sample, 55 were Married (36.7%), 81 are Unmarried/Single (54.0%), 13 were separated/ divorce (8.7%), 1 is widowed/widower (0.7%). According to Type of Family, 60 was Nuclear Family (40.0%), 78 were Joint family (52.0%) and 12 were extended family (8.0%). Distribution of samples according to Educational Qualification 35 was from G.N.M. Nursing (23.3%), 17 was from Post basic B.SC Nursing (11.3%), 81 was from B.Sc. Nursing (54.0%) and remaining 17 was from M.Sc. Nursing (11.3%).

Section-II:- Level of Perceived Performance Obstacles Faced by Staff Nurse.

Frequency and percentage wise distribution of samples scores regarding level of perceived performance obstacles faced by staff nurse. Out of 150 samples, Perceived Performance Obstacles is not present in 4 samples (2.7%), Perceived Performance Obstacles is Moderately present in 79 samples (52.7%) and Performance Obstacles is Fully present in 67 samples (44.7%). It revealed that majority of samples has Perceived Performance Obstacles where fully present is 44.7% and moderately present is 52.7% hence it is seen that Perceived Performance Obstacles is truly faced by staff nurse working in psychiatric department in government hospital of Gujarat state.

CONCLUSION:

The major conclusions derived from the present study are:-

1. Perceived Performance Obstacles are faced by staff nurses working in psychiatry department in government hospital of Gujarat state.
2. Perceived Performance Obstacles is Moderately present in 79 samples (52.7%) and Performance Obstacles is Fully present in 67 samples (44.7%).
3. There is Significant association was found between perceived performance obstacles score and demographic variable like Gender, Type of family.
4. There is No Significant association was found between perceived performance obstacles score and demographic variable like Age, Marital Status, and Educational Status.

It was also found that there is No Significant association was found between perceived performance obstacles score and demographic variable like Age, Marital Status, and Educational Status and There is Significant association was found between perceived performance obstacles score and demographic variable like Gender, Type of family. Hence, there is need of develop an information booklet for people in general so that they can be aware about perceived performance obstacles faced by the staff nurses working in psychiatry department, to help promote awareness and understanding of our own mental health needs. So, that they can learn the measures to decrease the perceived performance obstacles faced by the staff nurses working in psychiatry department, and also contribute in preventing mental stress and develop coping skills with obstacles.

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SEWAGE TREATMENT UNIT USING DUAL MEDIA FILTER- A STEP TOWARDS WATER CONSERVATION

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Abstract – *Waste water, is any water that has been adversely affected in quality by anthropogenic influence. The sewage from colonies as well effluent from industrial units has been identified as main cause for water pollution across our country. Sewage is a water – carried waste, in solution or suspension that is intended to be removed from a community. Also known as waste water, it is more than 99% water & is characterized by volume or rate of flow, physical condition, chemical constituents and the bacteriological organisms that it contains. During recent year, there has been an increasing awareness and concern about water conservation all over the world. Hence, new approaches towards achieving sustainable development of water resources have been developed internationally. The BOD, COD, TSS concentration of sewage ranges from 80-150 mg/l, 180-230 mg/ l & 90-180 mg/L respectively. Under this research paper, a cut to suit treatment technology has been developed to treat sewage. Treatment technologies adopted are sequencing batch reactor (SBR), Chlorination. A new approach Dual media filter results were very encouraging. The treatment system achieved 94% BOD, 96% COD and 95% TSS removal respectively.*

***Key Words*: Sequencing batch reactors, Activated sludge Process, BOD, Chlorination, COD, TSS, Dual Media Filtration, Reuse, Sewage etc.**

1. INTRODUCTION

Waste water is liquid waste discharged by domestic residences, commercial properties, industry, agriculture which often contains some contaminants that result from the mixing of waste water from different sources [1]. Based on first origin wastewater can be classed as sanitary, commercial, industrial, agricultural or surface runoff. Term wastewater need to be separated from the term sewage, the terms sewage and sewerage are sometimes interchanged. Sewage is contaminated with feces or urine. The sewage generates from residence, hospitals, offices, industries etc.

Domestic sewage contains a wide variety of dissolved and suspended impurities and is the primary source of pathogens and organic substances. All sewage from cities and towns is likely to contain pathogens of some type, potentially presenting a direct threat to public health. There has been an increasing awareness and concern about water conservation all over the world. Hence, a new approach towards achieving sustainable development of water resources has been developed internationally.[1]

1.1 Methods and Material

Methodology:

In this research paper the treatment technologies adopted for the treating sewage are as follows:

1. Sequencing batch reactor (SBR) Process
2. Filtration

1.2 Sewage Treatment Plant

Sewage treatment is the process of removing contaminants from wastewater and house hold sewage, both runoffs (effluents), domestic, commercial and institutional. It includes physical, chemical and Biological processes to remove physical, chemical and biological contaminants. Its objective is to produce an environmentally safe fluid waste stream and solid waste (or treated sludge) suitable for disposal or reuse. The treatment of waste water is not important for our own health but also kept our environmental clean and healthy.[1]

In a sewage treatment plant, the Sequencing batch reactor (SBR) process is a biological process that can be used for one or several of the purpose like oxidizing carbonaceous biological matter, oxidizing nitrogenous matter. Mainly ammonium & nitrogen generation a biological matter, removing phosphate, driving off entrained gases such as carbon dioxide, ammonia, nitrogen generating a biological floc that is easy to settle, generating a liquor that is low in dissolved or suspended material.

SBR (Sequencing batch reactors) are a type of activated sludge process for the treatment of waste water. SBR reactors treat wastewater such as sewage or output from anaerobic digesters or mechanical biological treatment facilities in batches. SBR is a modification of activated sludge process which has been successfully used to treat municipal and industrial wastewater. The difference between the two

technologies is that the SBR performs equalization, biological treatment and secondary clarification in a single tank using a timed control sequence. SBR technology is a method of waste water treatment in which all phase of the treatment process occur sequentially within the same tank.[6]

The SBR is fill draw activated sludge system. In this system, waste water is added to a single "batch" reactor, treated to remove undesirable components, and the discharged.

Five phase of SBR process:

Fill Phase: During this phase, the basin receives influent wastewater. The influent brings food to the microbes in the activated sludge, creating an environment for biochemical reactions to take place.

React Phase: During this phase, no wastewater enters the basin and the mechanical mixing and aeration units are on. This phase allows for further reduction of wastewater parameters.

Settle phase: During this phase, activated sludge is allowed to settle under quiescent condition. The activated sludge tends to settle as a flocculent mass.

Decant phase: Clarified treated effluent is removed from the tank.

Idle Phase: This step occurs between the decant and the fill phase. The idle period is used when the system is waiting for enough effluent to process.[6]

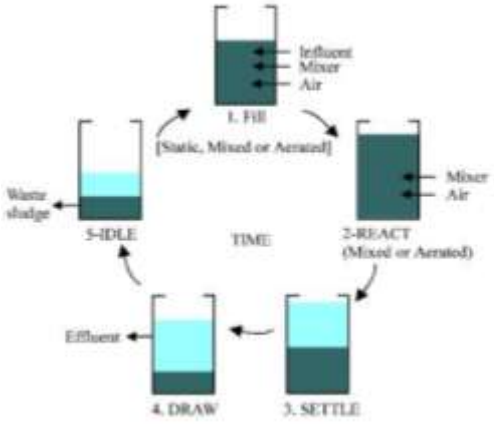

Fig -1: SBR operation for each tank for one cycle

Disinfection of sewage is necessary for healthy rivers and streams. Chlorination is by far the most common method of wastewater disinfection and is used worldwide for the disinfection of pathogens before discharge into receiving streams, rivers or oceans. Chlorine is known to be effective in destroying a variety of bacteria, Viruses and protozoa, including Salmonella, Shigella and vibrio cholera.

1.3 Filtration

Filtration is commonly the mechanical or physical operation which is used for the separation of solids from fluids by in reposing a media through which only the fluid can pass. The fluid that passes through is called filtrate. Two types of sand filter are in use: Slow sand filter and rapid sand Filter. Slow sand filters require much more surface area than rapid sand filters and are difficult to clean. Most modern water treatment plant now use rapid dual media filers following coagulation and sedimentation. A dual- media filter consists of layer of anthracite coal above a layer of fine sand. The upper layer of coal traps most of the large floc, and the finer sand grains in the lower layer trap smaller impurities. This process is called in depth filtration, as the impurities are not simply screened out or removed at the surface of the filter bed, as is the case in slow sand filter. In order to enhance in depth filtration, so calls mixed media are used in some treatment plants. These have a third layer, consisting of fine grained dense mineral called granite, at the bottom of the bed.[4]

2. Dual media Filter:

For this research paper a treated water from the Sewage treatment plant based on SBR (near Ahmedabad) will recycle and reuse water can be used for cooling water makeup, gardening, landscape development, toilet flushing, road washing etc. thus leading towards water conservation. A new Approach is "Sewage treatment plant followed by Dual media filter achieve very encouraging results. The Result achieved 94% BOD, 96% COD and 95% TSS removal respectively.

At Sewage treatment plant preliminary treatment (includes Screening, grit chamber, Parshall flume), SBR tank (Biological treatment) and chlorine contact tank were fabricated.

A lab scale study was conducted to testing of the results.

Table -1: Inlet and Out let parameter of Sewage Treatment plant

Sr no	Parameters	Inlet (mg/l)	Outlet (mg/l)
1.	pH	7.22	7.40
2.	BOD	85	10
3.	COD	190	20
4.	TSS	114	15

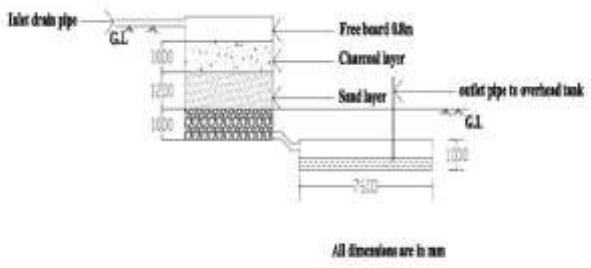

Fig-2: Plan of the Filtration Tank

Fig-3: Dual media model

Dual media filtration has been increasing interest and application in water treatment as well as in advance treatment of effluents for water renovation and for pollution control.[4] It consist of Activated Carbon AC at the top of the filter media, and sand in the bottom portion. The AC with a specific gravity of 2.55 is greater than the sand with sp. Gravity of 2.65. Therefor a lager AC gain has the same settling velocity as much smaller sand gain. This characteristics allows larger AC grains to be placed on the top of the smaller sand grains.[5]Dual media filter may behave much like the two single – medium filters, placed in series, one above the other, each with a different grain size. The top layer of AC particles removes the larger sized impurities as well as some smaller one; while the bottom sand, in its turn, captures the smaller impurities. As a consequence, more depth of filter is utilized for the removal of solids than in the stratified single medium filter.[5]

Sand either fine or core is generally used as a filter media. The size of the sand is measured and expressed by the term called effective size.[4] The layer of Sand may be supported on gravel, which permits the filtered water to move freely to the under drains, and allows the wash water to move uniformly upwards.[4]

The diameter of the activated carbon filter be selected to be 25% larger than the sand filter to reduce the frequency of the servicing.[4]

Filtration unit details:

Materials: Activated charcoal, Sand and Gravel
Top layer: Activated charcoal (granular),
Middle layer: Sand
Bottom Layer: Gravel

The rate of Filtration is 6 $m^3/m^2/hr$. (for this small unit)

Advantages and Disadvantages of Dual media Filter
Advantages:

-Higher filtration rate
-Requires small area
- Automated cleaning using backwash
- Can handle a wide range and more variable water quality than a rapid sand filter.
- Operation can become more automated are requires less man power.

Disadvantages:

-Not as efficient a filtration process and additional monitoring may be required before a high filtration rate can be used.
- A biologically active layer does not form
- Need frequent cleaning using significant amount of treated water.
- Operation requires a higher level of skill and thus more training.

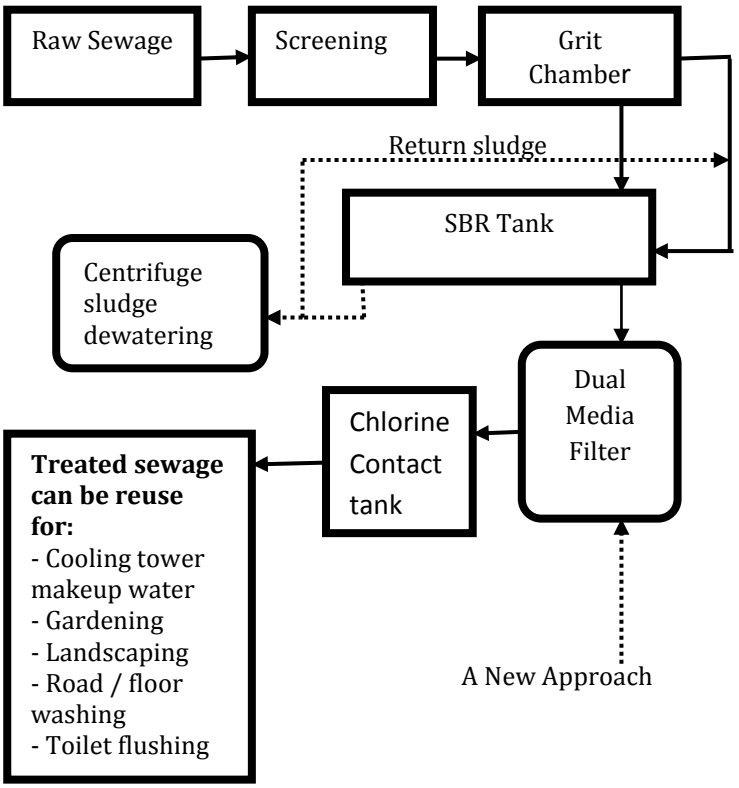

Chart 1: Flow chart of Sewage treatment plant with new approach

3. RESULTS AND CONCLUSIONS

Table -2: After dual media filter Reduction Results

Sr no.		pH	BOD (mg/l)	COD (mg/l)	TSS (mg/l)
1.	Raw Sewage	7.22	90	200	115
2.	SBR tank outlet	7.3	10	20	15
3.	After Dual media filter	7.3	6	8	6
	Reduction in %	**-**	**94%**	**96%**	**95%**

Conclusions:

With the Rapid Development of the cities and domestic water supply, quantity of sewage generation is increasing in the same proportion. Treatment of sewage and its reuse is the need of the hour. One of the Main pollution of surface water in our country is discharge of untreated sewage.

This research paper attempt has been made to treat sewage and put it back for reuse. The sewage has been treated by sequencing batch reactor (SBR) and the results have been very encouraging. BOD, COD and TSS reduction achieved were 10 mg/l, 20 mg/l and 15 mg/l respectively. After Dual media filtration BOD, COD and TSS results very encouraging 6mg/l, 8mg/l and 6mg/l respectively. [2]

The dual media filter system archived 94% BOD, 96% COD, and 95% TSS removal.

The treated sewage can be reused for various purpose like cooling water makeup, gardening, landscape development, toilet flushing, road washing etc. thus leading towards water conversation.

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HYPERLOOP: THE FIFTH MODE OF TRANSPORTATION

Abstract

Existing conventional modes of transportation consists of four unique types: rail, road, water, and air. These modes of transport tend to be either relatively slow (i.e., road and water), expensive (i.e. air) or a combination of relatively slow and expensive (i.e. rail). Hyperloop is innovative mode of transport that seeks to change this paradigm by being both fast and inexpensive for transportation. This new approach uses both permanent magnets and electromagnets to levitate, propel, and control a pod. The electro dynamic suspension system is emulated as a small pod attached with permanent magnets from the bottom, which resembles a short-rotor linear synchronous motor.

Passengers may enter and exit Hyperloop at stations located either at the ends of the tube, or branches along the tube length. In this study, the initial route, preliminary design, and logistics of the Hyperloop transportation system have been derived. Recently Virgin Hyperloop group plans to inaugurate a hyperloop linking the two INDIAN cities (Mumbai-Pune) that will cut down travel time to 13 minutes, or less instead of 2 hr. with conventional mode.

It quickly becomes apparent just how dramatically the Hyperloop could change transportation, road congestion and minimize the carbon footprint globally. With the Hyperloop, extremely fast, inexpensive intercity travel would be widely accessible. If both people and goods can move more quickly and comparatively cheaply, rapid growth is a logical outcome.

1. Introduction

A Hyperloop is a proposed mode of passenger and/or freight transportation, first used to describe an open-source vactrain design released by a joint team from Tesla and Space X. A hyperloop is a sealed tube or system of tubes through which a pod may travel free of air resistance or friction conveying people or objects at high speed while being very efficient.

The Hyperloop Alpha concept was first published in August 2013, proposing and examining a route running from the Los Angeles region to the Francisco Bay Area, roughly following the Interstate 5 corridor. The Hyperloop Genesis paper conceived of a hyperloop system that would propel passengers along the 560 km route at a speed of 1,200 km/h allowing for a travel time of 35 minutes, which is considerably faster than current rail or air travel times.

If we are to make a massive investment in a new transportation system, then the return should by rights be equally massive. Compared to the alternatives, it should ideally be:

- Safer
- Faster
- Lower cost
- More convenient
- Immune to weather
- Sustainably self-powering
- Resistant to Earthquakes
- Not disruptive to those along the route

2. Background of the Invention

The corridor between San Francisco, California and Los Angeles, California is one of the most often travelled corridors in the American West. The current practical modes of transport for passengers between these two major population centres include:

1. Road (inexpensive, slow, usually not environmentally sound)
2. Air (expensive, fast, not environmentally sound)
3. Rail (expensive, slow, often environmentally sound)

A new mode of transport is needed that has benefits of the current modes without the negative aspects of each. This new high-speed transportation system has the following requirements:

1. Ready when the passenger is ready to travel (road)

2. Inexpensive (road)

3. Fast (air)

4. Environmentally friendly (rail/road via electric cars)

The onboard compressor is also used to improve the efficiency of the pod at higher speeds. Once the pod reaches transonic speeds, the flow around the pod will start to choke, i.e. the flow around the pod will become sonic. At this sonic condition the so-called Kantrowitz limit. The mass flow around the pod is at its maximum. Therefore, when the speed is further increased, not all flow can travel around the pod and is therefore collected in front of the pod. The result is a column of air being pushed by the pod throughout its run. That pressure build-up results in significant additional drag. The Hyperloop Alpha concept therefore introduces the on-board compressor to compress the additional flow and suck it through the pod, while at the same time supplying compressed air to the air bearings.

A new high-speed mode of transport is desired between Los Angeles and San Francisco; however, the proposed California High Speed Rail does not reduce current trip times or reduce costs relative to existing modes of transport. This preliminary design study proposes a new mode of high-speed transport that reduces both the travel time and travel cost between Los Angeles and San Francisco. Options are also included to increase the transportation system to other major population centres across California. It is also worth noting the energy cost of this system is less than any currently existing mode of transport the only system that comes close to matching the low energy requirements of Hyperloop is the fully electric Tesla Model S.

3. Design Description

Hyperloop is a proposed transportation system for travelling between Los Angeles, California, and San Francisco, California in 35 minutes. The Hyperloop consists of several distinct components including:

1. Capsule:

a. Sealed capsules carrying 28 passengers each that travel along the interior of the tube depart on average every 2 minutes from Los Angeles or San Francisco (up to every 30 seconds during peak usage hours).

b. A larger system has also been sized that allows transport of 3 full size automobiles with passengers to travel in the capsule.

c. The capsules are separated within the tube by approximately 23 miles (37 km) on average during operation.

d. The capsules are supported via air bearings that operate using a compressed air reservoir and aerodynamic lift.

2. Tube:

a. The tube is made of steel. Two tubes will be welded together in a side by side configuration to allow the capsules to travel both directions.

b. Pylons are placed every 100 ft (30 m) to support the tube.

c. Solar arrays will cover the top of the tubes in order to provide power to the system.

3. Propulsion:

a. Linear accelerators are constructed along the length of the tube at various locations to accelerate the capsules

b. Stators are located on the capsules to transfer momentum to the capsules via the linear accelerators.

4. Route:

a. There will be a station at Los Angeles and San Francisco. Several stations along the way will be possible with splits in the tube. b. The majority of the route will follow I-5 and the tube will be constructed in the median.

CAPSULE

Two versions of the Hyperloop capsules are being considered: a passenger only version and a passenger plus vehicle version.

Hyperloop Passenger Capsule

Assuming an average departure time of 2 minutes between capsules, a minimum of 28 passengers per capsule are required to meet 840 passengers per hour. It is possible to further increase the Hyperloop capacity by reducing the time between departures. The current baseline requires up to 40 capsules in activity during rush hour, 6 of which are at the terminals for loading and unloading of the passengers in approximately 5 minutes.

Hyperloop Passenger Plus Vehicle Capsule

The passenger plus vehicle version of the Hyperloop will depart as often as the passenger only version, but will

Accommodate 3 vehicles in addition to the passengers. All subsystems discussed in the following sections are featured on both capsules.

For travel at high speeds, the greatest power requirement is normally to overcome air resistance. Aerodynamic drag increases with the square of speed, and thus the power requirement increases with the cube of speed. For example, to travel twice as fast a vehicle must overcome four times the aerodynamic resistance, and input eight times the power.

Hyperloop Passenger Capsule

The maximum width is 4.43 ft (1.35 m) and maximum height is 6.11 ft (1.10 m). With rounded corners, this is equivalent to a 15 ft2 (1.4 m2) frontal area, not including any propulsion or suspension components.

The aerodynamic power requirements at 800-900 kph is around only 100 kW with a drag force of only 320 N, or about the same force as the weight of one oversized checked bag at the airport. The doors on each side will open in a gullwing (or possibly sliding) manner to allow easy access during loading and unloading. The luggage compartment will be at the front or rear of the capsule.

The overall structure weight is expected to be near 3,100 kg including the luggage compartments and door mechanism.

TUBE

The main Hyperloop route consists of a partially evacuated cylindrical tube that connects the Los Angeles and San Francisco stations in a closed loop system. The tube is specifically sized for optimal air flow around the capsule improving performance and energy consumption at the expected travel speed. The expected pressure inside the tube will be maintained around 0.015 psi (100 Pa, 0.75 torr), which is about 1/6 the pressure on Mars. This low pressure minimizes the drag force on the capsule while maintaining the relative ease of pumping out the air from the tube. The efficiency of industrial vacuum pumps decreases exponentially as the pressure is reduced, so further benefits from reducing tube pressure would be offset by increased pumping complexity.

PASASENGER HYPERLOOP TUBE

The inner diameter of the tube is optimized to be 7 ft 4 in. (2.23 m) which is small enough to keep material cost low while large enough to provide some alleviation of choked air flow around the capsule. The tube cross-sectional area is 42.2 ft^2 (3.91 m2) giving a capsule/tube area ratio of 36% or a diameter ratio of 60%. It is critical to the aerodynamics of the capsule to keep this ratio as large as possible, even though the pressure in the tube is extremely low. As the capsule moves through the tube, it must displace its own volume of air, in a loosely similar way to a boat in water. The displacement of the air is constricted by the walls of the tube, which makes it accelerate to squeeze through the gaps. Any flow not displaced must be ingested by the onboard compressor of each capsule, which increases power requirements.

The closed loop tube will be mounted side by side on elevated pillars as seen in Figure 5. The surface above the tubes will be lined with solar panels to provide the required system energy. This represents a possible area of 14 ft (4.25 m) wide for more than 350 miles (563 km) of tube length. With an expected solar panel energy production of 0.015 hp/ft^2 (120 W/m^2), we can expect the system to produce a maximum of 382,000 hp (285 MW) at peak solar activity. This would actually be more energy than needed for the Hyperloop system.

Tube Construction

In order to keep cost to a minimum, a uniform thickness steel tube reinforced with stringers was selected as the material of choice for the inner diameter tube Tube sections would be pre-fabricated and installed between pillar supports spaced 100 ft (30 m) on average, varying slightly depending on Location.

This relatively short span allows keeping tube material cost and deflection to a minimum.

The steel construction allows simple welding processes to join different tube sections together. A specifically designed cleaning and boring machine will make it possible to surface finish the inside of the tube and welded joints for a better gliding surface. In addition, safety emergency exits and pressurization ports will be added in key locations along the length of the tube.

Pylons and Tunnels

The tube will be supported by pillars which constrain the tube in the vertical direction but allow longitudinal slip for thermal expansion as well as dampened lateral slip to reduce the risk posed by earthquakes. In addition, the pillar to tube connection nominal position will be adjustable vertically and laterally to ensure proper alignment despite possible ground settling. These minimally constrained pillars to tube joints will also allow a smoother ride. Specially designed slip joints at each station will be able take any tube length variance due to thermal expansion. This is an ideal location for the thermal expansion joints as the speed is much lower nearby the stations. It thus allows the tube to be smooth and welded along the high-speed gliding middle section.

The spacing of the Hyperloop pillars retaining the tube is critical to achieve the design objective of the tube structure. The average spacing is 100 ft (30 m), which means there will be near 25,000 pillars supporting both tubes and solar panels. The pillars will be 20 ft (6 m) tall whenever possible but may vary in height in hilly areas or where obstacles are in the way. Also, in some key areas, the spacing will have to vary in order to pass over roads or other obstacles. Small spacing between each support

reduces the deflection of the tube keeping the capsule steadier and the journey more enjoyable. In addition, reduced spacing has increased resistance to seismic loading as well as the lateral acceleration of the capsule.

ROUTE

The Hyperloop will be capable of travelling between Los Angeles and San Francisco in approximately 35 minutes. This requirement tends to size other portions of the system. Given the performance specification of the Hyperloop, a route has been devised to satisfy this design requirement.

The Hyperloop route should be based on several considerations, including:

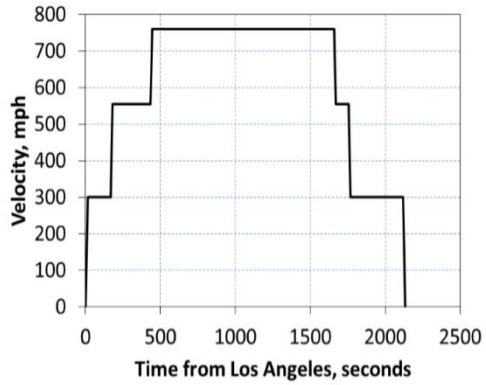
1. Maintaining the tube as closely as possible to existing rights of way (e.g., following the I-5).

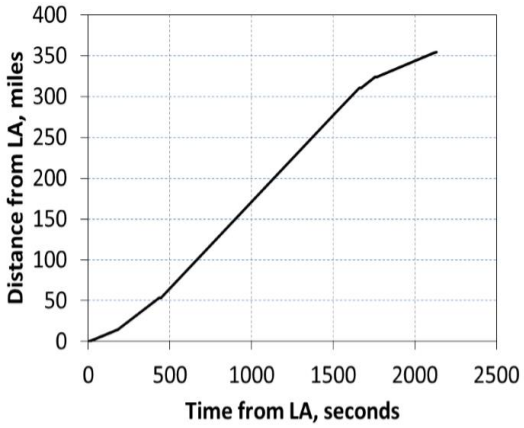
2. Limiting the maximum capsule speed to 760 mph (1,220 kph) for aerodynamic considerations.

3. Limiting accelerations on the passengers to 0.5g.

4. Optimizing locations of the linear motor tube sections driving the capsules.

5. Local geographical constraints, including location of urban areas, mountain ranges, reservoirs, national parks, roads, railroads, airports, etc. The route must respect existing structures.





4. Conclusion

The aerodynamic design strategy was two-fold. First, geometry sweeps were performed using a fast ax- symmetric viscous/in viscid analysis tool, while accounting for different flow rates between the ax symmetric and 3D shape. In the aerodynamic design it was crucial to transition the boundary layer to turbulent close to the front of the pod such that higher adverse pressure gradients are tolerated before separation. Such a design strategy increases friction drag but dramatically reduces pressure drag. Once the ax symmetric shape was decided upon, the final three-dimensional geometry was analyzed using a three-dimensional Naiver-Stokes solver to characterize its final performance at design speed.

Concluding, for the aerodynamic flow regime for this SpaceX Hyperloop Pod Competition, a droplet shaped aerodynamic shell is most elective at delaying flow separation, lowering the drag substantially. By investigating the performance of the design at transonic speed, it was also found that violating the Kantrowitz limit could lead to three-fold increase in drag coefficient for an increase in Mach number from 0.65 to 0.80.

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Spray Dryer for Evaporation of Effluent of Acid Black 194

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Abstract— Looking to the present status for compliance of Common Effluent Treatment Plans (CETPs), no new permissions for accepting effluent to CETP are permitted as Central Pollution Control Board, a statutory Body has imposed direction under section 18(1) B of the Water Act 1974.This retards the growth of industries which have potential to expand. Keeping this restriction in view, If alternative of CETP is explored, a situation may come up in favor to the industry which will not only comply the prevailing imposition of restriction under 18(1) b of the Water Act 1974 but also will allow industrial unit to grow. Alternative is not to discharge waste water to the CETP, instead it is to be evaporated keeping the air emission within National Ambient Air Quality Standards. As discussed in this paper, cost of evaporation of waste water bears higher cost than conventional treatment, products having good profit margin can go for pursuing alternative of spray drying of effluent. A case study of spray drying of treated waste water of Acid Black 194 is considered where the spray dryer is already existing for drying the products.

Keywords: Common Effluent Treatment Plant, Central Pollution Control Board, Reactive Dyes, Azo Dyes

I. INTRODUCTION

Honorable High Court of Gujarat in the year 1995, (in the case of Pravinbhai C Patel v/s Government of Gujarat and Others) issued closure to the industrial units causing pollution in Ahmedabad. In the order, it was directed to develop environmental infrastructure facilities namely Treatment, Storage, Disposal Facilities for solid waste (TSDF), and Common Effluent Treatment Plants (CETPs) for safe disposal of industrial effluent. As a result CETPs and TSDF at GIDC were come up. Due to change in market scenario over two decades, industrial units felt expansion with making of different range of products to meet international demand and at the same time performance of the CETP was also required to be improved. Keeping noncompliance of CETPs for discharge of waste water, Central Pollution Control Board (CPCB) issued direction under 18(1) b of The Water Act 1974 restricting them to accept additional hydraulic as well as organic load of effluent. This situation has compelled all the concerned to think of alternative of a CETP with making no additional discharge of waste water to CETP and pursue zero liquid discharge. Further, the industrial units started optimum use of water with reduction in volume of waste water. Following the zero liquid discharge scenario, Industrial units have started use of multiple effect evaporators (MEE), Agitated thin film dryers (ATFD) and spray dryers.

II. STUDY AREA

A study for evaporation of wastewater originated from manufacturing of Acid Black 194 to assess the adequacy of evaporation as well as economy of evaporation is performed at the industrial unit having facility of spray dryer for the product at the industrial unit located in Gujarat Industrial Development Corporation, Vatwa. GIDC, Vatwa is an industrial cluster located in the eastern side of the Ahmedabad City, Gujarat, India established in the year 1968. It has total area of 527 hectare and houses about 2500 industries most of them are Dyes and Dye Intermediates. It has common infrastructures like Common Effluent Treatment Plant and Treatment, Storage and Disposal facilities (TSDF) for hazardous waste.

III. METHODOLOGY OF THE STUDY

- Identification of manufacturing process of Acid Black 194.
- Collection of samples of waste water from manufacturing process of Acid Black 194 and after its primary treatment.
- Conduct of trial evaporation run in spray dryer for evaporation of waste water of Acid Black 194 which is already existing for spray drying of Acid Black 194.
- Collection of air emission sample during trial run from the stack attached to the Spray dryer followed by Air Pollution Control Devices.
- Comparing techno-economic feasibility between conventional treatments versus spray drying of waste water of Acid Black 194.

A detailed study of manufacturing process of Acid Black 194 revealed there is generation of 3500 kg of Acid Black 194 along with generation of waste water of 5884 Litre. A material balance is given in Table 1.

Sr. No	Input Quantity in kg		Sr. No	Output Quantity in kg	
1	Beta Napthol	300	1	Effluent to ETP	5884
2	Caustic	285	2	Acid Black 194	3500
3	Sodium Nitrate	154			
4	Water	1000			
5	ICE	2955			
6	6 Nitro 1-Diazo 2 Napthol 4 Sulphonic Acid	600			
7	Steam	2540			
8	Salicylic Acid	50			
9	Basic Chromium Sulphate	300			
10	Salt	1200			
	Total	9384	Total		9384

Table 1: Material Balance for Acid Black 194

Waste water generated after manufacturing of the intended product is collected for analysis from the collection

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tank of primary ETP and a sample is also collected from the treated waste water tank after primary treatment and results are given in Table 2.

Sr No.	Parameters	Unit	Untreated waste water of Acid Black 194	After Primary Treatment of waste water of Acid Black 194
1.	pH	pH Scale	7.0-8.0	7.5-8.5
2.	T.S.S	mg/l	150	80-90
3.	C.O.D	mg/l	6500-7500	5000-6500
4.	TDS	mg/l	120000-125000*	130000-45000

Table 2: Effluent Characteristics of Acid Black 194 before & After Primary Treatment

*Out of 1200 Kg Salt for isolation, around 80-85% salt goes with effluent

After primary treatment of effluent, possibility of the evaporation is explored in spray drier maintaining flow of 900 litre per hour with temperature profile 150 Deg C-250 Deg C which caused complete evaporation of the high TDS waste water. The evaporation occurs in spray dryer as effluent is allowed to pass through main chamber of spray dryer followed by cyclone separator, bag filters and water scrubber wherein majority of suspended particulates are settled and scrubbed with water. The scrubbed water is further recycled to spray dryer. Final emission complying prescribed norms is allowed through stack. As explained above, economy of the spray drying of waste water comes to be Rs 2.10 per litre if imported coal is used in hot air generator and it comes to 3.30 if natural as is used in hot air generator. A trial run is conducted for evaporation of waste water bearing characteristics mentioned in Table 1 in spray drier which is existing for spray drying of Acid Black 194 itself to evaluate feasibility. A sample of air emission through stack of spray dryer is collected during trial run for emission of Particulate Matter under iso-kinetic condition and emission results analyzed as 66.24 mg/NM3 which is well within National ambient air quality standard prescribed as 150 mg/NM3. Cyclone separator, bag filter followed by water scrubber are provided with spray dryers to control emission of particulate within norms.

- A=Solution or suspension to be dried in,
- B=Atomization gas in,
- 1= Drying gas in,
- 2=Heating of drying gas,
- 3=Spraying of solution or suspension,
- 4=Drying chamber,
- 5=Part between drying chamber and cyclone,
- 6=Cyclone followed by Water Scrubber,
- 7=Drying gas is taken away,
- 8=Collection vessel of Evaporation Salt

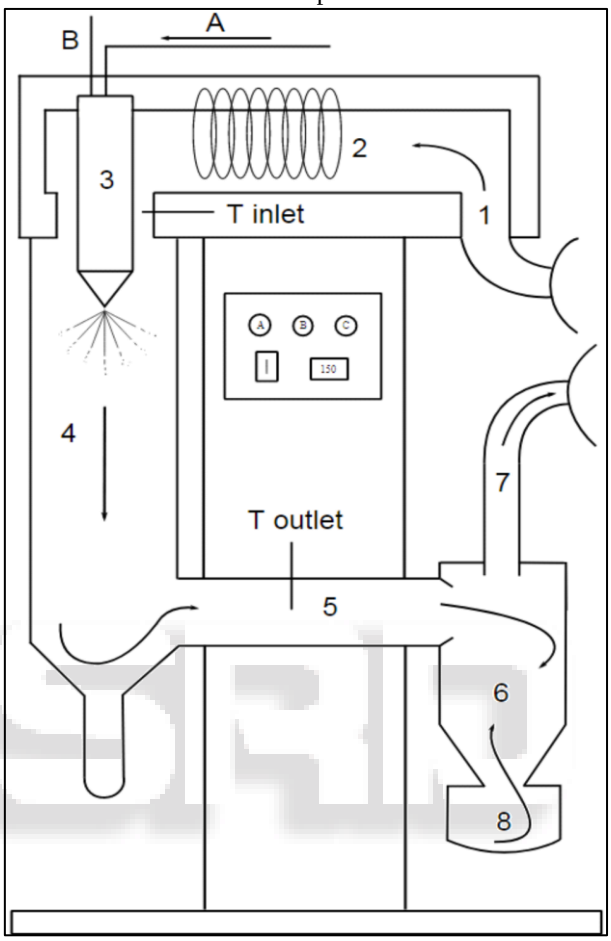

Fig. 1: Schematic Diagram of Spray Dryer

A Comparing scenario for the merits and demerits among conventional effluent treatment versus spray drying of waste water of Acid Black 194 is discussed in Table 3 given below.

Sr. No.	Particular	Disposal Through CETP	Disposal Through Spray Drier
1.	Area	Space restriction in small plant to installation and modification	Collection Tank is required for neutral wastewater
2.	Capital Cost	Capital Cost for primary treatment	Higher Capital Cost for installation of spray drier and its APCM
3.	Dosing Chemical	Area required to store chemical dosing and manpower is also required	No chemical dosing required for neutral wastewater
4.	Sludge	Separate Sludge storage area is required	No sludge storage area is required as direct drying occurs
5.	Norms	Inlet norms to CETP are to be maintained	No norms to be monitored as wastewater is without any VOC and spray drying emission falls within norms passing through Air Pollution Control Devices.
6.	Operation	0.50 INR per Liter of effluent	3.30 INR per litre of effluent in Natural Gas

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	Costing		2.10 INR per litre of effluent in Imported Coal
7	Manpower	Manpower required for ETP Operation	No manpower required as Operation is auto controlled by computer.
8	Operation and Maintenance	Easy to maintain and operate	For only wastewater disposal, it's difficult to operate but for dual purpose of spray drying of product as well as effluent, it is feasible based on product profit margin
9	Efficiency	Affected by manual error and dosing chemical properties	Time duration depend on TDS in wastewater. Higher TDS gets good result in evaporation.

Table 3: Comparison of Disposal Method of Waste Water of Acid Black 194

IV. Results & Discussion

The waste water generation from manufacturing of Acid Black 194 is explored to be evaporated in spray drying instead of its discharge to CETP. The discharge of treated waste water to CETP is restricted as per the inlet norms of CETP failing to which additional penalty is levied by CETP authority. In addition to this, due to nonperformance of CETP, expansion of the industrial unit is not permitted. Pursuing evaporation of waste water in spray drying with relatively higher cost than the conventional treatment, opens up scope of industrial unit to grow by obtaining statutory permissions from the concerned authorities.

The following facts come up after going through an experimental study of evaporation of waste water of Acid Black 194.

1) Net Profit to manufacture one kg of Acid Black 194: 12 INR/kg
2) Profit of 3500 Kg Acid Black 194 (One Batch) : INR 42000/-
3) Effluent quantity is 5884 litre for 3500 Kg of product and hence economy for conventional treatment of effluent in ETP considering 0.50 INR per litre= INR 2942/-
4) Spray drying based on natural gas for evaporation of 5884 litre of Acid Black 194 effluent considering Unit cost of evaporation as INR 3.3 per litre=INR 19,417/-.
5) Spray drying based on imported coal for evaporation of 5884 litre of Acid Black 194 effluent considering Unit cost of evaporation as INR 2.10 per litre=INR 12,356/- .

Considering above, it reveals that even after spray drying of effluent of Acid Black 194 with natural gas as fuel, it is acceptable to manufacture Acid Black 194 with selection of alternative to conventional ETP followed by its discharge to CETP. This can allow industrial unit to grow amidst prevailing strictures of CPCB under section 18-1-b of the Water Act 1974.

V. Conclusion

Waste water of Acid Black 194 can be evaporated in spray dryer complying prevailing norms which is certainly a costlier affair (cost of evaporation is 6.5 times higher than conventional treatment), however can be implementable to all dye making units for sustainable existence. In addition to above , tangible benefits for spray drying of effluent are (1) Energy conservation by switching over run of product to run of waste water for similar product (2) Ease of getting Statutory permission considering Zero Liquid Discharge units(3)Product loss if any can be recovered as bleed of scrubber thereby maintaining minimum loss.

VI. Declaration

A. Authors Contribution

All the authors make a substantial contribution to this manuscript. DT, and DS participated in drafting the manuscript. DT wrote the main manuscript; all the authors discussed the results and implication on the manuscript at all stages.

B. Acknowledgements

The authors are grateful to Swarnim Startup & Innovation University, School of Engineering for the permission to publish this research.

C. Availability of Data & Material

All relevant data and material are presented in the main paper.

D. Competing Interests

The authors declare that they have no competing interests.

E. Funding

Not Applicable

F. Consent for publication

Not applicable.

G. Ethics approval and consent to participate

Not applicable.

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DESIGN AND DEVELOPMENT OF AN ELECTRIC HYBRID RICKSHAW

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ABSTRACT

The auto rickshaw is one of the important transport medium for end to end connectivity in many cities. A motor assisted battery driven Hybrid rickshaw can provide a relatively comfortable non-polluting and a silent transport system for urban and rural areas of India. The primary focus of this research was to develop an Electric Hybrid Rickshaw without requiring significant changes to the structure of widely popular existing rickshaws. The proposed model is a modified form of conventional electric rickshaw and combination of a battery operated motor driving system with the solar battery charge system for ideal time. The model was developed so as to save energy, limit overuse, and keeping the identity and driving mechanism of old rickshaws. An idea of battery charging infrastructure using Solar-Battery-Charging-Station is also mentioned. The performance test revealed that the hybrid vehicle provides satisfactory speed, easier motion control and good scope of manipulating the shares of human effort and motor power. Besides reducing air and sound pollution, such rickshaws demanding less physical effort, may provide large scale employment in urban and rural areas of India.

Keyword:-*BLDC motor, Lithium-ion battery, Controller, Differential, solar panel, LDR module, Uno Arduino R3..*

1. INTRODUCTION

E-rickshaws are small vehicles, with three wheels and use electric power from batteries to run. They use an electrical motor of 650-1400W as engine which draws the electric power from the rechargeable batteries installed in rickshaw body. These battery operated vehicles are perfect for small distance transport, both cargo and people; they are perfect for running on narrow streets because of their small size. But biggest reason for their popularity is operating cost and zero pollution. They are like normal rickshaws but operated by electric motor instead of petrol or diesel. They are best for pollution free, environmental friendly transport system in short distances.

E-rickshaw is a good option due to less human effort and cost of fuel if compared with auto rickshaw and human pulled rickshaw. The pollution coming out from E-rickshaw is immensely less and it provides last mile connectivity that means it provides door to door service. Recently in India battery operated E-rickshaw are in much demand. Its comfortable and economic mode of transport has gained E-rickshaw popularity in India[1].

A study of travelling and charging of E-rickshaw patterns revealed that till today a household socket is the only option for the vehicle owners to charge their vehicle. As electricity comes from thermal power plants which emit CO_2 the e-rickshaw cannot be considered as a zero emission vehicle unless it will operated fully with the help of solar panel. 1.281 kg of CO_2 per unit of electicity generated is emitted in Coal-fired thermal power plant. 1.52 kg per litre of CO_2 is emitted by combustion of LPG. In combustion of diesel 2.71 kg per litre of CO_2 is emitted. From the figures in the table 1 given below it can be analyzed that e-rickshaw is more efficient than other vehicle [6].

TABLE 1 CARBON DIOXIDE EMISSION OF VARIOUS THREE WHEELERS

Sr.No.	**Vehicles**	**Specific CO2 emissions (gm/passenger-km)**
1.	Auto-rickshaw(LPG)	23.556
2.	Auto-rickshaw(Diesel)	21.51
3.	E-rickshaw	19.129

E-rickshaws are now of the preferred modes of transport in streets because of its low maintenance cost, eco-friendliness, being non noise pollutant, easy to drive. The motor is brushless DC motor manufactured mostly in India and China. The electrical system used in Indian version is 48V DC can run 90 to 100 km/full charge. Basic capacity is driver plus 3 passengers.

The main objective is to develop a model of e-rickshaw and interfacing system with solar panel. E-rickshaw is a basically battery operated vehicle which is directly equipped with battery and solar panel. The main aim to develop the pollution free vehicle with use of hybrid mechanism (battery and solar panel).

- To construct rickshaw light in weight
- Use of good material for a long life.
- To developed rickshaw is easy to operate.
- Non-polluted

To fulfill this objective this experimental research work involved the following processes:

• Study the structure and driving features of the existing conventional rickshaws and electric auto-rickshaws.

• To find a cost effective, feasible design and fabrication of parts for transforming conventional rickshaw to a hybrid one.

• Performance test of the hybrid vehicle to evaluate its feasibility and effectiveness compared to conventional and electric motor assisted rickshaws.

2 DESIGN AND CALCULATION ON TECHNICAL ASPECTS

The basic components require for experimental setup to develop prototype are BLDC motor, controller, Lithium ion battery, solar panel, Speedometer, Differential, LDR module, Tyre, Uno Arduino, Servo motor, Ultrasonic sensor.

2.1 BLDC MOTOR

Electronically commutated motors (ECMs) popularly known as Brushless DC electric (BLDC) motor. These are synchronous motor operated on DC power supply. In order to control the torque and speed of the motor the controller must capable enough to provide current pulses for the windings of motor[4]. The rotor consists of permanent magnets in the traditional configuration. The rotor whereas surrounded by the three stator windings. One of the trending applications of BLDC includes electric transportation system.

Calculations is carried out for Total Mass of electric vehicle: 350kg including weight of chassis (90kg), battery (45kg), person weight(1+2 person of total weight 250kg), Other weight (50kg) and for standstill or Initial velocity of EV: 0 and max velocity: 35km/hrs.

Parameter for calculation:
I = 22A
V = 48v

P = 900w
N = 2700 RPM
Pole=8

Torque: $T = \frac{60*P}{2*\pi*N} = \frac{900*60}{2*\pi*2700}$ = 3.18 N/M

Output Power:

$W = \frac{2*\pi*N}{60}$ = 282 rad/sec

Pout = T x W = 899.12

Efficiency:

Pin = V x I = 48 x 22 = 1056

% $\eta = \frac{Pout}{Pin} = \frac{900}{1056}$ *100 = 85.22 %

Now based on efficiency motor power should be greater than 900 W.

The existing BLDC motor to propose the controller for the same and the specification for the existing motor as follow:

- Voltages : 48Vdc
- Rated power : 1000W
- Speed : 2700 rpm
- Rated torque: 10Nm
- Peak torque : 25Nm
- Efficiency : > 85%
- Cooling options : air or liquid cooling

Figure-1 BLDC motor

2.2 CONTROLLER

Motor controller usually supplied with AC power. The power that comes in to a controller is at a set frequency. The motor controller first turns that AC to DC then turns the DC back into AC at right frequency. It use device called rectified to make DC current. The speed of a BLDC motor controlled by controlling the input DC voltage/current. The higher the voltage more is the speed. Many different controller algorithms have been used to provide the control the BLDC motor speed. The motor voltage is controlled by using a power transistor operating as a linear voltage regulator

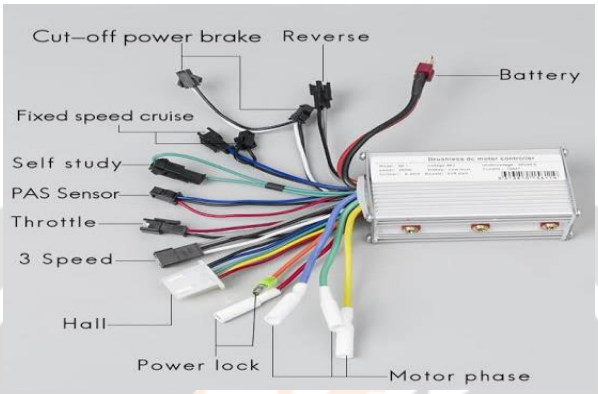

Figure-2 BLDC Motor controller

2.3 LITHIUM- ION BATTERY

The electrolyte carries positively charged lithium-ions from the anode to the cathode and vice versa through the separator. The movement of the lithium-ion creates free electrons in the anode which creates a charge at the positive current collector. The separator blocks the flow of electrons inside the battery.

Calculation of Lithium Ion Battery

P=VI
P=2400 watt
V=48 volt
2400=48×l
I=50 (50A for protection elements design)

Calculation of AH
2400watt×1hr=2400w-hrs.
Battery efficiency is around 85%
2400whr×1.15=2760
2760w-hr ÷ 48v =57.5 = 58 AH

Rated watt –hour capacity = Rated AH capacity x Rated battery voltage
= 58 x 48
= 2784 Watt – hour

Charging current 100rating / Charging current = 58 / 10 = 5.8 hrs.

To charge fully discharged battery Approx 5.8 hrs. is required. And for fast charging AH should be more which reduce charging time.

Specification

- Nominal voltage : 48 v
- Nominal capacity : 50A
- Weight : Approx 0.7kg
- Max. Charging current : 1.0C
- Max. Discharging current : 30-50A
- Cycle life : >500 times

Figure-3: Lithium-ion battery

2.4 DIFFERENTIAL

The axle is a part in e rickshaw which supports the differential and motor. We provide an axle designed to support motor weight and differential and also enhance performance of e-rickshaw. The quality of axle is important for safety and durability of the vehicle.

Figure-4: Differential

Specification:-

- Corrosion free
- Robust construction
- 1 ton load capacity
- Size 34 inches

2.5 SOLAR PANEL

Principle of solar panne : The photovoltaic effect, the photovoltaic effect is the conversation of sunlight energy into electricity. In pv system the pv cells exercise this effect.Semiconductor material in PV cells are dropped to from P-N structure as an internal electrical field[7].

Specifications:

- Maximum power : 330 W
- Maximum power voltage : 39V
- Maximum power current : 8.47A
- Short circuit current : 8.98A
- Open circuit voltage : 44.5V
- Maximum system voltage : 1000V

Figure-5: Solar panel

2.6 LDR MODULE

The automatic light used in E-RICKSHAW, it will provide a better solution for manual lighting of vehicle. It will sense the outside intensity of light and turns on the light automatically. The working principle of an LDR is photoconductivity, that is nothing but an optical phenomenon. When the light is absorbed by the material then the conductivity of the material reduces. When the light falls on the LDR, then the electrons in the valence band of the material are eager to the conduction band.

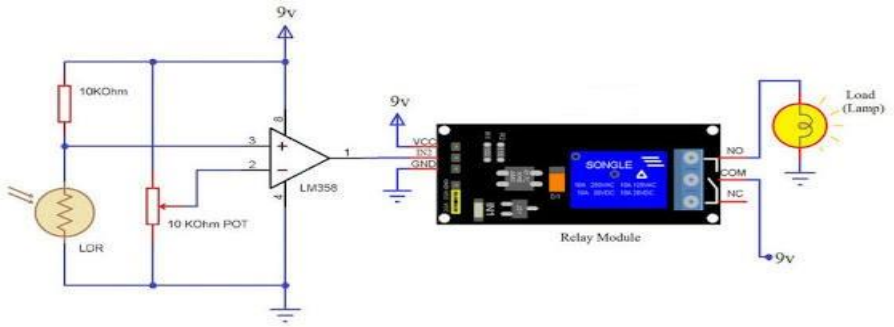

Figure-6 Automatic light controller using relays and LDR module

Specification:

- Operating Voltage : 3.3V to 5V DC
- Operating Current : 15milli amps
- LEDs indicating output and power
- Output Digital - 0V to 5V, Adjustable trigger level from preset

2.7 UNO ARDUINO R3

The automatic dustbin used in E-RICKSHAW. Which helps to create clean, safer, more hygienic environmental and enhanced operation efficiency while reducing Management costs , reduced, and rode side emissions.
The dustbin opens automatically when it receives the signal and closes it 'hatch. Also the dustbin consists of level sensing ultrasonic sensor that constantly measures the level of garbage in the dustbin and automatically detects if it is about the fill up.

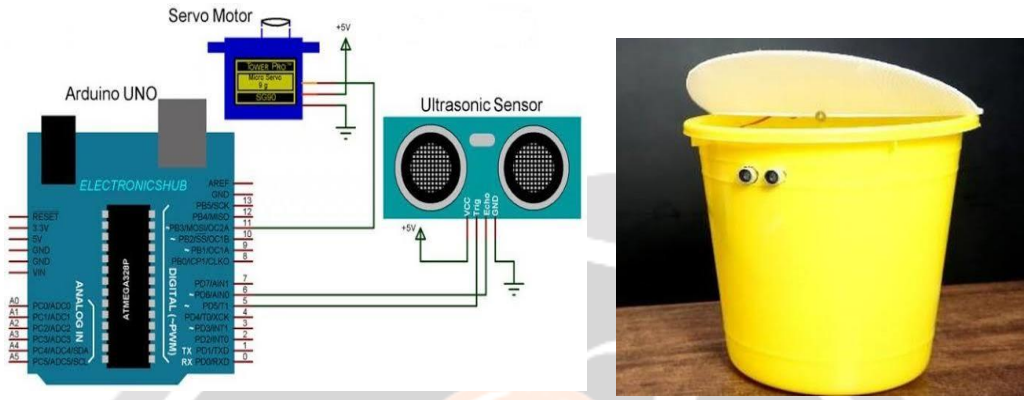

Figure-7: Circuit diagram smart dustbin using Uno Arduino R3

3 DESIGN METHODOLOGY

There are various factors and parts of the project that either had to be designed or selected. The major ones are given below with criteria for selection or design of each. In this e- rickshaw we have used a electric and mechanical controlling technology which is used to operate a mechanical & electrical equipment. The BLDC MOTOR controlled by controller using PWM technique having MOSFET. Motor controller usually supplied with AC power. The power that comes in to a controller is at a set frequency. The motor controller first turns that AC to DC then turns the DC back into AC at right frequency. It use device called rectified to make DC current. The speed of a BLDC motor controlled by controlling the input DC voltage/current. The higher the voltage more is the speed.
Many different controller algorithms have been used to provide the control the BLDC motor speed. The motor voltage is controlled by using a power transistor operating as a linear voltage regulator.

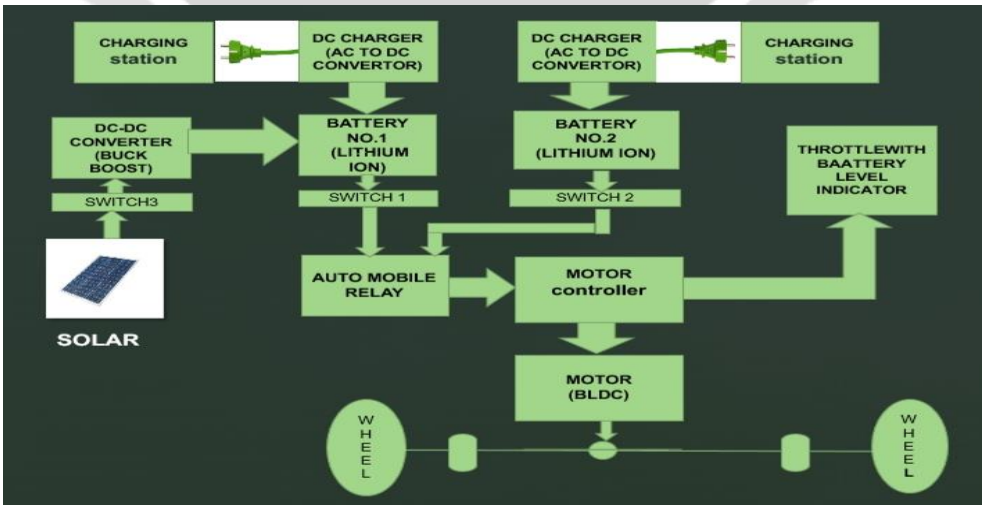

Figure-8 : Block Diagram of System

The block diagram gives whole process about the control system for vehicle. We are using two batteries connected through Automobile relay. The charged battery gives the supply for controller. The controller controls whole automated controlling devices. The controller gives respective commands to the motor, speedometer etc. Proper commands given from the input were further given to the controller and controller operates. Controller drives the motor which deal to move the vehicle. Automation controller controls the whole automation devices which are based on the user input.

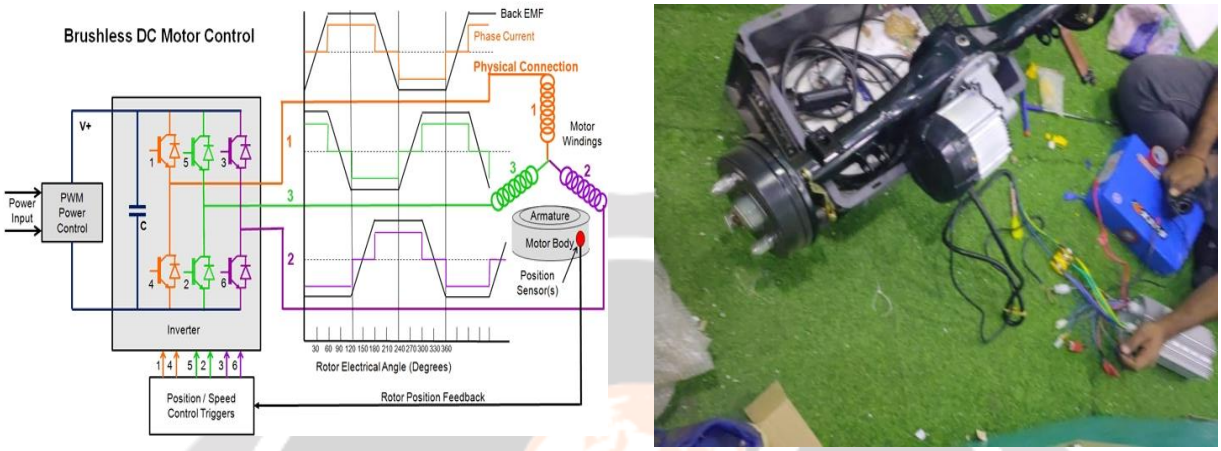

Figure-9 : Interfacing of BLDC motor with differential

Three Hall device embedded in the motor are usually used to provide digital signals which measure rotor position within 60 degree sectors and provide this information to the Motor controller. Because at any time ,the current in two of the winding are equal in magnitude and the third is zero.

This method can only produce current space vector having one of six different directions. As the Motor turns, the current to the motor terminals is electrically switched (commutated) ever 60 degree of rotation so that the current space vector is always within the nearest 30 degree of the quadrature direction.

Figure-10: Electrical and Mechanical testing

In the mechanical system such as in E-RICKSHAW, the brake shoes as actuated by a cum, which is attached to the brake linkage and pedal. When press the brake pedal, the cum turns. The friction between the brake linings and the drum causes the drum to stop rotating, there by stopping the wheel.

4 CONCLUSION

The study revealed that the e-rickshaws are energy efficient than other forms of motorized public road transport vehicles in the state. But the major challenges are required to be addressed for the proper implementation of these e-rickshaws. The paper shows the custom design of electric vehicle. While designing the vehicle there are different consideration and calculations. The one of main point is the selection of the motor and battery and its capacity. The design of chassis is also play the vital role in vehicle manufacturing. The points considered in this paper are the basic need of the designing of electric vehicle.

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Design and Fabrication of Water Vending Machine using PLC

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ABSTRACT

Now a day's water vending machines are available and operated on only one coin but we aim to design a water vending machine that is operated on different coins. In India, there is a problem with safe drinking water therefore we are going to provide mineral water. The rapidly rising population and changing lifestyles have increased the need for freshwater. It would be clear that in most rural areas, households are paying far more for water supply than the often-normal rates charged in urban areas.In summer we face the problem of drinking water.This project is based on coin operation. The water vending machine dispenses water on the detection of the right coin. It can be used in public places like Roads, Railway stations, Shopping Malls, etc. It can prove to be of great use and comfort for people.

Keyword: - Water vending machine, Programmable Logic Controller (PLC), Coin Sensor, RFID, Multi Coin operated

1.INTRODUCTION

The rapidly rising population and changing lifestyles have increased the need for freshwater. In summer, we face the problem of drinking water. So is the panic over drinking water supply in the city as well as in villages. The reservoir has just 35.63 feet of water, which is not even half of the total water level. We are going to design a project which is based on coin operation or RFID operation. It has been specially designed for village people. It is also use on Railway station, Bus station, public places etc. This system is based on PLC. The inputs to the PLC are coin and RFID tag and output in the form of water. Looking at the specifications required for water dispensing system and for simplicity of our application, microcontroller was found to be best suited. The machine has numerous input and outputs to provide service to the customer. The main motto of this system is to avoid the environmental pollution and also to avoid the wastage of water with the help of water control valve and give purified water to the customer. We know that the available water resources have initiated towards the end. This problem is quietly related to poor water allocation, inefficient use, and lack of adequate and integrated water management. Water Vending machine is going to be developed in such a way that water will get served to the customers.

Existing Systems In most of the developed countries the vending machines are situated at public places. These machines dispense the snacks, cold drinks, coffee, tea, etc. to the people. Also in developing countries the vending machines are used to provide these things. The basic idea of proposed system is originated from these existing systems. Majorly we are developing a system in which there are two water tanks to provide water to customer. The two major water tanks are as follows 1. Primary Tank (Front Tank) 2. Secondary Tank (Back Tank) Primary tank is only to give the required quantity of water to customers after inserting a coin in machine & secondary tank is connected to the hub tank (Central Tank) through the technique of pipelining[1]. Pipelining is useful to provide the water to the back tank (secondary tank) from the Hub tank (central tank). The Central Tank will be the main source of water to distribute water to secondary tank. Secondary tank will have two water levels empty & full respectively. These two water levels are controlled with the help of IC555 . Here PLC will be interfaced to maintain the constant water in the secondary tank using sensor.

2. TECHNICAL ASPECTS

2.1 PROGRAMMABLE LOGIC ONTROLLER

A Programmable Logic Controller is a solid-state industrial controller that performs discrete sequential logic in a factory environment. It is originally developed to mechanical relays, timers and counters. PLCs are used to perform difficult control operations in a plant. A sequence of instructions is performed by the user to the PLC memory and when the program is executed, the controller operates a system to the correct operating specifications.

A Programmable Logic Controller is currently defined by the National Electrical Manufactures Association (NEMA) as a digital electronics device that uses a programmable memory to store instructions and to implement specific functions such as logic, sequence, timing, counting and arithmetic operations to control machine and processes.

Figure 1 Programmable Logic Controller

2.2 SWITCHED MODE POWER SUPPLY

A switch mode power supply is a power converter that utilizes switching devices such as MOSFETs that continuously turn on and off at high frequency; and energy storage devices such as the capacitors and inductors to supply power during the non-conduction state of the switching device. The supplies have higher efficiencies of up to 90%, are small in size and widely used in computers and other sensitive electronic equipment.

SMPS offers advantages in terms of size, weight, cost, efficiency and overall performance. These have become an accepted part of electronic gadgets. Basically, it is a device in which energy conversion and regulation is provided by power semiconductors that are continuously switching “on” and “off” with high frequency.

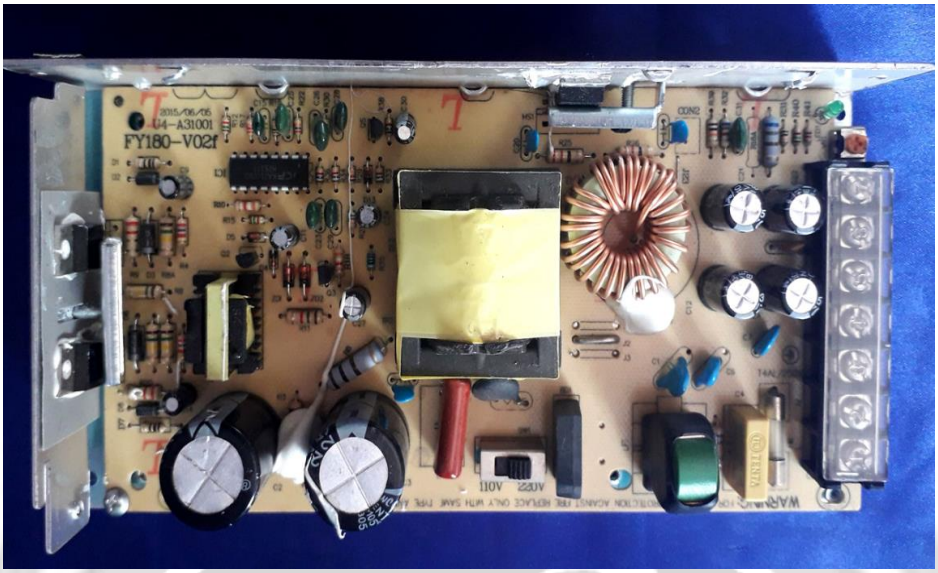

Figure 2 Switched mode power supply

2.3 COIN SENSOR

Coin sensor is the device which is used to detect the correct coin. The coin sensor uses the thickness, diameter and fall time of the coins to identify them. CH-926 is a multi-coin selector, can accept up to 6 kinds of different coins at the same time. This type of coin selector is widely used in Vending machine, Arcade Game, Message chair, and other self–management system. CH-926 is mainly based on material, weight and size to identify coins. It has the most up to date algorithm to design software. Therefore, CH-926 is very stable and accurate even when environment changes such as temperature, and humidity etc. In order to increase the accuracy, we suggest different version of coins use different channel to set up.

Figure 3 Coin Sensor

2.4 RFID SENSOR

A radio frequency identification reader (RFID reader) is a device used to gather information from an RFID tag, which is used to track individual objects. Radio waves are used to transfer data from the tag to a reader.RFID is a technology similar in theory to bar codes. However, the RFID tag does not have to be scanned directly, nor does it require line-of-sight to a reader. The RFID tag it must be within the range of an RFID reader, which ranges from 3 to 300 feet, in order to be read. RFID technology allows several items to be quickly scanned and enables fast identification of a particular product, even when it is surrounded by several other items.RFID tags have not replaced bar codes because of their cost and the need to individually identify every item.

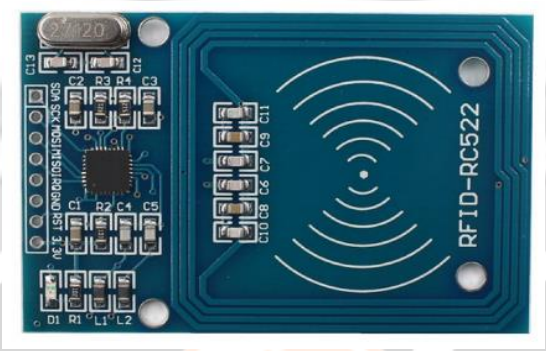

Figure 4 RFID sensor

2.5 SOLENOID VALVE

This is simple on\off type 9V dc supply valve. This type of valve is used in motors. This module consists of interface between vending machine and water output valve with the help of PLC. The switch is "Normally closed". (Automatic flush and shut off, auto power cut-off when filling, extends pump duration) when you connect it with high pressure switch. It shuts off the water supply when the tank is full. Normally controlled in the RO system by the booster pump High pressure switch.

Figure 5 Solenoid valve

2.6 PUMP

This water pump is use to take water from water tank or well. This water pump is connected between the water tank or well and tap where we can get water. In our project we use 0.5 HP, 0.37 kw monoblock water pump. Featuring brass impeller and copper winding, the special motor design of this water pump can work on UPS as well. This water pump is capable of priming up to 3 meters static suction lift without a foot valve at rated head and discharge. Well known for high performance, durability, efficiency, and reliability, this water pump can withstand with wide voltage fluctuation from 180 to 240 volts. With 33.6 LPM water flow and 50 hertz frequency, this water pump is applicable for use at household as well as commercial places.

Figure 6 Pump

Pump specification

Phase	Single phase
Motor body	Cast iron
Discharge	35 LPM
Suction delivery	25×25 mm
Voltage	230 volt
Motor power	0.5 HP
Frequency	50 Hz
Current	2 A

2.7 LCD

A liquid-crystal display (LCD) is a flat panel display, electronic visual display, or video display that uses the light modulating properties of liquid crystals. Liquid crystals do not emit light directly. LCDs are available to display arbitrary images (as in a general purpose computer display) or fixed images which can be displayed or hidden, such as preset words, digits, and 7- segment displays as in a digital clock. They use the same basic technology, except that arbitrary images are made up of a large number of small pixels, while other displays have larger elements.

Figure 7 LCD

3.DESIGN AND IMPLEMENTATION

3.1 Working Principle

This water vending machine is specially designed for village people to provide purified water. Machine is operated with the help of two sensors that are coin sensor or RFID sensor. The RFID sensor is designed for village, industry, company where people use this machine daily. So they have not to insert coin daily, they just need to scan their

RFID card and get water. Whereas the coin sensor operated machine is use every public place like Bus station, Railway station, garden or highways. They use coin of Rupee 1, 5 or 10.

A customer has to be insert coin in machine or RFID card is scan on sensor. The coin is checked whether the coin is correct or not by the coin sensor. The coin sensor uses the thickness, diameter and fall time of the coins to identify them. The RFID card is sense by the RFID sensor.

Now, when inserted coin or RFID card are appropriate or right the Programmable Logic Controller gives signal to the relay and relay will switch the R.O pump which is connected to the water tank. So the R.O pump will lift the water from water tank. Then water is flowing through the flow sensor. Flow sensor is sensing devices which continuously measure the amount of water. When flow sensor measures that amount of water which is defined for different coins, it will give signal to PLC and PLC give signal to the solenoid valve so valve will be off and water flow is stop. Solenoid valve controls the flow of water automatically. So customer will get purified water in the jug or any other watering vessel. Connection diagram is shown in figure 8.

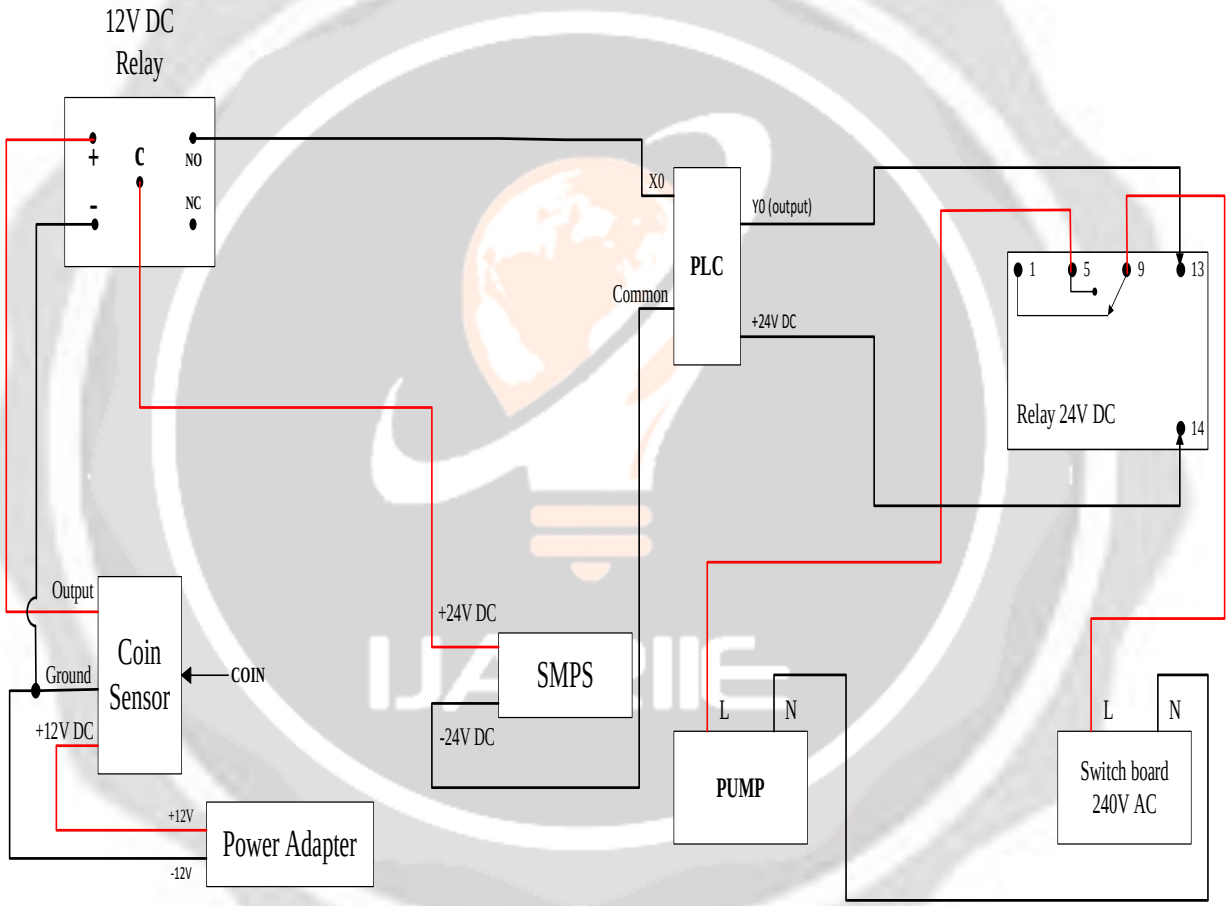

Figure 8 Connection Diagram

3.2 Flowchart of Water Vending Machine

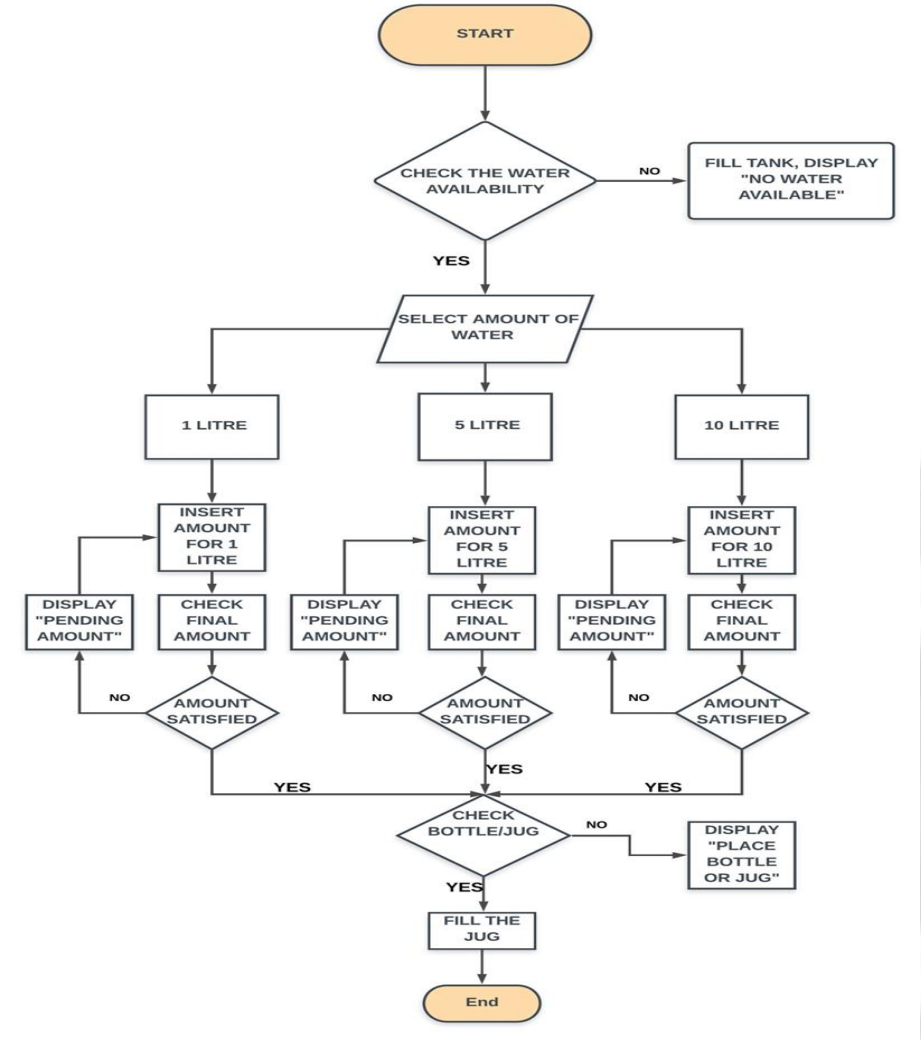

Figure 9 Flow Chart

The flow chart of water vending machine is shown as above. First machine check the status of the water in the water tank if there is no water then the LCD is displaying “Fill tank and No water available” and if water is available then the LCD is displaying “Select the amount of water”. Customer will select the amount of water that are one litre, five litre or ten litre. After that insert coin or scan the RFID card for selected amount of water. Now if the coin is correct then system will check the glass, bottle or jug is placed or not. So system will check whether glass or jug is placed or not. If jug is not placed then LCD displaying message “Place bottle/jug” and if the jug is place properly then water is dispatch into that jug. This way customer will get water and system is complete.

4. SIMULATION AND RESULTS

In this, we have done interfacing of coin sensor with PLC in winproladder software. Win Pro Ladder is easy to learn and use, and allows users of all types, beginner or expert to operate the software in a very efficient manner. For use in a Windows operating environment, completely designed in accordance with Windows environment operation methods. With run time editing feature, during the simulation process the program can be modified without stop the execution.

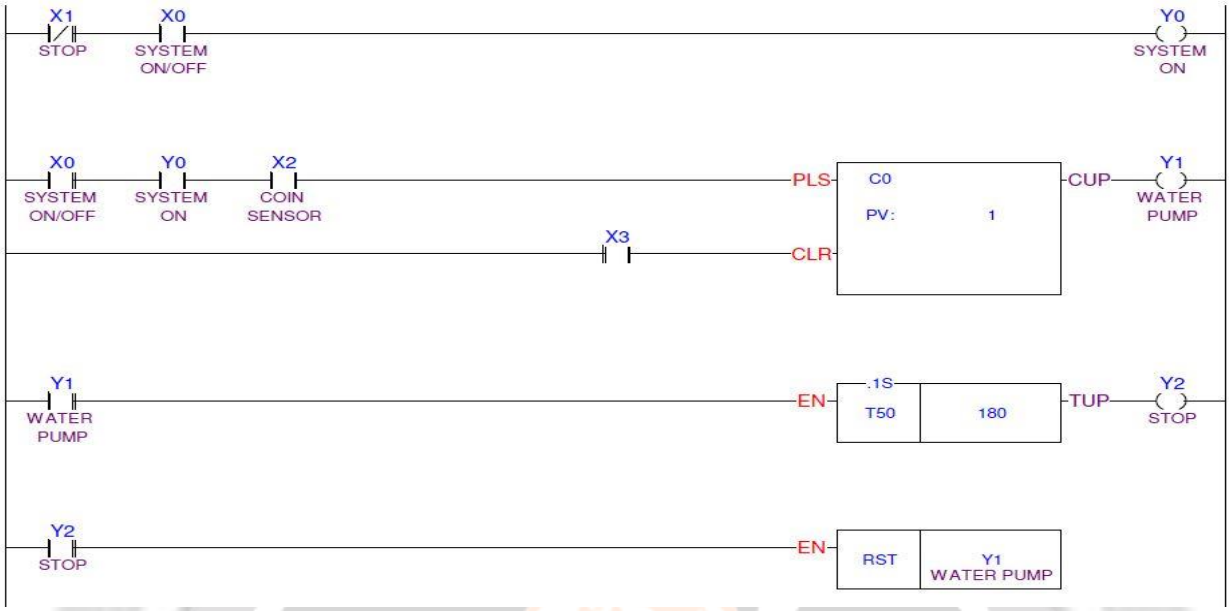

Figure 10 Ladder Diagram of interfacing of coin sensor with PLC

This is the ladder diagram of PLC done on win proladder software.

Here,

X0 = System on/off

X1 = Stop

Y0 = System on

X2 = Coin Sensor

Y1 = Water pump

C_0 = Counter

X3 = Push button for clear function

T50 = Timer

When push button X0 is processed our system is ON i.e. Y0 here X2 is our coin sensor so when coin is inserted it turns On and counter C_0 is increased by 1. So, our water pump Y1 is ON. There is one timer T50. When Y1 is on our timer T50 is ON for 180 seconds. After 180 seconds timer output turned ON the output coil Y2. The output of Y2 is given to reset function. In this reset function when done bit is given to it, the output associated with this function will be off. Here water pump Y1 is associated with reset function so after 180 seconds with the help of reset function water pump Y1 will be off.

In our project we conclude that acceptance ratio is almost 100% and vending machine works on arduino controller To develop low cost water vending machine. To avoid wastage of water.

5.FUTURE SCOPE

An increase in the diameter of the water solenoid valve and pipes would increase the flow rate. Hence, taking lesser time to fill in the tumbler. The whole product can be redesigned for it to be aesthetically pleasing and for its better usability. It can be used for other beverages and drinks also.

6.CONCLUSION

Implementation of Coin-Operated Automatic Drinking Water Machine is the step towards the future technology and it is a step to enter in eco-friendly world. This machine is easy to use and can be easily accessed by the ordinary person .We have developed a water vending machine which is an improved version of the normal water vending machine. This water vending machine reduces human efforts, less time consuming, economical and power consumption of the control system is less. A water vending machine is designed, developed, and demonstrated to give purified water at economical cost. Customers just have to insert coins or scan RFID card. By implementing this type of system, we can provide water at the village, public places like Bus station, Railway station, garden, and isolate place like highways.

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"SOIL MOISTURE AND TEMPRATURE BASED AUTOMATED VERTICAL GARDENING CONTROL SYSTEM"

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ABSTRACT

Urbanization which is one of the most serious problems in 21st Century causes many environmental problems such as concrete areas and population increase. Although the decreasing urban green areas cause many environmental problems, it provides a basis for developing vertical garden. The vertical gardens are defined as gardens that cover façade walls with using various plant species by systems. This paper primarily focuses on monitoring and controlling of Green wall environment parameters and automatically. The proposed system is based on various sensors such as moisture sensor and temperature sensor for continuous monitoring the various parameters responsible for plant growth. The present control system is designed using recent ARDUINO due to some important features such as sleep mode, 10- bit ADC, wide input voltage range and also higher memory capacity. A step-by-step approach to design the arduino-based system for monitor and control of the three essential parameters for vertically grown plant growth, i.e. Soil moisture and temperature has been followed. The measurement shows that the system performance is accurate and quite reliable.

Keyword: - *Vertical Gardening, Automatic watering, Capacitive soil moisture sensor, Temperature sensor, Arduino, solar charging controller and Renewable energy source*

1. Introduction

A green wall is a new and creative idea of growing greenery in an urban and indoor environment. Green walls consists special type of plant containers attached to wall structure at particular angle. Structures can be free standing or attached to wall. This advance greenery is eye catching, good looking and improves the look of once plain walls. Green walls are becoming more and more popular recently across the globe. These are widespread in Europe and also in other areas of higher temperatures. They can be made in the colder climates, with the proper plant variety. The system presented here maintains moisture in soil and controls the microclimatic parameters of a green wall environment. The system consists of sensors, ARDUINO, Relays, LCD display water pumps and Solar cells. The soil moisture sensors are deployed in the plant root zones. Aim of this system implementation is to demonstrate that the project can be used to save water, time and labor cost. When any of the environmental parameters cross a safety threshold value which we have to be maintained for plants growth, the sensors sense this change and send to controller at its input port through Arduino. Microcontroller then performs the necessary actions by actuating relays until the strayed-out factors have been brought back to its required advantageous level. For real time display of data received from various sensors and status of some other devices a Liquid crystal display (LCD) is also used. The system proposed here is an economical, low maintenance, runs on renewable

energy source and portable for green wall applications, especially in developing countries.

2 HARDWARE REQUIREMENTS

The basic components of our projects are Arduino UNO R3, solar panel, dc pump, capacitive soil moisture sensor, LM35 temperature sensor and SPDT relay.

2.1 LM35 Temperature Sensor

The temperature sensor used in this project is thermistor. It is basically thermal resistor which changes its resistance with change in temperature. The sensor circuitry is not subjected to oxidation normally It is sealed. It can measure temperature accurately. It also has low self–heating property and does not exceed more than 0.1oC temperature rise in still air. Its operating temperature limit is from -55°C to 150°C.

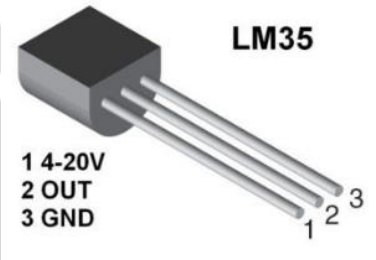

Figure -1: LM35 Temperature sensor

2.2 Capacitive soil moisture sensor

This moisture sensor consists of 2 copper conductors that are located at small distance from each other. For demonstration purpose, water pump is used and three soil moisture sensors for detecting soil moisture sensor. Both probes of soil-moisture-sensors are placed in soil. When no moisture is sensed by soil-moisture sensor in soil then the system turns on the motor or water pump until sensor senses the moisture in soil. Small potentiometer adjusts the Sense level. Its operating voltage ranges from 3.3V-5V.

Figure-2: Capacitive soil moisture sensor

2.3 Arduino UNO R3

This Arduino board has 14-digital I/O pins, a power jack, analog i/ps-6, ceramic resonator-A16 MHz, a USB connection, an RST button, and an ICSP header. All these can support the microcontroller for further operation by connecting this board to the computer. The power supply of this board can be done with the help of an AC to DC adapter, a USB cable, otherwise a battery.

Figure-3: Arduino UNO R3

2.4 Relay 12V DC

Relay is an electromagnetic device which is used to isolate two circuits electrically and connect them magnetically. They are very useful devices and allow one circuit to switch another one while they are completely separate. They are often used to interface an electronic circuit (working at a low voltage) to an electrical circuit which works at very high voltage. For example, a relay can make a 5V DC battery circuit to switch a 230V AC mains circuit. Thus a small sensor circuit can drive, say, a fan or an electric bulb.

Figure-4: SPDT Relay

2.5 DC Pump

DC powered pumps use direct current from motor, battery, or solar power to move fluid in a variety of ways. Motorized pumps typically operate on 6, 12, 24, or 32 volts of DC power. Solar-powered DC pumps use photovoltaic (PV) panels with solar cells that produce direct current when exposed to sunlight.

Figure-5: DC water pump

2.6 Solar charging controller

A charge controller is an important component in a battery based solar system and are not used in straight grid tie systems. The primary role is to manage charging the battery bank, prevent it from overcharging and many control the rate of the current and voltage at which it charges.

Figure-6: Solar charging controller

3. OBJECTIVES

In non conventional energy era, solar energy is one of the most effective energy sources , so solar cells are used to power our circuit .The main objective of this project was to design a greenwall monitoring system that is be highly reliable, cheaper in cost and efficient for growing the plants. Our project mainly focuses on the control of parameters such as-temperature and soil moisture. The block diagram of the green wall monitoring system has been shown in Figure 6.

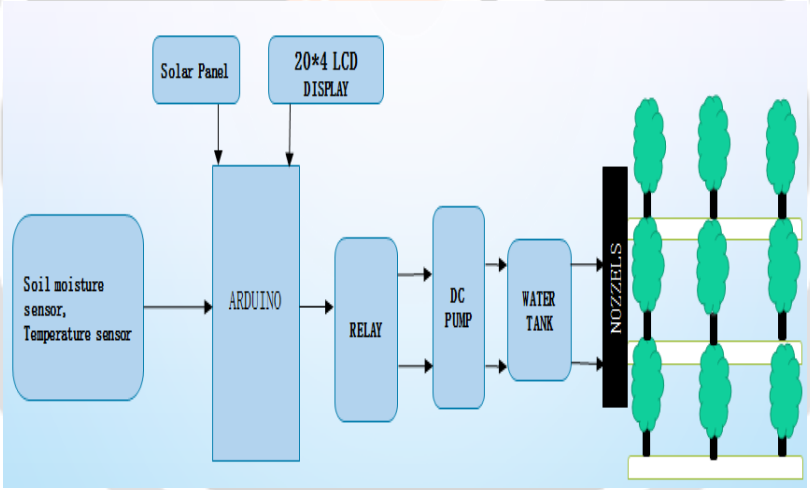

Figure-7: Block diagram of system

4. Methodology

System is switched on by solar panel or 9-volt dc battery and a Dc supply by solar panel to the pump. Solar panel provides the 7 to 9-volt supply to the Arduino. Sensor is connected to Arduino its getting power though the Arduino. Sensors output is given to ADC which provides digital signal at input port of microcontroller. Then controller generates necessary control signals to switch the Relay to operate the pump. The thermistor is used for sensing temperature. When temperature exceeds from a predefined level or critical level, then the system automatically switches on the sprinkles and also displays information of all parameters (Temperature, soil sensor and Electrical appliance on/off position) on LCD. And when the temperature falls below in normal range or comes to the predefined level pump will turns off automatically. Moisture sensor is used for sensing moisture in soil. When moisture comes down from a defined level, controller turns on the water pumps automatically to maintain moisture level in soil and made off in presence of moisture. The individual outputs from the sensor are in the analog form. Sensed analog signal is for further processing. Thus, the analog values are given to the Arduino to

indicate status of devices on LCD. The Arduino will read the sensor periodically and updates the value of sensor. If any of the Green wall parameters exceeds the threshold value set by the user, necessary control action will take place automatically. If the Green wall parameter falls below the threshold value, the controller will be turned off the device.

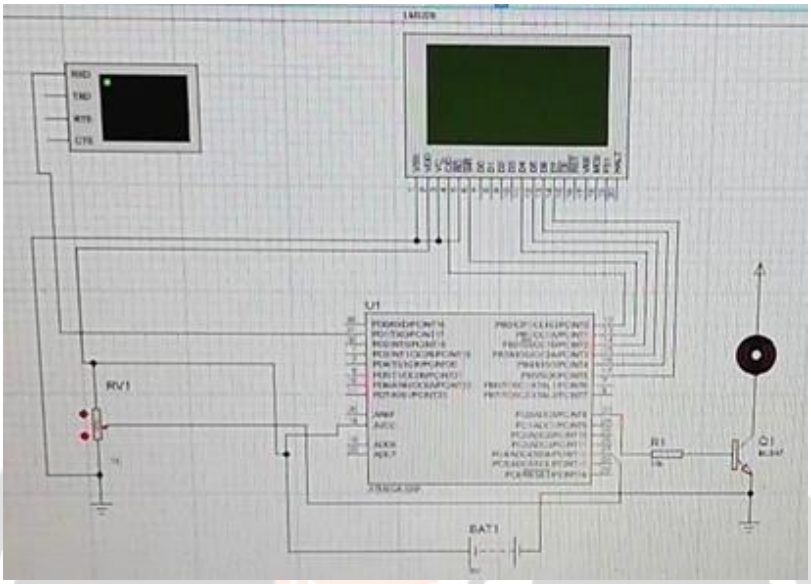

Figure-8: Simulation in proteus with atmega-328

The Proteus Design Suite is a proprietary software tool suite used primarily for electronic design automation. The software is used mainly by electronic design engineers and technicians to create schematics and electronic prints for manufacturing printed circuit boards.

In above simulation there is a sensor work as soil sensor which will give us an output of analog signal. This sensor is set on value of 51%. If the value is above the 51% the condition will be normal, which means soil has enough water for plants, so the motor doesn't work. But when the value of sensor goes below the 51% immediately the motor will start working by itself, and the display will keep showing the soil moisture level respective to sensor's output.

Efficient results have been obtained from the following project. Table 1 shows the recorded data in several days. The sensor that we are using are giving good results and performing to the expectations.

Table-1: Recorded Data

Soil moisture level	Relay	Water Pump ON/OFF
100%	Turns off	OFF
67%	Turns Off	OFF
48%	Turns On	ON
33%	Turns On	ON

5. Hardware arrangement

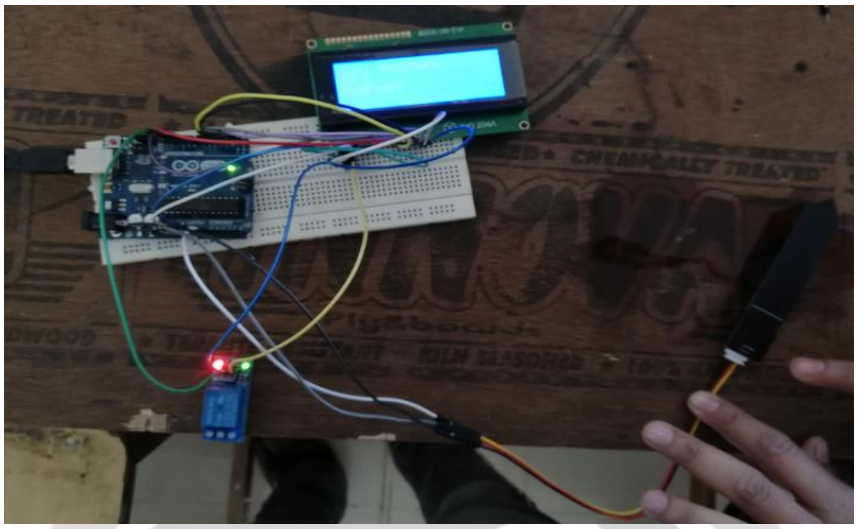

Figure-9: Hardware Arrangement

The same as interface in simulation Here we have connected soil moisture sensor and LCD display and arduino with the help of bread board. There are two different pots one with dry soil and another one with wet soil. As we put moisture sensor in wet soil, sensor passes the signal to the arduino that soil is wet so the pump should not be start. The moisture level shows on the LCD display. As we put moisture sensor in the dry soil, sensor detects it and passes the signal to the arduino that pump should be ON. As the soil getting wet by supplying the water the corresponding moisture level displays on the LCD display in percentage.

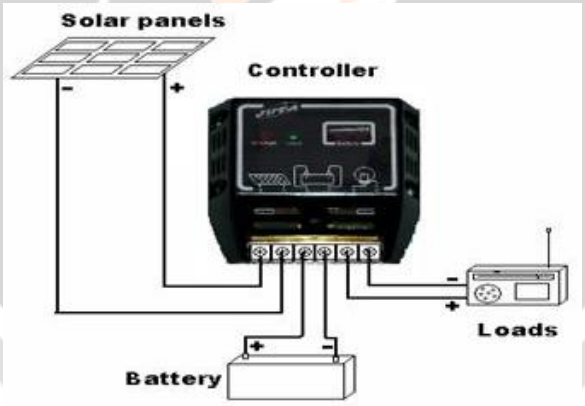

Figure-10: Solar charging controller connction

The most essential charge controller basically controls the device voltage and opens the circuit, halting the charging, when the battery voltage ascents to a certain level. More charge controllers utilized a mechanical relay to open or shut the circuit, halting or beginning power heading off to the electric storage devices. Generally, solar power systems utilize 12V of batteries. Solar panels can convey much more voltage than is obliged to charge the battery. The charge voltage could be kept at the best level while the time needed to completely charge the electric storage devices is lessened. This permits the solar systems to work optimally constantly. By running higher voltage in the wires from the solar panels to the charge controller, power dissipation in the wires is diminished fundamentally. The solar charge controllers can also control the reverse power flow. The charge controllers can distinguish when no power is originating from the solar panels and open the circuit separating the solar panels from the battery devices and halting the reverse current flow.

6. FUTURE SCOPES

- This system can be connected to the communication devises like cellular phone, modems, or satellite terminals for the remote collection of the recorded data.
- This system can be improved with the use of data logger and graphical LCD panel showing the sensor data after a period of time.
- Adding a Fertilizer sensor and automatic control on it will be a good improvement in this system.

7. CONCLUTION

A step-by-step approach to design the Arduino based system for monitor and control of the two essential parameters for vertically grown plant growth, i.e. Soil moisture, and temperature, has been followed. The measurement shows that the system performance is accurate and quite reliable. The designed system has successfully overcome the drawbacks of the previous system by reducing maintenance, complexity and the power consumption, at the same time providing very precisely management of providing the waters. Less amount of water is used due to controlled irrigation and it helps to save water and time. Use of multiple sensors reduces quantity of dead plants and increases quality and productivity of plants. Well developed and good quality plants results a beautiful living green wall. Thus, the system is efficient and compatible to change the environment.

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"SIMULATION BASED COMPARATIVE ANALYSIS OF HIGH FREQUENCY SINGLE PHASE MULTILEVEL INVERTER USING LEVEL SHIFTED IN PHASE DISPOSITION SPWM TECHNIQUE ON MATLAB SOFTWARE"

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ABSTRACT

In this project mainly focused on the design and implementation of new topology in a single phase cascaded H-bridge multilevel inverter by using only MATLAB software. The main objective of this project is to increase number of levels with a low number of switches and sources at the output without adding any complexity to the power circuit. The main merit of the new topology is to reduce the lower total harmonic distortion, lower electromagnetic interference generation and high output voltage. In this project, various carrier sinusoidal pulse width modulation techniques are proposed, which can minimize the total harmonic distortion and enhances the output voltages from proposed work of multilevel inverter. The various switching topologies of single-phase cascaded H-bridge multilevel inverters have been analysed in this paper.

Keywords: *single phase H-Bridge Inverter, Spwm technique using Matlab software.*

I.INTRODUCTION

While for high power applications multilevel inverters are the best available alternative, for medium or low power applications a controversy takes place. Experts on high frequency converters point out the compactness and reduced cost that can be achieved by employing high frequency switching. On the other hand, experts on low frequency converters claim that the very best efficiency and robustness belong to the topologies based on low frequency switching.

Cascaded H-bridge (CHB) multilevel inverter is One of the popular converter topologies used in high-power medium-voltage (MV) inverter. It is composed of a multiple units of single-phase H-bridge power cells. The H-bridge cells are normally connected in cascade on their ac side to achieve medium-voltage operation and low harmonic distortion. In practice, the number of power cells in a CHB inverter is mainly determined by its operating voltage and manufacturing cost. The CHB multilevel inverter requires a number of isolated dc supplies, each of which feeds an H-bridge power cell the single-phase H-bridge power cell, which is the building block for the CHB inverter, is reviewed. Various inverter topologies are introduced. Two carrier- based PWM schemes, phase-shifted and level-shifted modulations, are analyzed and their performance is compared. A staircase modulation with selective harmonic elimination is also presented.

II.INVERTER TOPOLOGY

Fig.1(a) shows a three-level diode-clamped inverter.The output voltage is expressed as v an where n is chosen as the neutral point. The series-connecting bulk capacitors C1and C2 can split the DC bus voltage V dc into three levels. The switching state for different output is shown as follows:

- When the output voltage van = Vdc/2, the upper two switch S1 and S2 are closed.
- When Van = 0, the switch S2 and S1' are closed.
- When Van = −Vdc/2, the lower two switch S1' and S2' are closed.

The clamping diodes D1 and D2' play as an important role in this kind of inverter which can clamp the switch voltage to half of the DC link voltage. The output voltage van = Vdc2 is served as an example. In this case, the switch S1 and S2 should be closed. D1' is used to balance out the voltage sharing between the two switch S1 and S2. The voltage across C1 is blocked by S1' and the voltage across C2 is blocked by S2'

The five-level diode-clamped multilevel inverter is shown in Fig.2-1(b). The DC link voltage Vdc is evenly shared by four capacitors C1, C2, C3 and C4. The output voltage van and the corresponding switch state are shown in figure 1

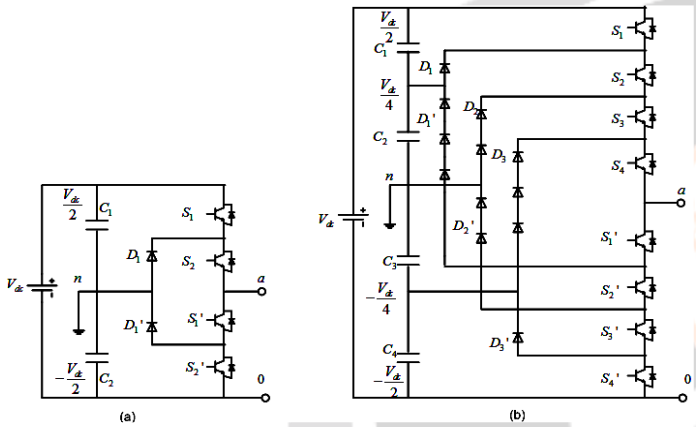

Fig. 1: Diode-clamped multilevel inverter topologies: (a) Three-level. (b) Five-level.

Voltage van	Switch State							
	S1	S2	S3	S4	S1'	S2'	S3'	S4'
van = Vdc/2	1	1	1	1	0	0	0	0
Van=Vdc/4	0	1	1	1	1	0	0	0
van = 0	0	0	1	1	1	1	0	0
van = −Vdc/4	0	0	0	1	1	1	1	0
van = −Vdc/2	0	0	0	0	1	1	1	1

Table 1.1. Switching states for a 5 level Diode-Clamped.

2. CAPACITOR-CLAMPED MULTILEVEL INVERTER

In Fig.2, the topologies of the three-level and five-level capacitor-clamped multilevel inverter are presented. They have similar structure as the diode-clamped multilevel inverter. The capacitors are used in the topology instead of diodes.

The three-level capacitor-clamped multilevel inverter is shown in Fig.2-2(a). One advantage of this kind of topology is that it can provide some redundancies for a certain output voltage. Taking the three-level Capacitor-Clamped Inverter as an example, for Van = 0, either pair (S1, S1') or (S2, S2') needs to be turned on. The number of redundancies will increase as the output voltage level increases. The switch state and its corresponding output voltage for five-level capacitor-clamped Inverters are shown in Table 2.2. With these redundancies, the capacitor voltages can be easily balanced with some control strategies and modulation methods since it is possible to choose which capacitor is to be charging and which one is to be discharging.

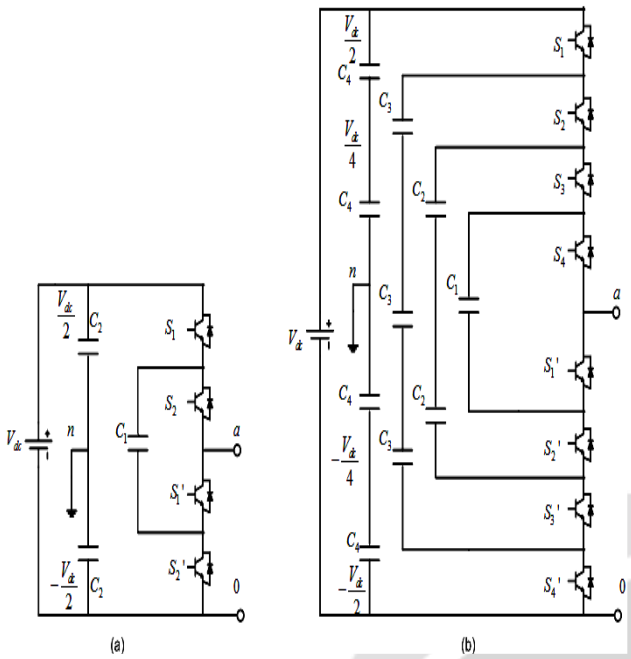

Fig. 2: Diode-clamped multilevel inverter topologies: (a) Three-level.(b) Five-level.

Voltage van	Switch State							
	S1	S2	S3	S4	S1'	S2'	S3'	S4'
van = Vdc/2(no redundancies)								
Vdc/2	1	1	1	1	0	0	0	0
van = Vdc/4(2 redundancies)								
Vdc/2 − Vdc/4	1	1	1	0	1	0	0	0
3Vdc/4 − Vdc/2	0	1	1	1	0	0	0	1
Vdc/2 − 3Vdc/4 + Vdc/2	1	0	1	1	0	0	1	0
van = 0 (5 redundancies)								
Vdc/2 − Vdc/2	1	1	0	0	1	1	0	0
Vdc/2 − Vdc/2	0	0	1	1	0	0	1	1
Vdc/2 − 3Vdc/4 + Vdc/2 − Vdc/4	1	0	1	0	1	0	1	0
Vdc/2 − 3Vdc/4 + Vdc/4	1	0	0	1	0	1	1	0
3Vdc − V − dc/2 + Vdc/4 − Vdc/2	0	1	0	1	0	1	0	1
3Vdc − Vdc/4 − Vdc/2	0	1	1	0	1	0	0	1
van = −V − dc/4 (2 redundancies)								
Vdc/2 − 3Vdc/4	1	0	0	0	1	1	1	0
Vdc/4 − Vdc/2	0	0	0	1	0	1	1	1
Vdc/2 − Vdc/4 − Vdc/2	0	0	1	0	1	0	1	1
van = −Vdc/2 (0 redundancies)								
−Vdc/2	0	0	0	0	1	1	1	1

Table 2.2. Switching states for a 5-level Capacitor-Clamped Inverter.

3. CASCADED H-BRIDGE MULTILEVEL INVERTER

The Cascaded H-Bridge (CHB) multilevel inverter is based on the series connection of single phase H-bridge inverters with separate DC sources. The topology is shown in Fig.2-3. The output phase voltage is synthesized by the addition of the voltages that are generated by different modules. If the separate DC sources have the same voltage level (Vdc), the resulting phase voltage will be able to range from −nVdc to nVdc which would have (2n + 1) levels. And n is the number of the total modules or the number of separate DC sources. As the number of DC sources increases, there would be more levels in the output voltage. So the output voltage waveform will be nearly sinusoidal, even without filtering.

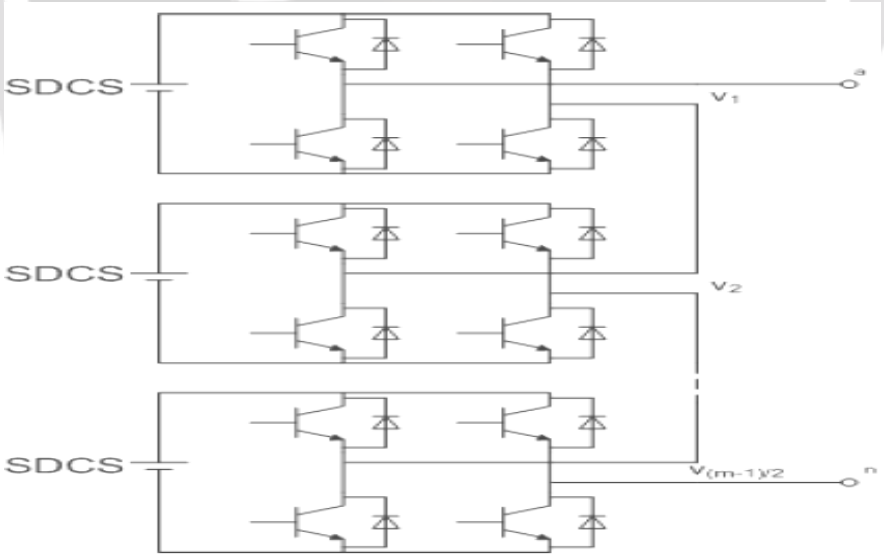

Fig. 3: CHB multilevel inverter topology.

III. MULTILEVEL MODULATIONS

When it comes to multilevel inverter modulation there are several ways to classify modulation techniques. Here, the way shown in is adopted and graphically presented in Fig.4. Multilevel modulations are meant to produce an average output voltage proportional to the reference given by some external algorithm, while multilevel controls are meant to apply an output voltage calculated by them, like Multilevel Direct Torque Control (MDTC).

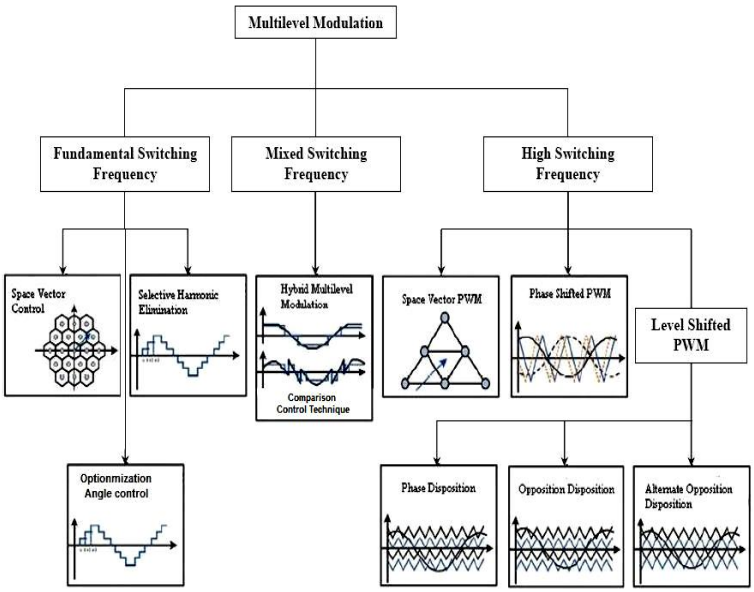

Fig.4: Classification tree for multilevel modulations.

III.PROBLEM IDENTIFICATION AND PROPOSED SOLUTION

Generally we are performing the simple inverter simulation in power electronics practical than we can't get efficient output voltage. Now a day requirement is better power quality. So we think about the less total harmonics distortion in output of the inverter voltage. And when controlling of power electronics switch at low frequency than harmonics is more in voltage. And also simple inverter is used for low power application and it have high THD ratio.

So we decided work on multilevel inverter for better output voltage. It is also use for high power application. and in multilevel inverter we are also use different technique like PWM and SPWM.

IV LEVEL SHIFTED PWM (LSPWM)

IV.I In Phase Disposition (IPD):- Level Shifted PWMs use more carriers, with the same amplitude and frequency, but translated in level as pictures in Fig, 5, show for a 5-level inverter. The number of carriers needed to generate the driving signals for an n-level converter is the same as PSPWM that is n-1.There are three major kinds of LSPWMs depending on how the carriers are disposed. The most evident method, depicted in Fig.5, is called In Phase Disposition (IPD).

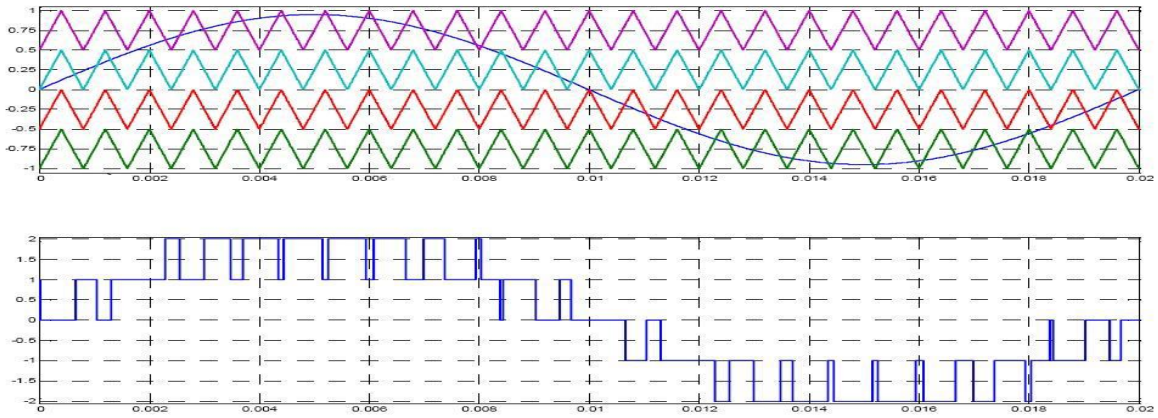

Fig. 5**:** LSPWM carriers and reference for a 5-level converter, In Phase Disposition (IPD)

The interval of possible voltage reference values is subdivided into one zone for each carrier which modulates the output only when the reference belongs to its zone. When the reference does not belong to a zone, associated carrier comparison output is fixed to high or low level: it is high when the reference is above the carrier; vice versa it is low when the reference is under the carrier. The comparison output, obtained in this way, and its negation can directly drive a couple of switches in diode-clamped. The sum of all the comparison outputs, shown in Fig.5, is a signal proportional to the instantaneous required output level.

IV.II Phase Opposite Disposition (POD):-

The **Phase Opposition Disposition** (**POD**) uses the same translation of carriers as IPD, but the carriers associated to negative levels are in opposition of phase as depicted in Fig.6. Fig.6 shows the signal obtained as sum of comparison output signals and it is proportional to the level required.

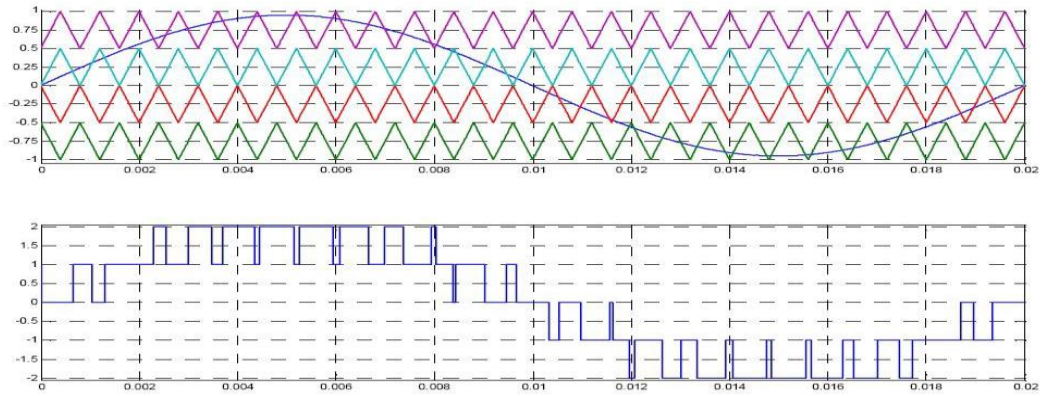

Fig.6**:** LSPWM carriers and reference for a 5-level converter, Phase Opposition Disposition (POD)

IV. III Alternative Phase Opposition Disposition (APOD):-

The **Alternative Phase Opposition Disposition** (**APOD**), depicted in Fig.7, has the carriers alternatively in phase or in opposition. Fig. 7 shows the output required by this kind of modulation.

As it can be seen comparing Fig.5, 6 and 7, the difference among these three LSPWMs is related to the symmetry of the output they produce. Indeed, POD and APOD have odd symmetry, while IPD positive half-wave can be mirrored and translated to coincide with the negative one. Each switch commutates at the carrier frequency only

when the reference belong to the zone related. Otherwise the switch is hold, but the converter is still commutating. This means that the switching frequency of the converter is equal to the carrier frequency (fcar), but the average switching frequency of the single switch (fsw) is lower and, for a n-level converter, it is given by (1)

$$fsw = \frac{fcar}{(n-1)} \quad \text{----------(1)}$$

Anyway, the carrier frequency has to be suited for the characteristics of the chosen switchs, so in LSPWM do not really allow to increase the output frequency as PSPWM does.

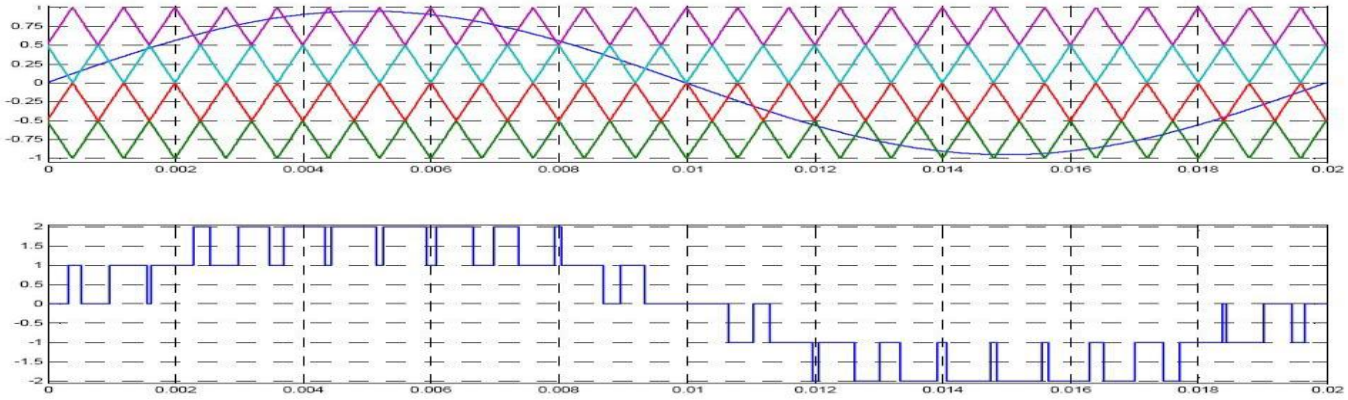

Fig. 7**:** Level Shifted PWM carriers and reference for a 5-level converter, Alternative Phase Opposition Disposition (APOD).

V. SIMULATION RESULT

V.I. SIMULATION RESULT 3 LEVEL SPWM INVERTER USING IN PHASE DISPOSITION (IPD) LEVEL SHIFTED PWM:-

The Matlab Simulink Model analysis for single phase 3-level 5 level and 7 level MLI using Level Shifted PWM Technique in phase disposition is shown in Fig.8. However few changes of no. of carriers and phase change of triangular carrier waves are required according to modulation techniques. LSPWM carriers and reference for a 3-level 5 level and 7 level converter, and variance gate pulse on Mosfet In Phase Disposition (IPD) MLI and LSPWM carriers and reference for a 3-level 5 level and 7 level converter, and variance gate pulse on Mosfet In Phase Disposition (IPD) MLI and Output voltage and FFT of 3-level 5 level and 7 level Converter using IPD, modulation techniques is shown in fig.9, 10 and 11 respectively.

V.I. SIMULATION RESULT 3 LEVEL SPWM INVERTER USING IN PHASE DISPOSITION (IPD) LEVEL SHIFTED PWM:-

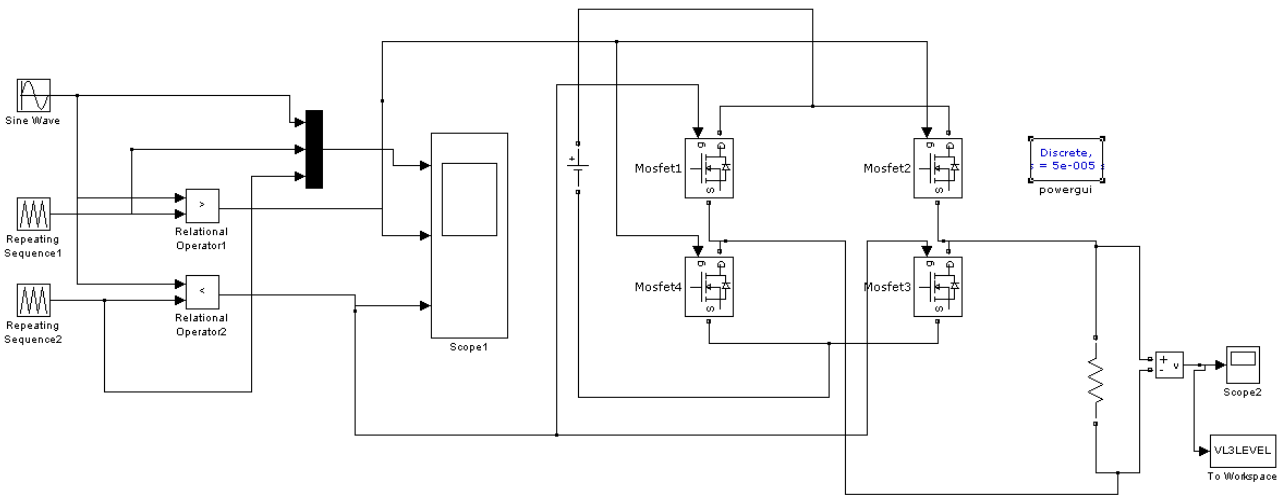

Fig.8 3-Level SPWM Inverter Simulation Circuit.

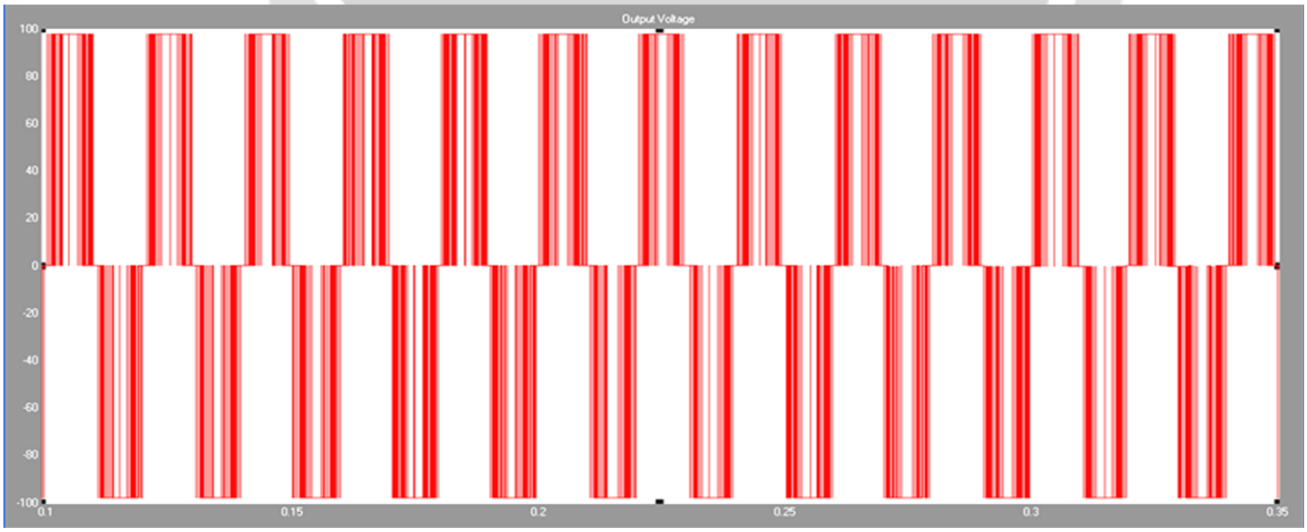

Fig.9.3-Level SPWM Inverter output voltage.

V.II. SIMULATION RESULT 5 LEVEL SPWM INVERTER USING IN PHASE DISPOSITION (IPD) LEVEL SHIFTED PWM:

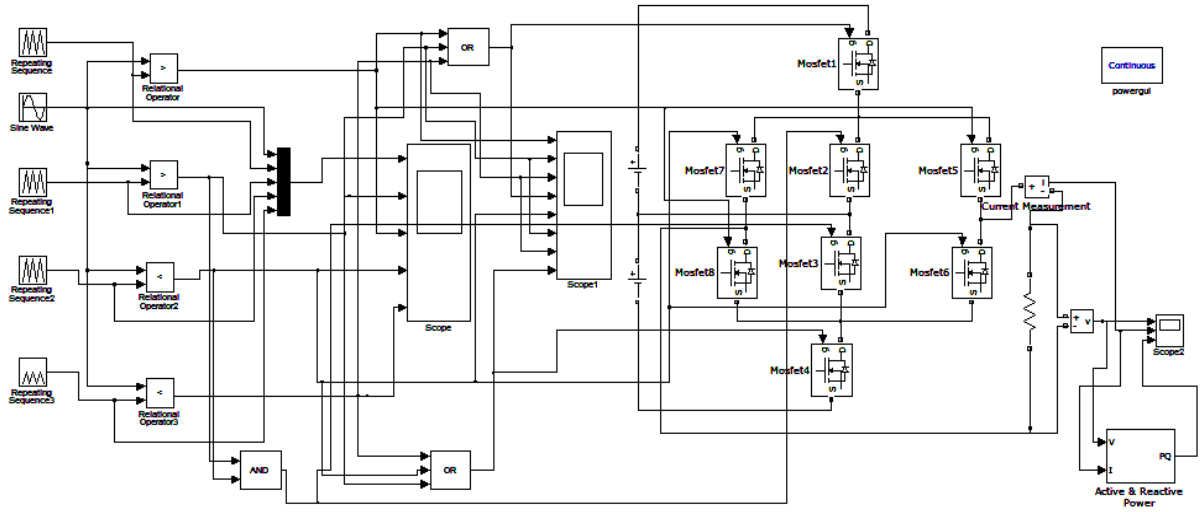

Fig.10 5-Level SPWM Inverter Simulation Circuit.

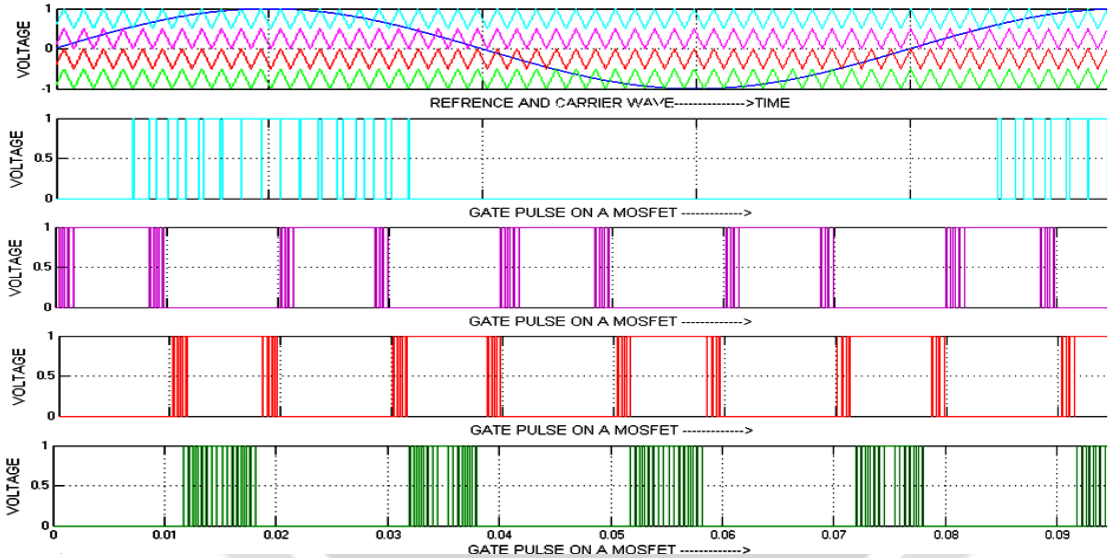

Fig. 11**:** LSPWM carriers and reference for a 5-level converter, and variance gate pulse on Mosfet In Phase Disposition (IPD) MLI

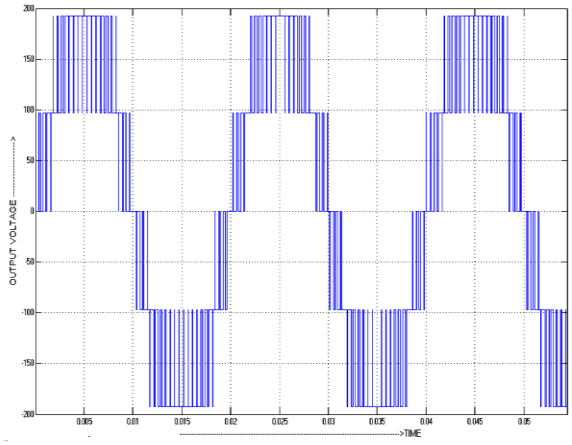

Fig. 12**:** Output voltage for a 5-level IPD- MLI

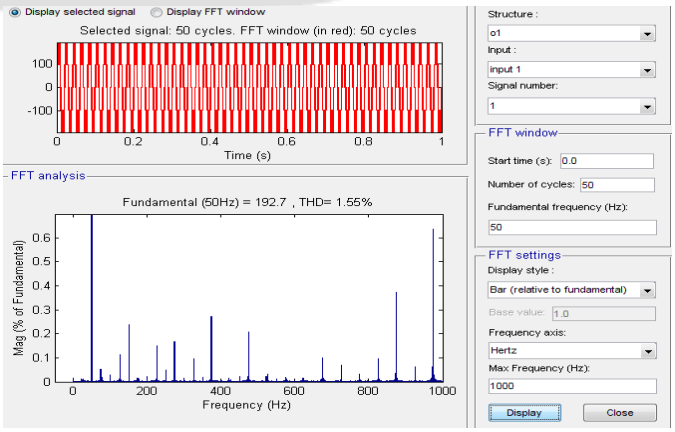

Fig. 13: THD on a Output voltage for a 5-level IPD- MLI

V.III. SIMULATION RESULT 7 LEVEL SPWM INVERTER USING IN PHASE DISPOSITION (IPD) LEVEL SHIFTED PWM:

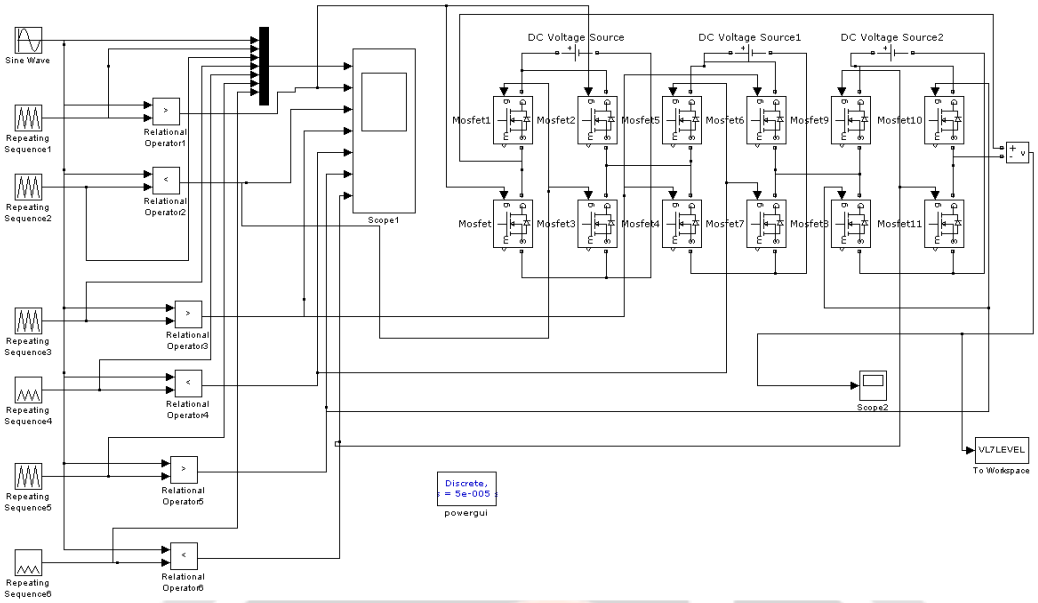

Fig.14. 7-Level SPWM Inverter Simulation Circuit.

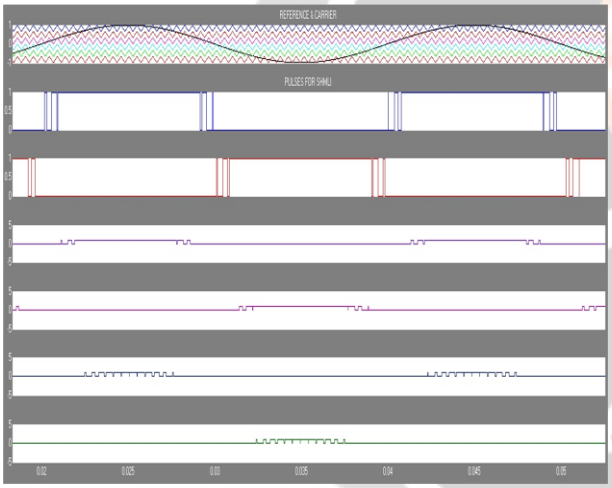

Fig. 15: Gate Pulse for a 7-level IPD- MLI

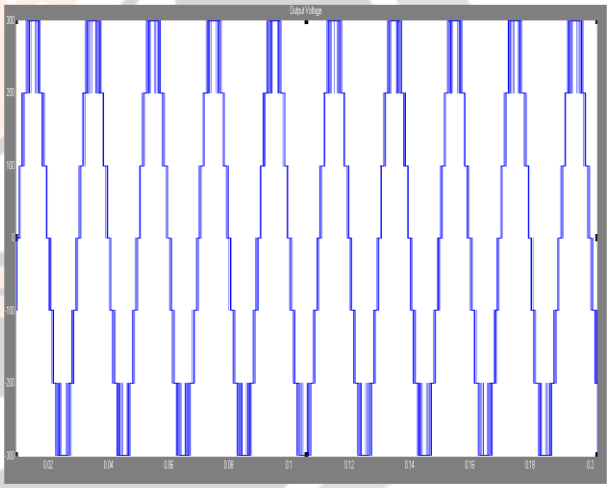

Fig. 12**:** Output voltage for a 7-level IPD- MLI

V.IV. COMPERATIVE ANALYSIS 3 LEVEL 5 LEVEL AND 7 LEVEL SPWM INVERTER USING IN PHASEDISPOSITION (IPD) LEVEL SHIFTED PWM:

Comparative analysis 3 level 5 level and 7 level spwm inverter using IPD PWM.

Sr No.	Level of MLI	METHOD	THD (%)
1	3	SPWM-IPD	4.08%
2	5	SPWM-IPD	2.01%
3	7	SPWM-IPD	1.38%

VI .CONCLUSION

In this paper Simulation result achieved High Switching Frequency H-Bridge Multilevel Inverter Using Level Shifted In Phase Disposition (IPD) Modulation using MATLAB Software, and desired output voltage THD is 1.55%,in this LSPWM is good opportunity for the realization of the single-phase inverter control and reduced harmonic distortion.

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Design and Fabrication of Water Vending Machine using PLC

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ABSTRACT

Now a day's water vending machines are available and operated on only one coin but we aim to design a water vending machine that is operated on different coins. In India, there is a problem with safe drinking water therefore we are going to provide mineral water. The rapidly rising population and changing lifestyles have increased the need for freshwater. It would be clear that in most rural areas, households are paying far more for water supply than the often-normal rates charged in urban areas.In summer we face the problem of drinking water.This project is based on coin operation. The water vending machine dispenses water on the detection of the right coin. It can be used in public places like Roads, Railway stations, Shopping Malls, etc. It can prove to be of great use and comfort for people.

Keyword: - Water vending machine, Programmable Logic Controller (PLC), Coin Sensor, RFID, Multi Coin operated

1.INTRODUCTION

The rapidly rising population and changing lifestyles have increased the need for freshwater. In summer, we face the problem of drinking water. So is the panic over drinking water supply in the city as well as in villages. The reservoir has just 35.63 feet of water, which is not even half of the total water level. We are going to design a project which is based on coin operation or RFID operation. It has been specially designed for village people. It is also use on Railway station, Bus station, public places etc. This system is based on PLC. The inputs to the PLC are coin and RFID tag and output in the form of water. Looking at the specifications required for water dispensing system and for simplicity of our application, microcontroller was found to be best suited. The machine has numerous input and outputs to provide service to the customer. The main motto of this system is to avoid the environmental pollution and also to avoid the wastage of water with the help of water control valve and give purified water to the customer. We know that the available water resources have initiated towards the end. This problem is quietly related to poor water allocation, inefficient use, and lack of adequate and integrated water management. Water Vending machine is going to be developed in such a way that water will get served to the customers.

Existing Systems In most of the developed countries the vending machines are situated at public places. These machines dispense the snacks, cold drinks, coffee, tea, etc. to the people. Also in developing countries the vending machines are used to provide these things. The basic idea of proposed system is originated from these existing systems. Majorly we are developing a system in which there are two water tanks to provide water to customer. The two major water tanks are as follows 1. Primary Tank (Front Tank) 2. Secondary Tank (Back Tank) Primary tank is only to give the required quantity of water to customers after inserting a coin in machine & secondary tank is connected to the hub tank (Central Tank) through the technique of pipelining[1]. Pipelining is useful to provide the water to the back tank (secondary tank) from the Hub tank (central tank). The Central Tank will be the main source of water to distribute water to secondary tank. Secondary tank will have two water levels empty & full respectively. These two water levels are controlled with the help of IC555 . Here PLC will be interfaced to maintain the constant water in the secondary tank using sensor.

2. TECHNICAL ASPECTS

2.1 PROGRAMMABLE LOGIC ONTROLLER

A Programmable Logic Controller is a solid-state industrial controller that performs discrete sequential logic in a factory environment. It is originally developed to mechanical relays, timers and counters. PLCs are used to perform difficult control operations in a plant. A sequence of instructions is performed by the user to the PLC memory and when the program is executed, the controller operates a system to the correct operating specifications.

A Programmable Logic Controller is currently defined by the National Electrical Manufactures Association (NEMA) as a digital electronics device that uses a programmable memory to store instructions and to implement specific functions such as logic, sequence, timing, counting and arithmetic operations to control machine and processes.

Figure 1 Programmable Logic Controller

2.2 SWITCHED MODE POWER SUPPLY

A switch mode power supply is a power converter that utilizes switching devices such as MOSFETs that continuously turn on and off at high frequency; and energy storage devices such as the capacitors and inductors to supply power during the non-conduction state of the switching device. The supplies have higher efficiencies of up to 90%, are small in size and widely used in computers and other sensitive electronic equipment.

SMPS offers advantages in terms of size, weight, cost, efficiency and overall performance. These have become an accepted part of electronic gadgets. Basically, it is a device in which energy conversion and regulation is provided by power semiconductors that are continuously switching “on” and “off” with high frequency.

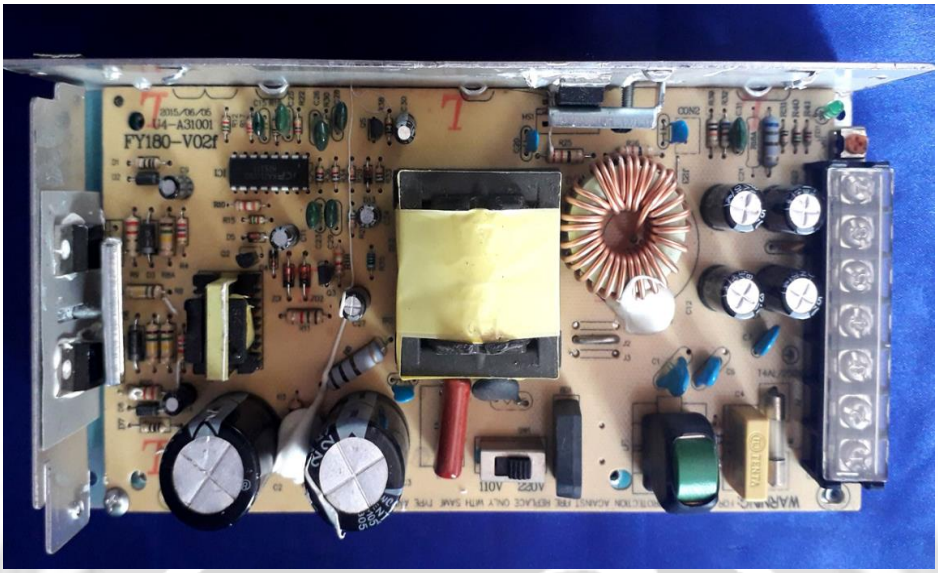

Figure 2 Switched mode power supply

2.3 COIN SENSOR

Coin sensor is the device which is used to detect the correct coin. The coin sensor uses the thickness, diameter and fall time of the coins to identify them. CH-926 is a multi-coin selector, can accept up to 6 kinds of different coins at the same time. This type of coin selector is widely used in Vending machine, Arcade Game, Message chair, and other self–management system. CH-926 is mainly based on material, weight and size to identify coins. It has the most up to date algorithm to design software. Therefore, CH-926 is very stable and accurate even when environment changes such as temperature, and humidity etc. In order to increase the accuracy, we suggest different version of coins use different channel to set up.

Figure 3 Coin Sensor

2.4 RFID SENSOR

A radio frequency identification reader (RFID reader) is a device used to gather information from an RFID tag, which is used to track individual objects. Radio waves are used to transfer data from the tag to a reader.RFID is a technology similar in theory to bar codes. However, the RFID tag does not have to be scanned directly, nor does it require line-of-sight to a reader. The RFID tag it must be within the range of an RFID reader, which ranges from 3 to 300 feet, in order to be read. RFID technology allows several items to be quickly scanned and enables fast identification of a particular product, even when it is surrounded by several other items.RFID tags have not replaced bar codes because of their cost and the need to individually identify every item.

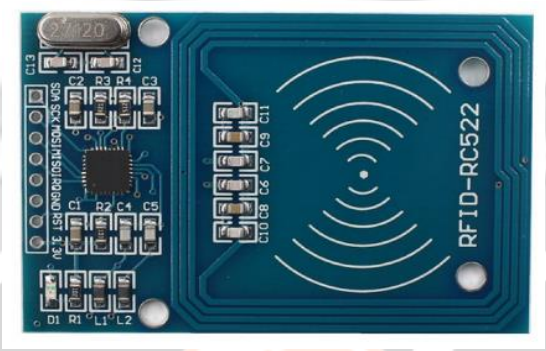

Figure 4 RFID sensor

2.5 SOLENOID VALVE

This is simple on\off type 9V dc supply valve. This type of valve is used in motors. This module consists of interface between vending machine and water output valve with the help of PLC. The switch is "Normally closed". (Automatic flush and shut off, auto power cut-off when filling, extends pump duration) when you connect it with high pressure switch. It shuts off the water supply when the tank is full. Normally controlled in the RO system by the booster pump High pressure switch.

Figure 5 Solenoid valve

2.6 PUMP

This water pump is use to take water from water tank or well. This water pump is connected between the water tank or well and tap where we can get water. In our project we use 0.5 HP, 0.37 kw monoblock water pump. Featuring brass impeller and copper winding, the special motor design of this water pump can work on UPS as well. This water pump is capable of priming up to 3 meters static suction lift without a foot valve at rated head and discharge. Well known for high performance, durability, efficiency, and reliability, this water pump can withstand with wide voltage fluctuation from 180 to 240 volts. With 33.6 LPM water flow and 50 hertz frequency, this water pump is applicable for use at household as well as commercial places.

Figure 6 Pump

Pump specification

Phase	Single phase
Motor body	Cast iron
Discharge	35 LPM
Suction delivery	25×25 mm
Voltage	230 volt
Motor power	0.5 HP
Frequency	50 Hz
Current	2 A

2.7 LCD

A liquid-crystal display (LCD) is a flat panel display, electronic visual display, or video display that uses the light modulating properties of liquid crystals. Liquid crystals do not emit light directly. LCDs are available to display arbitrary images (as in a general purpose computer display) or fixed images which can be displayed or hidden, such as preset words, digits, and 7- segment displays as in a digital clock. They use the same basic technology, except that arbitrary images are made up of a large number of small pixels, while other displays have larger elements.

Figure 7 LCD

3.DESIGN AND IMPLEMENTATION

3.1 Working Principle

This water vending machine is specially designed for village people to provide purified water. Machine is operated with the help of two sensors that are coin sensor or RFID sensor. The RFID sensor is designed for village, industry, company where people use this machine daily. So they have not to insert coin daily, they just need to scan their

RFID card and get water. Whereas the coin sensor operated machine is use every public place like Bus station, Railway station, garden or highways. They use coin of Rupee 1, 5 or 10.

A customer has to be insert coin in machine or RFID card is scan on sensor. The coin is checked whether the coin is correct or not by the coin sensor. The coin sensor uses the thickness, diameter and fall time of the coins to identify them. The RFID card is sense by the RFID sensor.

Now, when inserted coin or RFID card are appropriate or right the Programmable Logic Controller gives signal to the relay and relay will switch the R.O pump which is connected to the water tank. So the R.O pump will lift the water from water tank. Then water is flowing through the flow sensor. Flow sensor is sensing devices which continuously measure the amount of water. When flow sensor measures that amount of water which is defined for different coins, it will give signal to PLC and PLC give signal to the solenoid valve so valve will be off and water flow is stop. Solenoid valve controls the flow of water automatically. So customer will get purified water in the jug or any other watering vessel. Connection diagram is shown in figure 8.

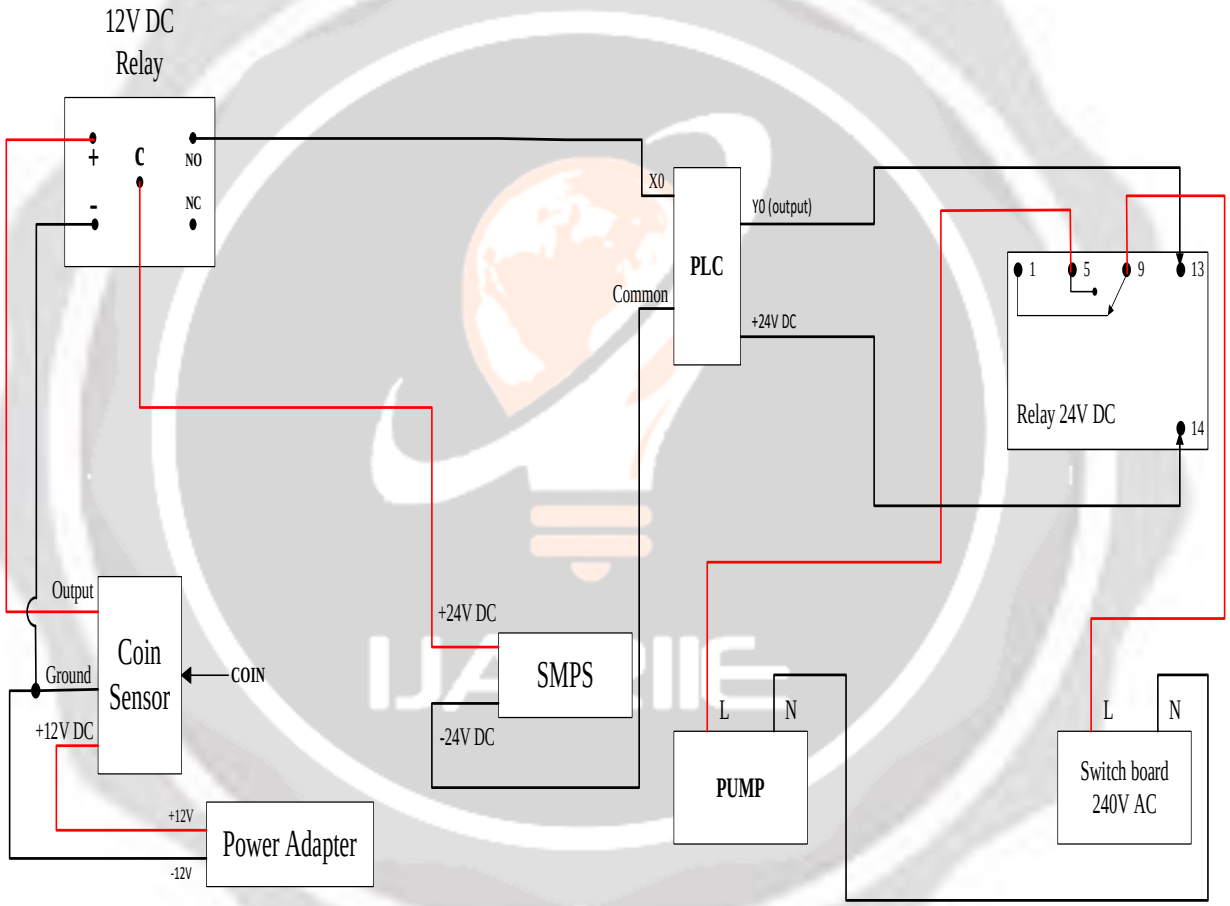

Figure 8 Connection Diagram

3.2 Flowchart of Water Vending Machine

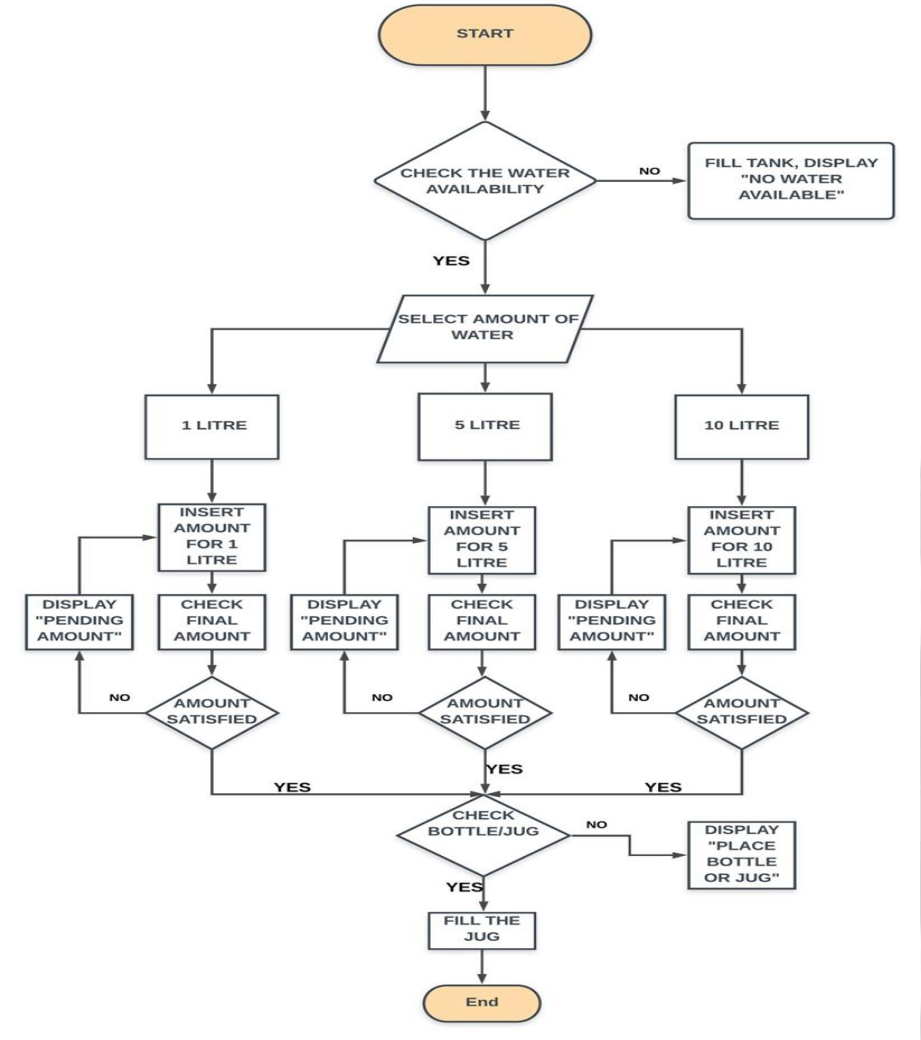

Figure 9 Flow Chart

The flow chart of water vending machine is shown as above. First machine check the status of the water in the water tank if there is no water then the LCD is displaying “Fill tank and No water available” and if water is available then the LCD is displaying “Select the amount of water”. Customer will select the amount of water that are one litre, five litre or ten litre. After that insert coin or scan the RFID card for selected amount of water. Now if the coin is correct then system will check the glass, bottle or jug is placed or not. So system will check whether glass or jug is placed or not. If jug is not placed then LCD displaying message “Place bottle/jug” and if the jug is place properly then water is dispatch into that jug. This way customer will get water and system is complete.

4. SIMULATION AND RESULTS

In this, we have done interfacing of coin sensor with PLC in winproladder software. Win Pro Ladder is easy to learn and use, and allows users of all types, beginner or expert to operate the software in a very efficient manner. For use in a Windows operating environment, completely designed in accordance with Windows environment operation methods. With run time editing feature, during the simulation process the program can be modified without stop the execution.

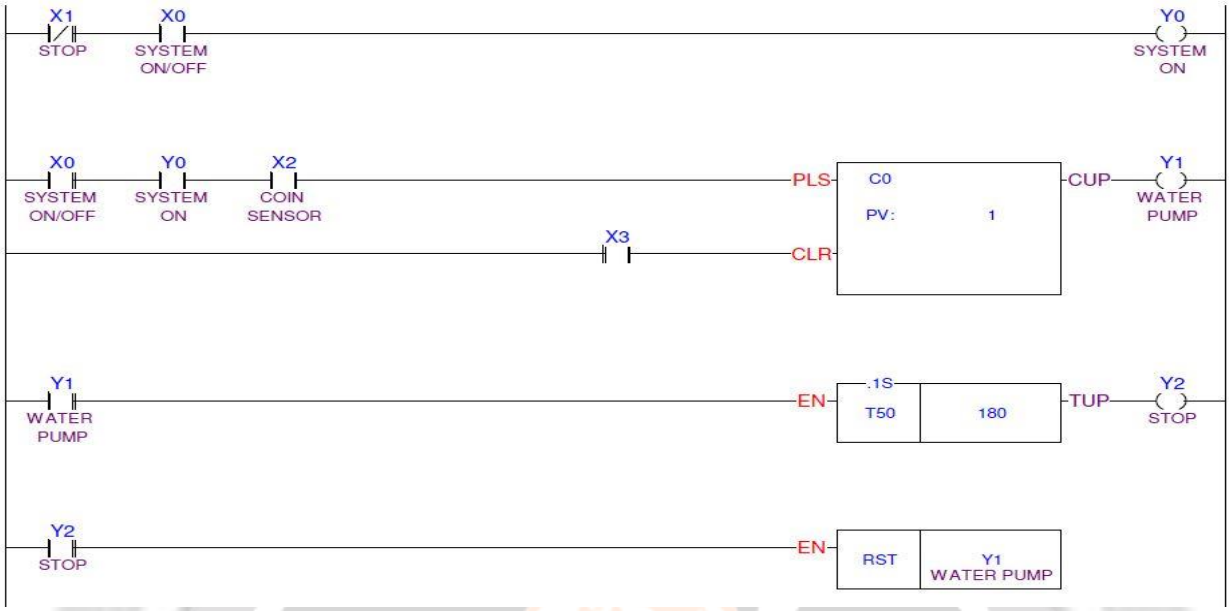

Figure 10 Ladder Diagram of interfacing of coin sensor with PLC

This is the ladder diagram of PLC done on win proladder software.

Here,

X0 = System on/off

X1 = Stop

Y0 = System on

X2 = Coin Sensor

Y1 = Water pump

C_0 = Counter

X3 = Push button for clear function

T50 = Timer

When push button X0 is processed our system is ON i.e. Y0 here X2 is our coin sensor so when coin is inserted it turns On and counter C_0 is increased by 1. So, our water pump Y1 is ON. There is one timer T50. When Y1 is on our timer T50 is ON for 180 seconds. After 180 seconds timer output turned ON the output coil Y2. The output of Y2 is given to reset function. In this reset function when done bit is given to it, the output associated with this function will be off. Here water pump Y1 is associated with reset function so after 180 seconds with the help of reset function water pump Y1 will be off.

In our project we conclude that acceptance ratio is almost 100% and vending machine works on arduino controller To develop low cost water vending machine. To avoid wastage of water.

5.FUTURE SCOPE

An increase in the diameter of the water solenoid valve and pipes would increase the flow rate. Hence, taking lesser time to fill in the tumbler. The whole product can be redesigned for it to be aesthetically pleasing and for its better usability. It can be used for other beverages and drinks also.

6.CONCLUSION

Implementation of Coin-Operated Automatic Drinking Water Machine is the step towards the future technology and it is a step to enter in eco-friendly world. This machine is easy to use and can be easily accessed by the ordinary person .We have developed a water vending machine which is an improved version of the normal water vending machine. This water vending machine reduces human efforts, less time consuming, economical and power consumption of the control system is less. A water vending machine is designed, developed, and demonstrated to give purified water at economical cost. Customers just have to insert coins or scan RFID card. By implementing this type of system, we can provide water at the village, public places like Bus station, Railway station, garden, and isolate place like highways.

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Process Enhance of PCB Micro-Drilling

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Abstract

In this growing world of technology miniaturization is a key word. Drilling is one of the most fundamental machining technologies and is moving toward high precision/high speed application for productivity enhancement. The drill tools play a critical role is increasing the productivity of a cutting process. Although the price of a cutting tool itself is relatively low, the costs caused by tool failures are considerably higher. Therefore, from the viewpoint of cost and productivity, modelling and optimization of drilling processes are micro drilled holes are utilized in many of today's fabrication processes. Precision production processes in industries are trending toward the use of smaller holes with higher aspect ratios, and higher speed operation for micro hole drilling .Experiment was conducted on FR-2 as a work piece material using carbide drill having 0.7 mm diameter.FR-2 sheet with copper foil lamination on one or both sides is widely used to build low-end consumer electronic equipment.In the present work, spindle speed and feed are chosen as machining parameter to see the effect of circularity and taper angle on workpiece.Usingtaguchi methodology, L27 orthogonal array has been chosen and experiment has been performed as per orthogonal array design. For validation of the predicted value and optimization result, confirmation experiments have been performed with optimum levels of machining parameters. It is experimentally found that spindle speed is more influencing parameter for hole quality in terms of circularity and taper angle.

Index Terms—*Micro-Drilling, PCB, Speed, Feed*

I. INTRODUCTION

Printed circuit boards (PCBs) are widely used in industries such as aviation, microelectronics, instrumentation, precision machinery and medical equipment. The base material of PCBs is a copper clad laminate (CCL), which is a multi-material sheet. It consists of dielectric layer (resin/glass fiber cloth) and high purity metal conductor (copper foil).CCL is a heterogeneous, anisotropic material. The machining properties of CCLs are quite different from homogenous metallic material. Qualities of holes are one in which the deposited copper layer can be connected stably at each layer of circuit with repeated thermal shock. Controlling the quality of the holes drilled and increasing the wear resistance of micro-drilles have become an important issue. To optimize the PCB micro-hole drilling, the drilling mechanism, drilling force, circularity and taper of hole should be studied systematically. Many studies of chip curling in machining had been performed.J.Prasanna [1] said that higher spindle speed engendered to lesser thrust force and produce holes with good circularity and lesser taper angle .Micreaancau [2] said that as the number of stacked PCBs increases, the stack thickness to be drilled increases and so the drill rout for a single hole increases accordingly. Lijuanzheng [3] said that the PCB drilling process was complex because it included both continuous chip formation and brittle chip formation. The continuous chip formation mainly occurred at the glass fiber cloth layer.H.Nakagawa [4] said that a reduction in the workload caused by friction is effective for improving the quality of micro drilled hole. In this study, several experimental tests were conducted to quality of hole when drilling PCBs. It was important to study circularity and taper of hole during the PCB drilling process as this process affected the hole quality. The drilling process was digitally photographed and the basic removal mechanism of the PCB was analyzed. Additionally, the hole quality including entry hole diameter and exist hole diameter were observed, measured and analyzed. The influence of drilling conditions (feed and spindle speed) on the drilling process and hole quality were also studied.

II. EXPERIMENTAL DETAILS

In this experiment, small holes of diameter 0.7 mm were drilled on FR2 plate of thickness 4.8 mm under different combinations of spindle speed and feed rate. The drill used was twisted carbide tool. The accuracy of the drilled holes was analyzed in terms of circularity and taper angle. Each experiment was repeated 3 times in order to make the database reliable.

Machining Setup

The drilling experiments were conducted on a high speed drilling process. The thrust force measurements were made using a Kistler dynamometer and simultaneously the values were sent to Kistler charge amplifier and stored in a personal computer. The work piece was fastened on to the dynamometer which was placed on the machine table as shown in Fig. 1. The hole quality assessment was done by 2D Vision System, which is shown in Fig.2

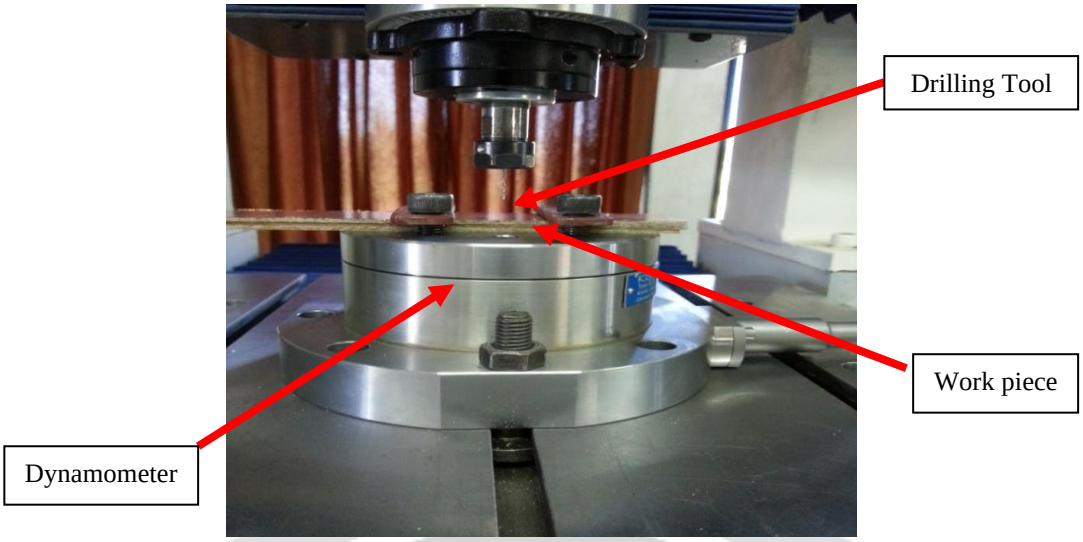

Fig.1. Experimental set-up

Fig.2. 2D vision system.

Measurement Procedure of Performance Parameter

Circularity: The roundness error of the machined hole is proposed in terms of circularity. The error of circularity is defined as the distance between the minimum circumscribing circle diameter and the maximum inscribing circle diameter .The circularity error exists both at the entrance and the exit of the machined hole, their maximum value was used for evaluating the circularity of the machined hole [1].

Taper: Taper angle between the entry and exit surface was calculated by using the formula given below

$\text{Tan}\theta = \frac{(D-d)}{2L}$

Where D is the average diameter of the entry surface, d is the average diameter in exit surface; L is the depth of cut [1].

Optimization and Modeling

The experiments were conducted using Taguchi L9 design approach. The significance and contribution of each process parameter on the performance characteristics were found out using ANOVA method. The objective of this research was to determine the process parameters required to achieve minimum circularity and taper. Therefore, the quality characteristics of 'smaller is better' for all performance characteristics were engaged in this study. The ANOVA results were developed by using the statistical software MINITAB. Each process parameter was designed to have three levels which are shown in Table 1 and the experimental results are presented in Table 2.

Table.1 Experimental Parameters and Their Levels

Process parameter	Symbols	Level	Level	Level
		1	2	3
Feed rate(mm/rev)	f	0.02	0.03	0.04
Spindle speed (rpm)	N	20000	22000	24000

Table.2 Experimental Data

Exp.no	Speed	Feed	Force	SN ratio	Circularity	SN ratio	Taper	SN ratio
1	20000	0.02	6.8	-16.8797	0.0755	-16.8797	0.1191	-13.8702
2	20000	0.02	7.6	*	0.0912	*	0.1191	*
3	20000	0.02	6.5	*	0.1123	*	0.0595	*
4	20000	0.03	8.3	-19.6889	0.0551	-19.6889	0.1191	-16.6787
5	20000	0.03	9.9	*	0.0332	*	0.0595	*
6	20000	0.03	10.6	*	0.0568	*	0.1191	*
7	20000	0.04	8.6	-19.6107	0.0936	-19.6107	0.0595	-16.6011
8	20000	0.04	9.6	*	0.1079	*	0.1191	*
9	20000	0.04	10.4	*	0.1393	*	0.0595	*
10	22000	0.02	8.8	-18.2199	0.0891	-18.2199	0.1787	-15.2101
11	22000	0.02	7.8	*	0.0865	*	0.1191	*
12	22000	0.02	7.8	*	0.0894	*	0.0595	*
13	22000	0.03	10.9	-19.8289	0.0707	-19.8289	0.1787	-16.8189
14	22000	0.03	9.6	*	0.0951	*	0.1787	*
15	22000	0.03	8.8	*	0.0809	*	0.0595	*
16	22000	0.04	9.6	-21.1377	0.0991	-21.1377	0.0595	-18.1277
17	22000	0.04	12.2	*	0.1205	*	0.1191	*
18	22000	0.04	12.2	*	0.0871	*	0.1787	*
19	24000	0.02	4.5	-16.899	0.0537	-16.899	0.0595	-13.8891
20	24000	0.02	8.3	*	0.0595	*	0.0595	*
21	24000	0.02	7.6	*	0.0795	*	0.1191	*
22	24000	0.03	8.3	-18.327	0.1103	-18.327	0.0595	-15.3171
23	24000	0.03	8.8	*	0.0641	*	0.1787	*
24	24000	0.03	7.6	*	0.0427	*	0.1191	*
25	24000	0.04	9.1	-19.7548	0.0262	-19.7548	0.1191	-16.7446
26	24000	0.04	9.4	*	0.0638	*	0.0595	*
27	24000	0.04	10.6	*	0.0325	*	0.0595	*

III. RESULT AND DISCUSSION

The experiments were conducted using L27 orthogonal array. The force, circularity and taper were calculated as per discussed erlier.The experimental results for force, circularity and taper is given in table 2.

Analysis on Thrust Force

In order to see the effect of machining parameter on thrust force, Experiments were conducted using L27 OA.The experimental result data for thrust force is given in table 2.The thrust force is smaller the better type quality characteristics. So S/N ratio is calculated for smaller the better criteria. Main effect plot for S/N ratio are plotted in figure 3.

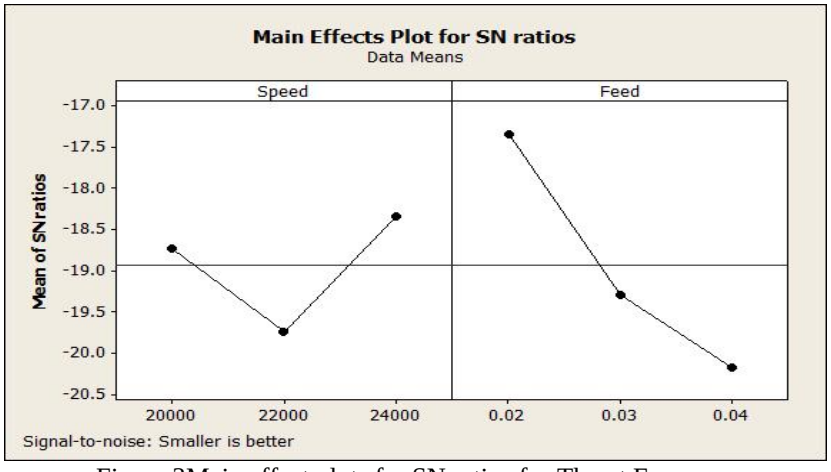

Figure 3Main effect plots for SN ratios for Thrust Force

Figure. 3 shows that feed has main effect on thrust force as the speed increases feed also increase. From taguchi analysis the range of speed and feed 22000 rpm and 0.04 mm/rev respectively are better for creating the good hole accuracy. The speed has not significant effect as much as feed on thrust force. It is seen from the figure 4 that there is very weak interaction between the machining parameters affecting the thrust force since the performance at different levels of machining parameter value are almost parallel.

In order to study the significance of the machining parameter on thrust force, taguchi analysis was performed.Taguchi analysis for thrust force versus speed and feed is given in table 3.The table includes rank based on delta statistics, which compare the relative magnitude of effects. The delta statistic is the highest minus the lowest average for each factor. Minitab assign rank based on delta values, Rank 1 to the highest delta value, Rank 2 to second highest delta and so on. The rank indicates the relative importance of each factor to the response. From table 3, the rank and delta values show that feed has the greatest effect on Thrust force. As thrust force is the 'smaller is better' type quality characteristic, it can be seen from figure 3 that second level of speed (22000) and third level of feed (0.04) provide minimum value of thrust force.

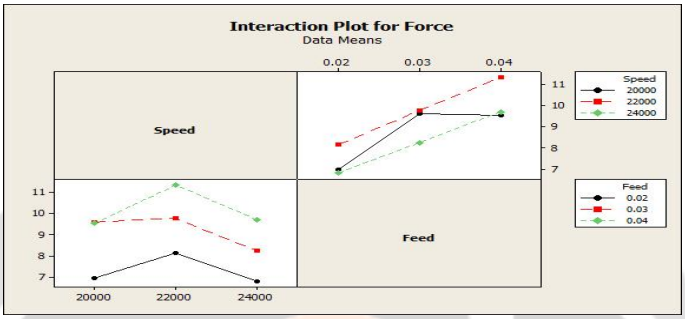

Figure 4. Interaction plot for SN ratios for Thrust Force

Table 3. Response table for S/N ratio

Level	Speed	Feed
1	-18.73	-17.33
2	-19.73	-19.28
3	-18.33	-20.17
Delta	1.40	1.65
Rank	2	1

Analysis on Circularity

In order to see the effect of Machining parameters on the Circularity, experiments were conducted using L27 OA.The experimental data for circularity is given in table 4.

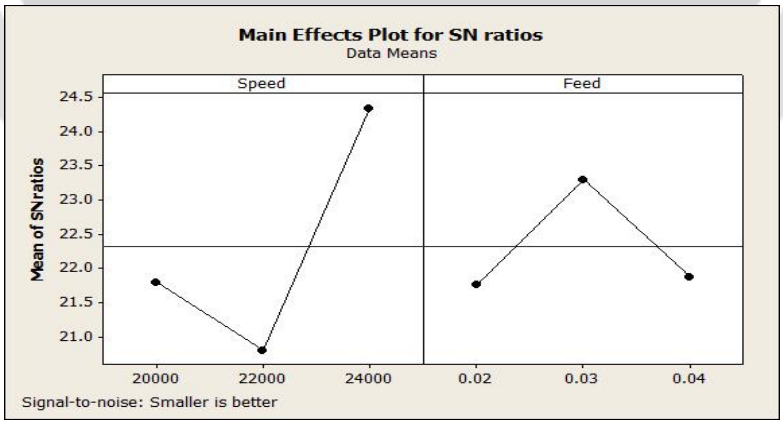

Figure 5Main Effect plot for SN ratio

Circularity is smaller the best type quality characteristic so the S/N ratio was calculated for smaller the better criteria. The main effect plot for circularity is plotted as shown in figure 5.It is seen from the figure 5that speed has the most significant effect on the circularity. Circularity increases with increase in speed of spindle. Circularity increases sharply when feed rate increases from 0.02 mm/rev to 0.03 mm/rev and circularity again gradually reduces from increase in feed rate from 0.03 mm/rev to 0.04 mm/rev.It is observed from the figure 6 that there is a slight interaction between spindle speed and feed rate.

The response table for signal to noise ratio for circularity is shown in table 4.The rank and delta values show that speed has the greatest effect on circularity.

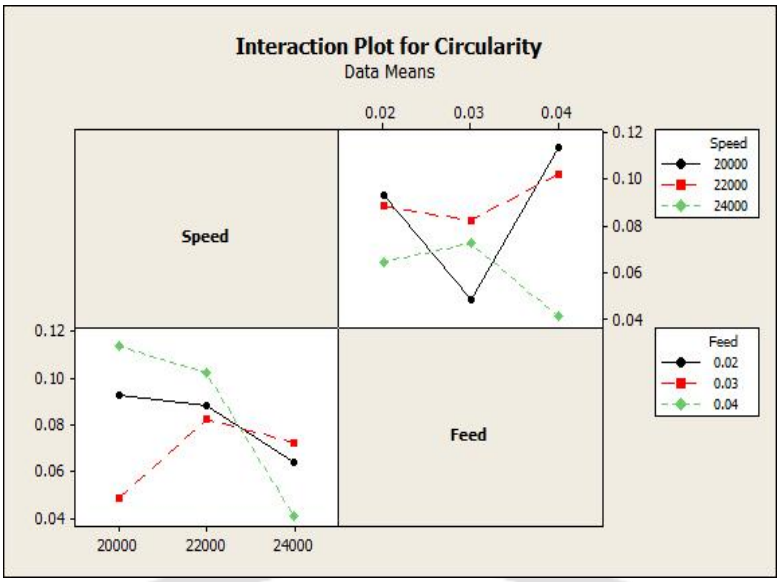

Fig 6 Interaction Plot for Circularity

Table 4 Response table for S/N ratio

LEVEL	SPEED	FEED
1	21.80	21.77
2	20.81	23.31
3	24.35	21.88
DELTA	3.53	1.54
RANK	**1**	**2**

As circularity has "lower is better" characteristic, from the figure 5, second level of speed (22000), first level of feed rate (0.02), third level of feed rate (0.04) for reducing circularity.

Analysis on Taper

In order to see the effect of machining parameters on the taper, Experiments were conducted using L27OA.The experimental data is given in table 2. Taper is smaller the better type quality characteristic so S/N is calculated for the Smaller the better type. The main effect plot for S/N is given figure 7.when spindle speed increases from 20000 rpm to 22000 rpm the taper angle reduces and when spindle speed increases from 22000 rpm to 24000 rpm the taper angle increases.Increasing in feed rate from 0.02 mm/revto 0.03 mm/rev, first taper is reduces but after increases feed rate from 0.03 mm/rev to 0.04mm/rev, taper angle is increases. It is clear from the figure 8 that there is moderate interaction between speed and feed rate.

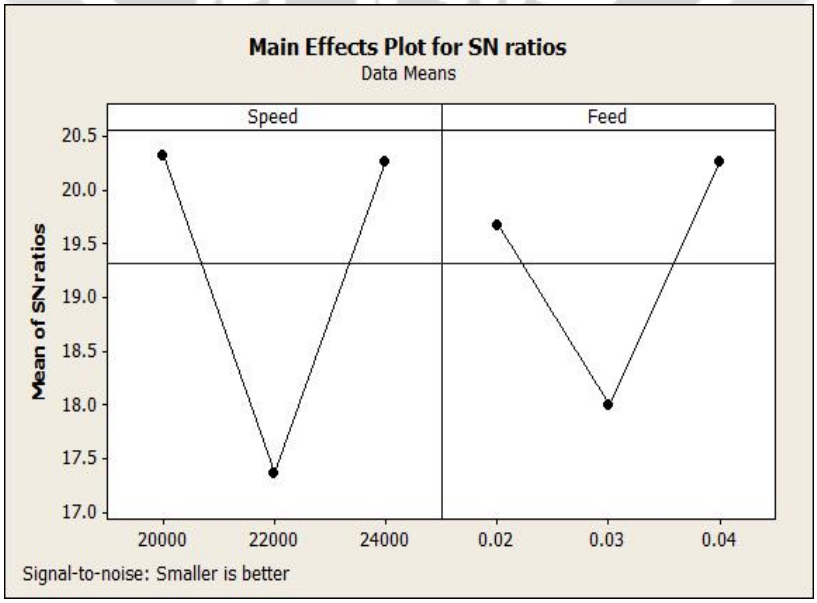

Figure 7 Main Effect plot for SN ratio

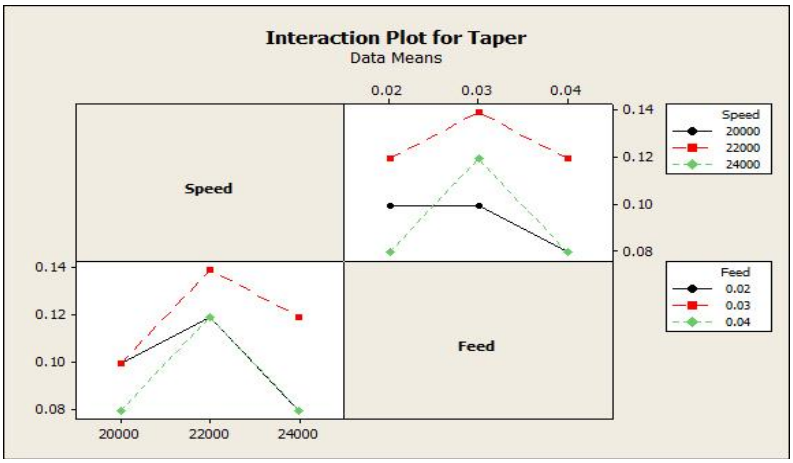

Figure 8 Interaction plot for Taper

The response table for Signal to Noise ratio for taper is shown in table 5.The rank and delta values show that speed has the greatest effect on taper.

Table 5 Response table for S/N ratio

LEVEL	SPEED	FEED
1	20.32	19.68
2	17.37	18.01
3	20.27	20.27
DELTA	2.95	2.26
RANK	**1**	**2**

As taper has "lower is better" characteristic, so from figure 7 second level of speed (22000), second level of feed rate (0.03) for reducing taper angle

IV. ESTIMATION OFOPTIMUM MACHINING PARAMETER

In this section, the optimal values of the process parameter i.e. thrust force, circularity, taper angle have been predicted. The optimal levels of the machining parameter for Performance parameter have been identified from taguchi analysis and S/N Ratio. The optimal value of machining parameter is predicated considering the significant parameter only. The response table 2 using Taguchi method is employed here to calculate the effect of each level of machining parameter on Process parameter. It is done by sorting the mean values of machining characteristics corresponding to levels of the process parameter in each column of the orthogonal array, and taking an average on those with same level

V. CONCLUSION

In the present study, the effect of machining parameter on process parameter i.e. thrust force, circularity and taper angle of the FR2 plate using carbide drill have been investigated for micro-drilling process. The experiments were conducted under various machining parameter setting of spindle speed and feed rate. L27 OA based on taguchi'sdesign was performed, Minitab 16 software was used for analysis the result an optimal set of process variables that yields the optimum quality features to machined parts produced by micro-drilling process has also been obtained. The important conclusions from the present research work are summarized in this chapter:

- The minimum thrust force is obtained at spindle speed of 22000 rpm and feed rate 0.04 mm/rev.
- The minimum circularity is obtained at spindle speed of 22000 rpm and feed rate 0.04 mm/rev.
- The minimum taper angle is obtained at spindle speed of 22000 rpm and feed rate 0.03 mm/rev.

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Design and Analysis of Suspension System for Light Weight Vehicle

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Abstract

An Independent wheel suspension system is used nowadays in almost all new modern cars. The conventional system which uses dependent suspension is not of much use as it creates more jerk in the car body. Normally, when any bump or hindrance comes across the vehicle, the suspension system reduces the disturbance in the car. The dependent system is connected with chassis and car body frame. So with any jerk, the car body faces the disturbance. In Independent wheel vehicle suspension, the spring is connected with the wheel, which absorbs all shock and does not allow any jerk in the car body.

The research paper covered a brief literature review on the analysis of the independent suspension system. First studied existing suspension design as per standard design procedure then identifying design issue in existing design by using mechanism calculation. By using CAD tools like Solid work for a critical component of independent suspension for analysis purposes and according to result for the conclusion. Optimization of taper spring concerning material properties and plot result.

IndexTerms–*Independent suspension system, Car body, Design, Analysis, CAD.*

1. INTRODUCTION

A suspension system is an assembly of springs, shock absorbers and linkages that connects a vehicle to its wheels. In a running vehicle, it is the suspension system that keeps the occupants comfortable and isolated from road noise, bumps, and vibrations. The suspension system also provides the vehicle excellent handling capabilities, allowing the driver to maintain control of the vehicle over rough terrain or in case of sudden stops. Additionally, the suspension system prevents the vehicle from damage and wear.
The basic components of the suspension system include springs, shock absorbers, kinetic parts, and auxiliary devices. The springs absorb impacts and provide cushioning when a wheel hits a bump in the road. The springs also resist the wheel's movement and rebounds, pushing the wheel back down. The type, number, and location of the springs differ based on a different type of suspension system, which will be demonstrated in the next section. The shock absorbers (dampers) restrain the spring motions and prevent the spring from continuing vibrating. In a suspension system, one shock absorber is located at each wheel.

2. LITERATURE SURVEY

Mahmoud Omar, M.M. El-Kassab, Walid Abdelghaffar **[1]** were represented the active performance compared against the passive is performed experimentally and numerically utilizing SIMULINK's Simscape library. Both systems are modeled as single-degree-of-freedom to simplify the validation process. Economic considerations were considered during the rig's implementation. The rig consists of two identical platforms fixed side by side allowing testing two independent suspensions simultaneously. Position sensors for sprung and unsprung masses on both platforms are installed.

Tian Mi, Gabor Stepan, Denes Takacs**[2]** was presented to study the shimmy problem of the electric vehicle with independent suspensions, a 5 DoF model is established using the Lagrange Equation. Gyroscopic moment and tire nonlinearity are both considered, and tire-road constraint equations are derived on the non-slip assumption. Stability charts are conducted with the linearized model, while the numerical simulation is also made so that these two methods can verify each other. The results show that bifurcation occurs at certain vehicle forward speeds. Suspension structural parameters, such as caster angle, affect wheel shimmy. Furthermore, the presented model enables the analysis of any parameters in the system, and as an example, the influence of dampings on shimmy is investigated.

Carlos Arana, Simos A. Evangelou, Daniele Dini **[3]** had represented the potential of the Series Active Variable Geometry Suspension (SAVGS) for comfort and road holding enhancement. The SAVGS concept introduces significant nonlinearities

associated with the rotation of the mechanical link that connects the chassis to the spring-damper unit. Although conventional linearization procedures implemented in multi-body software packages can deal with this configuration, they produce linear models of reduced applicability.

Jan Dizo, StasysSteisunas, Miroslav Blastnicky**[4]** had focused on the vibration analysis of the coach, which wheel is damaged by the wheel-flat. Analyses are carried out in multibody software and results are evaluated in terms of influencing suspension parameters to change on accelerations output signals. The article consists of two parts. The first part is aimed at the problem of the damaged wheel's origin and its consequence during rail vehicles running on tracks during real operation. There is also included the system of forces and accelerations measurement during rail vehicles running on the given track section. The second part is focused on the assessment of selected measured parameters of a rail vehicle with wheel-flat which are obtained from computer simulations. As evaluation parameters signals accelerations in the selected location during passenger car running on the straight track for various stiffness of coil spring of the primary and secondary suspension were assessed.

Anirban. C. Mitra, Gourav. J. Desai, Saaish. R. Patwardhan**[5]** had represented one of the challenging tasks for engineers. The main function of any suspension system is to reduce or eliminate the road excitations transmitted to the vehicle body. An effort has been made in this paper for a passive suspension system by using an optimization technique called the Genetic algorithm to absorb vibrations as per ISO 2631-1: 1997 standards. The spring stiffness (ks), damping coefficient (cs), sprung mass (ms), unsprung mass (mu), tire stiffness (kt) are optimized in such a way that ride comfort is increased. The quarter car and driver seat with the driver's body is simply modeled together as four degrees of freedom (DOF) system by using SIMULINK for analyzing the ride comfort.

A.A. Koshurina, M.S. Krasheninnikov, R.A. Dorofeev**[6]** had represented a universal Arctic rotary-screw rescue vehicle (URV) was chosen as an object of the research. At the moment this rescue vehicle is being developed at the NNSTU named after R.E. Alekseev. A distinctive feature of the URV is the original design of an operated equalizing beam suspension, which has not previously been used for this kind of vehicle. The analysis of the equalizer beam various designs is presented in the article. Calculation schemes and simulation models are developed following the specificity of the rotary-screw vehicle motion. The models and strength calculations have been carried out with standard tools of Autodesk Inventor 2015. The article presents the stress-strain states of different equalizing beam embodiments. The conclusion about the reasonability of the application of the particular equalizer beam embodiment for developing a rotor-screw rescue vehicle is based on the performed comparative analysis of researched constructions.

PanosBrezas, Malcolm C. Smith, Will Hoult **[7]** had represented the problem of optimal control for semi-active vehicle suspensions. A specific goal is to develop an algorithm that is capable of optimizing ride and handling behavior simultaneously in an experimental situation. A time-domain optimal control approach is adopted in which ride and handling are modeled as exogenous disturbances acting on the vehicle: road disturbances (modeled stochastically), and driver inputs (treated as deterministic quasi-static disturbances). A control algorithm is derived from a solution of the stochastic Hamilton–Jacobi–Bellman equation for the finite horizon case. The advantages of the approach are demonstrated experimentally on a test vehicle performing a steering maneuver on a bumpy roundabout.

Werner Scheele, Igor Iroz**[8]** had represented, to random excitation by the unevenness of the road. For a dynamical analysis, vehicle models of the vertical vibrations, as well as guideway models of the road unevenness, are required. The fundamental dynamics of vehicle suspensions can be already modeled by a quarter car featuring the decoupling of the car body motion and the wheel motion. This suspension model is characterized by five design parameters where two of them, the shock absorber and the tire spring, are highly uncertain due to wear and poor maintenance. For the assessment of the vehicle's performance three criteria have to be used: ride comfort, driving safety, and suspension travel. These criteria depend on all the five design parameters resulting in a conflict or a Pareto-optimal problem, respectively. In this paper, the uncertainties of the parameters are projected into a criteria space to support the decision to be made based on a Pareto-optimal problem. Simulations with uncertainties support the robust suspension design. It is shown that controlled suspension parameters remain uncertain due to the unpredictable decisions made by the driver.

M. Soleymani, M. Montazeri-Gh, R. Amiryan**[9]** had represented the design of an adaptive active suspension system, to simultaneously improve ride comfort and travel suspension under various traffic conditions, is addressed in this paper. For this purpose, using a full-vehicle model, with eight degrees of freedom, two separate fuzzy controllers are designed for front and rear suspensions. The parameters of the fuzzy controllers are then tuned for various traffic conditions of a driving pattern, using a multi-objective Pareto-optimal solution.

VladimírGoga, Marian Klúcik**[10]** had represented vehicle suspension is to achieve good driving stability and passenger comfort regardless of the road surface. These requirements are often contradictory. This article aims to show the possibilities offered by a combination of modeling in a virtual environment and evolutionary computation in the process of optimization. The mathematical half-car model was created in Matlab/Simulink. Passive suspension parameters (damping and stiffness coefficients) were optimized with the use of evolutionary computation. Results from simulations of the model with original and optimized suspension parameters were compared.

SamantSaurabh Y., Santosh Kumar, Kaushal Kamal Jain, Sudhanshu Kumar Behera**[11]** had represented in detail the design procedure of the front double A-arm pushrod suspension system for a formula student race car. The type of suspension system used generally is reviewed. The CAD models of the components in the suspension system are made using SolidWorks and the Finite element analysis of the components is done using ANSYS Workbench. Both kinematic and dynamic analysis of the designed suspension system is performed. The results of vibration or ride analysis and roll steer analysis are also presented for the designed suspension system. The method for spring design is elucidated. This work emphasizes the method for designing and analyzing the suspension system for a race car in various aspects.

KameshJagtap, YogeshRathod, AnmayShedge, MitaliGramopadhye, Prof. VivekDiware**[12]** had represented an On-Road Commercial Vehicles in terms of its all-terrain capability due to its large travel and Ride Quality; also it has to face various ground conditions such as mud, ice, rocks, bumpy tracks, etc. Hence it needs to be Robust enough to sustain in such frequently occurring Undulations. Suspension systems of commercial vehicles are designed considering normal road conditions. While designing the suspension system of an ATV, various terrain conditions have to take into consideration. This paper gives a review of suspension systems for ATV.

Prof. Sameer Verma, Parvez Raza **[13]** had represented a very popular and efficient form of the suspension system. It has one control arm and a strut assembly. Coil spring and shock absorber will normally from parts of the strut assembly. Macpherson suspension system is generally used as the front suspension system in passenger cars. Coil spring may be mounted on the control arm instead of being around the strut. On this type, the shock absorber connects the knuckle to the frame. This type of suspension strut is often also used on the rear suspension system. Macpherson strut is set up is still popular in high-performance passenger cars.

Reena Mishra, AnandBaghel**[14]** had represented the significant increase in the research activity on the front wishbone in the last few years, the present article identifies and highlights the various research that is most relevant to the design, analysis, and optimization of the front wishbone suspension system. Present work is focused in the field of the material selection methods, impact load, deformation of the material, stress, weight reduction for ATV vehicle for improving the stability and handling of the vehicle to minimizing the un-sprung mass, better durability and less expensive also. The outcome of the discussed research is intended to give the reader a brief verity of the research carried out on the front wishbone suspension system.

Dongchen Qin, Junjie Yang, Qiang Zhu, Peng Du **[15]** had represented one of the key parts in vehicles, which can directly influence such performances as steering stability and ride comfort. The multi-body dynamics model of multi-purpose vehicles (MPV) front suspension is built with ADAMS/VIEW, and the location parameters of the front wheel are simulated. To improve the kinematics performance and steering stability, the sensitivity analysis and optimization design for the front suspension are carried out. The results can provide some guide and reference for the R&D of the MPV.

Jihui Liang, Lili Xin **[16]** had represented Suspension system transfers force and torque between the wheel and automobile frame, guides, and controls the relative motion of the wheel and automobile body to ease up the impact from the road surface and the shock from attenuation system. Kinematic characteristics of the suspension refer to variation regularities of parameters such as kingpin inclination angle, camber angle, caster angle, and the like when automobile wheels jump up and down, namely, wheels and vehicle bodies have relative movement in the vertical direction. Rational choice of suspension structure and performance parameters has a great and direct influence on the traveling smoothness, steering stability, and comfortableness of the automobile.

P. Nagarjuna, k. Devaki Devi **[17]** had represented the Suspension system of an automobile plays an important role in ensuring the stability of the automobile. Although it has been achieved to a considerable extent, another major aspect of the suspension system is passenger car is luxury. A lot of research is going on in this direction, which led to the development of an independent suspension system. The control arm plays a major role in an independent suspension system. It is generally made of forged steel which has considerable disadvantages such as weight, cost, etc. The project involves the development of sheet metal control arm, which has many advantages over forged metal. The component has been modeled using the curves extracted from the workspace available in PRO-E. This model is translated into a STEP file, which is then retrieved in 'Unigraphics' for analysis. The model is subjected to different load conditions and thus analyzed using Structures P.E solver. The stress and stiffness of the model are studied from the results obtained from the analysis to verify the success of the design.

Mohammad ImanMokhlespourEsfahani, MasoudMosayebi**[18]** had represented Simulation accuracy by recent dynamic vehicle simulation multidimensional expression significantly has progressed and acceptable results not only for passive vehicles but also for active vehicles normally equipped with advanced electronic components is also provided. Recently, one of the subjects that have been considered, is increasing the safety car in design. Therefore, many efforts have been done to increase vehicle stability, especially in the turn. One of the most important efforts is adjusting the camber angle in the car suspension system. Optimum control camber angle in addition to vehicle stability is effective in the wheel adhesion on road, reducing rubber abrasion and acceleration and braking. Since the increase or decrease in the camber angle impacts the stability of vehicles, in this paper, a car suspension system mechanism is introduced that could be adjusted camber angle and the mechanism is an application and also inexpensive. To reach this purpose, in this paper, a passive double wishbone suspension system with a variable camber angle is introduced and then a variable camber mechanism designed and analyzed for study the designed system performance, this mechanism is modeled in Visual Nastran software and kinematic analysis is revealed.

Arvin Niro**[19]** had represented a big part of NASA's curiosity into exploring what is beyond our atmosphere and NASA's rovers have allowed us to do just that. They are equipped with state of the art technology that allows us to see and measure if life can exist elsewhere. In this project, we aim to design and build a suspension system that can be incorporated onto a rover that was constructed last semester at Kapi'olani Community College by Eric Caldwell and Lee Do. This rover features wireless technology and a mecanum drive system that allows it to be extremely maneuverable. However, due to its maneuverability, this generates uncontrollable vibration in the rover. In an attempt to suppress the vibration, a double-wishbone suspension design was used with a spring and damper system to reduce and dampen the vibration generated from the mecanum wheels. The result of this allowed a suspension system to be designed and optimized for this specific rover by utilizing SolidWorks and finite element analysis to decide the overall design of the system.

Dr. Naser LAJQI, Dr. Azem KYÇYKU, Dr. Shpetim LAJQI **[20]** had represented the research methodologies utilized for developing a suspension system for four-wheel-drive terrain vehicles. The main research methods can be identified as literature studies; design processes by applying CAD systems, numerical analysis methods, mathematical modeling and simulation, optimization of the mechanical systems, as well as the comparison, analysis, and evaluation of the obtained results. The proposed suspension system for the terrain vehicle was successfully derived from a classic double-wishbone control arm. Optimization of the suspension parameters for passive ones is performed by Multi-Objective Genetic Algorithms, whilst for active damping force by employing the Hooke-Jeeves non-linear programming method. Based on comprehensive analysis it is shown the active systems are more adequate. The proposed suspension design provides relatively small lateral wheel motion, zero camber angles, and effectively absorbs the vibrations caused by road excitation.

3. OPTIMIZATION OF TAPER SPRING

The simulation and analysis of coil spring were done with different materials. The materials selected were steel structure, copper alloy, and carbon composite. The coil spring was simulated with Solidworks 2020 with specific dimensions which are listed in Table 5.1.

Table 1 The Specification of Taper Spring

No	Specification	Value
1	Outer diameter	135 mm
2	Inside diameter	115 mm
3	Wire diameter	10 mm
4	Free length	160 mm
5	Number of active coils	5
6	Pitch	35 to 8 mm
7	Taper angle	270°

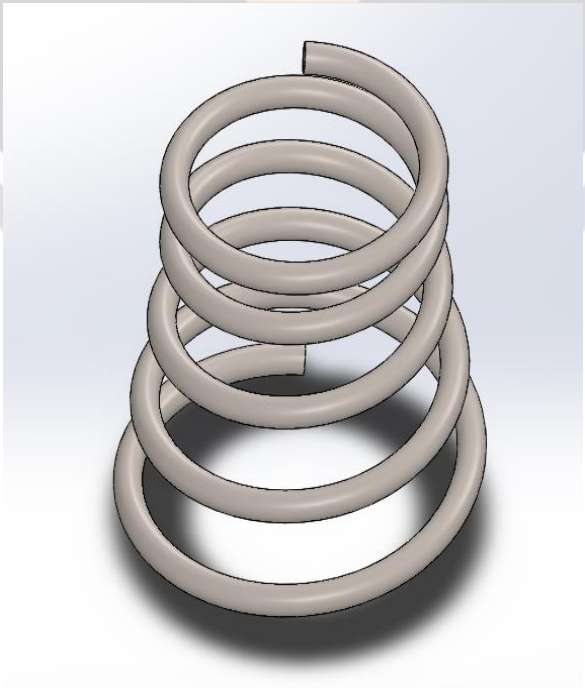

Fig. 1 The Taper Spring

The properties of materials used for producing the coil spring in this paper listed in Table 2.

Table 2 Properties of Material

Materials	Steel Structure	Copper Alloy
Density	7850 kg/m3	8300 kg/m3
Young Modulus	2 X 1011 Pa	1.1 X 1011 Pa
Poisson ratio	0.3	0.34

The numerical analysis was done by using a finite elements analyzer in Solidworks 2020. The spring has meshed with programmed generated mesh with fine meshing. The mesh of taper spring shown in Figure 2.

Fig. 2 The Mesh of Taper Spring

Mesh Information
The mesh type is solid mesh.
Mesher used curvature-based mesh.
Total nodes are 100855.
The total elements are 61482.
The spring was fixed in the bottom end and the load was subjected to the upper end with different values (1500, 2000, 2500) N to get the total deformation, stress, strain, and shear stress. The analysis was carried out with static analysis in Solidworks 2020. The analysis steps could be summarized as the flow chart in Figure 3.

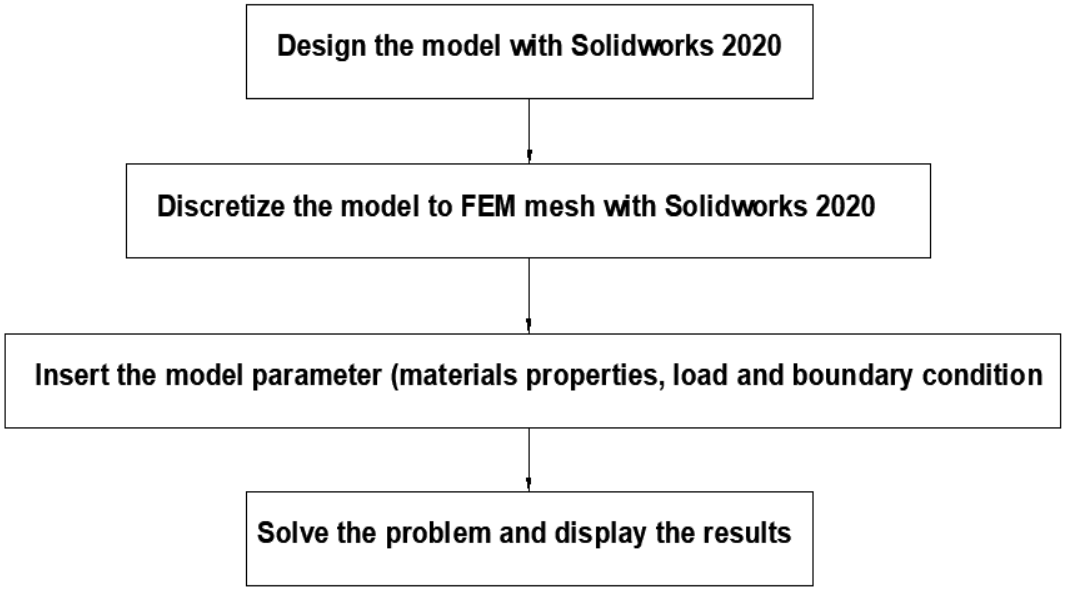

Fig. 3 Flow Chart for Analysis Process

5.2 RESULTS

The total deformation, stress according to von – Mises theory, strain, and shear stress were obtained numerically for the three materials with various values of the load to compare between them and choose the best material that can be used in the production process of the tapered spring in modern automobiles. For the value of load (1500N), the maximum total deformation happened in taper spring made of Steel Structure and it was (167 mm) as shown in Figure 4 below.

Fig. 4 Total Deformation in Spring Made of Steel Structure

While the minimum total deformation happened in spring made of Copper Alloy and the value was (133 mm) as shown in Figure 5 below

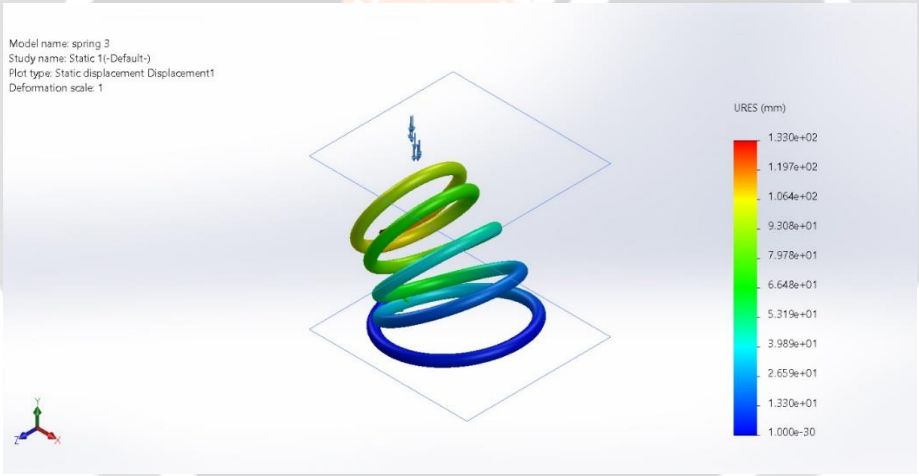

Fig. 5 Total Deformation in Spring Made of Copper Alloy

For the stress, under load (1500N) the maximum stress according to von-mises theory occurred in spring made of steel structure and the value was (1902 MPa) as shown in Figure 6 below.

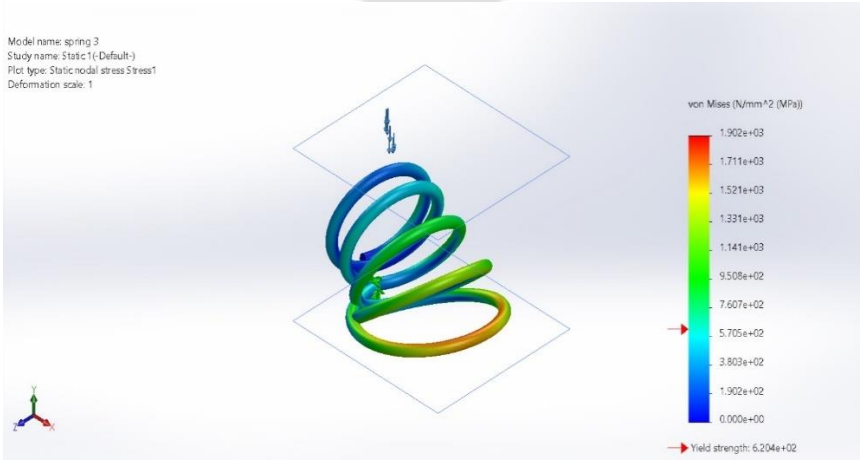

Fig. 6 The Stress in Spring Made of Steel Structure

The minimum value of stress under load (1500) N happened in Copper Alloy with the value (723.2 MPa) as shown in Figure 7.

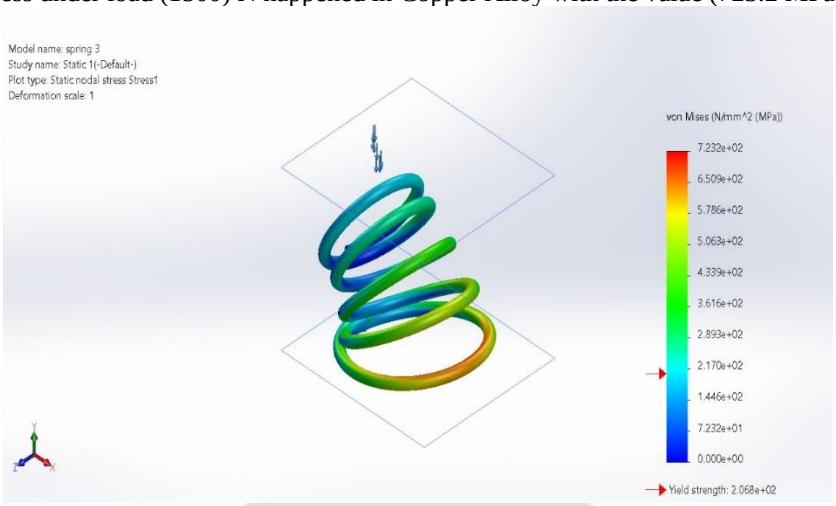

Fig. 7 The Stress in Spring Made of Copper Alloy

For the strain under load (1500N), the maximum strain occurred in spring with copper alloy with value (0.005341mm/mm) as shown in Figure 8 below.

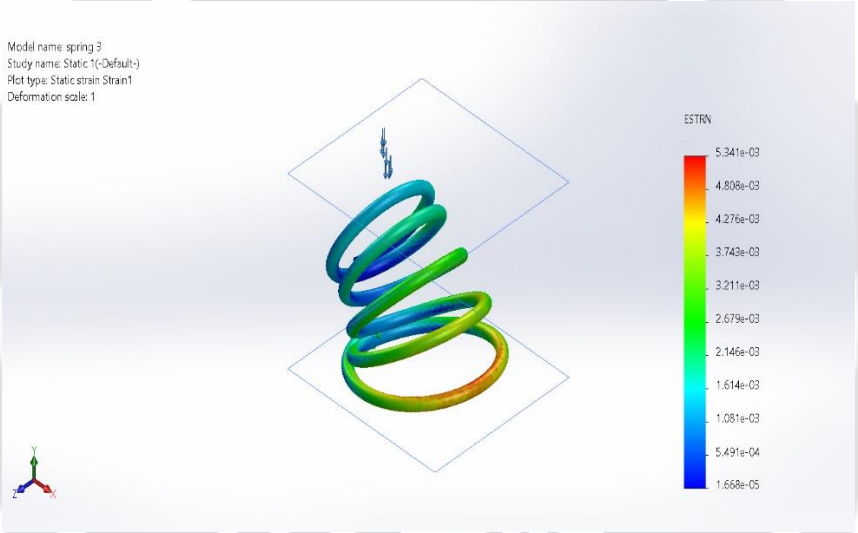

Fig. 8 The Strain in Spring Made of Copper Alloy

The minimum strain occurred in spring made of carbon composite and the value of strain was (0.006849 mm/mm) as shown in Figure 9 below.

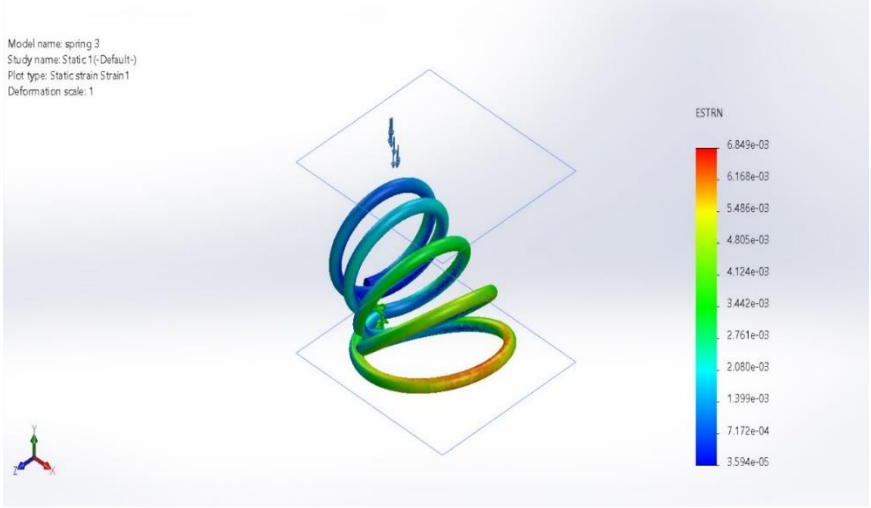

Fig. 9 The Strain in Spring Made of Steel Structure

The results (total deformation, stress, and strain) for different loads (1500) N for the three materials could be summarized in Table 3 below.

Table 3 Result for Load (1500N)

Materials	Load (N)	Total Deformation (mm)	Stress (MPa)	Strain (mm/mm)
Steel Structure	1500	167	1902	0.006849
Copper Alloy	1500	133	723.2	0.005341

The results (total deformation, stress, and strain) for different loads (2000) N for the three materials could be summarized in Table 4 below.

Table 4 Result for Load (2000N)

Materials	Load (N)	Total Deformation (mm)	Stress (MPa)	Strain (mm/mm)
Steel Structure	2000	160.4	1811	0.006520
Copper Alloy	2000	118.8	631.4	0.004667

The results (total deformation, stress, and strain) for different loads (2500) N for the three materials could be summarized in Table 5 below.

Table 5 Result for Load (2500N)

Materials	Load (N)	Total Deformation (mm)	Stress (MPa)	Strain (mm/mm)
Steel Structure	2500	220.6	2650	0.009617
Copper Alloy	2500	109.8	575.4	0.004257

The comparison of total deformation at various values of load for the two materials shown in Figure 10.

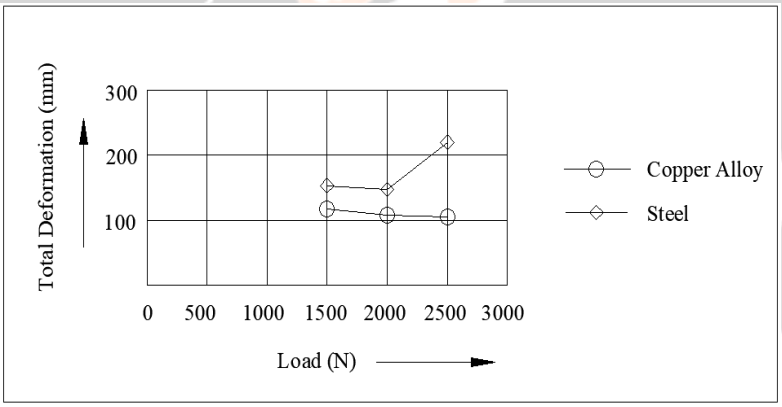

Fig. 10 Total Deformation (mm) vs. Load (N)

The comparison of stress at various values of load for the two materials shown in Figure 11.

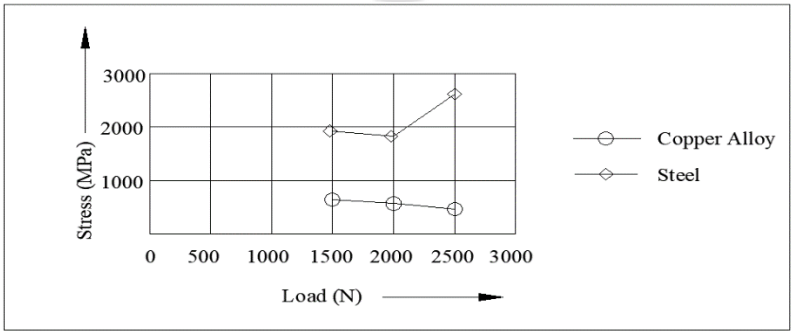

Fig. 11 Stress (MPa) vs. Load (N)

The comparison of strain at various values of load for the two materials shown in Figure 12.

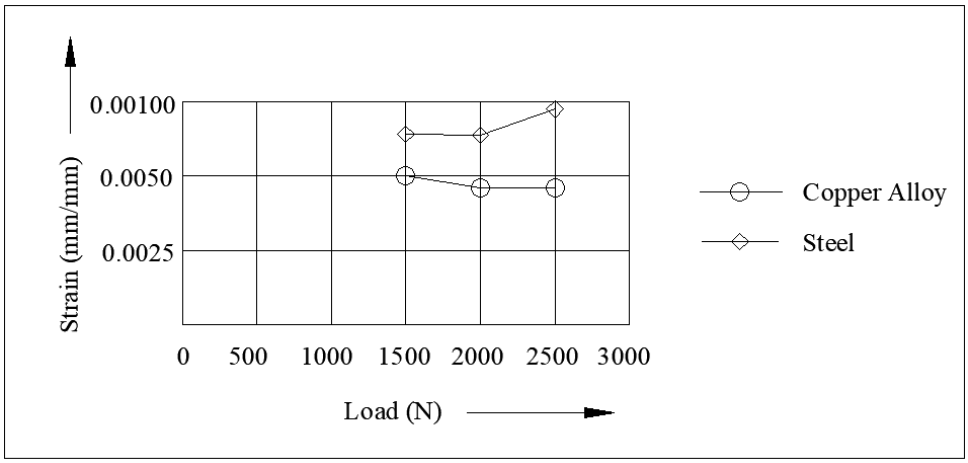

Fig. 12 Strain (mm/mm) vs. Load (N)

CONCLUSION

In this study, the simulation and analysis of tapered spring which is the main part of the suspension system in modern vehicles were carried out by using Solid works 2020. Two different materials were chosen to manufacture the spring under various values of the load. The results showed that the less value of total deformation happened in spring made of copper alloy for all the values of the load. The deformation reduced by 20% in copper alloy comparing with the deformation in the steel. The deformation, strain, and stress increased by increasing the load in case of steel material. It could be concluded that the copper alloy is the suitable material to fabricate the tapered spring in the suspension system in automobiles.

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A Review Paper on Vibration Monitoring of Lathe

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Abstract

In any machining operation vibration is frequently problem, the vibration signatures for different arrangement are recorded to determine the dynamic characteristics of the system,. These vibration signatures are analyzed to determine causes of inaccuracy in the manufacturing process and faulty components. Many condition monitoring techniques are available to monitor the machine experimentally. Among these techniques vibration monitoring is the most widely used technique because most of the failures in the machine tool could be due to increased vibration level. Experimental vibration analyses are conducted for a lathe system to detect the possibility of faults and to develop accurate cutting process. Experiments are carried out using the condition monitoring instrument Accelerometer to measure vibration severity for different cutting speed, depth of cut, feed rate for different work piece material.

Keywords: *Machine conditioning monitoring, Accelerometer, DAQ, Lab view.*

I. INTRODUCTION

Approximately half of all operating costs in most processing and manufacturing operations can be attributed to maintenance. This is ample motivation for studying any activity that can potentially lower these costs. Machine condition monitoring is one of these activities Condition monitoring of machinery is the measurement of various parameters related to the mechanical condition of the machinery (such as vibration, bearing temperature, oil pressure, oil debris, and performance), which makes it possible to determine whether the machinery is in good or bad mechanical condition. If the mechanical condition is bad, then condition monitoring makes it possible to determine the cause of the problem. The modern trend of machine tool development is required to produce precise, accurate and reliable product which are gradually becoming more prominent features. In a machining operation, vibration is frequent problem, which affects the machining performance and in particular, the surface finish and tool life. Severe vibration occurs in the machining environment due to a dynamic motion between the cutting tool and the work piece. The monitoring of manufacturing processes and equipment conditions are the essential part of a critical strategy that drives manufacturing industries towards being leaner and more competitive. Many sensors were used for tool condition monitoring system namely; touch sensors, power sensors, vibration sensors, temperature sensors, force sensors, vision sensors, flow sensors, acoustic emission sensors and so on. All operating machines, having rotary and/or reciprocating parts give rise to vibration. Machine tools are liable to deterioration in their performance level. With respect to time due to various causes such as wear and tear, ageing, unbalance, looseness of parts etc., and produce a corresponding increase of the vibration level. Machine tool vibration, if uncontrolled, can adversely affect the surface finish, dimensional accuracy and tool life. About 70% of the failures in the machine tool could be due to increased vibration level of the machine. Lathe is one of the most important machine tool in manufacturing industries. The extraction of vibratory signatures can be a valuable diagnostic tool to predict impending failures of the bearing and tool post. In all the cutting operations like turning, boring and milling, vibrations are induced due to the deformation of the work piece, machine structure and cutting tool. Today, the standard procedure adopted to avoid vibration during machining is by careful planning of the cutting parameters and damping of cutting tool.

II. TYPES OF CONDITIONING MONITORING TEQNIQUE

There are two types of Conditioning Monitoring System.

1) Periodic monitoring
2) Permanente monitoring

A. Periodic monitoring

In a periodic monitoring system (also called an off-line condition monitoring system), machinery Vibration is measured (or recorded and later analyzed) at selected time intervals in the field, then an analysis is made either in the field or in the laboratory. Intermittent monitoring provides information at a very early stage about incipient failure and usually is used where,

1) Very early warning of faults is required,
2) Advanced diagnostics are required,
3) Measurements must be made at many locations on a machine,
4) Machines are complex.

B. Permanent monitoring

In a permanent monitoring system, transducers are mounted permanently at each selected measurement point. For this reason, such a system can be very costly, so it is usually used only in critical applications where:
No personnel are available to perform measurements (offshore, remote pumping stations, etc.).

1) It is necessary to stop the machine before a breakdown occurs in order to avoid a catastrophic accident,
2) An instantaneous fault may occur that requires machine shutdown, and
3) The environment (explosive, toxic, or high- temperature) does not permit the human

Involvement required by intermittent measurements.

III. CONDITION MONITORING TECHNIQUE

1) Vibration monitoring – this is the most commonly used and effective technique to detect internal defects in rotating machinery.
2) Acoustic emission monitoring – this involves detection and location of cracks in bearings, structures, pressure vessels and pipelines.
3) Oil analysis – lubrication oil is analyses and the occurrence of certain microscopic particles in it can be connected to the condition of bearings and gears.
4) Particle analysis – worn machinery components, whether in reciprocating machinery, gearboxes or hydraulic systems, release debris. Collection and analysis of this debris provides vital information on the deterioration of these components.
5) Ultrasonic monitoring – this is used to measure thickness of corrosion or crack on pipelines, offshore structures, pressure vessels.
6) Thermography – this is used to detect thermal or mechanical defects in generators, overhead lines, boilers, misaligned coupling and cell damage in carbon fiber structures on aircrafts.
7) Performance monitoring – this is used to determine the performance problems in equipment. The efficiency of machines provides a good inside on their internal conditions

In this review paper mainly focused on Vibration monitoring on lathe machine.

LITERATURE REVIEW

Nidhi gupta, sawan arya, nitin rai [1] were carried out experiment on center lathe machine measured vibration using conditioning monitoring instrument vibrometer. They were measure vibration in axial and tangential direction at three level of cutting speed, feed rate, and depth of cut. then they were plotted Graff between R.M.S value and feed rate at different cutting speed for different depth of cut in both the direction for two different tool material carbon tool and diamond tool and indicate that increase in above parameters, there is a continuous increase in cutting tool vibration value. With the help of vibration data the optimum condition of parameter for running the machinery can be identify and increased tool life by reducing vibration. They were also concluded vibration level is increased in diamond tool as compare to carbon tool.

Dr.Pratesh jayaswal, Nidhi gupta [2] in this paper they were carried out experiment on center lathe machine measured vibration using vibrometer. they were measure vibration in axial and tangential direction at tool post and Bering, vibration signal collected through vibrometer data acquisition system they were varied parameter at four level and plotted graph between r.m.s value verses feed rate at different spindle speed and at depth of cut finally they were conclude that the parameter which is highly affect the vibration is cutting speed then depth of cut and then feed rate. The optimal condition for working on centre lathe machine is cutting speed of 230-350 rpm, feed rate of 0.1-0.2 mm/rev and depth of cut up to 1 mm so it is not advisable to work on high cutting speed, feed rate and more depth of cut because it directly affect the tool life it also shows that vibrations at bearing and in tangential direction are highly occurred comparatively at tool post and in axial direction.

Jagdish.M.S,H.VRavindra[3] studied that the Finite Element Method to study the effect of defective spindle bearing and unbalance forces on the vibration characteristics of the lathe structure by performing Eigen value, frequency response and transient dynamic analysis. Experiments were carried out to determine the vibration velocity level on the headstock both at the front and rear bearing. plot the graph vibration velocity verses spindle speed and then Experimental results were compared with the theoretical results and conclude that Transient dynamic analysis showed that the vibration velocity level increases as the damage in the outer race increases. It was also found that the vibration velocity level depends upon the location of the defect. The value of vibration velocity obtained from frequency response analysis considering unbalance force is lower compared with the experimental value because in actual practice, the various effects like vibration due to belt tension fluctuations, gear tooth frequencies at the mating gears, defects in bearing and due to unbalance rotors were also included. From the experimental analysis, it was found that vibration velocity increases with the increase of spindle speed. Hence the theoretical results are agreement with experimental results. The present work shows that the FEM is a valuable tool in finding sources of increased or undesirable vibrations from various defects. Thus Finite Element Analysis is not only helpful during the development of new structures but also helpful to analyze the existing lathe structure under given circumstances.

S.s abhutakeer p.v mohnram g.mohan kumar[4] In this paper, Experiments were conducted on CNC lathe using CCGT-0930FL carbide turning insert, machining variables such as cutting tool vibration in tangential and axial direction were measured in CNC machining processes based on the vibration signal collected through a Lab VIEW data acquisition system and controlled by using Viscoelastic material (VEM) neoprene. The effect of cutting parameters such as cutting speed, depth of cut and feed rate on machining variables is evaluated. The testing result showed that the developed method was successful.

Julie and Joseph [5] have been trying to demonstrate tool condition monitoring approach in an end-milling operation based on the vibration signal collected through a low-cost, microcontroller-based data acquisition system.

Marlon C. Battery and Hamid R. Hamidzadeh [6] has done analytical and experimental vibration analyses for a lathe system to detect the possibility of faults and to develop an accurate cutting1process.the vibration signatures were analyzed to determine cause of inaccuracy in the manufacturing process and faulty components. Problem causing components for several case studiers (different speeds feed rate and tool lengths) were identified.

Kirby and Chen [7] the researchers determine mean amplitude of vibration using accelerations in both directions along the axes.

Tasks [8] have proposed the On-line vibration control system for turning operation uses a closed loop Feedback circuit which measures the relative vibration between the cutting tool and the work piece. There have been many investigations on vibration prediction and controlling based on periodic measurements of various machining conditions using accelerometer and active vibration controller.

Choudhury et al [9].has developed a computer program using Visual Basic programming language in order tana-alyze one and two degree of freedom of machine toolch-atter vibrations.

Vinay.V.N [10] was studied that The mass correction effected on the Motor-spindle assembly for the purpose of

unbalance correction should not be altered in any manner. Doing so would alter the balance quality achieved. Any change in the rotating mass of Motor-spindle assembly will change the balance quality achieved.

S.Saravanan, G.S.Yadava and P.V.Rao [11] In this study, critical subsystems and components have been identified for lathes using failure data. The application of condition monitoring techniques like vibration, acoustic emission (AE) and surface roughness monitoring have been successfully implemented for diagnosing faulty bearings in a lathe. they were conclude that Headstock subsystem is critical because it faces a longer downtime and frequent failures of components like spindle bearings and gears For defective bearing conditions, overall vibration levels at headstock spindle beatings are higher than those in defect free lathes. This increase in vibration level is much greater at higher feed and depth of cut values. For defective beating conditions, significant peaks at the beating fault frequencies are observed. Larger sized contamination particles increase surface waviness considerably. As a result, the vibration level increased considerably at larger particle sizes. AE levels show an increasing trend with an increase in feed rate and depth of cut. For defective bearing conditions, AE levels are higher than those measured under healthy conditions. The increase in AE levels is much greater for higher values of feed and depth of cut. For defective bearing condition, surface roughness value increases sharply.

Robert X. Gao[12] Extensive research over the past decade has turned neural networks into an indispensable tool for solving a wide range of problems in both scientific labs and on the factory floor. In the specific areas of machine condition monitoring, fault diagnosis, and remaining service life prognosis, neural networks will play an increasingly important role, and its ability will be continually enhanced through other innovative and complementary technologies. Research is continuing in the author's group, with the ultimate goal to develop effective and efficient bearing condition monitoring and diagnostic techniques that can be applied to solving real-world problems.

Amit R Patel [13] in this paper Test rig for vibration monitoring of bearing have been designed. The design of test rig includes design of Shaft, Bearing selection, pedestal selection, motor selection, and base preparation. A 3-D model have been developed using Pro-engineer modeling software. The vibration signals generated by the healthy/faulty bearing can be captured by the accelerometer mounted on the test bearing. The analysis of the vibration signal is useful for the condition monitoring of rolling Element bearings.

Sutej Reddy Dr. S. P. Gupta, Dr. Vinod Kumar [14], in this paper a remote condition monitoring system has been developed using Lab VIEW. This developed system enables the transfer of the digital data simultaneously from the plant location to the several remotely placed control stations through internet or any other transmission networks like LAN, WAN e.tc. Particular attention has been paid to the wavelet analysis of the vibration signal for demonstrating the condition monitoring of the induction motor. The developed system has been tested for the bearing fault identification of the Laboratory test motor. A key feature of this work is the development of the sophisticated GUI at the server and the client locations thus facilitating the operators at both the ends with not only customized and user friendly but also efficient remote condition monitoring system.

CONCLUSION

From the above study we can conclude that lots of works have already been done in the area of vibration measurement. All experiment done using the same material of work piece to find the optimum machining parameter. Further study can be done on Lathe machine measuring vibration for different work piece material by putting NI instrument Accelerometer at tool post Which is connect to Portable data acquisition system(DAQ) Which is supported by Lab view software And can calculate optimum condition of lathe machine for working on different work piece material.

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"An investigation and analysis of abrasive water jet cutting process for maraging steel using response surface methodology"

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ABSTRACT: Abrasive water jet cutting is a cutting process which in which abrasive particles are entrained into a jet of water which is accelerated to high velocities by use of pressures normally in excess of 130MPa.The particle-laden water jet impinges onto the surface of the work piece and material is removed by an erosion process. Maraging 300 grade steel is widely used in aerospace and tooling sector because of practical application. It have excellent properties like medium to high carbon material as it doesn't endure issues like high carbon content advancing the erosion or furthermore, making the break. This study investigates the effect of process parameter (like travel speed, abrasive mass flow rate, standoff distance and pressure) on the kerf width, material removal rate and surface roughness. The analysis of variance (ANOVA) and regression models will be developed based on experimental results. In this study, the multi objective optimization has been carried out to find optimal process parameter.

While studying the effect of the process parameters on the material removal rate, it was observed that cutting speed, standoff distance, pressure and abrasive mass flow rate, square effect of abrasive mass flow rate are the influencing parameter.it has been found that standoff distance, square effect of stand of distance are the influencing parameter for kerf width.

The grey relational analysis have suggested the optimum process parameters value of traverse speed of 100 mm/min, 200 gm/min of abrasive mass flow rate, 1 mm of standoff distance and 400 Mpa of pressure. From the confirmation test, it has been found that the suggested model is very excellent in terms of accuracy.

KEYWORDS: Abrasive Water Jet Machine (AWJM), Surface roughness, Material removal rate, Kerf width, Grey Relational Analysis (GRA), Regression.

I. INTRODUCTION

Abrasive Water Jet (AWJ) machining is non traditional or non conventional machining process. Mechanical energy of water and abrasive phases are used to achieve material removal or machining. Profitable technique and can be more competitive than laser cutting if several cutting heads are used. New machining technology in that it makes use of the impact of abrasive material to erode the work piece material. Maraging steel is offering an appealing alternative to the medium to high carbon material as it doesn't endure issues like high carbon content advancing the erosion or furthermore, making the break.

There are many advantages of this such as Cut virtually any material & are very safe extremely fast setups and programming, Very low side forces during the machining, No heat generated on the part, Machine thick plates, Capital cost is low, Clean cutting process without gasses or oils.

Abrasive Water Jet Cutting process applied on many industries like Paint removal, Cleaning, Cutting soft material, Textile & leather industry, Cutting, Drilling, Turning, Pocket milling.

[1] Radovanovic, (2020) has investigated the abrasive water jet cutting process with help of cutting various types of material and thickness of it. For that, it has been used various input parameter like water pressure, water flow rate, orifice diameter, nozzle diameter, abrasive mass flow rate, traverse speed and standoff distance. In order to conduct study, it had used carbon steel S235 as a

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material; also applying the multi objective optimization to find optimal process parameter for productivity and operating cost. It had considered three constrain like perpedicularity tolerance, surface roughness limit and traverse speed for separation cut. It has revealed that optimal process parameter at 6.5 mm thick: traverse rate vf=127 mm/min, abrasive flow rate ma=300 g/min and standoff distance h=1 mm. they have concluded that machining time needed to produce a unit of cut surface is t=7.266 s/cm2 (productivity is Q=8.258 cm2/min) and operating cost per meter of cut is C=2.048 EUR/m.

[2] Schwartzentruber, Spelt, & Papini, (2017) have used three dimensional techniques to predicate the surface roughness while cutting of composite material by abrasive water jet cutting process. They have revealed that individual particle of abrasive material would be generated crater which one was follow by the multi particle impact profile in case of two dimensional model for said study. In case of three dimensional model, it can be concluded that the conical crater has been developed until steady surface roughness found. At the end of study. It has been found that average error of 10 % and 16% were found for the 2D & 3D models respectively.

[3] Ravi Kumar, Sreebalaji, & Pridhar (2018) have conducted researched based on the aluminium/ tungsten carbide composites by abrasive water jet cutting process. For that, they have fabricated composite material by using various sizes (like 2, 4, 6, 8 and 10 wt% tungsten carbide) of tungsten carbide. They have used response surface methodology to investigate the said process. They have varied speed of cutting, stand-off distance and percentage of carbide in material to optimize the material removal rate and surface roughness. They have found that the surface roughness is being varied by the carbide content in material. They have seen the breaks, bulge of the tungsten carbide and voids in the material while microstructure examination. Multi Response Optimization dependent on attractive quality is utilized to assess the arrangement of information measure boundaries to increase material removal rate and limiting surface roughness. They have concluded that optimal process parameter are following: standoff distance 4.22mm, cross over speed-223.28 mm/min, and rate tungsten carbide- 2.10%.

[4] Tudor & Andrea, (2013) have carryout the study for optimisation of abrasive jet cutting by means of taguchi methods. They have been influenced the process parameter like jet pressure, feed speed, stand-off distance, abrasive graining, mass flow, etc. The roughness of the machined surfaces and the thickness of the cut part are output quantities of the system, their values depending on the input parameters and the influence of various disturbing factors (noises). They obtained surface roughness consequently to abrasive jet cutting. By assigning these optimum set points to the input quantities the machining system becomes robust, and consequently the roughness of the machined surfaces will not deviate from the desired and predicted value.

[5] Narayanan, Balz, Weiss, & Heiniger, (2013) have developed the model of abrasive particle energy in water jet machining. They took process parameter with wide variations in cutting-head geometry, operating pressure, and abrasive mass flow rates. The cross-sectional averaged abrasive particle velocity at the exit of the focussing tube has been predicted with good accuracy over the whole range of experiments.

[6] Begic-Hajdarevic, Cekic, Mehmedovic, & Djelmic, (2015) have investigated on surface roughness through effects of material thickness, traverse speed and abrasive mass flow rate during abrasive water jet cutting of aluminium. They show that traverse speed has great effect on the surface roughness at the bottom of the cut. They discussed the correlation between the surface roughness and other abrasive water jet cutting variables. The surface being cut by the abrasive water jet was characterized by two types of surface texture. The first texture was located at the beginning of the cut and was characterized by the smooth surface. The second texture was located at the bottom of the cut and was characterized by the rough surface. They suggested optimal solution is the choice of medium traverse speed with which can be achieved higher productivity with acceptable surface roughness.

Problem definition

Facing problem like higher surface roughness of machined surface, lower material removal rate, taper of cutting as well as the kerfwidth in the plate, Kerf taper, the wear of nozzle, limited machining capability.

Confused about following problem.

- How thick is the metal want to cut?
- Traditional way of cutting takes a lot of time.
- The most important factors that influence the cutting process?
- What type of material is to cutting?
- What are the best conditions to achieve optimum performances?

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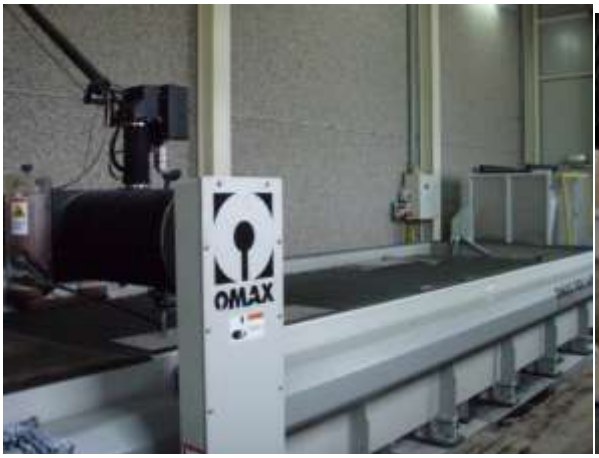
II. EXPERIMENTAL SETUP AND DETAILS



The equipment used for machining the samples will Abrasive Water Jet Machine of model 2626 OMAX Jet Machining Centre equipped with OMAX High- Pressure Pump with the design pressure of 345MPa (50,000 psi) and the nozzle diameter was 0.75mm. The OMAX variable speed, high-pressure pump is an electrically driven, variable speed, positive displacement, crank shaft drive triplex pump designed for use with the OMAX precision jet machining system and other applications requiring high pressure water required by the OMAX jet machining system to operate. The pump control panel provides a keypad display screen, and pumps start/stop controls. When the pump is attached to an OMAX jet machining centre, controls sheared between the Jet machining centre controller and the pump.

Maraging steel is offering an appealing alternative to the medium to high carbon material as it doesn't endure issues like high carbon content advancing the erosion or furthermore, making the break. These may be answerable for the startling disappointment of the part or the durability. The low carbon substance of maraging steel diminishes the danger of unpredicted failure. Generally, the maraging steel are widely popular in die and mould making industries as aforesaid reasons. Moreover, the H13, P20 steel is used to make the die and mould, but it have high carbon percentage which leads aforesaid problem. The application of the maraging steel does not limit upto the tooling industries, but it also widely used in aerospace and automotive sector as has excellent corrosion resistance and high remarkable mechanical properties[7]-[9]. Experimental specimens having dimension 850mm X 150mm x 14mm have been prepared for the experimental work. The material for test specimen is maraging steel 300 grades.

Table 2.1 Chemical composition of maraging steel 300 grade.

Element	Grade 300
Iron	Balance
Nickel	**18.0-19.0**
Cobalt	8.5-9.5
Molybdenum	4.6-5.2
Titanium	0.5-0.8
Aluminum	0.05-0.15

Process parameters:

The process parameters include parameters relating to the forming of the AWJ. These parameters can be sorted into four following sub-groups :

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1. Hydraulic parameters including water pressure and orifice diameter.
2. high pressure water
3. orifice abrasive supply mixing chamber focusing tube

-Mixing parameters including focusing tube (or nozzle) diameter and focusing tube length.

Abrasive parameters including

1. abrasive material,
2. abrasive particle size,
3. abrasive shape, and
4. abrasive mass flow rate.

Cutting parameters including

1. standoff distance,
2. impact angle,
3. traverse rate and
4. number of passes.

III. METHODOLOGY

3.1 Design of experiment

Design of experiment is powerful way to deal with limit the quantity of analyses yet separate all the information about the reliance of result on the procedure boundaries. It is basic to follow a methodology of experimentation where input boundaries of procedure might be fluctuated all the while to contemplate their impact on the procedure yield. The connection among yield and at least one info process boundaries might be direct or non straight in nature. The choice of structure of trials relies upon the straight or the non-direct nature of the procedure. The information about nature of variety is important to sort the issue either as straight or non-direct [10].

3.2 Analysis of variance (ANOVA)

The aim of this research, to analyzed the output response parameters like MRR (mm^3/min), Surface roughness (µm), Kerf width (mm) by Considering Traverse speed (mm/min), Abrasive mass flow rate (gm/min), Stand-off distance(mm), Pressure (MPa) as input parameters for VCR engine. The corresponding response parameters were noted, when experiments are carried out as per the run order of the minitab-17 input parameters given by Box behnkhen method. The model was analyzed by using Analysis of variance (ANOVA). RSM was used for optimized output parameters with highest desirability.

3.3 RSM Methodology

There are four types of design experiments such as Factorial, Response surface, mixture and Taguchi in Minitab. Minitab provides analytical and graphical tools to help understand the results after the following steps to crate, analyze, and graph of experimental design.

Response surface methodology (RSM) is a collection of mathematical and statistical techniques that are useful for the modeling and analysis of problems in which a response of interest is influenced by several variables and the objective is to optimize response. In practice the requirement of RSM for to chose the sample point such that the sufficient accurate model can be generated with the minimum number of experiments. Response Surface Method is used to examine the relationship between a response and a set of quantitative experimental variables or factors.

3.4 Determination of independent variables and their levels

Select the parameters (variable) that have major effects on output. The levels of the parameters are determined. All variable will be tested over the same range. Range of the variable are forced between the ranges of coded variable -1 to 1. Equation of coding is given below:

$$X = (x-[x_{max}+x_{min}]/2)/([x_{max}-x_{min}]/2) \quad \ldots\ldots(1.1)$$

Where, X = coded variable

x = natural variable

xmax ,xmin = maximum and minimum values of the natural variable.

3.5 Box-Behnken Method

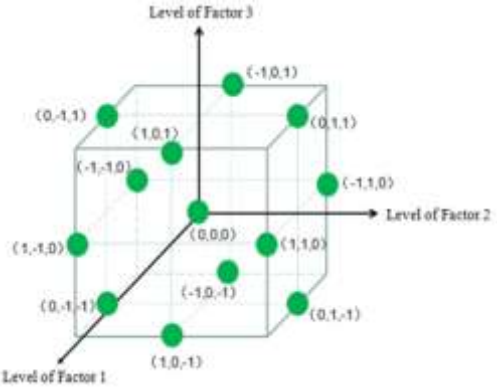

Figure 3.1 Box–Behnken designs for three factors

Appeared differently in relation to the CCD, this structure has preferences. The three-factor BBD requires just 12 test runs with notwithstanding the repeats at the inside point, while its CCD has 14 non-focus focuses. Generally speaking, the amount of test focuses is given by $2k(k-1) + nc$ (where, k= no. of factor and nc = runs at focus). Similarly, each factor is learned at only three levels, with some critical highlights in some exploratory circumstance. While, using $\alpha = 1$ out of a CCD also achieves three levels for each factor. In

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most certified applications, these differentiations are apparently not unequivocal in making sense of which configuration to use, in any occasion for this number of variables. In various sensible assessments that require RSM, specialists are inclined to require three fairly scattered levels. Thusly, the BBD is a beneficial decision and point of fact an imperative differentiating choice to the CCD (Yang, 2008). Note that the Box–Behnken plan (BBD) is very equivalent in various structure focuses to the CCD for k = 3 and k = 4. (There is no BBD for k = 2). For k = 3, the CCD contains 14+ nc runs while the BBD contains 12+ nc runs. For k = 4 the CCD and BBD both contain 24+ nc structure points. In BBD, just three degrees of procedure boundary have been required to run the investigation, likewise there is no focuses lie on the vertices of the trial region. This is the fundamental trait of the BBD techniques [11], [12], [12]–[14].

Box-Behnken structures never incorporate runs where all elements are at their extraordinary setting, for example, the entirety of the low settings, in contrast to focal composite plans. Besides, In Box-Behnken structure there are less plan focuses than focal composite structures which brings about more affordable to run with a similar number of variables. Response Surface strategies are utilized to look at the connection between at least one reaction factors and a lot of quantitative exploratory factors or factors. These strategies are frequently utilized after distinguished the significant controllable variables and to discover the factor choice that upgrades the reaction [15], [16].

Table 3.1 - Range of process parameter

Parameters	Unit	Level 1	Level 2	Level 3
Traverse speed	Mm/min	100	150	200
Abrasive mass flow rate	g/min	200	250	300
Stand off distance	Mm	0.5	0.75	1
Pressure	Mpa	300	400	500

Table 3.2 Box-Behnken design for experiment work in actual foam

Sr. no.	Traverse speed	Abrasive mass flow rate	Stand off distance	Pressure
1.	100	200	0.75	400
2.	200	200	0.75	400
3.	100	300	0.75	400
4.	200	300	0.75	400
5.	150	250	0.50	300
6.	150	250	1.00	300
7.	150	250	0.50	500
8.	150	250	1.00	500
9.	100	250	0.75	300
10.	200	250	0.75	300
11.	100	250	0.75	500
12.	200	250	0.75	500
13.	150	200	0.50	400
14.	150	300	0.50	400
15.	150	200	1.00	400
16.	150	300	1.00	400
17.	100	250	0.50	400
18.	200	250	0.50	400
19.	100	250	1.00	400
20.	200	250	1.00	400
21.	150	200	0.75	300
22.	150	300	0.75	300
23.	150	200	0.75	500
24.	150	300	0.75	500

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25.	150	250	0.75	400
26.	150	250	0.75	400
27.	150	250	0.75	400

3.6 Performance characteristics

3.6.1 Surface Roughness

Roughness is a measure of the texture of a surface. It is quantified by the vertical deviations of a real surface from its ideal form. If these deviations are large, the surface is rough; if they are small the surface is smooth. Roughness is typically considered to be the high frequency, short wavelength component of a measured surface. Surface roughness normally measured. Roughness plays an important role in determining how a real object will interact with its environment. Rough surfaces usually wear more quickly and have higher friction coefficients than smooth surfaces (see tribology). Roughness is often a good predictor of the performance of a mechanical component, since irregularities in the surface may form nucleation sites for cracks or corrosion. In this thesis, the average surface roughness is measured and calculated. The average surface roughness is the integral of the absolute value of the roughness profile height over the evaluation length and is denoted by the following equation [17], [18].

$$Ra = \frac{1}{L\int_0^L Y(x)dx}$$

Where L is the length taken for observation, and Y is the ordinate of the profile curve.

Fig 3.2 Surface roughness tester

Table 3.3 Specification of surface roughness tester

Manufacturer	Mitutoyo SJ210
Travelling length	01mm to 50mm
Force	4Mn
Stylus	Diamond 2µm tip radius
LCD dimension	36.7 X 48.9 mm
Mass	500g

3.6.2 Kerf Width

Kerf width is one of the important performance measures in WEDM. Kerf width is the measure of the amount of the material that is wasted during machining. It determines the dimensional accuracy of the finishing part. The internal corner radius to be produced in WEDM operations are also limited by the Kerf width [19], [20]. The setup for the kerf width is shown in fig. 3.3. the technical specification of the profile projector as per table 3.4.

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Fig 3.3 profile projector

Table 3.4 specification of the profile projector

Item	Specification
Optical Head	45º inclined Monocular Head; Rotatable
Stage	60mm black/white stage plate and paired clips
Focuser	Rack and Pinion
Objective	4x; Working Distance 58mm
Eyepiece	10x; 18mm

3.6.3 Material removal rate

The material removal rate can be defined as the volume of material removed divided by the machining time. Material Removal Rate (MRR) is defined by following formula [21], [22].

$$MRR = (Wi - Wf) / (\rho w T)$$

Where,

Wi = initial weight of work piece (g)

Wf = final weight of work piece material (g)

T = cutting time(s)

ρw = Work piece density (g/ mm3)

Fig.3.4 Digital weighting scale

Table 3.5 Specification of the Digital weighting scale

Max. Capacity	210g
Readability	0.0001g
Repeatability	0.0001g
Linearity	0.0003g

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Adjustment weight internal	No
Adjustment weight external	200g

IV. RESULT

The experimental result, effect of process parameter like Traverse speed (mm/min), Abrasive mass flow rate (gm/min), Stand-off distance (mm) and Pressure (MPa) on the responses like material removal rate, surface roughness and kerf width. Analysis of various table for the aforesaid response.

Table 4.1 Experimental Readings

Column	Define
A1	Sr. no
A2	Traverse speed (mm/min)
A3	Abrasive mass flow rate (gm/min)
A4	Stand-off distance(mm)
A5	Pressure (MPa)
A6	MRR (mm^3/min)
A7	Surface roughness (µm)
A8	Kerf width (mm)

A1	A2	A3	A4	A5	A6	A7	A8
1	100	200	0.75	400	5.38	6.34	1.28
2	200	200	0.75	400	5.52	2.34	1.30
3	100	300	0.75	400	5.55	2.40	1.31
4	200	300	0.75	400	5.60	3.50	1.26
5	150	250	0.50	300	5.11	2.57	1.27
6	150	250	1.00	300	5.37	3.91	1.56
7	150	250	0.50	500	5.45	3.46	1.25
8	150	250	1.00	500	5.49	2.94	1.56
9	100	250	0.75	300	5.22	4.56	1.28
10	200	250	0.75	300	5.55	4.06	1.27
11	100	250	0.75	500	5.50	3.03	1.27
12	200	250	0.75	500	5.61	2.70	1.28
13	150	200	0.50	400	5.20	4.51	1.23
14	150	300	0.50	400	5.37	2.30	1.24
15	150	200	1.00	400	5.58	3.87	1.65
16	150	300	1.00	400	5.70	2.12	1.57
17	100	250	0.50	400	5.11	4.08	1.25
18	200	250	0.50	400	5.45	3.84	1.27
19	100	250	1.00	400	5.35	4.51	1.56
20	200	250	1.00	400	5.59	4.29	1.53
21	150	200	0.75	300	5.54	3.97	1.27
22	150	300	0.75	300	5.44	3.57	1.20
23	150	200	0.75	500	5.24	3.40	1.22
24	150	300	0.75	500	5.90	2.35	1.25
25	150	250	0.75	400	5.43	4.43	1.24
26	150	250	0.75	400	5.44	4.44	1.24
27	150	250	0.75	400	5.44	4.42	1.25

4.2 Main effect of input parameter on the response

In this section, it has been discussed the effect of various input parameter like Traverse speed (mm/min), Abrasive mass flow rate (gm/min), Pressure (MPa) and Stand-off distance (mm)on the targeted response like material removal rate, surface roughness and kerf width.

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4.2.1 Main Effects Plot of material removal rate

The main effects plot for material removal rate versus Traverse speed (mm/min), Abrasive mass flow rate (gm/min), Pressure (MPa) and Stand-off distance (mm)is shown in fig.4.2, which is generate from the value of material removal rate as per table 4.1 in minitab-17 statistical software. It is useful to find out optimum parameter value for response variable. Fig. 4.2 shows that high material removal rate will meet at transverse speed 200 mm/min, 300 gm/min of abrasive flow rate, 1 mm of stand of distance and 500 Mpa of pressure. The graph generates by use of minitab-17 statistical software for material removal rate is shown in fig. 4.2

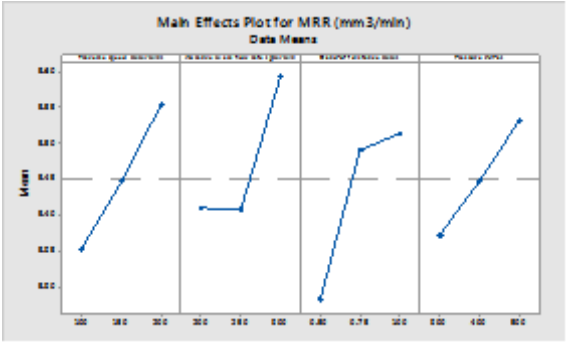

Fig. 4.2 Effect of control factor on material removal rate

From the fig. 4.2, it has been concluded that the optimum combination of each process parameter for high material removal rate is meeting at high cutting speed[A3], high abrasive mass flow rate [B3], high standoff distance[C3] and high pressure [D3].

This aforesaid combination is representing the single objective response optimization where material removal rate is getting higher without considering other response. The reason behind this optimum process parameter has been discussed here. It very well may be seen that the Width of the grating plane progressively grows because of spreading as the separation from spout tip increments and therefore speed (or kinetic energy) of the rough particles diminishes. Since kinetic energy bestowed by the abrasive is utilized to bit by bit dissolve material from work surface, bigger standoff distance brings about lower infiltration just as lower material material rate. Then again, in the event that stand off distance is too little, adequate section won't be accessible for the pre-owned rough abrasive to come out from the machining zone after impact. It can considerably reduced speed of new abrasive as a result of impact that can prompt decreased adequacy of the jet regarding material disintegration. Hence, at first with expansion in standoff distance, both the MRR and entrance increment slowly; notwithstanding, after certain breaking point, both diminishing with additional increment in standoff distance. Along these lines an ideal worth of deadlock distance is needed for acquiring good execution in rough stream machining.

4.2.2 Main Effects Plot of Kerf width

The main effects plot for kerf width versus Traverse speed (mm/min), Abrasive mass flow rate (gm/min), Pressure (MPa) and Stand-off distance (mm)is shown in fig.4.3.

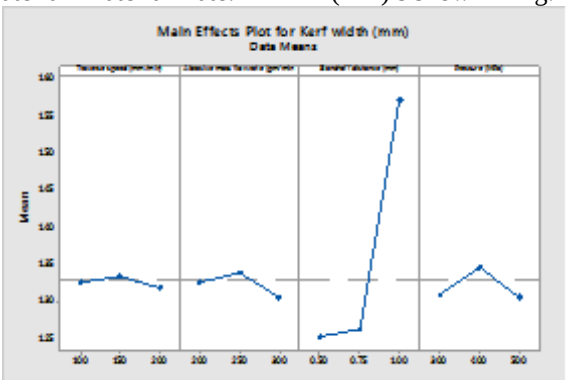

Fig. 4.3 Effect of control factor on Kerf width

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From the fig.4.3, it has been conclude that the optimum combination of each process parameter for low Kerf width is meeting at high cutting speed [A3], high abrasive mass flow rate [B3], low stand off distance[C1] and high pressure [D3].

This aforesaid combination is representing the single objective response optimization where Kerf width is getting lower without considering other response. The reason behind this optimum process parameter has been discussed here. It has been seen that the rough particles have an adequate degree of active energy to destruct the material. This little harmed district is portrayed by a little adjusted corner at the top edge because of the plastic miss happening of material brought about by the underlying AWJ assault. As the grating particles infiltrate into the material, a portion of the energy is utilized in disintegrating the material in loses dynamic energy. A fly with lower energy will in general avoid the typical way to the plane of cutting, which will bring about striations to be shaped on the cutting surface. As the rough fly stream crosses the part, the stream is diverted, henceforth bringing about the formation of a one of a kind cutting math. The level of diversion increments with speeding up.

4.2.3 Main Effects Plot of surface roughness

The main effects plot for surface roughness versus Traverse speed (mm/min), Abrasive mass flow rate (gm/min), Pressure (MPa) and Stand-off distance (mm)is shown in fig.4.4, which is generate from the value of kerf width as per table 4.1 in minitab-17 statistical software. It is useful to find out optimum parameter value for response variable. Fig.4.3 shows that the lower surface roughness will meet at transverse speed 200 mm/min, 300 gm/min of abrasive flow rate, 0.5 mm of stand of distance and 500 Mpa of pressure.The graph generate by use of minitab-17 statistical software for material removal rate is shown in fig.4.2

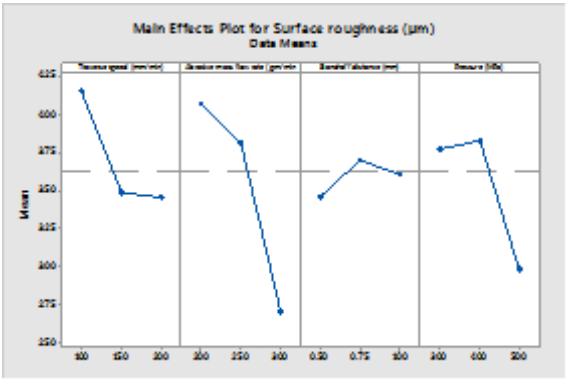

Fig. 4.4 Effect of control factor on surface roughness

From the fig.4.3, it has been conclude that the optimum combination of each process parameter for low surface roughness is meeting at high cutting speed [A3], high abrasive mass flow rate [B3], low stand off distance [C1] and high pressure [D3].

This aforesaid combination is representing the single objective response optimization where surface roughness is getting lower without considering other response. From the test results, it very well may be seen that an increment in the cutting speed causes a consistent expansion in the surface unpleasantness. This might be expected as expanding cutting speed permits less cover machining activity and less grating particles to encroach the surface, reducing the surface finish.

4.3 Analysis of Variance

In this section, the analysis of variance for the responses like material removal rate and surface roughness has been discussed. The analysis of variance is representing the effect of the input parameter on the responses in terms of the p- test and F test.

Analysis of variance (ANOVA) is a statistical model which can be used for find out effect of independent parameter on single dependent parameter and also it can be use full to find out the significant machining parameters and the percentage contribution of each parameter.

4.3.1 Analysis of Variance for the material removal rate

According to the analysis done by the MINITAB 17 software, if the values of probability are less than 0.05, it indicated that the factors are significant to the response parameters. Comparing the p-value to a commonly used α- level = 0.05, it is found that if the p- value is less than or equal to α, it can be concluded that the effect is significant.

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Table no. - 4.2 Analysis of variance for the material removal rate

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Model	14	0.73271	0.052336	8.59	0
Linear	4	0.46065	0.115162	18.91	0
A	1	0.122008	0.122008	20.04	0.001
B	1	0.100833	0.100833	16.56	0.002
C	1	0.161008	0.161008	26.44	0
D	1	0.0768	0.0768	12.61	0.004
Square	4	0.09831	0.024578	4.04	0.027
A*A	1	0.00049	0.00049	0.08	0.782
B*B	1	0.037037	0.037037	6.08	0.03
C*C	1	0.028356	0.028356	4.66	0.052
D*D	1	0.00037	0.00037	0.06	0.809
2-Way InteractioN	6	0.17375	0.028958	4.76	0.011
A*B	1	0.002025	0.002025	0.33	0.575
A*C	1	0.0025	0.0025	0.41	0.534
A*D	1	0.0121	0.0121	1.99	0.184
B*C	1	0.000625	0.000625	0.1	0.754
B*D	1	0.1444	0.1444	23.71	0
C*D	1	0.0121	0.0121	1.99	0.184
Error	12	0.073075	0.00609		
Lack-of-Fit	10	0.073008	0.07301	19.02	0.5
Pure Error	2	0.000067	0.000033		
Total	26	0.805785			

Model Summary

S	R-sq	R-sq(adj)
0.0780358	90.93%	80.35%

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From ANOVA result it is observed that the cutting speed, standoff distance, pressure and abrasive mass flow rate, square effect of abrasive mass flow rate are the influencing parameter for material removal rate as they are all less than 0.05 p. The confidence level (CL) used for investigation is taken 95% for this investigation. The parameter R-Sq described the amount of variation observed in material removal rate is explained by the input factor. R-Sq= 90.93% which indicate that the model is able to predicate the response with high accuracy.

4.3.2 Analysis of variance for Kerf width

From ANOVA result it is observed that the pulse on, wire feed rate, current, effect of square effect of pulse of, wire feed rate and effect of two way interaction of pulse off versus wire feed, and effect of two interaction of pulse off versus current are influencing parameter for Kerf width as they are all less than 0.05 p.

Table 4.3 Analysis of variance for the Kerf width

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Model	14	0.469057	0.033504	39.61	0
Linear	4	0.308567	0.077142	91.2	0
A	1	0.000133	0.000133	0.16	0.698
B	1	0.0012	0.0012	1.42	0.257
C	1	0.3072	0.3072	363.19	0
D	1	0.000033	0.000033	0.04	0.846
Square	4	0.153916	0.038479	45.49	0
A*A	1	0.002601	0.002601	3.07	0.105
B*B	1	0.000779	0.000779	0.92	0.356
C*C	1	0.131601	0.131601	155.59	0
D*D	1	0.000001	0.000001	0	0.974
2-Way InteractioN	6	0.006575	0.001096	1.3	0.33
A*B	1	0.001225	0.001225	1.45	0.252
A*C	1	0.000625	0.000625	0.74	0.407
A*D	1	0.0001	0.0001	0.12	0.737
B*C	1	0.002025	0.002025	2.39	0.148
B*D	1	0.0025	0.0025	2.96	0.111
C*D	1	0.0001	0.0001	0.12	0.737
Error	12	0.010015	0.000846		

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Lack-of-Fit	10	0.010083	0.001008	3.25	0.32
Pure Error	2	0.000067	0.000033		
Total	26	0.479207			

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
0.0290832	97.88%	95.41%	87.85%

From ANOVA result it is observed that the stand off distance, square effect of stand of distance are the influencing parameter for kerf width as they are all less than 0.05 p. The confidence level (CL) used for investigation is taken 95% for this investigation. The parameter R-Sq described the amount of variation observed in kerf width is explained by the input factor. R-Sq= 97.88% which indicate that the model is able to predicate the response with high accuracy.

4.3.3 Analysis of variance for surface roughness

From ANOVA result, table 3.4, it is observed that the abrasive mass flow rate, pressure square effect of abrasive mass flow rate, two way interaction effect of cutting speed and abrasive mass flow rate are influencing parameter for surface roughness as they are all less than 0.05 p.

Table 4.4 Analysis of variance for the surface roughness

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Model	14	20.8508	1.48934	4.78	0.005
Linear	4	9.0054	2.25134	7.23	0.003
A	1	1.463	1.46301	4.7	0.051
B	1	5.5897	5.58968	17.95	0.001
C	1	0.0645	0.06453	0.21	0.657
D	1	1.8881	1.88813	6.06	0.03
Square	4	4.3122	1.07806	3.46	0.042
A*A	1	0.0064	0.00638	0.02	0.889
B*B	1	2.3027	2.30271	7.39	0.019
C*C	1	1.0364	1.03645	3.33	0.093
D*D	1	2.436	2.436	7.82	0.016
2-Way Interaction	6	7.5332	1.25554	4.03	0.019
A*B	1	6.5025	6.5025	20.88	0.001
A*C	1	0.0001	0.0001	0	0.986
A*D	1	0.0072	0.00722	0.02	0.881

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B*C	1	0.0529	0.0529	0.17	0.687
B*D	1	0.1056	0.10562	0.34	0.571
C*D	1	0.8649	0.8649	2.78	0.121
Error	12	3.7368	0.3114		
Lack-of-Fit	10	3.7366	0.37366	3736.6	0
Pure Error	2	0.0002	0.0001		
Total	26	24.5876			

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
0.558033	84.80%	67.07%	12.46%

The confidence level (CL) used for investigation is taken 95% for this investigation. The parameter R-Sq described the amount of variation observed in surface roughness is explained by the input factor. R-Sq= 84.80 % which indicate that the model is able to predicate the response with high accuracy.

4.4 REGRESSION MODEL

The regression model for predicting the response parameters in turning can be derived using methods like Regression analysis.
Regression analysis is often used to:

- Determine how the response variable changes as particular predictor variable changes.
- Predict the value of the response variable for any value of the predictor variable, or combination of values of the predictor variables.

4.4.1 Regression Equation for Material removal rate

The regression equation for the material removal rate is following:

Material removal rate (mm3/min) =
7.39 + 0.00902 A - 0.02793 B + 3.64 C - 0.00607 D + 0.000004 A*A + 0.000033 B*B - 1.167 C*C + 0.000001 D*D - 0.000009 A*B - 0.00200 A*C- 0.000011 A*D - 0.00100 B*C + 0.000038 B*D - 0.00220 C*D .....(4.1)

4.4.2 Regression Equation for Kerf width

The regression equation for the kerf width is following:

Kerf width (mm) =
2.645 - 0.00062 A - 0.00222 B - 2.610 C - 0.00153 D + 0.000009 A*A + 0.000005 B*B + 2.513 C*C - 0.000000 D*D - 0.000007 A*B - 0.00100 A*C+ 0.000001 A*D - 0.00180 B*C + 0.000005 B*D + 0.000200 C*D.....(4.2)

4.4.3 Regression Equation for surface roughness

The regression equation for the surface roughness is following:

Surface roughness =
-8.7 - 0.1340 A + 0.0474 B + 15.95 C + 0.0709 D - 0.000014 A*A- 0.000263 B*B - 7.05 C*C - 0.000068 D*D + 0.000510 A*B + 0.0004 A*C+ 0.000008 A*D + 0.0092 B*C - 0.000033 B*D - 0.0186 C*D.....(4.3)

V. MULTI OBJECTIVE OPTIMIZATION

5.1 Grey Relational Analysis

The grey relational analysis, a grey relational grade can be obtained to evaluate the multiple performance characteristic. As a result, optimization of the complicated multiple performance characteristic can be converted into the optimization of a single grey relation grade. For multiple performance characteristic optimizations using GRA, following steps are followed:

1. Conduct the experiments of different settings of parameters based on available design of experiment.
2. Normalization of experimental result for all performance characteristics.

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3. Performance of grey relational generating and calculation of grey relational coefficient (GRC).
4. Calculation of grey relation grade using weighing factor for performance characteristics.
5. Analysis of experimental results using GRG and statistical analysis of variance (ANOVA).
6. Selection of optimal levels of process parameters.
7. Conducting confirmation experiment to verify optimal process parameter settings.

Table 5.1 Experimental value and Normalized value of response

Sr. no.	MRR (mm^3/min)	Surface roughness (µm)	Kerf width (mm)	MRR (mm^3/min)	Surface roughness (µm)	Kerf width (mm)
				Normalization		
1	5.38	6.34	1.28	0.341772	0	0.822222
2	5.52	2.34	1.30	0.518987	0.947867	0.777778
3	5.55	2.40	1.31	0.556962	0.933649	0.755556
4	5.60	3.50	1.26	0.620253	0.672986	0.866667
5	5.11	2.57	1.27	0	0.893365	0.844444
6	5.37	3.91	1.56	0.329114	0.575829	0.2
7	5.45	3.46	1.25	0.43038	0.682464	0.888889
8	5.49	2.94	1.56	0.481013	0.805687	0.2
9	5.22	4.56	1.28	0.139241	0.421801	0.822222
10	5.55	4.06	1.27	0.556962	0.540284	0.844444
11	5.50	3.03	1.27	0.493671	0.78436	0.844444
12	5.61	2.70	1.28	0.632911	0.862559	0.822222
13	5.20	4.51	1.23	0.113924	0.433649	0.933333
14	5.37	2.30	1.24	0.32911	0.957346	0.911111

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				4		
15	5.58	3.87	1.65	0.59493 7	0.585308	0
16	5.70	2.12	1.57	0.74683 5	1	0.177778
17	5.11	4.08	1.25	0	0.535545	0.888889
18	5.45	3.84	1.27	0.43038	0.592417	0.844444
19	5.35	4.51	1.56	0.30379 7	0.433649	0.2
20	5.59	4.29	1.53	0.60759 5	0.485782	0.266667
21	5.54	3.97	1.27	0.54430 4	0.561611	0.844444
22	5.44	3.57	1.20	0.41772	0.656398	1
23	5.24	3.40	1.22	0.16455 7	0.696682	0.955556
24	5.90	2.35	1.25	1	0.945498	0.888889
25	5.43	4.43	1.24	0.40506 3	0.452607	0.911111
26	5.44	4.44	1.24	0.41772 2	0.450237	0.911111
27	5.44	4.42	1.25	0.41772 2	0.454976	0.888889

Table 5.2 Grey relational grade (GRG)

Sr. no.	MRR (mm^3/min)	Surface roughness (µm)	Kerf width (mm)	**GRG**
	Grey relational coefficient			
1	0.593985	1	0.378151	0.657379
2	0.490683	0.345336	0.391304	0.409108
3	0.473054	0.34876	0.39823	0.406681
4	0.446328	0.426263	0.365854	0.412815
5	1	0.358844	0.371901	0.576915

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6	0.603053	0.464758	0.714286	0.594032
7	0.537415	0.422846	0.36	0.440087
8	0.509677	0.38294	0.714286	0.535634
9	0.782178	0.542416	0.378151	0.567582
10	0.473054	0.480638	0.371901	0.441864
11	0.503185	0.389299	0.371901	0.421461
12	0.441341	0.366957	0.378151	0.395483
13	0.814433	0.535533	0.348837	0.566268
14	0.603053	0.343089	0.354331	0.433491
15	0.456647	0.460699	1	0.639115
16	0.401015	0.333333	0.737705	0.4906
17	1	0.482838	0.36	0.614279
18	0.537415	0.457701	0.371901	0.455672
19	0.622047	0.535533	0.714286	0.623955
20	0.451429	0.507212	0.652174	0.536938
21	0.478788	0.470982	0.371901	0.440557
22	0.544828	0.432377	0.333333	0.436846
23	0.752381	0.417822	0.343511	0.504571
24	0.333333	0.345902	0.36	0.346412
25	0.552448	0.524876	0.354331	0.477218
26	0.544828	0.526185	0.354331	0.475114
27	0.544828	0.523573	0.36	0.476134

5.2 Main Effect of Factors on Grey Relational Grade (GRG)

For the combined response maximizatoin, fig.5.1 gives optimum value of each control factor. It interprets that level A1, B1, C3 and D2. The desired result of each response namely maximum material removal rate, minimum kerf width and minimum surface roughness has been attained at the value of traverse speed of 100 mm/min, 200 gm/min of abrasive mass flow rate, 1 mm of stand off distance and 400 Mpa of pressure. The mean of grey relational grade for each level of the other machining parameters can be computed in similar manner.

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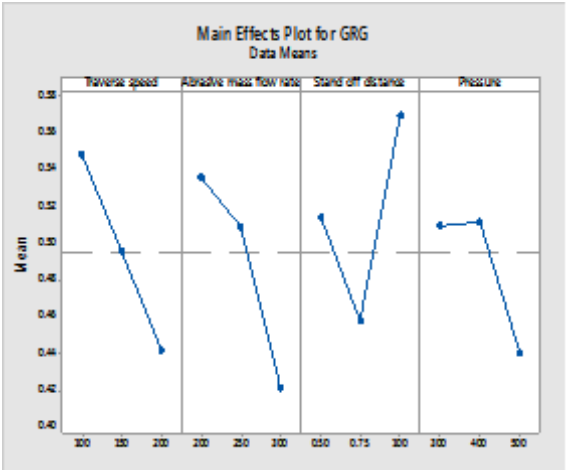

Fig 5.1 – Main effect of factor on Grey Relational Grade

Table 5.3 Main effect of factors on Grey Relational Grade

Symbol	Control factor	Level 1	Level 2	Level 3
A	Traverse speed	**0.5485**	0.4955	0.4419
B	Abrasive mass flow rate	**0.5361**	0.5088	0.4211
C	Standoff distance	0.5144	0.4579	**0.5700**
D	Pressure	0.5096	**0.5116**	0.4406

As per the grey relational theory, it can be said that higher grey relational grade value will give optimum value of material removal rate, surface roughness and Kerf width. Thus it is revealed that response will be optimum at value of traverse speed of 100 mm/min, 200 gm/min of abrasive mass flow rate, 1 mm of stand off distance and 400 Mpa of pressure.

VI. CONCLUSION

In this study, the experimental investigation and analysis are carried out on AISI1045 steel material by using abrasive water jet cutting process. The following conclusions are made.

1. The material removal rate is increased with increase of cutting speed, stand off distance, pressure and abrasive mass flow rate. It has been observed that the high material removal rate will meet at transverse speed 200 mm/min, 300 gm/min of abrasive flow rate, 1 mm of stand of distance and 500 Mpa of pressure.
2. While studying the effect of the process parameters on the material removal rate, it was observed that cutting speed, standoff distance, pressure and abrasive mass flow rate, square effect of abrasive mass flow rate are the influencing parameter.
3. The optimum condition for surface roughness is A3 B3 C1 D3. The said combination is like, lower surface roughness will meet at transverse speed 200 mm/min, 300 gm/min of abrasive flow rate, 0.5 mm of stand of distance and 500 Mpa of pressure.
4. It has concluded that optimum kerf width can be attained at the, transverse speed 200 mm/min, 300 gm/min of abrasive flow rate, 0.5 mm of stand of distance and 500 Mpa of pressure. From the table of analysis of variance, it has been found that stand off distance, square effect of stand of distance are the influencing parameter for kerf width.
5. Thus, aforesaid single objective optimization can be provided / utilized for the single targeted goal. Hence engineer can be targeting the response as per requirement. However, in multi contradictorily goal, multi-objective optimization has been applied.
6. The grey relational analysis have suggested the optimum process parameters value of traverse speed of 100 mm/min, 200 gm/min of abrasive mass flow rate, 1 mm of standoff distance and

400 Mpa of pressure.

7. From the confirmation test, it can be seen that the error between the predicted and actual experiment are less that the -/+10 %. Hence, it can be said that the predication accuracy of suggested model is excellent.
8. Regression analysis have been carried out simultaneously for the individual response, so, engineer can manipulate value of process parameters for this particular work- material.

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A Review on Laser marking by Nd-Yag Laser and Fiber Laser

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ABSTRACT

Laser marking provides a unique combination of speed, permanence and versatility. Laser engraving is a manufacturing method for those applications where previously Electrical Discharge Machining (EDM) was the only choice. Laser engraving technology removes material layer-by-layer and the thickness of layers is usually in the range of few microns. Also there is many types of laser machines are available in recent time. Therefore for Optimum Use of Laser energy it is necessary to optimum use of process parameters to get best marking speed, Quality. This review paper presents various important work on Laser marking and its parameters i.e. Width, Depth, Contrast of Marking.

Keyword: - *Laser Marking, Nd-YAG laser, Fiber Laser*

1. INTRODUCTION

In the past decades, laser has been widely used in cutting and welding operations. Quite recently, this technology has been adopted in other industrial processes like marking, selective ablation and machining of different materials, thanks to the introduction of laser sources characterized by short and ultra-short pulses having from nanosecond to femtosecond duration.[3]

Marking is a process to make a mark on a product for the purpose of product identification. There are many marking methods, such as ink-marking, mechanical engraving and electro-chemical methods. Laser marking is a new marking method. There are many advantages in laser marking compared with conventional marking methods, such as no wear on tools, high degree of automation, free programming and choice of characters [1].

The main advantages of laser process are non-contact working, high repeatability, and high scanning speed, worked area comparable to the laser spot, high flexibility and automation. Furthermore, the use of shorter wavelengths, which are better absorbed by the material, allows smaller feature sizes to be worked, while the use of shorter pulses reduces heat-affected zone and opens new ways for nanometric accuracy [3].

The mark qualities, especially mark clearance, are most important in the marking process. In order to obtain a clear mark, suitable processing parameters must be selected. There are mainly three processing parameters used in laser marking: pulse frequency, Focal point and scanning speed, in which the pulse frequency of the laser has significant effects on mark quality. The laser marking process of EN8 Bearing steel with a Q-switched Nd:YAG laser and Fiber Laser was studied in this work. The aim was to find the relationship between the pulse frequency of the laser and the mark quality characteristics so as to be able to obtain high quality marks.

2. LASER MARKING PHENOMENA

(1) Vaporization

The laser beam is focused to a small spot, which greatly increases the energy density. When the energy is high enough, and the surface temperature is raised well above the melting point, most of the material on which the beam is focused will vaporize.

(2) Softening/Melting
Some materials are melted by infrared laser radiation, e.g. metals, epoxies. In the case of metals, mark contrast is achieved by oxidation or incorporation of impurities into the melt. In the case of plastics, the material melts and forms ridges. Depending on types of material, different colours may appear.

(3) Layer removal/ablation
Layer removal/ablation is actually a form of controlled vaporisation . A thin layer of plastic film, paper, ink or paint is vaporized exposing the different coloured under-layer.

(4) Colour change
At certain energy densities (below melting point), materials can undergo chemical changes when exposed to laser radiation of a specific wavelength. The chemical change can be either light or heat induced, e.g. excimer laser induced photo-chemical colour change for aircraft cable marking (white to black), and CO2 laser-induced (heat-induced) colour change on PVC (gray to red-brown). The color change is due to changes in chemical composition or in molecular structures

3. LITERATURE REVIEW

J. Qi, K.L. Wang, Y.M. Zhu [1] studied on the influence of the pulse frequency of the laser beam on the mark depth, width and mark contrast. A Q-switched Nd:YAG laser was used in the laser marking process of stainless steel. The mark contrast is the ratio of the apparent brightness between the mark and unmarked areas which shows the clearance degree of the mark. An optical microscope, scanning electron microscope and surface profile instrument were used to measure the effects of pulse frequency on the mark depth and width. An image-analysis system with a frame-grabber card and a charged-couple-device (CCD) was used to measure mark contrast. Also they have Investigated that The pulse frequency of a Q-switched Nd:YAG laser has a significant effect on the mark quality. There is maximum maximum mark depth when the pulse frequency is about 3 kHz, while the mark width remains almost constant at different pulse frequency. With the increase in pulse frequency, evaporation of material decreases, whilst at the same time oxidization is more significant, which leads to the improvement of mark contrast. The highest mark contrast was obtained when the pulse frequency of the laser was about 8 kHz.

T.W. Ng, S.C. Yeo [2] has studied on the CIE colour difference formula was applied to evaluate four types of material surfaces; anodized aluminium, stainless steel, poly-butylenes tetra-phthalate (PBT), and phenol formaldehyde, marked using a Nd:YAG laser, and viewed under three common modes of illumination; tungsten, Fluorescent and daylight at different speeds. The colour difference values were based on the spectral reflectance readings obtained from a spectrophotometer. The plots of colour difference value against laser marking speed revealed different trends for the materials and illumination modes applied. In terms of operational laser marking speeds, stainless steel could be classified as low, anodized aluminium as medium, and PBT and phenol formaldehyde as high. In terms of maximal colour difference values, anodized aluminium could be classified as low, PBT and stainless steel as medium, and phenol formaldehyde as high.

C. Leone, S. Genna, G. Caprino, I. De Iorio [3] has carried out Laser marking tests to determine the correlation occurring between working parameters (i.e. pulse frequency, beam scanning speed, and current intensity) and resulting mark visibility on AISI 304 steel, using a Q-switched diode pumped Nd:YAG laser. The latter was evaluated as the contrast index measured from digital images of the marks. . To characterize mark features, its width and roughness were estimated, and analyses employing optical and scanning electron microscopy coupled with energy dispersive X-ray technique were carried out. From the experimental results they have concluded that within the range of process parameters employed, mark width is only moderately affected by operating conditions. Mark contrast is affected by both surface roughness and oxidation, with the former probably prevailing at low contrast, and the latter at high contrast. If the aim is obtaining good mark visibility, relatively low frequencies and average powers should be used. The best mark visibility achievable is strictly dependent on the operating features of the particular laser system used. An empirical model was built, and from it the best processing conditions for optimum mark visibility, taking into account the operating constraints of the laser system used, were drawn.

Janez Diaci, Drago Bracun, Ales Gorkic, Janez Mozina [4] has presented a novel method for rapid and flexible laser marking and engraving of tilted, curved and freeform work-piece surfaces. The method is based on integrating

a three-dimensional (3D) laser measurement system into a 3D laser marking system. The same laser source and optics for measurement and processing with a minimum of additional hardware components were used. A novel method is presented that allows rapid and flexible laser marking and engraving of tilted, curved and freeform work-piece surfaces. An implementation is described where a digital camera is integrated into a 3D laser marking system in such a way that it is possible to measure the 3D shape of the work-piece surface just before processing. The measurement phase takes typically less than 10 seconds. Custom software has been developed which allows 3D surface measurement, placement of the laser mark onto the measured surface and process control. Examples are presented which demonstrate the advantages of the novel 3D system with respect to the existing industrial 2D and 3D systems. This paper has discussed key issues concerning an implementation of the method and presents typical examples of markings and engravings, which demonstrate the advantages of the method with respect to the existing industrial 2D and 3D laser marking and engraving methods. The method can also be applied to flexible laser structuring and micro processing of curved surfaces.

F.Agalianos, S.Patelis, P. Kyratsis, E. Maravelakis, E.Vasarmidis, A.Antoniadis[5] has investigated on the influence of the process parameters on the surface quality when machined by laser engraving. The examined parameters were: the pulse frequency, the beam speed and the layer thickness. The surface quality was determined by the surface roughness for every set of parameters. Based on the experimental work of the present paper in laser engraving of Al7075 using a Q-switched Yb:YAG fibre laser, it can be summarized that the surface roughness strongly depends on the frequency and the scan speed used. In addition it was proven that the resulted roughness depends less by the layer thickness. When considering all the experimental data of the current experimental plan, the best surface roughness was achieved when using a frequency of 20 kHz, a scan speed in the range of 600-700mm/s and a layer thickness of 4 and 6μm. Experimental results on Al7075 material showed that the surface roughness strictly depends on the process parameters used.

Sefika Kasman[6] has investigated the machinability of hard metal produced with powder metallurgy and puts forward a new approach relating to the laser engraving of P/M metals. The main objective of this study is to determine the impact of laser engraving process on Vanadis 10. For this purpose, three process parameters – namely effective scan speed, frequency, and laser effective power – were correlated with the surface roughness (Ra) and engraving depth (D). The Taguchi and linear regression were used in the analysis. The experiments were performed in accordance with an L9 orthogonal array. Based on the S/N ratio for Ra and D, the optimal condition was found as SS3F2P1 for Ra and SS1F2P3 for D. the ANOVA was performed to evaluate the statistical significance of each parameter on the performance characteristics. Also he has determined that

(1) The scan speed appeared to be the main effective parameter for the two performance characteristics. The experimental results showed that increasing scan speed decreases both Ra and D. To minimize Ra, the scan speed should be selected at a high level (800 mm/s), whereas to maximize D, the scan speed should be selected at a low level (200 mm/s).

(2) The optimal level for Ra is where the scan speed is at 800 mm/s, the frequency is at 30 KHz, and power is at 25W (SS3F2P1). Optimal levels for D for each material type were obtained at a scan speed of 200 mm/s, a frequency of 30 KHz, and with power at 50W (SS1F2P3).

(3) After determining the optimal level for each parameter, a confirmation experiment was performed for both Ra and D. The predicted and experimental results were compared, and the results show that there is a high correlation between them. To achieve a good surface finish, a high scan speed at the lower power level is recommended.

(4) ANOVA was performed using the S/N ratio to investigate the significance of each parameter and to determine the percentage contribution to both Ra and D. The effect of scan speed on both Ra and D is 83.84% and 76.69%, respectively. However, the effect of frequency has little that determined by the p value (0.367). The percentage contribution of frequency is 3.47% and 0.56% to the Ra and D, respectively.

(5) To test the predicted linear regression model, a set of experiments at different condition were used to predict both Ra and D. Results show that the predicted results (test results) are very close to the actual value. This means that Ra explains the model of laser engraving process for Vanadis 10. Besides this, the data taken from the test experiments also explain the model for D

4. CONCLUSION

1. In terms of operational laser marking speeds, stainless steel could be classified as low, anodized aluminium as medium, and PBT and phenol formaldehyde as high.

2. In terms of maximal colour difference values, anodized aluminium could be classified as low, PBT and stainless steel as medium, and phenol formaldehyde as high.
3. Mark contrast is affected by both surface roughness and oxidation, with the former probably prevailing at low contrast, and the latter at high contrast.
4. With the increase in pulse frequency, evaporation of material decreases, whilst at the same time oxidization is more significant, which leads to the improvement of mark contrast.
5. To achieve a good surface finish, a high scan speed at the lower power level is recommended. The surface roughness strongly depends on the frequency and the scan speed used. In addition it was proven that the resulted roughness depends less by the layer thickness.

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AN AUTONOMOUS BOTTLE FILLING MACHINE ADDING TO THE ACCURACY AND PRECISION ALONG WITH REJECTION MECHANISM

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ABSTRACT

Filling is a task carried out by a machine that packs liquid products such as cold drink, water, Medicines Cosmetic Creams or Face wash etc. in current Manufacturing and packaging industries. Traditional methods of bottle filling involved workers and it can be very tedious to handle this kind of stuff for the MNC companies. Traditional methods are time consuming which Adds to the expense. My paper aims at filling of bottle and the rejection of incomplete filled bottle at the same time. It also includes a user-defined volume selection through which the user can input the desired volume to be filled in the bottles .The entire system is more flexible and time saving. The filling and rejection Operations is controlled using microcontroller. This is because microcontroller is very user friendly and easy to program, cost effective, space efficient and reduces complexity. By programming the microcontroller we control the entire system. Hence the changing of data such as flow rate control, delay, counting of bottles, rejection criteria is easily modified. The process is fully automatic; during the process no worker is required so the designation of our project is "Autonomous bottle filling machine".

Keyword: - *Bottle Filling, Bottle Rejection, Micro Controller.*

1. INTRODUCTION

Automation plays an increasingly important role in the world economy. One of the important applications of automation is in the soft drink and other beverage industries, where a particular liquid has to be filled continuously. For these kinds of applications, the trend is moving away from the individual device or machine toward continuous automation solutions. Totally Integrated Automation puts this continuity into consistent practice. Our project is also an application of automation wherein we have developed a bottle filling system .The various processes are controlled using a microcontroller. In the past, Human resources were the Pillar for controlling a system. In recent trends, electricity has been used for control in the filling plant and this electrical control was based on relays. These relays only allow power to be switched on and off without a mechanical switch. It is common to use relay to make simple logical control decisions. The advent of the microcontroller began to be the most common choice for manufacturing controls. Microcontroller has been gaining popularity on the factory floor and will probably remain predominant for some time to come. Mostly because of the advantages mentioned:

- Cost effective for controlling complex systems.
- Flexible and can be reapplied to control other systems quickly and easily.
- Computational abilities allow more sophisticated control.
- Trouble shooting aids make programming easier and reduce downtime.
- Reliable components make these likely to operate for years before failure.

Control systems are an integral part of modern society. There are many numerous applications that uses control system around us. A control system provides a desired output or response for a given input or stimulus. The reason that control system was built is for power amplification, remote control, convenience of input form; and compensation for disturbances. Today control system finds widespread application in the guidance, navigation; Control of missiles and space crafts, as well as it navigates planes and ships at sea. The applications is also expanded

for the process control industry, regulating liquid level tanks, chemical concentrations in vats, as well as thickness of fabricated material.

2. PROCESS TECHNIQUES

Bottle Detection Using Sensor
Bottles are kept in position in their respective holders which are fixed to the conveyor at the input side. Photo electric sensors are used to detect the presence of bottles in the holder. Depending on the output of the sensors the filling operation takes place. A time delay is set in order to set the status of the bottles. If bottle is present the corresponding status bit in microcontroller which leads input to set at "1" else it is set to "0". Depending on this output the filling process of the bottles takes place. Thus for all the "n" bottles present in the input side then the sensor gives the corresponding output to the microcontroller which in turn switches ON the corresponding
Solenoid valve for filling operation to take place. If a particular bottle is not present the corresponding valves remain OFF.

Operating Solenoid Valve
When the sensor senses the bottle, the conveyor belt will be stopped after pre assigned seconds. So the bottle comes in the alignment of the output of the solenoid valve.

Filling Operation
Once the bottles are detected in the input side the conveyor motor switches ON and it starts moving in the forward direction. The bottles then reach the desired position for filling and the conveyor stops. The corresponding pumps in process tank switch ON and filling operation takes place. There are three tanks present in the filling side namely: process tank, concentrate tank (Tank 1) and tank to store liquid (Tank 2).Tank 1 and tank 2 have low level and high level sensors (LLS and HLS) respectively. Process tank has three level sensors (LLS, HLS and MLS). MLS is used to denote the middle level of the tank. When the liquid in the process tank reaches below low level (LLS) pumps in Tank 1 and Tank 2 switches ON and the process tanks get filled. When the level of liquid reaches high level (HLS) the pumps in Tank 1 and Tank 2 switch OFF.

Rejection
The rejection is based on the level of liquid in the bottle. The sensor (self-made sensor) detects the level of the liquid. If the level of liquid is not in the linear line / level of the positioning transmitter and receiver, the bottles will be rejected through the motor connected with the rejection Flap that is placed in the conveyor path.

Controlling
The all the task are controlled by the microcontroller. The programming is done in C language. The modification can easily be done in Set program as per the requirements and the programming module is attached with the computer. The ARDUINO software is used in the project to control the program.

3. MECHANICAL DESIGN

Photoelectric Sensor
The photoelectric sensor is operated on 12V DC and the relay output is given to the PLC input terminal. The sensor we use here is the product of the AUTONICS Ltd.

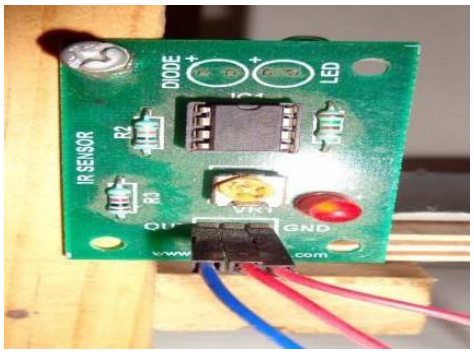

Fig 1: Photoelectric Sensor

Motors

10 RPM, 12V DC geared motor for robotics and multi applications. Very easy to use and also available in standard size. Nuts and threads required to mount on shaft are easily connected and internal threaded shaft for easily connecting it to the roller of the conveyor.

Features

- 10 RPM 12V DC motors with Gearbox.
- 6mm shaft diameter with internal hole.
- 125gm weight.
- Same size motor available in various RPM.
- 2kg-cm torque
- No-load current = 60 mA (Max), Load current = 300 mA (Max).
- The 10 RPM DC gear motor is used in the project to run the conveyor belt. And the 45 RPM DC motor is used to reject the incomplete bottle.

Solenoid Valve

The solenoid valve for liquid is used to allow the liquid to pass to the output. The liquid solenoid valve operates at 12V DC and we use it for ON-OFF condition. When the bottle is exactly under the valve, the microcontroller gives the signal to Open /ON Condition for the valve so the liquid is able to flow. When the bottle filling is completed, the valve gets Closed/OFF and the conveyor belt starts. The valve remains open for the pre assigned time so that bottle filling is done at the desired level.

- Latch time of solenoid valve is calculated with the help of flow rate equation.
- Elevation of tank in our project is not very high so increase of velocity is negligible in pipe.

4. EXPERIMENTAL SETUP

The Line diagram of the entire Bottle Filling Plant has been represented herewith below, as well as main aspects and main parts used are Proximity Sensor, Conveyor belt, Solenoid Valve, Level Sensor, Mechanical Arm, Motor, Roller

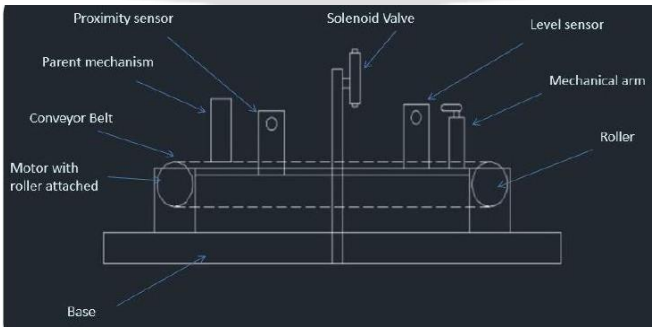

Fig 2: Line Diagram of the Bottle Filling System

The entire plant can be run in the following series as the Bottle to be filled is supposed to be kept on the conveyor belt as with the help of motor and roller the bottle moves in the linear positive direction and proximity sensor senses the bottle after which the bottle moves ahead as pre defined time and stops exactly under the solenoid valve, through which the bottle gets filled, after this process the bottle again moves in linear direction, now level sensor checks the level of liquid if the level is found to be below the Lower Limit than the mechanical arm will reject the bottle and if the level is found to be within the limit of approval than the bottle is preceded for the capping and packaging.

5. CONCLUSION

This project lead us to an effective conclusions, mostly for mass production which is the case in today's industries and MNC's, it is cost effective with high rate of Accuracy and precision which can be run by minimum labor and still the high rate production can be achieved. Secondly it is also time effective and due to reject mechanism the customer satisfaction for the guaranteed amount of goods can be achieved, with future scope point of view, easy operating so that unskilled labour can also operate very easily.

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EXPERIMENTAL INVESTIGATION OF EFFECTS OF CUTTING PARAMETERS ON SURFACE ROUGHNESS IN THE WEDM PROCESS

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ABSTRACT

The experimental study presented in this paper aims to select the most suitable cutting and offset parameter combination for the wire electrical discharge machining process in order to get the desired surface roughness value for the machined work pieces. A series of experiments have been performed on 1040 steel material of thicknesses 30, 60 and 80 mm, and on 2379 and 2738 steel materials of thicknesses 30 and 60 mm. The test specimens have been cut by using different cutting and offset parameter combinations of the "Sodick Mark XI A500 EDW" wire electrical discharge machine in the Middle East Technical University CAD/CAM/Robotics Centre. The surface roughness of the testpieces has been measured by using a surface roughness measuring device. The related tables and charts have been prepared for 1040, 2379, 2738 steel materials. The tables and charts can be practically used for WEDM parameter selection for the desired work piece surface roughness. Ó 2000 Elsevier Science Ltd. All rights reserved.

Keyword: - *WEDM; Surface roughness; Cutting parameters*

1. INTRODUCTION

In wire electrical discharge machining (WEDM), the cost of machining is rather high due to a high initial investment for the machine and the cost of the wire which is used as a tool in this process. The WEDM process is economical if it is used to cut complex work pieces and difficult to- machine materials. In manufacturing die and meld components like sheet metal press dies, extrusion dies, etc., prototype and special form inserts manufacturing, WEDM is commonly used. As surface roughness is one of the most important parameters in manufacturing, various investigations have been carried out by several researchers for improving the surface roughness of the WEDM process [1–8]. These investigations show that the surface roughness of the process is closely dependent on the machining parameters. However, the published papers available do not provide any specific information on the selection of machining parameters for various machining conditions and materials. Since WEDM is a necessary process with a high cost, it is required that the appropriate machining parameters are selected for an economical machining operation. The machining parameters can be set for optimum machining with the knowledge of the effect of the machining parameters on the surface roughness of the process, as a result of the experimental study [9].

2. EXPERIMENTAL TECHNIQUES AND PROCEDURES

Three different materials have been cut by using a five-axis A500 Fine Sodick Mark XI EDW [10, pp. 8-1, 8-2] and surface roughness values of the specimens are measured in order to find the effects of cutting parameters on surface roughness in the WEDM process. WEDM is used extensively in the fields of blanking, shearing, cold forming and plastic molding. So, for the selection of the materials, we have tried to choose the most commonly used cold work tool steel and plastic mold steel [11, pp. 19–43]. For the experiments, initially a 1040 steel specimen is used because of its cheapness and extensive use in manufacturing. The results of the experiments for the 1040 steel specimen are used to plan the experimental procedure for the cold work tool steel "2379" and plastic mold steel "2738" specimens. Cold work steels, with properties such as good machinability, dimensional stability on heat treatment, high wear resistance, sufficient toughness and compressive strength, are used generally in the fields of blanking,

shearing and cold forming. 2379 is one of the most widely used cold work tool steels [11] and it has a chemical composition of 1.55 C, 12.0 Cr, 0.7 Mo, 1.0 V (in %) [11]. The increasing demands for tools in plastic moulding have necessitated the specific development of tool steels. Tools for the processing of plastics are mainly stressed with regard to pressure and wear. According to the type of plastics, there may in addition exist stressing by corrosion. The various types of plastics and different processing methods impose certain requirements on the tool steel, such as economic machinability or cold-hobbling ability, dimensional stability on heat treatment, good polish ability, great compressive strength, high wear resistance, sufficient corrosion resistance, etc. The selection of a steel for a given tool is governed by these requirements. 2738 is one of the most widely used plastic mold steels [11]and it has a chemical composition of 0.40 C, 1.5 Mn, 1.9 Cr, 0.2 Mo, 1.0 Ni (in %) [11]. For the control of A500 Fine Sodick Mark XI EDW, there are 11 cutting variables and the operator only sets two general purpose parameters, which are the cutting parameter "C" and the offset parameter "H". These two parameters arrange the conditions that are needed for cutting and offset, respectively. The rest of the parameters are adjusted automatically by the machine itself [10]. The cutting parameter "C" and offset parameter "H" are given in a form so that they are followed by three integer numbers. Each "C" parameter defined in this way includes the parameters which control the setting of the pulse energy and the cutting speed adjustment, for instance, pulse width, peak current value, no-load voltage, servo reference voltage, capacitor, servo speed, wire tension, wire speed, etc. [10].

During the cutting, dielectric water is used as the fluid type and the "open" condition is selected for the flushing. A dielectric flow pressure of 1 bar, tension of the wire of 1133 g, diameter of the brass wire of 0.25 mm and a wire speed of 1550 cm/min are kept as constant in all the experiments, since these values are recommended in the tables [10]. For the surface roughness measurements of the workpieces, a portable device called "Surftronic 3+" is used and the traverse length of the experimental measurements is calculated as 4.2 mm for this particular device [12, pp. 1–53]. This value is important, because it is used to decide the length of the experimental cuts. The experimental test section is chosen to be 20 mm in length to be on the safe side. As the wire breakage that may occur during the cuts increases the surface roughness values of that experimental section, the test results may deviate from the true surface roughness values. A 20-mm test cut for each parameter combination gives enough length to measure the true surface roughness values without being affected by the wire breakage. By using different cutting parameter "C" and offset parameter "H" combinations and keeping all the other variables and conditions constant, a series of cuts are performed on 1040, 2379 and 2738 steel specimens [9]. For each different "C" and "H" parameter combination, a section of the material is cut of length 20 mm and is defined as the "test section". At the end of each test section, a cut of 0.5 mm in depth is performed in order to indicate the border of the section.

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A Hybrid Framework to Prioritize the Performance Metrics of Reconfigurable Manufacturing System: An Integrated Fuzzy AHP–TOPSIS approach

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Research Article

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A hybrid framework to prioritize the performance metrics of reconfigurable manufacturing system: An integrated fuzzy AHP–TOPSIS approach

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A hybrid framework to prioritize the performance metrics of reconfigurable manufacturing system: An integrated fuzzy AHP–TOPSIS approach

Abstract:

The Reconfigurable Manufacturing System (RMS) meets the challenges of dynamic customer demands, technological advancements, and reducing lead time, among other things. It is necessary to have a framework that can assist in increasing RMS adoption as well as evaluating its performance. The present study seeks to develop a hybrid framework for prioritizing performance metrics of RMS that helps the designers of the manufacturing system in decision making. A total of 31 indicators for RMS are identified through a literature survey, the weight of each indicator is computed by Fuzzy-AHP (Analytic Hierarchy Process) method and the Fuzzy-TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) method is used to prioritize 22 performance metrics of RMS. The findings of the presented study reveal that among all the main indicators; smart factory indicators have the highest weightage followed by strategy and policy indicators. The prioritization of performance metrics shows that lead time, reconfiguration time, and product flexibility are the top three most important performance metrics for RMS. The feasibility and appropriateness of the framework is tested through a case application of the manufacturing organization. The framework developed has a high capacity to assist designers during the adoption of the RMS and will facilitate the identification of the relevant parameters. Authors believe that researchers and professionals will find this study as a ready reference for stepwise adoption of RMS. The study presented here is likely the first to present a hybrid framework in which a set of indicators and performance metrics are presented together.

Keywords: *Reconfigurable Manufacturing System, Multi-criteria Decision Making, Indicators, Performance Metrics, TOPSIS, Fuzzy AHP, Manufacturing System Design*

1. Introduction

1.1 *Study Motivation*

Customer expectations are constantly changing and are becoming dissimilar due to globalization. The product and its features must therefore be personalized. To achieve such customization, there is a need for a flexible and high-quality manufacturing system that meets the future requirements in complex environments (Haddou Benderbal & Benyoucef, 2019). According to (Yadav et. al., 2018), manufacturing companies face challenges like fulfilling customized product demands, quick supply, and high quality. RMS, which emerged from the configurable computing system used during the design of computing systems around the 1960s, has been introduced to meet such dynamic conditions. It comprises several modules that can be replaced so that reconfiguration is possible (Abdi & Labib, 2003), provides a rapid and cost-effective response to fulfill changing customer needs (Battaïa et al., 2017). Introduced by Koren in 1999, RMS overcomes the limitations of the traditional manufacturing system, it can change its structure rapidly in response to market needs (Koren Y. et al., 1999) and consists of Reconfigurable machines whose function and capacity can be configured. The comparison of advanced manufacturing systems like RMS is carried out with Dedicated Manufacturing System (DMS) and Flexible Manufacturing System (FMS) as shown in Table 1,

Table 1: Comparison of manufacturing systems (Abdi & Labib, 2003)

Comparison of various Manufacturing systems			
Aspects	**Traditional Manufacturing System such as DMS**	**Conventional Manufacturing System such as CMS, FMS**	**Advanced Manufacturing System such as RMS**
Technology used for particular time period	Fixed	Needs to be adaptable to market	Should be responsive to market
Market conditions	Stable	Predictable	Uncertain
Manufacturing Policy	Pushing	Pulling	Customizing
The gap level between Manufacturing system and demand variation	High/Very high	Medium/ High	Low/ Very Low

RMS, capable of manufacturing different product families in a short time, at a minimum cost, without sacrificing the quality of the product, high responsiveness, and performance efficiency (Koren & Shpitalni, 2010). However, for the success of the production system, the time required to bring the product onto the market and the ramp-up time required are becoming more and more crucial. RMS meets most of these challenges in the global market, which traditional manufacturing systems cannot meet due to their

limitations (Abdi & Labib, 2004). The adaption of new products by reconfiguration is now possible due to RMS as depicted in Figure 1.

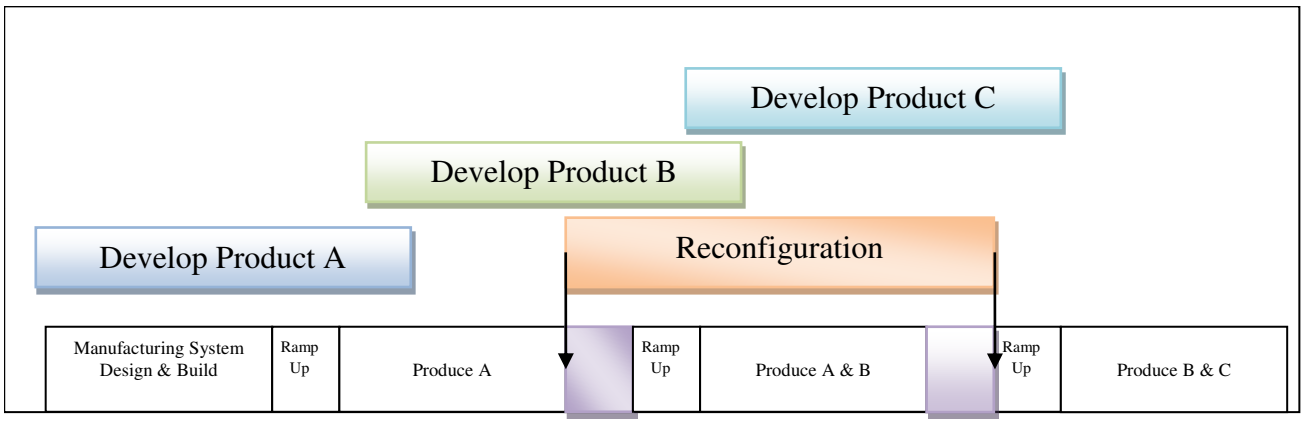

Figure 1: Adaptation to production of new products through rapid reconfiguration (Koren Y. et al., 1999)

1.2 Need of study

Available literature describes various frameworks and methodologies that can be used to implement RMS in industrial applications, however, the results of RMS have not yet been proven (Maganha et al., 2018). The core characteristics of RMS are Modularity, Scalability, Convertibility, customization, and Diagnosability which supports the reconfiguration (Singh et al., 2007, Gumasta et al., 2011). Along with this, it is important to identify the factors that help the system to penetrate RMS and are called Indicators. This will help the designer of the manufacturing system to identify and focus on them while implementing the RMS (David et. al., 2001). Also, it is essential to measure the performance of the manufacturing system based on various performance criteria. Qualitative and quantitative criteria should be included for thorough performance analysis of any manufacturing system (Yurdakul, 2002). These factors are termed as performance metrics that enable the evaluation of the RMS, and attempts can be made to improve performance. Also, it is necessary to prioritize them for successful evaluation of system.

1.3 Research objectives and overall approach

This paper has the following objectives,

- Identify various indicators of RMS and compute their weights.
- Prioritize and rank the performance metrics of RMS.

To achieve the aforementioned objectives, a thorough review of RMS articles is conducted, and 31 indicators and 22 performance metrics are identified. The fuzzy AHP method is used to compute indicator weights, followed by the fuzzy TOPSIS method to prioritise performance metrics using expert opinion.

1.4 Organization of paper

The paper is organized into a total of 8 sections, including the current section. Section 2 presents the literature review, indicators, and performance metrics of RMS. Section 3 describes the research methodology along with the Fuzzy AHP-TOPSIS method and the various steps followed. Section 4 consists of data collection from experts as well as data analysis whereas section 5 represents the findings of the study. Section 6 constitutes theoretical contributions followed by implications of the study in section 7. The conclusions, limitations, and future scope are summarized in section 8.

2. Literature Review

The literature review on RMS, indicators, and performance metrics, along with the MCDM approach used, is presented in this section. Below are some of the findings of the literature review,

2.1 Literature retrieval and selection

The process of collecting various publications is carried out by retrieving publications from the Scopus database. The search applied consists of keywords such as 'Reconfigurable Manufacturing System', 'Indicators', 'Performance Metrics', 'Assessment of RMS', and 'Enablers'. The publications that appeared in peer-reviewed journals, book chapters, and few renowned conference proceedings are included in the study. Many of these publications are found to be irrelevant to our subject and are then excluded. The exclusion is done by reading the abstract and conclusion of each paper served primarily as an initial screening of research papers. The second stage exclusion was done by reading a full-length paper. All relevant papers so collected are then stored in one place so that they can be retrieved as and when required. The word relevant refers to the publications that present various frameworks, indicators, barriers, and assessments of RMS. Finally, 281 papers are selected for the study.

These 281 papers are further divided into three categories; the first category consists of all papers related to frameworks, RMS optimization techniques. The second category consists of papers in which various indicators, RMS assessment, performance metrics are discussed. The third category consists of

papers using various MCDM techniques. Research papers of the first two categories are thoroughly studied to identify indicators and performance metrics for RMS. Certain indicators and performance metrics found to be general, applicable to any manufacturing system, are also considered for study purposes. Initially, all of these indicators and performance metrics are listed in the Microsoft Excel file, regardless of their meaning and repetitive nature. It is noted that most researchers considered the key characteristics of RMS to develop methodologies and frameworks to optimize performance (Chaube et al., 2012; El Maraghy, 2006; Koren et al., 2017). These factors are further sorted and the repetitions are removed. The reframing of these factors is done in such a way as to give them the correct meaning and the list is modified accordingly. References for all of these factors are also added to this table so that the source of the information can be highlighted. The table was finally prepared with 31 indicators as shown in Table 2 and 22 Performance Metrics as shown in Table 3.

2.2 Reconfigurable Manufacturing System (RMS)

RMS is one of the most recent manufacturing systems that can provide flexibility at the lowest possible cost. The design, implementation, reconfiguration control, layout optimization, process planning, and production planning of RMS are key aspects and active research topics (Bi et al., 2008, Bortolini et al., 2018). Reconfigurability is defined as the ability of the manufacturing system to change its production capacity and functionality in a cost-effective way to meet the requirements of a dynamic market (Bi et al., 2008). Also, (El Maraghy, 2006; Mehrabi et al., 2000; Wiendahl et al., 2007) defined RMS as a machine system which with the help of basic process modules that includes hardware and software can be rearranged or replaced in short time duration and reliably. The key enabler of RMS is Reconfigurable Machine Tool (RMT) which is designed specially to customize the product (Chaube et al., 2012). Eguia, et al. (2017), proposed an approach for machine cell design including grouping of machines and cell loading for multiple reconfigurable machine cells having RMT and Computer Numeric Control (CNC). However, the design and implementation of RMS is a major challenge compared to the traditional manufacturing system. Despite the many contributions made by many scientists, the systematic design method of RMS is lacking (Andersen, Brunoe, Nielsen, & Rösiö, 2017). There is limited evidence of a breakthrough in reconfigurability in the manufacturing sector, and therefore further research and contributions from scientists and professionals in this field are needed. Given this need, the authors identified RMS indicators and performance metrics as discussed below.

2.3 Indicators of RMS

Indicators are the factors that help in RMS penetration in the manufacturing industry. In the 21st century, the manufacturing industries are facing unpredictable and high-frequency changes in market demands. Therefore, there is a need for a manufacturing system having high responsiveness at the minimum setup cost and time. According to (Koren Y. et al., 1999), RMS can meet these requirements of the manufacturing system cost-effectively and quickly. Abdi & Labib (2004) has developed a reconfiguration link between market requirements and RMS design and have also developed a design loop for manufacturing system design. He also added some additional criteria that are important for the successful implementation of RMS, such as reusability, various costs, operator skills, motivations, employee training, feasibility, process work, etc. Many researchers have tried to identify the key characteristics of RMS so that designers can focus on these factors for successful implementation (Abdi et al., 2018). Few researchers considered a case study of RMS to identify the prerequisites and barriers to the system and concluded that the development of RMS in the industry is still a challenge and needs to be addressed in future research work. El Maraghy (2006) compared the characteristics of both FMS and RMS. He focused on flexibility and classified it into ten types, such as Machine flexibility, Material handling flexibility, etc., and added that changeability (Changeover ability, Reconfigurability, Flexibility, Transformability, and Agility) is very important for successful RMS implementation. Further, he indexed various enablers of transformability such as Compatibility, Modularity, Scalability, Mobility, and Universality which also helps for RMS implementation. Deif & ElMaraghy (2006) said that mass customization and responsiveness are two main characteristics of today's manufacturing system. He presented architecture to design RMS starting with market demand to a selection of best configuration. Wiendahl & Heger, (2011) described a method that would make it possible to calculate the cost of change in any manufacturing company. Whereas Singh et al. (2007) established a decision-making module to evaluate RMS using tangible and intangible factors. He considered criteria and sub-criteria such as measurement, diagnostics, compensation, etc. had an impact on the judgment. Bi et al. (2008) discussed the requirements of the manufacturing system to meet the customer requirements, including shorter lead time, more variant, low and fluctuating volume, low price, etc. However, Mubarok & Faculty (2010) discussed the SWOT analysis for RMS, considering indicators such as flexibility, quick decision, etc. Gumasta et al. (2011) further categorized core characteristics of RMS, such as detectability, distinguishability, predictability, etc., and tried to measure reconfigurability of RMS. Bortolini et al. (2018) reviewed literature for RMS and included many new factors such as sustainability, Availability, system complexity etc. which contribute to the successful RMS implementation. Prasad &

Jayswal (2019) reviewed the flexibility and reconfigurability of the RMS and discussed various types of flexibility such as machine flexibility, operation flexibility etc. Finally, the selected indicators are shown in Table 2.

Table 2: List of Indicators for RMS

Sr. No.	Name of Indicator	Description	Reference
1	Agility/ Granularity	The system can make changes quickly to respond to changing markets in a short duration of time.	(Sânchez & Pérez, 2001; Wiendahl et al., 2007)
2	Reconfigurability	The ability of the system to switch to another product family in minimum time and effort. It may include the use of artificial intelligence to initiate the reconfiguration process.	(El Maraghy, 2006; Goyal, Jain, & Jain, 2013b; Wiendahl et al., 2007)
3	Evolvability	A manufacturing system can generate adaptive evolution.	(Wiendahl et al., 2007)
4	Integrability	The system can integrate different components.	(El Maraghy, 2006; Gumasta et al., 2011)
5	Scalability	The system can perform under an increased/decreased workload.	(El Maraghy, 2006; Gumasta et al., 2011)
6	Adaptability to market change	The system can change products, businesses, or services as per the need of the market.	(Chaube et al., 2012)
7	Modularity/ Adjustability	Modularity is the degree to which the components can be decoupled and recombined to facilitate economical alterations in the process.	(El Maraghy, 2006; Gumasta et al., 2011; Yurdakul, 2002)
8	Recruitment of Multi-skill Employees	Multi-skill employees enable the system to adapt to changes and maintain performance.	(Abdi & Labib, 2003; Dixit & Gupta, 2013)
9	Innovations in product & Process	The innovative discoveries in products and processes enable easy implementation of RMS.	(Dixit & Gupta, 2013; Koren Y. et al., 1999)
10	Customization and Design flexibility	Customization represents the alterations made in the system to fulfill individual customer requirements which also provide flexibility in designing a product.	(El Maraghy, 2006; Gumasta et al., 2011; Wiendahl et al., 2007)
11	Kanban Methods	Kanban is a method to manage product creation with continual delivery without overburdening development teams.	(Dixit & Gupta, 2013)
12	Distinguishability	The property of the system due to which the functionality loss can be detected. It also includes proper maintenance requirements.	(Dixit & Gupta, 2013; Gumasta et al., 2011; Sânchez & Pérez, 2001)
13	Supplier Integration	It is the extent to which manufacturing system and suppliers takes part in inventory control, forecasting, planning, etc.	(Dixit & Gupta, 2013)
14	Sustainable system culture	A sustainable system refers to maintaining the environmental balance, cultural practices, heritage conservation, etc.	(Chaube et al., 2012)
15	Government promotion & regulations	The encouraging policies and rules of government may promote the RMS implementation.	(Chaube et al., 2012)
16	Advanced Machinery setups	The availability of programmable/reconfigurable machines in the manufacturing system helps the adoption of RMS.	(Goyal & Jain, 2016; Haddou Benderbal et al., 2018)

17	Transformability	The capacity of the system to switch over to a new product. It allows quick changeover between products.	(El Maraghy, 2006; Goyal et al.,2013a, 2013b; Gumasta et al., 2011; Wiendahl et al., 2007)
18	Usage of RFID techniques for Diagnosability	Detectability/Diagnosability using RFID techniques is the quality of the manufacturing system due to which it is being detectable or being countable to quickly and easily identify the quality and reliability-related problems.	(El Maraghy, 2006; Gumasta et al., 2011)
19	Industrial & Social Integration	Industrial integration is the linking of formerly separate enterprises, firms, or processes to reap economies of scale or finance. Social integration is promoting harmonious interaction with all levels of society.	(Chaube et al., 2012)
20	Appropriate practice of automation ability	It represents the ability of a system to automate various processes using advanced technology.	(Wiendahl et al., 2007)
21	Awareness of economic benefits	It represents the awareness of economic benefits among the employees and management due to the implementation of RMS.	(Chaube et al., 2012; Dixit & Gupta, 2013; Haddou Benderbal & Benyoucef, 2019)
22	Digitization of organizational activities	The system can convert and store the information in digital form.	(El Maraghy, 2006; Gumasta et al., 2011)
23	Employee teamwork	It builds creativity and learning, conflict management becomes easy and develops complementary strengths.	(Sânchez & Pérez, 2001)
24	Education and Training of employees	It enables employees to handle new responsibilities which can improve the performance of RMS.	(Dixit & Gupta, 2013; Yurdakul, 2002)
25	Effective utilization of infrastructure	The available infrastructure like space, equipment, etc. may be utilized effectively in RMS.	(Dixit & Gupta, 2013)
26	Appropriate evaluation of Demand of Product Family/ Diversity	It is the ability to predict and evaluate the demand for the product so that the manufacturing system can be selected and implemented successfully.	(Abdi & Labib, 2004; Haddou Benderbal et al., 2018; Sânchez & Pérez, 2001; Yurdakul, 2002)
27	Systematic Inventory Control processes	It is the process of maintaining appropriate stock along with the quality of raw material to meet the customer requirements. It also includes the flexibility of the material handling system.	(Dixit & Gupta, 2013; Koren Y. et al., 1999; Mapes, 2000)
28	CAD/CAM technologies	Advanced software packages for design and manufacturing are very helpful in changing environments. In the case of complex part geometry, such technologies are very useful.	(Dixit & Gupta, 2013; Koren Y. et al., 1999)
29	Effective assessment of PLM and Reliability	PLM provides systematic ways to achieve good quality and reliability using fully integrated methods.	(Haddou Benderbal et al., 2018)
30	Adoption of cyber-physical system	It integrates physical systems, computations, and networking. Its main purpose is to control the physical process through feedback.	(Dixit & Gupta, 2013; Mapes, 2000)
31	Quality Assurance	It is the process of maintaining the desired quality of product through each stage of the manufacturing process.	(Koren Y. et al., 1999; Lozano, Villa, & Eguía, 2017)

2.4 Performance Metrics of RMS

Performance metrics are the factors that reflect the current status of the manufacturing situation, are related to some specific goals in manufacturing, and reveal a real insight into the performance measurement (Hwang, 2014). Kumar, (2013) defined performance metrics as a measurable quantity that indicates an

aspect of the specific performance. The study is carried out to identify the performance metrics of RMS as discussed below.

Garbie (2014) considered manufacturing cost to be one of the criteria for RMS performance analysis and measurement, while (Prasad & Jayswal, 2019b) considered various costs, including manufacturing costs, the sum of all resources used to manufacture the product to evaluate the performance of sustainable manufacturing system. Manpower requirement is another important criterion for assessing the manufacturing system, hence Garbie (2014) while assessing RMS considered overtime costs, which include the amounts paid to workers for additional duties performed by them other than normal working hours. Also, various costs associated with the manufacturing system are important criteria while evaluating RMS hence (Garbie, 2014) considered additional costs, including repairs and maintenance cost of equipment. He also considered depreciation costs of a fixed asset to be other criteria. Likewise, total wages paid to labor (labor cost) indicates overall design effectiveness and overhead expenses is another important factor (Spicer & Carlo, 2007). Overhead expenses may include rent paid, taxes, communication expenses, etc. (Chen & Huang, 2006) while reviewing performance measures of manufacturing system, considered various parameters to evaluate the performance and one of them is process capability or operational capability. Product quality is also to be taken into account when assessing RMS, as a result of which (Garbie, 2014) considered number of defective products produced in particular time period as one of the factor.

Considering the importance of lead time, researchers have tried to reduce it so that the product can be delivered to the customer in minimum time and RMS is one of the ways to reduce the same (Garbie, 2014). Another important factor to evaluate RMS is machine utilization which indicates potential output produced when full capacity is used (Garbie, 2014; Mittal & Jain, 2014; Yurdakul, 2002). While evaluating the performance of a sustainable manufacturing system, (Bi et al., 2008) considered two important factors product durability and product reliability whereas (Mittal & Jain, 2014) supported this by considering these two factors while evaluating RMS. Further, (Abdi & Labib, 2011) emphasized the concept of flexibility and categorized it into various types such as product volume flexibility, product (mix) flexibility, and process flexibility. Flexibility in manufacturing indicates the ability of the manufacturing system to deal with mixed parts, mixed volume, and a mixed process called product (mix) flexibility, volume flexibility, and process flexibility respectively. Further, Garbie (2014) considered system productivity as a criterion to evaluate RMS whereas researchers focused on minimizing work in progress (WIP) which indicates semi-finished products which are entered into the production system but not yet completed. Further, customer complaint as a criterion to evaluate RMS because it indicates the quality of the product as well as the happiness of the

customer regarding that product (Yurdakul, 2002). Lesser customer complaints indicate more customer happiness. Hence, sales growth is yet another important factor related to the performance of RMS (Abdi & Labib, 2004; Yurdakul, 2002). However, Yurdakul, (2002) expressed that waste in the manufacturing system results in an increase in the cost of the product and does not add value to the product. Further, various wastes, such as overproduction/ wages paid for overproduction, transportation wastes, materials, scrap, rework, manpower etc. should therefore be minimized and their impact on plant performance should be taken into account (Mapes, 2000). Gumasta et al., (2011) further added the relationship between performance measurement and manufacturing system design wherein he considered the on-time-deliveries as an important criterion for measuring performance of manufacturing system. The term Reconfiguration time defined as the time required to changeover from one product to another should be minimum to reduce the lead time and cost required for the same called as set up cost is of great significance because RMS is designed to act in dynamic situations (Mapes, 2000). Further, (Touzout & Benyoucef, 2019) also added that the number of accidents that have occurred in that manufacturing system and health issues of employees indicates health & safety of employees which is one of the RMS performance metrics. The performance measures of RMS are also absenteeism and retention of employees. Many researchers have highlighted the importance of the term "Overall Equipment Effectiveness" (OEE). It indicates the extent to which manufacturing facilities/resources are used in relation to their full potential within a scheduled timeframe. According to (Abdi & Labib, 2003; Goyal et al., 2013b), terms such as the Responsive Index (RI) also need to be measured. Furthermore, (Touzout & Benyoucef, 2019) suggested that air, water and land pollution resulting from the production system should also be taken into account while evaluating the production system. Finally, the list of the selected 22 performance metrics are shown in Table 3.

Table 3: **List of Performance Metrics for RMS**

Sr. No.	Name of Performance Metrics	Description	Reference
1.	Productivity	Production rate is the ratio of the number of products produced and the time spent while producing them. Productivity can be considered shift-wise.	(Garbie, 2014; Mapes, 2000)
2.	On-time deliveries	It represents whether the delivery of the product is as per promise or delays.	Gumasta et al., (2011)
3.	Environmental Sustainability	It indicates the rates of pollution creation, depletion of non-renewable sources, etc.	(Touzout & Benyoucef, 2019)
4.	Sales Growth	It is a metric to measure the increase of revenue over a fixed time.	(Abdi & Labib, 2011; Yurdakul, 2002)

5.	Product Flexibility	It indicates the ability of the system to change its production volume, type, and process.	(Abdi & Labib, 2011)
6.	Customer complaints	It represents the number of complaints raised by customers while using the product. It also indicates product durability.	(Mittal & Jain, 2014; Yurdakul, 2002)
7.	Responsive Index (RI)	RI represents the speed and economy at which the machine can handle changes and functional requirements.	(Abdi & Labib, 2003; Goyal et al., 2013a)
8.	Percentage of defective products	It indicates Conformance of quality which is the degree to which the manufactured products meet certain design standards determined by the producer.	(Garbie, 2014)
9.	Total manpower requirements	The term indicates the total cost of manpower required for manufacturing. It also indicates total manpower wastage as well as the cost of overtime given to workers.	(Garbie, 2014; Mapes, 2000)
10.	Manufacturing Cost	It represents the total cost for material, labor, and overhead costs in producing the products.	(Prasad & Jayswal, 2019b)
11.	Equipment Repairs & Maintenance cost	It represents the total amounts required for repairs and maintenance of equipment.	(Garbie,2014)
12.	Machine Utilisation	It represents the measurement of use and performance of machines used in manufacturing.	(Garbie, 2014; Mittal & Jain, 2014; Yurdakul, 2002)
13.	Lead Time	It represents the time required from the start of a process to the completion of the product.	(Garbie,2014)
14.	Process capability	It represents the repeatability and consistency of manufacturing processes when compared with the specification limits of the product.	(Chen & Huang, 2006)
15.	Transportation Wastage	It indicates the unnecessary movement of, double handling of materials, shuffling of inventory, etc. during manufacturing.	(Mapes, 2000)
16.	Material Wastage/ Scrap	It represents the rejected material/ rework required during manufacturing.	(Mapes, 2000)
17.	Overall Equipment Effectiveness	It is the standard used for measuring manufacturing productivity by identifying the percentage of truly manufacturing time.	(Heilala & Voho, 2001)
18.	Energy utilisation/ Electricity/Fuel consumption	It is the measure of the benefits due to savings during utilization of electricity.	(Choi & Xirouchakis, 2015)
19.	Overproduction Wastage	This indicates manufacturing of products before it is ordered.	(Abdi & Labib, 2017)
20.	Health & Safety of employees	It represents total health-related complaints reported by employees.	(Dixit & Gupta, 2013)
21.	Reconfiguration time/ Set up Cost	It indicates the time taken for adjusting machine tools, removing tools, adding new machine tools, and transporting machine tools.	(Mapes, 2000; Mittal & Jain, 2014)
22.	Absenteeism & Retention of employees	It indicates the satisfaction of employees in the present working environment, space, etc.	(Dixit & Gupta, 2013)

2.5 *MCDM techniques used in RMS*

Multi-criteria Decision Analysis (MCDA) or Multi-criteria Decision Making (MCDM) is a branch of Operations research that deals with the design of mathematical and computational tools for the subjective evaluation of the decision alternative in presence of multiple, usually conflicting criteria (Karim & Karmaker, 2016). The MCDM is used for screening, prioritization, ranking, or selection of various independent, incommensurate, or conflicting sets of alternatives. MCDM is further classified into two categories: MADM (multiple attribute decision making) and MODM (multi objective decision making). MADM is generally used for the discrete and limited number of pre-specified alternatives. Furthermore, MODM is concerned with mathematical optimization problems involving more than one objective function and is to be optimized simultaneously. Some of the recent applications are shown in Table 4.

Table 4: Applications of MCDM for various applications

Sr. No.	Author Details & Year	Area of application	Adopted Methodology
1.	(Anand & Kodali, 2008)	Selecting Lean Manufacturing System (LMS)	Preference ranking organization method for enrichment evaluations (PROMETHEE)
2.	(Abdi & Labib, 2011)	Performance evaluation of RMS	Analytic Network Process (ANP)
3.	(Amalnick et al., 2016)	Cloud manufacturing resource allocation	FAHP-FTOPSIS
4.	(Azadeh et al., 2011)	Operator selection of cellular manufacturing system	FAHP-FTOPSIS
5.	(Büyüközkan & Göçer, 2017)	Ranking competing supplier alternatives	Intuitionistic fuzzy AHP
6.	(Sindhwani & Malhotra, 2018)	Ranking of facilitators for Agile Manufacturing System	MOORA, VIKOR
7.	(Yi, Wang, & Zhao, 2018)	Evaluation and optimization of the design schemes of reconfigurable machine tools based on multiple-attribute decision-making	VIKOR
8.	(Singh et al., 2007)	Justification for the selection of an RMS: a fuzzy AHP	AHP

2.4 Gaps identified through literature

Based on the literature review, the gaps identified are as follows,

- Most of the RMS literature focuses on the identification of key characteristics, however, outright identification of indicators seems to be unexplored.
- Few studies presented the evaluation of RMS using a set of criteria, however, there is a need to explore the complete evaluation of RMS using the full set of performance metrics.
- A limited number of studies have published the framework to improve the performance of RMS by identifying and prioritizing performance metrics of RMS.

- Very few studies considered expert opinion to improve the performance of RMS; however, the presented study considers expert opinion for better improvements.
- The literature, strategy, and decision-based problems of RMS reveal that statistical analysis and MCDM techniques can assist in problem-solving.

The above discussion indicates the gap in the literature which highlights the need for MCDM techniques for RMS indicators and performance metrics.

3. Research Methodology

This section describes the complete methodology adopted to carry out the research. Figure 2 depicts the flow chart of the research methodology adopted.

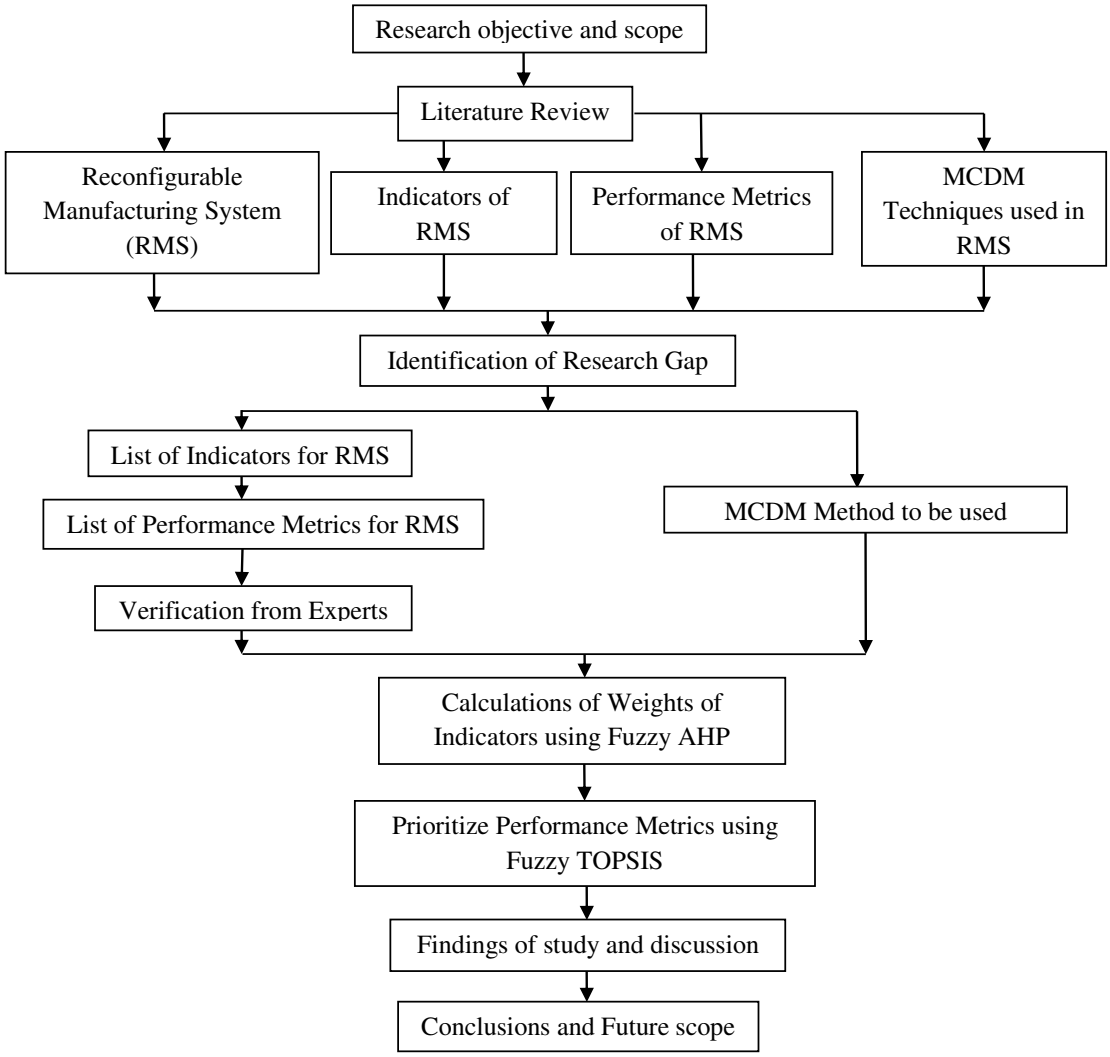

Figure 2: Flow chart for Research methodology

A literature review is carried out to identify various indicators and performance metrics for RMS. The selected indicators were categorized into five major groups: Strategy and policy indicators, Managerial and HR indicators, Organizational indicators, Tangible and intangible indicators, Technical and Smart factory indicators. The inputs from various experts are collected for the hybrid fuzzy AHP-TOPSIS approach. This approach is helpful not only to compute the weights of indicators but also to prioritize the performance metrics of RMS. Figure 4 shows a flow chart of the three-stage hybrid approach used to carry out the above process.

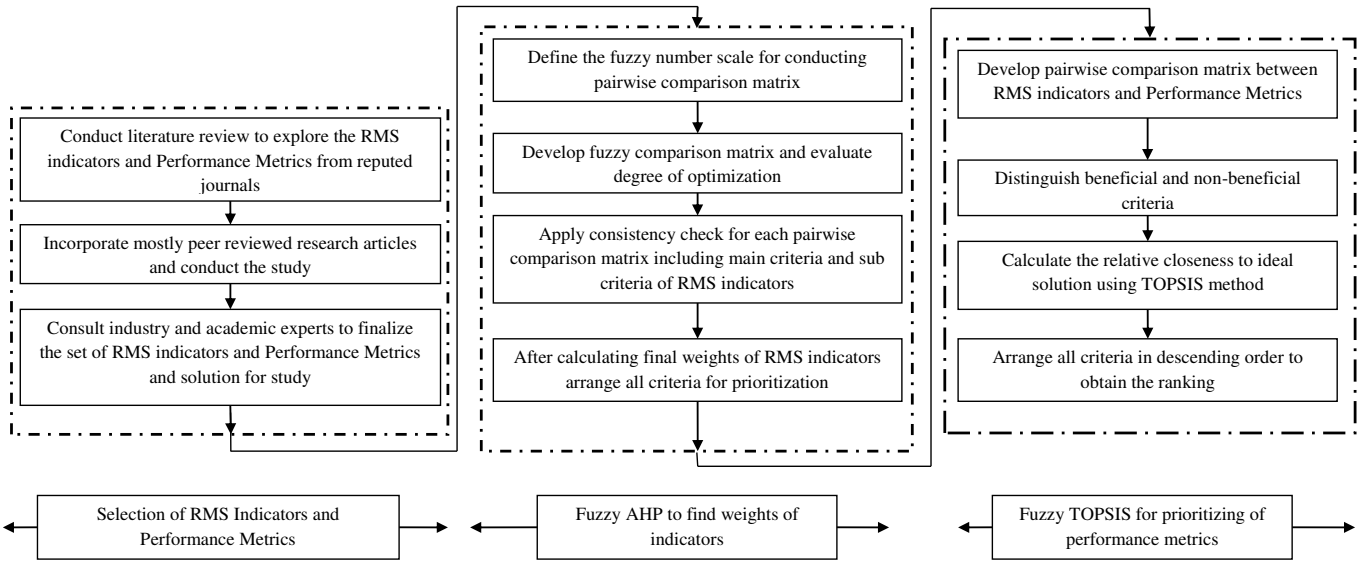

Figure 4: A proposed three-stage hybrid framework

3.1 Determining criteria weights by FAHP

AHP is an MCDM tool for complex decision-making processes based on mathematics and psychology, developed by Thomas L. Saaty (Karim & Karmaker, 2016). While evaluating alternative solutions, we need to attach weights to the criteria to ensure the correct conclusion. AHP is the most accurate method for quantifying the weights of criteria. The degree of relative importance is obtained using a pairwise comparison matrix which is developed using Saaty 1-9 preference scale (Amalnick et al., 2016; Yadav et al., 2018).

In AHP, decision-makers are asked to compare the two individual criteria with finite value, but it is very difficult in practice. In many cases, the decision-maker may be influenced by bias and might contain vagueness during their decision-making. To avoid this, (Chang, 1996) proposed an approach of Fuzzy AHP

based on the extent analysis method and is widely used for supplier selection problems. In this method, linguistic variables are used to express the comparative judgment of the decision-maker. The integrated Fuzzy-AHP process helps practitioners to achieve the best possible solution by considering different types of fuzzy members. The most commonly practiced fuzzy number is triangular fuzzy member wherein the limit range is obtained by considering alpha cut values which are later converted into the crisp number for analysis purposes. The entire fuzzy AHP process is executed using the following steps (Büyüközkan & Göçer, 2017),

i. The relationship between the two criteria is allotted through fuzzy numbers mentioned in the scale of relative importance as shown in table 5.

Table 5: Fuzzy numbers and their membership function

Fuzzy Number	Membership Function
$\tilde{1}$	(1,1,3)
$\tilde{3}$	(1,3,5)
$\tilde{5}$	(3,5,7)
$\tilde{7}$	(5,7,9)
$\tilde{9}$	(7,9,11)

This means that if the fuzzy number 1 is assigned to a relationship between two criteria, it means that, instead of considering a finite value, the whole area covered by the triangle of its corresponding membership function is considered to have a relationship as shown in Figure 3.

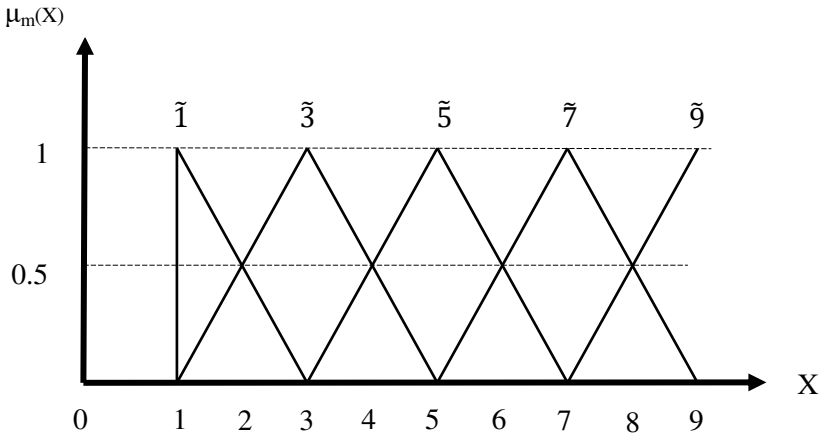

Figure 3: Triangular Fuzzy numbers

ii. After obtaining the membership function, the next step includes defining the range for the comparison between two specific criteria. This range is obtained by following alpha cut values,

$$[l^{\alpha}, \mu^{\alpha}] = [(m-l)\alpha + l, -(u-m)\alpha + u]$$

Where l, u, m are the lower, middle, and upper value of membership function whereas α=0.5

iii. Once the range between comparison allotment is obtained, the next step includes the conversion alpha cut matrix into the corresponding crisp comparison matrix by using the relation as follows,

$$\tilde{a}_{ij}^{\alpha} = \mu a_{ijl}^{\alpha} + (1-\mu) a_{iju}^{\alpha}$$

Where a_{ijl}^{α} is the lower value of the range

a_{iju}^{α} is upper value of the range

μ is the degree of optimization taken as 0.5

iv. Once a crisp comparison matrix is obtained the next step includes the checking of matrix consistency by computing the Eigenvector and then the standard procedure of traditional AHP is followed as explained in subsequent steps.

v. The decision-makers are asked to compare the pair of each criterion in a single matrix. Compute the square of the initial matrix to perform the first iteration.

vi. Take the ratio of the sum of the square matrix and then decide the final column by its sum. This will give first Eigenvector.

vii. It is further required to continuously perform the iterations until you obtain the common Eigenvector in two consecutive iterations.

viii. After obtaining the final Eigenvector, indicate that Eigenvector as 'X' and identify the value of λ_{max} by using the following relation,

$$AX = \lambda_{max} X$$

It is desired to first find the product of AX and later compare it with λ_{max} X.

ix. After computing $\lambda_{max,}$ the next step is to compute consistency index using the relation,

$$C.I. = \frac{\lambda_{max} - n}{n-1}$$

Where n is the number of criteria included in the problem.

x. Finally, it is required to obtain consistency ratio which is obtained by,

$$C.R. = \frac{C.I.}{R.I.}$$

Here, R.I. indicates the random index. It is further required to check whether the consistency ratio is less than 0.1. If the value of C.R. exceeds 0.1 then it indicates that the Eigenvectors obtained are not consistent. The value of R.I. can be obtained from table 6,

Table 6: Random index numbers

No. of Criteria	1.	2.	3.	4.	5.	6.	7.
R.I.	0	0	0.52	0.89	1.11	1.25	1.35

3.2 TOPSIS Method

TOPSIS, developed by Hwang and Yoon in 1981, is a MADM technique based on a comparison of different alternatives with a Negative Ideal Solution (NIS) and a Positive Ideal Solution (PIS). In this method, the ideal solution is the longest distance from the NIS as well as the shortest distance from the PIS (Dağdeviren, 2010). The following steps are to be followed for TOPSIS (Ighravwe & Oke, 2017; Karim & Karmaker, 2016),

i. Construct normalized decision matrix which transforms various attribute dimensions into non-dimensional attributes. We can use,

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum x_{ij}^2}} \qquad \text{For i = 1, 2, 3, ----------m}$$

j = 1, 2, 3, ----------n

ii. Construct the weighted normalized matrix. Multiply each column of the normalized decision matrix by its associated weight. An element of new matrix is,

$$v_{ij} = w_{ij}.r_{ij}$$

iii. Determine the positive ideal solution and negative ideal solutions using the following relation,

The positive ideal solution,

$$A^* = \{V_1^*, V_2^* - - - - - V_n^*\}$$

$$V_j^* = \{(\max(V_{ij}) \ if \ j \in J), (\min(V_{ij}) \ if \ j \in J')\}$$

The negative ideal solution,

$$A' = \{V_1', V_2' - - - - - V_n'\}$$

$$V_j' = \{(\max(V_{ij}) \ if \ j \in J), (\min(V_{ij}) \ if \ j \in J')\}$$

Where J is associated with beneficial criteria whereas J' is associated with non-beneficial criteria.

iv. Calculate the separation measures for each alternative,

The separation measures for the positive ideal solution (PIS) is,

$$S_i^* = \sqrt{\sum_j (V_j^* - V_{ij})^2}$$

Where, i = 1, 2, 3----------m

Similarly, the separation measures for the negative ideal solution (NIS) is,

$$S_i' = \sqrt{\sum_j (V_j' - V_{ij})^2}$$

Where, i = 1, 2, 3----------m

v. Calculate the relative closeness to the ideal solution,

$$C_i^* = \frac{S_i'}{(S_i^* + S_i')}$$

4. Case application

The authors agreed to check the appropriateness of their hybrid framework for ABC manufacturing organization (established in the year 2008) as a case application, as seen in (Yadav et al., 2018). This helps to understand the working of the hybrid framework as well as demonstrates its ability for researchers and practitioners. It reduces the gap between theoretical studies and practical situations. The main intention of this work is to demonstrate the ability of the developed framework to researchers and practitioners. The considered ABC manufacturing organization is located at Bhiwandi, Thane district. The organization produces a wide range of control valves (such as Globe control valve, Butterfly control valve, Ball valves, Flush Bottom valves, Pressure regulating valve, De-super heater, etc.). The company having a total of around 70 employees operates in general shift and having an approximate turnover of ₹25 crores. The organization supplies its products mainly to Siemens India Limited, Rotork Limited, Space alloys, Siddhi cast, and many more.

4.1 Problem description

ABC manufacturing organization is facing many challenges due to increasing competition, changing customer demands, etc. Hence there is a need for techno-managerial solutions such as indicators, performance metrics in the manufacturing organization to reduce the lead time, manufacturing cost, and many more advantages. The kind of framework developed in this work requires the commitment of top management for implementation, as the training and resources play a vital role for it. The challenges were increasing in front of ABC organization as all competing organizations started to implement various technologies in their organization such as 5S, Kaizen, Industry 4.0, and many more. The management of ABC organization is matured enough and was keen to implement such kind of framework as their products are changing continuously. The experience and cooperation of staff and officers have been very helpful during the framework development. After a proper understanding of the concept, the top management of ABC organization realized that they could reduce lead time and manufacturing costs with the help of a developed framework. During the discussion with ABC management, they also expressed that they could not get some of the orders because they could not supply the product in time which incurred a financial loss to them. Management also realized that the quality of their products can also be improved along with increased profit share due to the implementation of this framework. For this reason, the management of the ABC organization decided to participate in the framework development without wasting any more time.

The management of ABC organization expressed their desire to study all Indicators and Performance Metrics, particularly smart factory indicators, during the first meeting. So the authors decided to handover the detailed list of the same to the ABC management so that they could understand it clearly. This approach of management indicates their interest while developing the hybrid framework and the maturity shown by management was very helpful during the study.

4.2 Data collection and Framework development

Stage 1: Shortlisting of indicators and their performance metrics

As discussed earlier, all the indicators and performance metrics identified through the literature review are presented to the expert panel as observed in the study (Yadav et al., 2018). The expert panel studied the list of all indicators and performance metrics and did the necessary shortlisting. The experts suggested categorizing all indicators into various subgroups: Strategy and policy indicators, Managerial and

HR indicators, Organizational indicators, Tangible and intangible indicators, Technical indicators, and Smart factory indicators as shown in Figure 5.

Stage 2: Identification of indicators weights using Fuzzy AHP

Indicators identified through the literature review were presented to the panel for their expert opinion as per the study (Yadav et al., 2018). They were requested to provide their expert opinion (comparison matrix) necessary for the preparation of the decision hierarchy so that they could be prioritized. The structure in the form of groups as shown in Figure 5 could be adopted for indicators and the proven method for grouping is to seek help from subject experts.

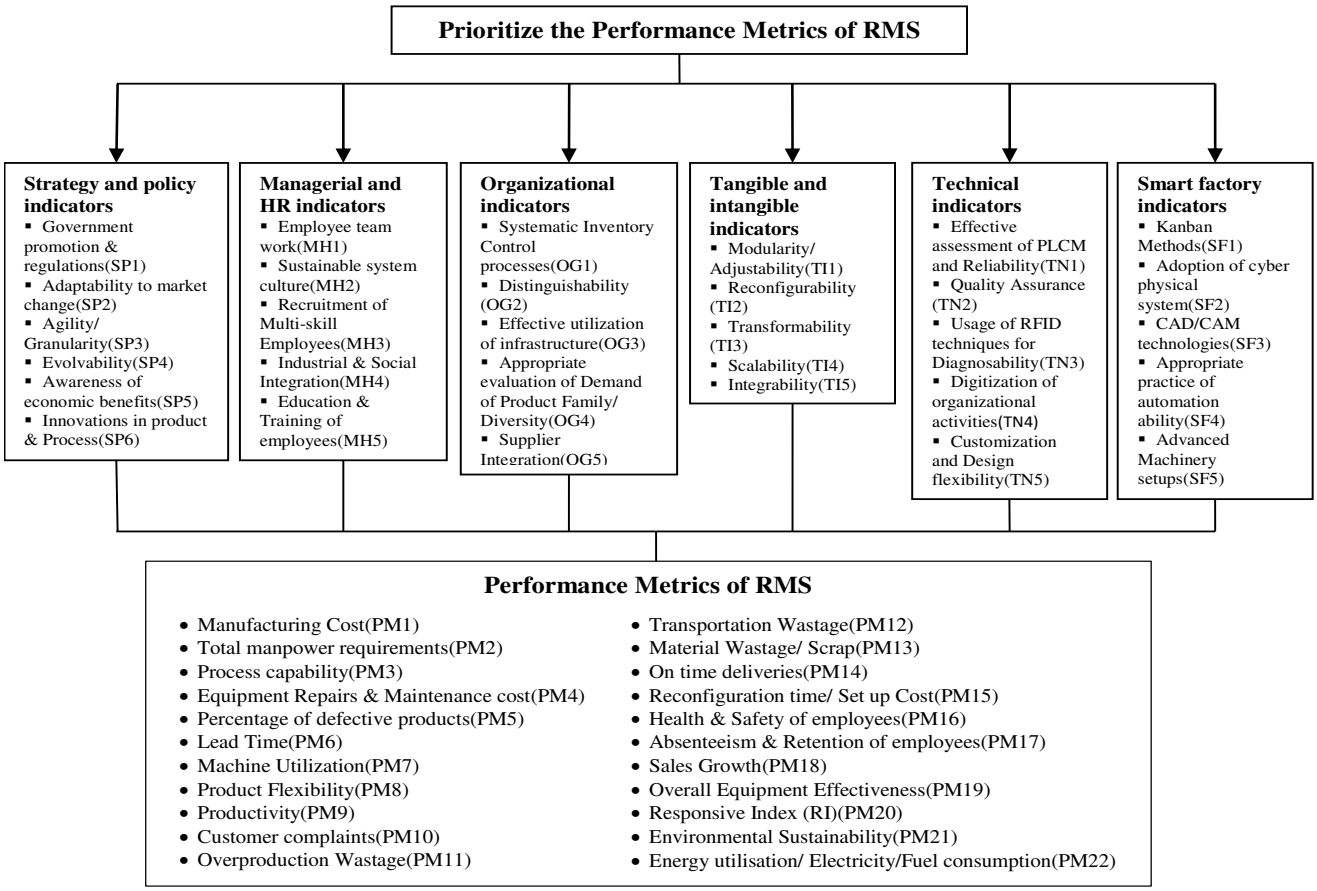

Figure 5: Hierarchical structure of Indicators

The hierarchy of importance of these fuzzy numbers was explained to the experts and asked to prepare an initial pairwise comparison matrix using a five-point scale as shown in Table 7.

Table 7: Relative importance scale (Yadav et al., 2018)

Variables	Fuzzy notification	Corresponding membership function
Equal preference	$\widetilde{M1}$	(1,1,3)
Weak preference	$\widetilde{M3}$	(1,3,5)
Strong preference	$\widetilde{M5}$	(3,5,7)
Very strong preference	$\widetilde{M7}$	(5,7,9)
Extremely strong preference	$\widetilde{M9}$	(7,9,11)

The panel of eight experts from the ABC organization prepared a pair-wise comparison as shown in Table 8-14. The standard procedure of Fuzzy-AHP as described earlier is followed to calculate the weights of all indicators. During this process, complete precautions have been taken for consistency and, if any matrix as stated above is found to be inconsistent, experts are requested to revise their opinion for pair-wise comparison.

Table 8: Pairwise comparison matrix for main criteria indicators

Main Criteria	Strategy and Policy	Organisational	Tangible and Intangible	Managerial and HR	Smart factory	Technical
Strategy and Policy	$\widetilde{M1}$	$\widetilde{M5}$	$\widetilde{M3}$	$\widetilde{M1}$	$\widetilde{M3}$	$(\widetilde{M3})^{-1}$
Organisational	$(\widetilde{M5})^{-1}$	$\widetilde{M1}$	$(\widetilde{M3})^{-1}$	$(\widetilde{M5})^{-1}$	$(\widetilde{M3})^{-1}$	$(\widetilde{M3})^{-1}$
Tangible and Intangible	$(\widetilde{M3})^{-1}$	$\widetilde{M3}$	$\widetilde{M1}$	$(\widetilde{M3})^{-1}$	$(\widetilde{M3})^{-1}$	$(\widetilde{M7})^{-1}$
Managerial and HR	$\widetilde{M1}$	$\widetilde{M5}$	$\widetilde{M3}$	$\widetilde{M1}$	$\widetilde{M7}$	$(\widetilde{M5})^{-1}$
Smart factory	$(\widetilde{M3})^{-1}$	$\widetilde{M3}$	$\widetilde{M3}$	$(\widetilde{M7})^{-1}$	$\widetilde{M1}$	$(\widetilde{M3})^{-1}$
Technical	$\widetilde{M3}$	$\widetilde{M3}$	$\widetilde{M7}$	$\widetilde{M5}$	$\widetilde{M3}$	$\widetilde{M1}$

Table 9: Pairwise comparison matrix for Strategy and Policy indicators

Strategy and Policy	SP1	SP2	SP3	SP4	SP5	SP6
SP1	$\widetilde{M1}$	$(\widetilde{M3})^{-1}$	$(\widetilde{M5})^{-1}$	$\widetilde{M1}$	$(\widetilde{M3})^{-1}$	$\widetilde{M9}$
SP2	$\widetilde{M3}$	$\widetilde{M1}$	$\widetilde{M3}$	$\widetilde{M5}$	$\widetilde{M7}$	$\widetilde{M9}$
SP3	$\widetilde{M5}$	$(\widetilde{M3})^{-1}$	$\widetilde{M1}$	$\widetilde{M9}$	$\widetilde{M3}$	$\widetilde{M9}$
SP4	$\widetilde{M1}$	$(\widetilde{M5})^{-1}$	$(\widetilde{M9})^{-1}$	$\widetilde{M1}$	$(\widetilde{M3})^{-1}$	$\widetilde{M5}$
SP5	$\widetilde{M3}$	$(\widetilde{M7})^{-1}$	$(\widetilde{M3})^{-1}$	$\widetilde{M3}$	$\widetilde{M1}$	$\widetilde{M3}$
SP6	$(\widetilde{M9})^{-1}$	$(\widetilde{M9})^{-1}$	$(\widetilde{M9})^{-1}$	$(\widetilde{M5})^{-1}$	$(\widetilde{M3})^{-1}$	$\widetilde{M1}$

Table 10: Pairwise comparison matrix for Managerial and HR indicators

Managerial and HR	MH1	MH2	MH3	MH4	MH5
MH1	$\widetilde{M1}$	$(\widetilde{M5})^{-1}$	$(\widetilde{M3})^{-1}$	$(\widetilde{M3})^{-1}$	$(\widetilde{M7})^{-1}$
MH2	$\widetilde{M5}$	$\widetilde{M1}$	$\widetilde{M5}$	$\widetilde{M3}$	$(\widetilde{M3})^{-1}$
MH3	$\widetilde{M3}$	$(\widetilde{M5})^{-1}$	$\widetilde{M1}$	$(\widetilde{M3})^{-1}$	$(\widetilde{M7})^{-1}$
MH4	$\widetilde{M3}$	$(\widetilde{M3})^{-1}$	$\widetilde{M3}$	$\widetilde{M1}$	$(\widetilde{M3})^{-1}$
MH5	$\widetilde{M7}$	$\widetilde{M3}$	$\widetilde{M7}$	$\widetilde{M3}$	$\widetilde{M1}$

Table 11: Pairwise comparison matrix for Organizational indicators

Organisational	OG1	OG2	OG3	OG4	OG5
OG1	$\widetilde{M1}$	$\widetilde{M3}$	$(\widetilde{M5})^{-1}$	$(\widetilde{M5})^{-1}$	$(\widetilde{M3})^{-1}$
OG2	$(\widetilde{M3})^{-1}$	$\widetilde{M1}$	$(\widetilde{M5})^{-1}$	$(\widetilde{M3})^{-1}$	$(\widetilde{M5})^{-1}$
OG3	$\widetilde{M5}$	$\widetilde{M5}$	$\widetilde{M1}$	$(\widetilde{M3})^{-1}$	$\widetilde{M3}$
OG4	$\widetilde{M5}$	$\widetilde{M3}$	$\widetilde{M3}$	$\widetilde{M1}$	$\widetilde{M3}$
OG5	$\widetilde{M3}$	$\widetilde{M5}$	$(\widetilde{M3})^{-1}$	$(\widetilde{M3})^{-1}$	$\widetilde{M1}$

Table 12: Pairwise comparison matrix for Tangible and Intangible indicators

Tangible and Intangible	TI1	TI2	TI3	TI4	TI5
TI1	$\widetilde{M1}$	$\widetilde{M3}$	$\widetilde{M5}$	$\widetilde{M3}$	$\widetilde{M5}$
TI2	$(\widetilde{M3})^{-1}$	$\widetilde{M1}$	$\widetilde{M5}$	$\widetilde{M3}$	$\widetilde{M3}$
TI3	$(\widetilde{M5})^{-1}$	$(\widetilde{M5})^{-1}$	$\widetilde{M1}$	$(\widetilde{M5})^{-1}$	$\widetilde{M3}$
TI4	$(\widetilde{M3})^{-1}$	$(\widetilde{M3})^{-1}$	$\widetilde{M5}$	$\widetilde{M1}$	$\widetilde{M5}$
TI5	$(\widetilde{M5})^{-1}$	$(\widetilde{M3})^{-1}$	$(\widetilde{M3})^{-1}$	$(\widetilde{M5})^{-1}$	$\widetilde{M1}$

Table 13: Pairwise comparison matrix for Technical indicators

Technical	TN1	TN2	TN3	TN4	TN5
TN1	$\widetilde{M1}$	$\widetilde{M3}$	$\widetilde{M1}$	$\widetilde{M3}$	$\widetilde{M5}$
TN2	$(\widetilde{M3})^{-1}$	$\widetilde{M1}$	$(\widetilde{M3})^{-1}$	$(\widetilde{M5})^{-1}$	$(\widetilde{M3})^{-1}$
TN3	$\widetilde{M1}$	$\widetilde{M3}$	$\widetilde{M1}$	$(\widetilde{M3})^{-1}$	$\widetilde{M3}$
TN4	$(\widetilde{M3})^{-1}$	$\widetilde{M5}$	$\widetilde{M3}$	$\widetilde{M1}$	$\widetilde{M7}$
TN5	$(\widetilde{M5})^{-1}$	$\widetilde{M3}$	$(\widetilde{M3})^{-1}$	$(\widetilde{M7})^{-1}$	$\widetilde{M1}$

Table 14: Pairwise comparison matrix for Smart factory indicators

Smart factory	SF1	SF2	SF3	SF4	SF5
SF1	$\widetilde{M1}$	$(\widetilde{M9})^{-1}$	$(\widetilde{M5})^{-1}$	$(\widetilde{M3})^{-1}$	$(\widetilde{M9})^{-1}$
SF2	$\widetilde{M9}$	$\widetilde{M1}$	$\widetilde{M3}$	$\widetilde{M5}$	$\widetilde{M3}$
SF3	$\widetilde{M5}$	$(\widetilde{M3})^{-1}$	$\widetilde{M1}$	$(\widetilde{M3})^{-1}$	$(\widetilde{M5})^{-1}$
SF4	$\widetilde{M3}$	$(\widetilde{M5})^{-1}$	$\widetilde{M3}$	$\widetilde{M1}$	$(\widetilde{M3})^{-1}$
SF5	$\widetilde{M9}$	$(\widetilde{M3})^{-1}$	$\widetilde{M5}$	$\widetilde{M3}$	$\widetilde{M1}$

Finally, the weights of major criteria and sub-criteria were computed using the standard fuzzy-AHP procedure and the obtained weights are presented in Table 15.

Table 15: Final indicator weights

Major Criteria	Major criteria weights	Sub criteria weights	Ratio weights	Final weights
Smart factory indicators	0.2280	SF1	0.1898	0.0423
		SF2	0.2294	0.0511
		SF3	0.1910	0.0425
		SF4	0.1939	0.0432
		SF5	0.1956	0.0435
Strategy and policy indicators	0.2100	SP1	0.1956	0.0410
		SP2	0.1578	0.0331
		SP3	0.1472	0.0309
		SP4	0.1104	0.0231
		SP5	0.1898	0.0398
		SP6	0.1990	0.0418
Technical indicators	0.2054	TN1	0.1951	0.0401
		TN2	0.1751	0.0359
		TN3	0.2066	0.0424
		TN4	0.2177	0.0447
		TN5	0.2053	0.0421
Managerial and HR indicators	0.1315	MH1	0.1666	0.0219
		MH2	0.2310	0.0304
		MH3	0.1824	0.0240
		MH4	0.1930	0.0254
		MH5	0.2268	0.0298
Organizational indicators	0.1162	OG1	0.1811	0.0210
		OG2	0.1782	0.0207
		OG3	0.1999	0.0232
		OG4	0.2473	0.0287
		OG5	0.1933	0.0224
Tangible and intangible indicators	0.1138	TI1	0.2271	0.0258
		TI2	0.2133	0.0242
		TI3	0.1870	0.0212
		TI4	0.2044	0.0232
		TI5	0.1680	0.0191

Stage 3: Prioritization of performance metrics using Fuzzy-TOPSIS

All these weights calculated in the above steps are used in the TOPSIS method for the ranking of performance metrics. The five-point scale is used to collect expert opinions as shown in Table 16 and to compare all indicators with performance metrics.

Table 16: Fuzzy score conversion of linguistic scale (Rao & Patel, 2010; Yadav et al., 2018)

Linguistic Term	Fuzzy Number	Crisp Score
Criteria 'A' is very low significant to criteria 'B'	F1	0.115
Criteria 'A' is low significant to criteria 'B'	F2	0.295
Criteria 'A' and criteria 'B' are equally significant	F3	0.495
Criteria 'A' is more significant to criteria 'B'	F4	0.695
Criteria 'A' is extremely significant to criteria 'B'	F5	0.895

The comparison matrix is presented in table 17, where the numbers presented are fuzzy. Then the various steps explained in 3.2 are followed for the comparison matrix presented in Table 17. The weighted normalized matrix is presented in Table 18 which is obtained by taking the product of the normalized matrix using the crisp score and global weights.

Table 17: Initial Comparison matrix for TOPSIS

	SF1	SF2	SF3	SF4	SF5	SP1	SP2	SP3	SP4	SP5	SP6	TN1	TN2	TN3	TN4	TN5	MH1	MH2	MH3	MH4	MH5	OG1	OG2	OG3	OG4	OG5	TI1	TI2	TI3	TI4	TI5
PM1	4	4	5	3	5	4	4	3	4	4	4	4	3	4	3	5	4	4	4	2	3	4	3	4	3	3	4	4	4	4	4
PM2	4	4	3	4	3	3	2	4	3	2	4	3	4	4	2	2	4	4	3	4	4	4	2	3	4	4	3	4	4	2	4
PM3	4	4	2	5	4	4	3	4	4	2	5	4	3	3	4	4	3	2	4	4	5	4	3	4	3	4	3	3	3	4	3
PM4	4	3	4	2	4	4	4	3	4	4	2	3	2	4	3	2	2	4	2	4	4	3	3	4	2	4	4	2	3	4	3
PM5	4	2	4	3	3	4	3	4	3	2	3	4	5	4	4	3	4	5	5	3	5	2	4	3	4	2	2	3	2	4	2
PM6	4	4	4	5	4	5	4	3	5	3	4	5	4	4	4	4	4	4	5	4	5	4	4	3	4	5	5	4	4	5	4
PM7	4	3	5	4	5	2	4	3	4	2	3	2	4	4	3	5	4	3	3	4	4	4	4	4	4	4	4	5	5	2	5
PM8	4	4	5	3	4	3	5	4	5	3	3	5	4	4	3	5	5	3	5	3	5	3	4	4	5	5	4	5	4	5	5
PM9	3	5	3	5	3	3	3	5	3	3	5	3	4	3	5	4	3	3	4	5	3	5	3	3	3	5	3	3	3	4	3
PM10	4	3	4	2	4	3	3	4	3	3	4	4	2	3	4	2	3	4	2	5	3	2	4	2	3	2	3	3	2	3	3
PM11	3	2	4	2	2	4	2	2	4	3	2	4	3	2	2	2	2	3	2	2	4	2	3	2	3	2	3	2	2	2	2
PM12	3	2	3	2	3	3	2	3	2	4	2	2	2	3	4	2	3	3	3	2	4	2	3	2	4	2	2	3	2	3	2
PM13	4	3	3	4	4	3	3	2	4	3	2	2	4	3	2	4	3	2	2	2	4	2	2	4	4	2	3	2	4	3	2
PM14	4	5	4	5	4	5	2	5	4	5	4	3	4	3	4	3	4	3	4	2	4	3	3	4	3	3	3	3	4	4	3
PM15	5	4	4	3	3	5	3	4	4	5	3	5	4	5	4	3	3	5	3	4	5	4	4	5	4	4	5	4	4	5	4
PM16	3	3	3	4	3	3	3	3	2	3	3	3	3	2	3	4	2	3	2	2	2	4	2	3	3	3	2	4	2	3	2
PM17	3	2	4	3	2	3	2	4	3	2	2	3	2	2	2	3	3	2	2	3	2	2	4	2	2	3	2	3	2	2	2
PM18	3	2	3	2	3	4	2	4	3	2	3	2	3	4	3	2	3	4	2	3	2	4	2	2	3	4	2	2	4	2	3
PM19	4	3	3	2	3	4	3	2	4	3	3	3	5	2	3	4	3	2	4	3	2	4	3	3	4	4	2	3	3	4	3
PM20	4	3	4	3	3	3	4	2	2	4	3	2	4	2	2	2	4	3	3	4	3	2	4	3	2	4	2	2	4	2	3
PM21	4	2	2	3	3	2	2	2	3	3	3	3	2	2	4	2	2	2	2	2	2	2	2	3	2	3	2	3	2	3	3
PM22	3	4	2	2	2	2	3	3	2	2	4	2	2	2	4	3	3	2	4	3	3	3	4	3	2	2	3	4	2	3	3

Table 18: Weighted Normalized matrix for TOPSIS

	SF1	SF2	SF3	SF4	SF5	SP1	SP2	SP3	SP4	SP5	SP6	TN1	TN2	TN3	TN4	TN5	MH1	MH2	MH3	MH4	MH5	OG1	OG2	OG3	OG4	OG5	TI1	TI2	TI3	TI4	TI5
PM1	0.0097	0.0132	0.0129	0.0077	0.0141	0.0099	0.0094	0.0055	0.0057	0.0110	0.0109	0.0103	0.0064	0.0114	0.0082	0.0140	0.0058	0.0080	0.0062	0.0028	0.0049	0.0056	0.0039	0.0062	0.0054	0.0039	0.0072	0.0063	0.0057	0.0058	0.0052
PM2	0.0097	0.0132	0.0071	0.0109	0.0078	0.0071	0.0040	0.0078	0.0041	0.0047	0.0109	0.0073	0.0090	0.0114	0.0049	0.0046	0.0058	0.0080	0.0044	0.0066	0.0069	0.0056	0.0024	0.0044	0.0075	0.0055	0.0051	0.0063	0.0057	0.0025	0.0052
PM3	0.0097	0.0132	0.0043	0.0140	0.0109	0.0099	0.0067	0.0078	0.0057	0.0047	0.0140	0.0103	0.0064	0.0081	0.0115	0.0109	0.0041	0.0034	0.0062	0.0066	0.0089	0.0056	0.0039	0.0062	0.0054	0.0055	0.0051	0.0045	0.0040	0.0058	0.0037
PM4	0.0097	0.0094	0.0100	0.0046	0.0109	0.0099	0.0094	0.0055	0.0057	0.0110	0.0046	0.0073	0.0038	0.0114	0.0082	0.0046	0.0024	0.0080	0.0026	0.0066	0.0069	0.0040	0.0039	0.0062	0.0032	0.0055	0.0072	0.0027	0.0040	0.0058	0.0037
PM5	0.0097	0.0056	0.0100	0.0077	0.0078	0.0099	0.0067	0.0078	0.0041	0.0047	0.0077	0.0103	0.0116	0.0114	0.0115	0.0078	0.0058	0.0103	0.0080	0.0047	0.0089	0.0024	0.0055	0.0044	0.0075	0.0023	0.0031	0.0045	0.0024	0.0058	0.0022
PM6	0.0097	0.0132	0.0100	0.0140	0.0109	0.0128	0.0094	0.0055	0.0073	0.0078	0.0109	0.0133	0.0090	0.0114	0.0115	0.0109	0.0058	0.0080	0.0080	0.0066	0.0089	0.0056	0.0055	0.0044	0.0075	0.0071	0.0093	0.0063	0.0057	0.0075	0.0052
PM7	0.0097	0.0094	0.0129	0.0109	0.0141	0.0042	0.0094	0.0055	0.0057	0.0047	0.0077	0.0044	0.0090	0.0114	0.0082	0.0140	0.0058	0.0057	0.0044	0.0066	0.0069	0.0056	0.0055	0.0062	0.0075	0.0055	0.0072	0.0081	0.0073	0.0025	0.0067
PM8	0.0097	0.0132	0.0129	0.0077	0.0109	0.0071	0.0121	0.0078	0.0073	0.0078	0.0077	0.0133	0.0090	0.0114	0.0082	0.0140	0.0074	0.0057	0.0080	0.0047	0.0089	0.0040	0.0055	0.0062	0.0097	0.0071	0.0072	0.0081	0.0057	0.0075	0.0067
PM9	0.0069	0.0170	0.0071	0.0140	0.0078	0.0071	0.0067	0.0100	0.0041	0.0078	0.0140	0.0073	0.0090	0.0081	0.0148	0.0109	0.0041	0.0057	0.0062	0.0086	0.0049	0.0072	0.0039	0.0044	0.0054	0.0071	0.0051	0.0045	0.0040	0.0058	0.0037
PM10	0.0097	0.0094	0.0100	0.0046	0.0109	0.0071	0.0067	0.0078	0.0041	0.0078	0.0109	0.0103	0.0038	0.0081	0.0115	0.0046	0.0041	0.0080	0.0026	0.0086	0.0049	0.0024	0.0055	0.0026	0.0054	0.0023	0.0051	0.0045	0.0024	0.0041	0.0037
PM11	0.0069	0.0056	0.0100	0.0046	0.0046	0.0099	0.0040	0.0033	0.0057	0.0078	0.0046	0.0103	0.0064	0.0048	0.0049	0.0046	0.0024	0.0057	0.0026	0.0028	0.0069	0.0024	0.0039	0.0026	0.0054	0.0023	0.0051	0.0027	0.0024	0.0025	0.0022
PM12	0.0069	0.0056	0.0071	0.0046	0.0078	0.0071	0.0040	0.0055	0.0024	0.0110	0.0046	0.0044	0.0038	0.0081	0.0115	0.0046	0.0041	0.0057	0.0044	0.0028	0.0069	0.0024	0.0039	0.0026	0.0075	0.0023	0.0031	0.0045	0.0024	0.0041	0.0022
PM13	0.0097	0.0094	0.0071	0.0109	0.0109	0.0071	0.0067	0.0033	0.0057	0.0078	0.0046	0.0044	0.0090	0.0081	0.0049	0.0109	0.0041	0.0034	0.0026	0.0028	0.0069	0.0024	0.0024	0.0062	0.0075	0.0023	0.0051	0.0027	0.0057	0.0041	0.0022
PM14	0.0097	0.0170	0.0100	0.0140	0.0109	0.0128	0.0040	0.0100	0.0057	0.0142	0.0109	0.0073	0.0090	0.0081	0.0115	0.0078	0.0058	0.0057	0.0062	0.0028	0.0069	0.0040	0.0039	0.0062	0.0054	0.0039	0.0051	0.0045	0.0057	0.0058	0.0037
PM15	0.0124	0.0132	0.0100	0.0077	0.0078	0.0128	0.0067	0.0078	0.0057	0.0142	0.0077	0.0133	0.0090	0.0146	0.0115	0.0078	0.0041	0.0103	0.0044	0.0066	0.0089	0.0056	0.0055	0.0080	0.0075	0.0055	0.0093	0.0063	0.0057	0.0075	0.0052
PM16	0.0069	0.0094	0.0071	0.0109	0.0078	0.0071	0.0067	0.0055	0.0024	0.0078	0.0077	0.0073	0.0064	0.0048	0.0082	0.0109	0.0024	0.0057	0.0026	0.0028	0.0029	0.0056	0.0024	0.0044	0.0054	0.0039	0.0031	0.0063	0.0024	0.0041	0.0022
PM17	0.0069	0.0056	0.0100	0.0077	0.0046	0.0071	0.0040	0.0078	0.0041	0.0047	0.0046	0.0073	0.0038	0.0048	0.0049	0.0078	0.0041	0.0034	0.0026	0.0047	0.0029	0.0024	0.0055	0.0026	0.0032	0.0039	0.0031	0.0045	0.0024	0.0025	0.0022
PM18	0.0069	0.0056	0.0071	0.0046	0.0078	0.0099	0.0040	0.0078	0.0041	0.0047	0.0077	0.0044	0.0064	0.0114	0.0082	0.0046	0.0041	0.0080	0.0026	0.0047	0.0029	0.0056	0.0024	0.0026	0.0054	0.0055	0.0031	0.0027	0.0057	0.0025	0.0037
PM19	0.0097	0.0094	0.0071	0.0046	0.0078	0.0099	0.0067	0.0033	0.0057	0.0078	0.0077	0.0073	0.0116	0.0048	0.0082	0.0109	0.0041	0.0034	0.0062	0.0047	0.0029	0.0056	0.0039	0.0044	0.0075	0.0055	0.0031	0.0045	0.0040	0.0058	0.0037
PM20	0.0097	0.0094	0.0100	0.0077	0.0078	0.0071	0.0094	0.0033	0.0024	0.0110	0.0077	0.0044	0.0090	0.0048	0.0049	0.0046	0.0058	0.0057	0.0044	0.0066	0.0049	0.0024	0.0055	0.0044	0.0032	0.0055	0.0031	0.0027	0.0057	0.0025	0.0037
PM21	0.0097	0.0056	0.0043	0.0077	0.0078	0.0042	0.0040	0.0033	0.0041	0.0078	0.0077	0.0073	0.0038	0.0048	0.0115	0.0046	0.0024	0.0034	0.0026	0.0028	0.0029	0.0024	0.0024	0.0044	0.0032	0.0039	0.0031	0.0045	0.0024	0.0041	0.0037
PM22	0.0069	0.0132	0.0043	0.0077	0.0046	0.0042	0.0067	0.0055	0.0024	0.0047	0.0109	0.0044	0.0038	0.0048	0.0115	0.0078	0.0041	0.0034	0.0062	0.0047	0.0049	0.0040	0.0055	0.0044	0.0032	0.0023	0.0051	0.0063	0.0024	0.0041	0.0037

4.3 Data analysis

Various steps for fuzzy-TOPSIS are followed till the distance from the positive ideal solution (PIS), the negative ideal solution (NIS), and the relative closeness from the ideal solution and ranking is obtained. As the values of the relative closeness represent the distance from the negative/worst solution, the highest value is given the top ranking as shown in Table 19.

Table 19: Ranking obtained using TOPSIS

Performance Metrics code	Positive Ideal Solution (PIS)	Negative Ideal Solution (NIS)	Relative closeness	Ranking
PM1	0.0179	0.0269	0.5998	4
PM2	0.0259	0.0204	0.4409	10
PM3	0.0221	0.0249	0.5291	7
PM4	0.0270	0.0197	0.4215	11
PM5	0.0256	0.0223	0.4655	9
PM6	0.0140	0.0302	0.6835	1
PM7	0.0231	0.0255	0.5246	8
PM8	0.0175	0.0295	0.6274	3
PM9	0.0212	0.0268	0.5589	6
PM10	0.0272	0.0190	0.4110	12
PM11	0.0352	0.0127	0.2651	20
PM12	0.0334	0.0134	0.2867	19
PM13	0.0294	0.0170	0.3670	14
PM14	0.0198	0.0276	0.5816	5
PM15	0.0167	0.0298	0.6403	2
PM16	0.0294	0.0148	0.3355	16
PM17	0.0358	0.0107	0.2304	22
PM18	0.0325	0.0145	0.3084	18
PM19	0.0281	0.0177	0.3871	13
PM20	0.0304	0.0162	0.3483	15
PM21	0.0350	0.0108	0.2360	21
PM22	0.0320	0.0153	0.3234	17

5. Findings of the study

Implementation of the RMS is more costly compared to other manufacturing systems, but the benefits accrue are more than other systems. It is therefore important to ensure the correct implementation of the various indicators and performance metrics, otherwise, the performance and efficiency of the system may be affected. The main objective of this study is to develop a hybrid Fuzzy AHP –TOPSIS framework that can be very useful for decision-making during the implementation of the system. The two phases of this study include the computation of the major criterion and the weights of the sub-criterion indicators. Initially, all

the major criterion, as well as the sub-criterion, are ranked within the group by computing their relative weights. This helps to compare indicators both within the group and outside the group with the help of global weight. The second phase is to rank shortlisted performance metrics using the Fuzzy-TOPSIS method.

Finally, the results obtained using Fuzzy-AHP and the ranking obtained using Fuzzy-TOPSIS are analyzed for interpretation, revealing that the 'smart factory' indicators have the highest weight among the other indicators followed by the 'strategy and policy' indicators. It demonstrates that the use of advanced manufacturing and material handling technologies can lead to the successful implementation of RMS, and these indicators can improve many important performance metrics, such as lead time, reconfiguration time, etc. Strategy and policy indicators are also very important, as rigid management policies can act as major obstacles to the effective implementation of the RMS. The utilization of technical resources such as digitization and RFID is the key to success in the successful RMS implementation. It is also observed that the education and training of employees has an impact on implementation, as the skills of employees have a major impact on the system. Among the performance metrics, ‘Lead time’ holds the highest positions which are followed by ‘Reconfiguration time’ and ‘Product flexibility’ offered by the manufacturing system. ‘Manufacturing cost’ is at fourth position, as it is a very important metrics as far as product cost is concerned. ‘On-time deliveries’ is vital if any manufacturing organization wants to sustain itself in the market, hence it is in the fifth position. The later positions of performance metrics are occupied by ‘Productivity’, ‘Process capability’, ‘Machine utilization’, and ‘Percentage of defective Products’ etc.

6. Theoretical contributions of the study

Many researchers discussed the core characteristics of RMS. At the same time, none of the researchers discussed indicators, their weights, and the ranking of performance metrics for RMS. Hence, this study tries to find indicators and performance metrics of RMS along with their ranking using the hybrid Fuzzy AHP-TOPSIS. This hybrid framework is used to compute the weights of the indicators to assess their influence during the implementation of RMS and these weights are used to rank the performance metrics in link with indicators. Authors expect the presented work will save efforts, time, and funds of practitioners of the manufacturing system. This research can be viewed as a significant contribution to MCDM as well as RMS promoting applications in the domain areas.

The main contribution of this study is the identification of RMS indicators and performance metrics. The exhaustive literature survey is conducted, with 31 indicators and 22 performance metrics that are best

suited to the RMS manufacturing environment being finalized. Authors have tried to include highly influential domain-specific indicators and performance metrics for RMS and are prioritized for smooth and successful implementation of RMS.

7. Implications for practitioners and researchers

The main aim of this paper is to develop a hybrid framework for prioritizing RMS performance metrics. To achieve success in the field of techno-managerial solutions, the key requirement is the hybrid framework (Prashar, 2016; Yadav et al., 2018). The inputs are taken from researchers and industry practitioners. The researchers mainly contribute to the creation of a hybrid framework and mathematical calculations, while the practitioner helps with the inputs of the framework (Yadav et al., 2018). The contribution of both researchers and practitioners is therefore essential for the development of such a framework.

Following implications are important for practitioners and researchers interested in application areas of RMS.

- The study illustrates the use of the Fuzzy AHP-TOPSIS hybrid approach to the RMS framework and provides three main inputs. First, many articles in the field of MCDM (Kurttila et al., 2000; Saaty, 2008) used AHP alone as a methodology in which the chances of vagueness and bias cannot be neglected. This is why Fuzzy-AHP is introduced, which gives the decision-maker flexibility for comparison (Yadav et al., 2018). Second, TOPSIS is used to rank alternatives aimed at finding the best alternative that has the shortest distance from the PIS and at the same time the distance from the NIS (Karim & Karmaker, 2016). Using AHP's fuzzy theory to assess the weight of TOPSIS parameters will reduce the ambiguity and uncertainties inherent in making decisions on the most efficient number of operators and the successful calculation of RMS operator assignments. Thirdly, the framework developed in this work can be used in any other field, irrespective of the nature of the problem.
- Many studies (Karim & Karmaker, 2016; Yadav et al., 2018) have tried to focus on the importance of developing a hybrid framework, but there is still a lack of such studies in practice. There is also a need to develop a generalized type of framework that can be used in any application domain with slight modification. This is particularly important in developing countries where the risk of failure to implement cannot be afforded. Such frameworks will therefore be very useful in decision-making areas where indicators and performance metrics play an important role in the manufacturing system.

- The authors of this work agree that not all indicators can be considered and included during the implementation of the RMS, but based on the weights obtained, important indicators with high-intensity weights can be considered and included. The hybrid framework developed here plays an important role and the author wants to encourage this kind of work in other areas.
- The hybrid framework that has been developed in this way offers many benefits to practitioners and researchers that can show new directions in research. There is still a need to explore more opportunities in this area. The hybrid framework can also be used to assess several other issues in the industry. This developed framework can be taken as a foundational step in this direction.

8. Conclusions, Limitations, and Future Scope

The work presented is an initial attempt to improve the adaptability of RMS so that different manufacturing firms wishing to produce different products using the same manufacturing facilities can easily implement RMS. Finalized Indicators and Performance Metrics are evaluated by developing the RMS decision hybrid framework using the Fuzzy AHP–TOPSIS approach. Fuzzy-AHP is used to calculate the Indicators' weights, while Fuzzy-TOPSIS is used to evaluate the Performance Metrics ranking. This will help the practicing managers to take appropriate and timely decisions in the event of RMS adoption and performance measurement. An initial facilitator study can help policymakers understand the potential of actual RMS implementation in the manufacturing industry. The developed hybrid framework is an important techno-managerial solution in the field of RMS. Such work, which can handle both indicators and performance metrics, is rarely reported in the RMS field. The results of this study suggest that 'Smart Factory' indicators have the highest priority, which means that the adoption of the latest and automated manufacturing technologies can improve the performance of RMS. Authors assume that ranking performance metrics will be simpler and more efficient through their analysis and will support the execution of RMS. Manufacturing enterprise management should make a strategic effort to manage RMS applications.

In addition to the above-noted benefits of the study, some of the limitations of the study cannot be neglected. The first major limitation of the study is that if someone is not familiar with MCDM techniques, this framework may increase the complexity of the study. The study presented here is validated by the use of expert data in the form of a matrix of comparison. This work can be extended and simulation-based evaluations can be carried out to compare the results. The experts involved may likely have missed some

important indicators and performance metrics. Authors appeal to researchers and practitioners to use a specific range of indicators and performance metrics to explore this approach. Researchers may also try to apply this framework to other areas of production and the results can be verified. Authors expect both researchers and practitioners to benefit from experimenting with this study in a variety of sectors and to continue this research work.

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Figures

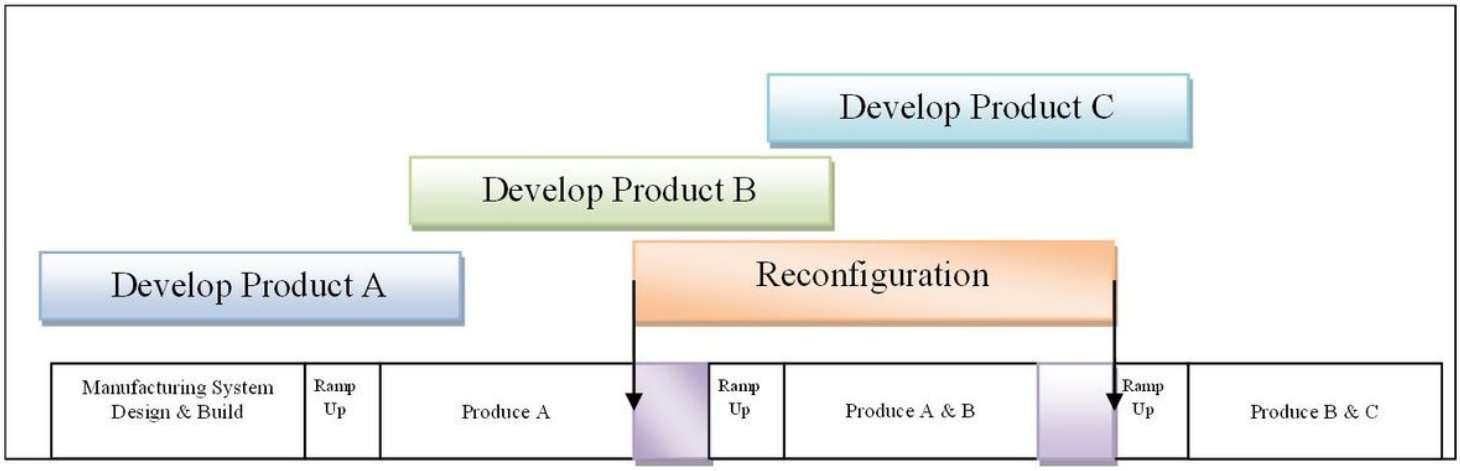

Figure 1

Adaptation to production of new products through rapid reconfiguration (Koren Y. et al., 1999)

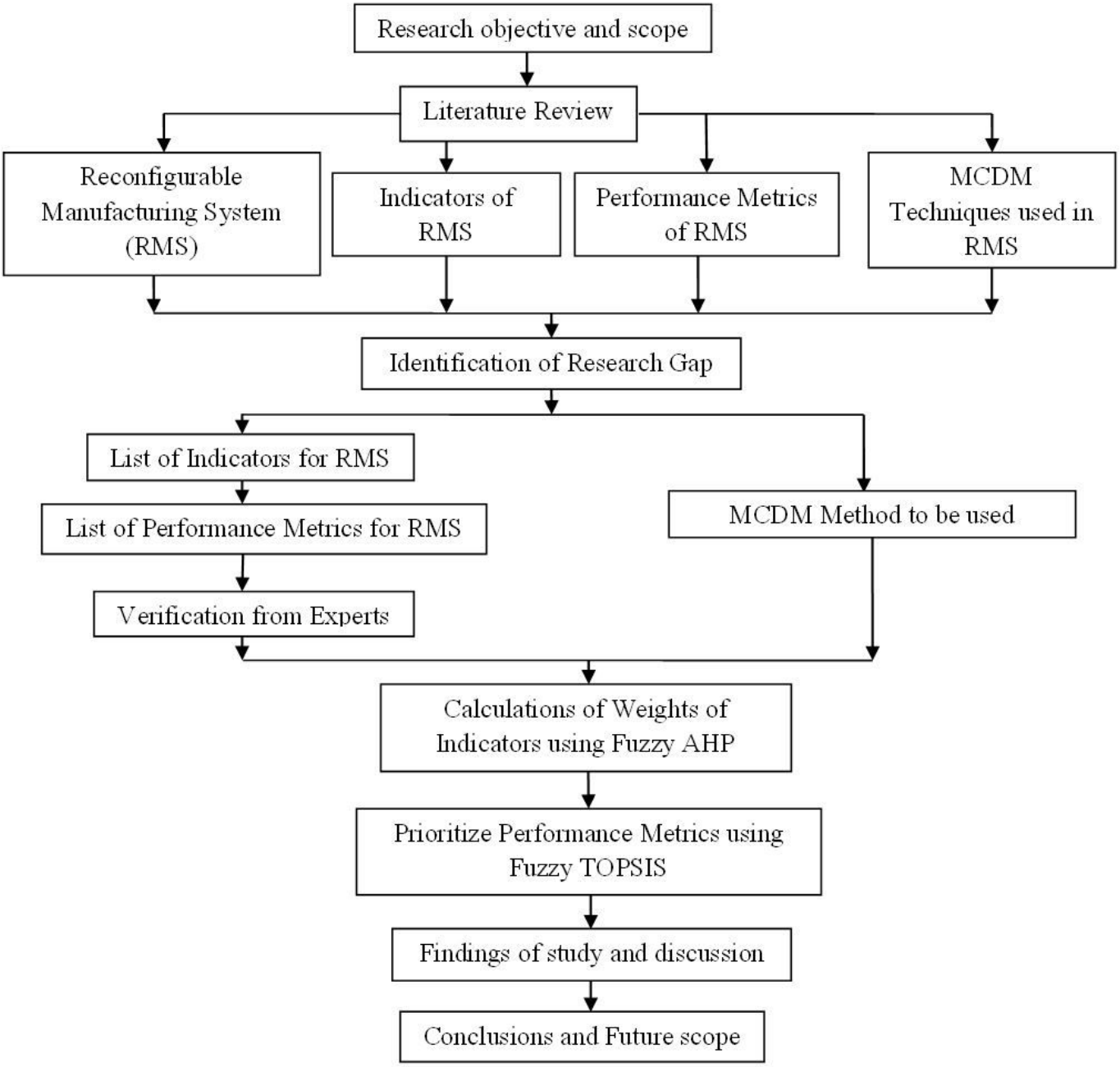

Figure 2

Flow chart for Research methodology

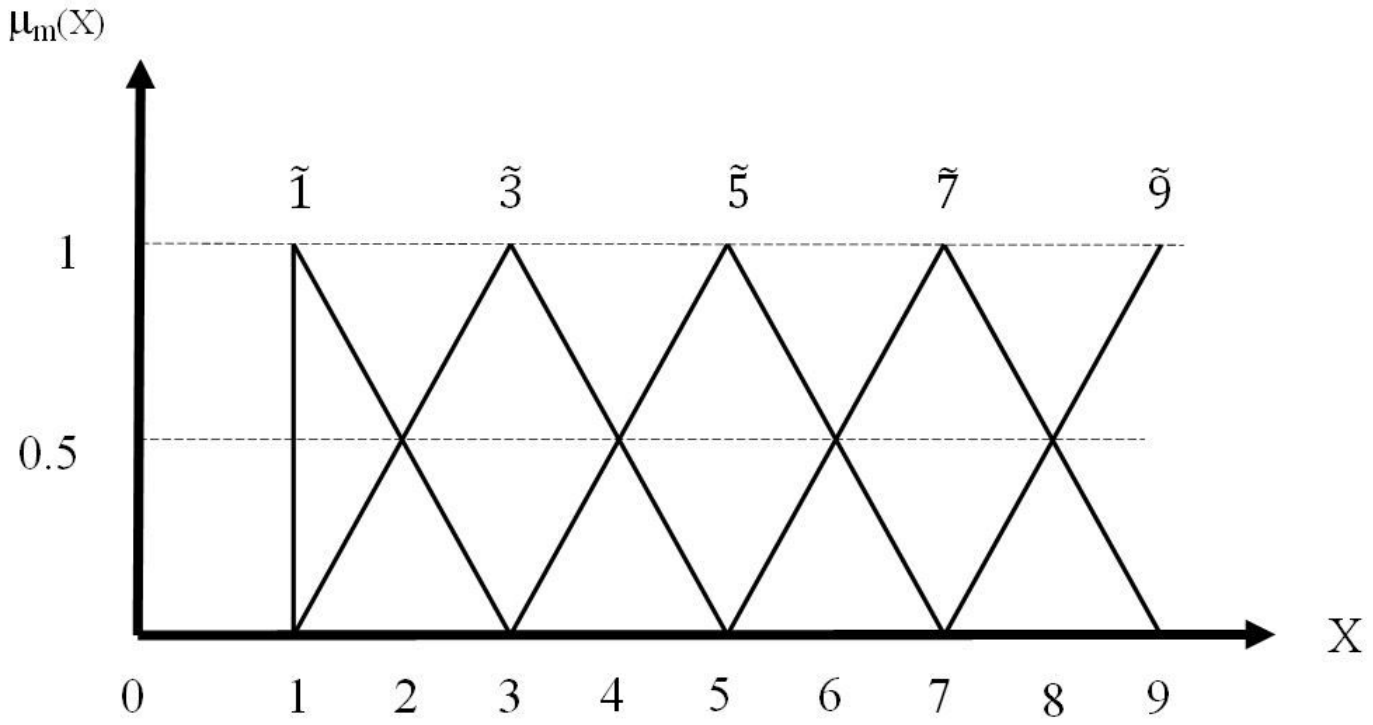

Figure 3

Triangular Fuzzy numbers

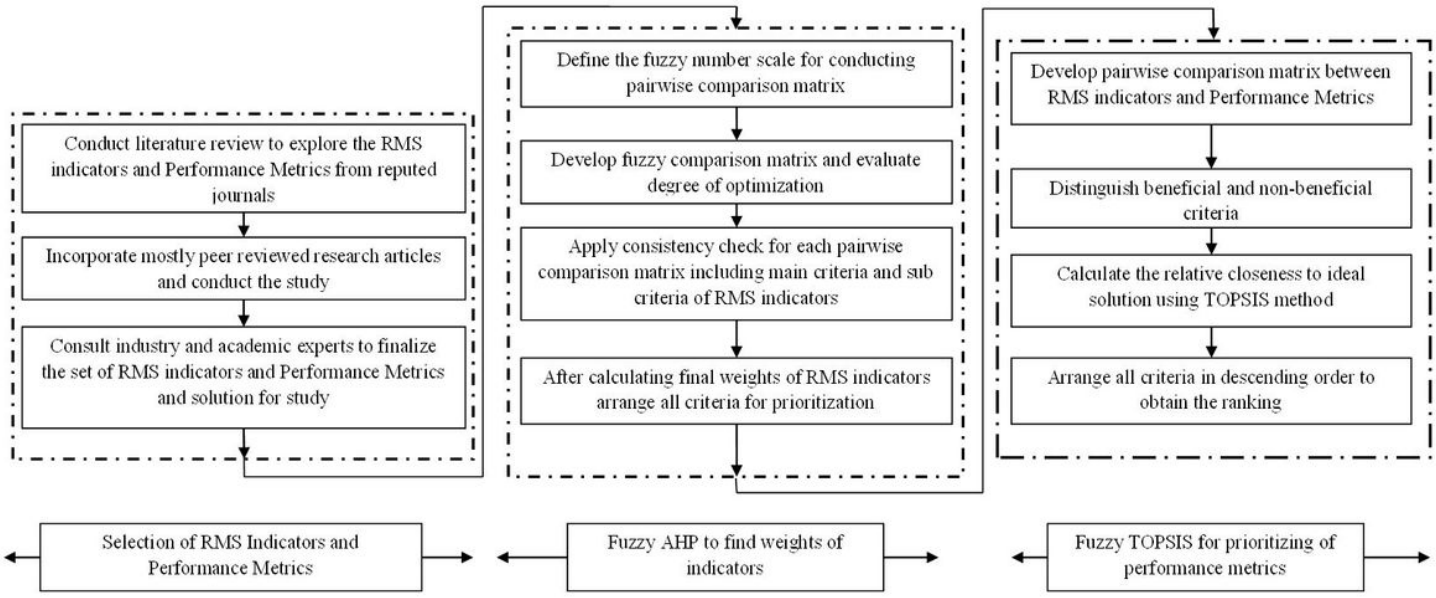

Figure 4

A proposed three-stage hybrid framework

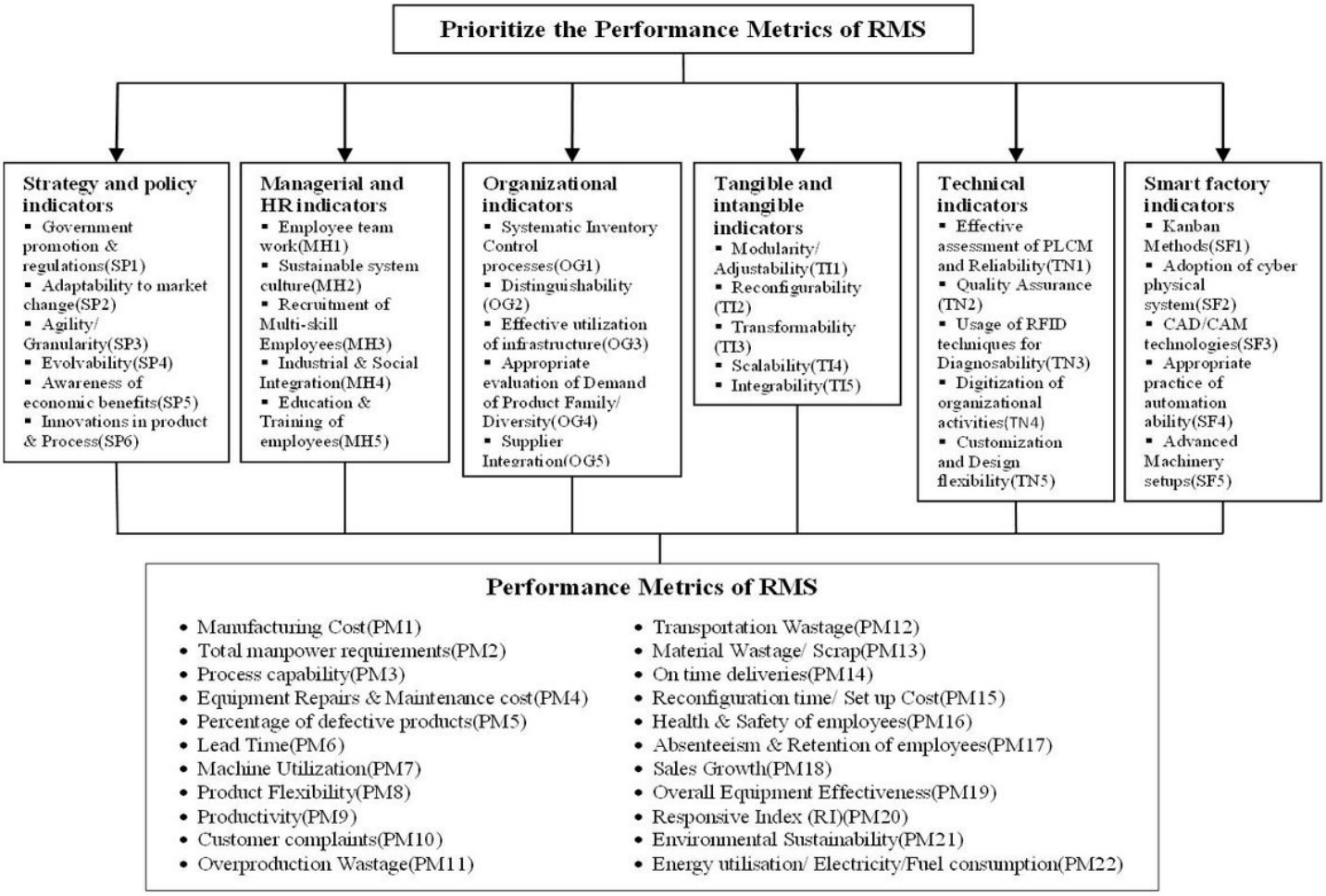

Figure 5

Hierarchical structure of Indicators

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Exploring Indicators of Circular Economy Adoption Framework through A Hybrid Decision Support Approach

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Exploring indicators of circular economy adoption framework through a hybrid decision support approach

Abstract: Circular economy (CE) focuses on a circular approach to energy and material resources, which provides economic, environmental and social benefits for manufacturing organisations. CE adoption in emerging economies facilitates in substantial economic growth through appropriate utilisation of energy and material resources across manufacturing industries. This study identifies CE indicators in the context of an emerging economy. The study further develops a framework for the adoption of CE and tests it through a hybrid Best Worst Method and Decision-Making Trial and Evaluation Laboratory approach. The framework is validated through an Indian manufacturing case organisation. While Best Worst Method computes the CE related indicator weights, Decision-Making Trial and Evaluation Laboratory analyses the inter-relationship among indicators. Disparate CE related indicators, e.g. strategic, managerial, informational and technological, supply chain and organisational, influence the CE adoption in an emerging economy context. The findings reveal that the strategic and managerial indicators have the strongest influence on developing other indicators. The causal digraph and relationship diagram assist the practitioners in predicting the inter-relationship of indicators in CE adoption. The study outcomes will help the practitioners, policymakers and researchers to draw a framework for adoption of circular and green practices and usage of resources sustainably.

Keywords: Circular economy; Indicators; Decision-making; Sustainable operations; Emerging economies; India.

1. Introduction

Circular economy (CE) has emerged as one of the important aspects of a nation's economy (Mahpour, 2018). From various definitions of CE reported in the extant literature, it is difficult to have an in-depth understanding of CE (Kirchherr et al., 2017) as the definitions represent different perspectives (Sarkis and Zhu, 2017). Several studies have put an effort to link CE to different areas, such as industrial ecology, reverse logistics and waste reductions. However, CE is not limited to material and/or waste recovery as CE can be extended to energy utilisation, supply chain activities, production activities and sharing economy (Saidani et al., 2017). CE works in a closed or circular loop, but it can also be used in a forward loop (Korhonen et al.,

2018a). Several frameworks, such as BECE (backcasting and eco-design for the circular economy) and ReSOLVE, are proposed for effective adoption of CE (Mendoza et al., 2017).

CE has a direct link to manufacturing organisations. CE adoption in manufacturing industries can be beneficial for nations' growth. Researchers argue that manufacturing organisations play a pivotal role, especially in developing nations such as China, India, Thailand etc., as they are outsourcing hubs to the developed economies (Fang et al., 2017; Lieder and Rashid, 2016). CE adoption in the manufacturing sector is a cumbersome process as it calls for an effective examination of some crucial factors before initiating the process. Some of these factors are CE adoption policies, its feasibility, effectiveness and adaptability to the sector. In literature, the factors are sometimes referred to as indicators, critical success factors, enablers, drivers and facilitators.

Driven by this concern, this study contributes to the literature by identifying the indicators that assist in the CE adoption process. The indicators are the factors that help in enhancing the CE adoption. Indicators possess the different intensity of influence (Govindan and Hasanagic, 2018). The intensity of influence refers to the weightage of each indicator during the CE adoption process. While, the study of Saidani et al. (2019) reports an exhaustive list of CE indicators, it fails to capture their intensity and does not highlight any information related to their inter-relationship. Therefore, another contribution of this study is to bridge this knowledge gap through identifying the intensity of influence of the indicators, the absence of which may hinder practitioners to implement an effective CE adoption process in manufacturing organisations. Further, the mere identification of the intensity of influence of the indicators is not adequate. Therefore, yet another contribution of the study is to analyse causal relationships of the indicators and explore their interaction possibilities in a whole system to facilitate the decision-making process of practitioners and policymakers for CE adoption.

A paradigm shift in the CE literature is reported in this study through the objectives of identifying the CE indicators, analysing their intensity of influence and examining their causal relationship. Here, the paradigm shift refers to explore different diversifying opportunities in CE literature. To address these objectives, a hybrid decision-support approach using the Best Worst Method (BWM) and Decision-Making Trial and Evaluation Laboratory (DEMATEL) methods is employed to analyse a case of an Indian manufacturing organisation. The exhaustive study identifies a set of CE indicators that affect the CE adoption process. These indicators are confirmed and validated through an expert panel. While the intensity of influence of the indicators is ascertained through the BWM approach, the DEMATEL approach explores the causal relationship of the indicators.

This article is organised as follows. Section 2 examines the theoretical foundation of the work through a thorough literature review. Section 3 describes the research methodology. Section 4 elucidates development and testing of the CE adoption framework through the considered case. Section 5 discusses the outcomes of the study. Section 6 provides an insight into the contributions and implications. Finally, in section 7, the article concludes with recommendations for future research.

2. Literature Review

To explore disparate CE indicators, a systematic literature review approach is conducted as set out in Tranfield et al. (2003). The articles considered in this literature review possess a strong focus on CE adoption and its indicators. The following keywords are framed and used in various combinations to identify the extant literature: 'circular economy indicators', 'circular economy enablers', 'circular economy critical success factors', 'circular economy drivers', 'circular economy and manufacturing', 'circular economy and developing economies' and 'circular economy facilitators'. The databases used include: "Web of Science", "Scopus" and "Google Scholar". The titles, abstracts and keywords of the identified articles are further scrutinised based on the following criteria: (a) inclusion of only journal articles which are peer-reviewed and excluding all the conference proceedings, and (b) inclusion of only English language articles. Although CE domain gained its momentum from 2010 (in terms publication of articles), few articles have been observed in the early 2000s. Therefore, the review time horizon is 2000 to 2019. The initial shortlisting left us with 231 articles. While the initial shortlisting of articles is performed according to the above procedure, the final scrutiny of the articles is conducted through forward snowball and backward snowball approach (Wohlin, 2014) which left us with 63 articles.

The articles that strictly focus on the indicators for developing economies and related to manufacturing concerns are though included. This approach assists to identify the articles strongly related to the present study. This review helps in developing a better understanding of CE and building a foundation to enhance various research threads in this domain.

2.1 Circular Economy related Indicators

Although the CE research is in a state of infancy, several publications (de Jesus and Mendonça, 2018; Lazarevic and Valve, 2017) report sets of indicators influencing the CE adoption process. These indicators influence the adoption process in a broader context (i.e. developed and developing nations' context). A study on CE (Mahpour, 2018) reports 'effective

planning and management for CE adoption', 'allocation of financial budgets for CE', and 'top management commitment for CE adoption' as the most critical indicators influencing the CE adoption process. The strategic planning and budget allocation are directly linked to the top management (Bodar et al., 2018) to facilitate building effective strategies. Further, effective strategic planning assists in attaining sustainable resource management (Genovese et al., 2017). Sustainable resource utilisation can directly contribute to the CE adoption process thereby strengthening a nation's economy and future resource managing aspects (Parchomenko et al., 2019).

Govindan and Hasanagic (2018) argued that adoption of CE is a challenge until economic benefits are understood. Therefore, it is significant to have some strong strategies and policies for CE adoption (Kim and Lui, 2015). From this standpoint, the following indicators have emerged as prime importance: 'redesign based on customer feedback', 'effective lifecycle analysis', and 'rewards and incentives for greener activities' (Homrich et al., 2018).

Indicators relating to performance measures that aid in mapping CE performance are required to be considered (Wang and Li, 2006) in the CE adoption process. The indicators viz. 'effective facility layout decision making', 'effective information management system' (e.g. IoT), and 'adoption of innovative quality improvement practices' (Martins, 2018) are considered as key players in the CE adoption process. Adoption of CE requires indicators facilitating advanced technology transfer and constant monitoring on changing market needs (Anzola-román et al., 2018). In this regard, Saavedra et al. (2018) emphasise on the penetration of social media and big data analytics within an organisation. This helps to circulate the information within a correct loop. Availability of advanced technological setups will facilitate the practitioners to carry out their production activities and simultaneously help in providing high-quality products to the end-users (Urbinati et al., 2017).

CE possesses a strong linkage to the supply chain activities in manufacturing organisations (Batista et al., 2018b). Coordination and collaboration among the supply chain members is very essential for building the loop of CE (Geng et al., 2012). This leads to the emergence of the following indicators, viz. 'supplier commitment for recyclable materials' and 'CE education for suppliers'. Adopting reverse supply chain activities, e.g. includes Reverse Logistics (RL) and Extended Product Responsibility (EPR) etc., enhance the CE adoption process (Saridakis et al., 2019). Further, green practices and initiatives, such as green purchasing, green design and green packaging, strengthen the social and environmental dimensions of CE (Kirchherr et al., 2017). Such practices enhance supply chain performance and strengthen the closed-loop

mapping procedures (Whicher et al., 2018). Linking CE to supply chain further assists in maintaining the product cost under control (Yadav et al., 2020).

Some highly impactful indicators for the CE adoption framework are 'adoption of 6R's', 'multi-stage quality check system', and 'reduction in carbon emission' (Heyes et al., 2018). The multi-stage quality check system helps to diagnose the defects at the production stage and recycle the same for corrective actions. Similarly, reduction in carbon emission and using it in other activities enhance the organisational productivity (Wang et al., 2018). The 6R's includes redesign, reduce, recycle, reuse, recover and remanufacturing which strongly correlate to CE (Kazancoglu et al., 2018). Hence, adoption of 6R's significantly improves the CE adoption possibility. Additionally, effective inventory management emerges as one of the key indicators in the CE adoption process (Ormazabal et al., 2018). Employee empowerment and motivation is a requirement for the successful implementation of these identified indicators (Ricciardi et al., 2016). Therefore, focussed training for the CE adoption process is needed. Table 1 identifies and collates the indicators essential for the CE adoption framework.

Table 1: Circular economy related indicators reported in the literature

Sl. No.	Circular economy related indicators	Description	Literature
1	Effective planning and management	Effective planning and management to align resources appropriately for CE adoption	Martins (2018); Homrich et al. (2018)
2	Top management commitment	Top management engagement and involvement enhance opportunities for CE adoption	Saavedra et al. (2018); Bodar et al. (2018)
3	Allocation of financial budgets	Separate budget allocation for the execution of CE practices is crucial	de Jesus and Mendonça (2018); Mahpour (2018)
4	Sustainable resource management	Appropriate usage of sustainable resources is required for CE adoption	Bodar et al. (2018); Genovese et al. (2017)
5	Supportive participation of stakeholders	Stakeholders' participation is essential for the adoption of CE framework	Fang et al. (2017); de Oliveira et al. (2017)
6	Building a brand image	Brand image in effective CE culture boosts the opportunities	Genovese et al. (2017); Lieder and Rashid (2016)
7	Understanding exact implications of CE (economic and social benefits)	Economic and social benefits are required to be understood explicitly for an effective CE adoption	de Oliveira et al. (2017); Wang and Li (2006)
8	Focussed training for CE adoption	Appropriate training sessions facilitate CE adoption process	Martins (2018); Lieder and Rashid (2016)

9	Employee empowerment and motivation	Motivating employees and transferring responsibilities to them to improve the productivity of an organisation	Zhu and Tian (2016); Kirchherr et al. (2017)
10	Multi-stage quality check system	Conducting quality checks for in-process products at checkpoints assist in diagnosing defects at an early stage for necessary rework	Sarkis and Zhu (2017); Urbinati et al. (2017)
11	Adoption of 6 R's	Adoption of 6 R's helps organisation to penetrate CE effectively	Korhonen et al. (2018a); Ghisellini, Cialani, and Ulgiati (2016)
12	Effective inventory management	Appropriate forecasting techniques aid practitioners to manage inventories	Tukker (2015); Zhu et al. (2010)
13	Reduction in carbon emission	Reducing carbon emission and using it further for any productive recycling process boosts the CE adoption process	Merli et al. (2018); Korhonen et al. (2018)
14	Coordination and collaboration among SC members	Effective collaboration and communication among the supply chain entities help to manage supply chain operations	Geng and Doberstein (2008); Heyes et al. (2018)
15	Supplier commitment for recyclable materials	Suppliers' commitment to recyclable materials promotes the CE adoption process	Zhu, Geng, and Lai (2010); Tseng et al. (2018)
16	Adopting reverse supply chain practices (e.g. EPR, reverse logistics)	Effective implementation of EPR and reverse logistic practices indirectly assist in the CE adoption process	Whicher et al. (2018); Kirchherr et al. (2017)
17	Adopting green practices (in purchasing, design and packaging)	Adoption of green purchasing, design and packaging develop a recyclable product	Korhonen et al. (2018b); Lazarevic and Valve (2017)
18	Educating customers for CE practices	The end-users are required to be educated regarding the benefits of CE	Bodar et al. (2018); Lacy and Rutqvist (2016)
19	Adopting innovative practices	Adoption of advanced quality improvement practices at different functional areas of supply chain help in the CE adoption process	Genovese et al. (2017); Fang et al. (2017)
20	Advanced technological transfer and applicability	Availability and applicability of advanced technology transfer help in mapping activities that improve inter-departmental communication within the organisation	van Loon and Van Wassenhove (2018); Lieder and Rashid (2016)
21	Penetrating social media and big data analytics in the organisation	Implementation of big data analytics and social media in the organisation facilitates understanding of customers' requirements to take effective measures	Govindan and Hasanagic (2018); Lazarevic and Valve (2017)

22	Effective facility layout decision making	Allocation of facilities in an optimised manner is extremely important that directly correlates to the product cost	Pomponi and Moncaster (2017); Homrich et al. (2018)
23	Constant monitoring of changing market needs	Observation on changing market needs helps effectively in modifying/developing products	Martins (2018); Fang et al. (2017)
24	Effective information management system (e.g. IoT)	Effective implementation of the internet of things (IoT) in the organisation facilitates in handling complex information management system	Saavedra et al. (2018); Pomponi and Moncaster (2017)
25	Adopting industrial ecology initiatives	Implementation of industrial ecology facilitates the assessment of the system's environmental impact	Geng et al. (2012); Genovese et al. (2017)
26	Availability of CE oriented framework (e.g. ReSOLVE)	Focussed CE framework facilitates its better penetration in the organisation	Martins (2018); Sarkis and Zhu (2017)
27	Redesign based on customer (internal and external) feedback	An effective closed-loop feedback system facilitates appropriate modification in design	Tseng et al. (2018); Geng and Doberstein (2008)
28	Effective life cycle analysis	Review and analysis of product life cycle and its effective implementation facilitates to adapt new products	Merli et al. (2018); Sarkis and Zhu (2017)
29	Rewards and incentives for greener activities	Rewards and incentives boost employee morale to facilitate the implementation of environmentally sustainable activities	Ormazabal et al. (2018); Zhu and Tian (2016)
30	Identifying performance measures for CE	Effective performance measures assist in analysing CE's benefits	van Loon et al. (2017); Urbinati et al. (2017)
31	Supportive government policies	Government regulations for promoting CE and subsequent subsidies and rebate in taxes can enhance the CE adoption process	Govindan and Hasanagic (2018); Lazarevic and Valve (2017)

2.2 Circular Economy in Developing Nations

Although the success stories of CE have broadly captured by the developed economies, the developing economies are struggling to adopt CE effectively across their manufacturing firms. Effective CE adoption is crucial in developing nations as their economies partly depend on outsourcing/off-shoring market and/or foreign direct investments (Saavedra et al., 2018). Developing nations provide cheap labour and deliver final products at low costs. China is considered as one of the largest exporters of electronic goods (Mangla et al., 2019). India and Thailand export electronics manufactured goods to all parts of the globe (Wang et al., 2018).

It becomes an extremely challenging task to adopt CE in these countries when they are compared to the developed nations (Ghisellini et al., 2016). These nations' struggle to meet the basic requirements along with their poor strategic infrastructure find CE implementation an extremely challenging task (Luthra et al., 2019). Adoption of CE in the developing nations will facilitate them to attain economic stability, economic perks (Tseng et al., 2018) and simultaneously set a roadmap for transition from developing to developed nations. Therefore, adoption of CE will help them to get rid of the problem.

Mere understanding of CE is not enough as identification of its indicators plays a pivotal role in its effective adoption (Sarkis and Zhu, 2017). Thus to facilitate the CE adoption process, it is necessary to identify the indicators influencing the CE adoption in the context of developing nations. It is pertinent to note that majority of the studies (Wang et al., 2018) consider cases from China. Literature is scant on the studies highlighting the CE indicators from other developing nations like India, Sri Lanka and Thailand etc.

2.3 Knowledge Gaps

An exhaustive examination of the extant literature identifies the following knowledge gaps:

- While the majority of research articles (Wang and Li, 2006; Homrich et al., 2018) discuss CE adoption benefits, the literature emphasising a framework facilitating the CE adoption process in manufacturing organisations is scant.
- Determination of the intensity of influence the CE indicators are extremely significant for the CE adoption process. The extant literature is unavailable on this aspect of the CE indicators.
- Existing CE adoption frameworks (Bodar et al., 2018; Genovese et al., 2017) do not rely on standard analytical validation treatments justifying the CE adoption process.
- Lack of adequate technological infrastructure and sustainable resources differentiate the nature of the CE indicators of the developing and developed nations because non-availability of these resources makes it extremely difficult for developing nations to adopt CE effectively. Little is known in this regard although a few studies (Lieder and Rashid, 2016; de Oliveira et al., 2017) report some of the key CE indicators. Therefore, indicators related to developing nations need to be identified.
- Literature is unavailable on the causal relationship of the CE indicators. It is important to examine the behavioural aspect of an indicator when it interacts with the others.

These knowledge gaps call for exploring the importance weights of the identified CE indicators in a decision-making context for examining their intensity of influence on the CE adoption process, which is elucidated in the next sections.

3. Research Methodology

Figure 1 illustrates the research methodology and describes the data collection in five phases. This collection procedure is conducted in the case organisation. The CE indicators derived from the extant literature are further verified through an expert panel (see section 4.1 for expert details). These experts are asked to categorise the shortlisted indicators into diverse groups for the development of the CE adoption framework. The hybrid BWM-DEMATEL approach examines disparate feasibility aspects of the developed framework and causal relationship of the indicators.

3.1 The Hybrid BWM-DEMATEL Approach

The hybrid BWM-DEMATEL approach is formulated to examine the feasibility of the developed CE adoption framework. This approach works in two stages. In the first stage, BWM computes the final shortlisted CE indicators and assesses the intensity of influence of each indicator. Researchers' prime choice (Yadav and Desai, 2017) is Analytic Hierarchy Process (AHP) among all other multi-criteria decision-making (MCDM) approaches. These decision-making approaches work on the principle of pair-wise comparison. Computation of weights in these approaches becomes complex when the number of considered criteria is large. Researchers (Gupta and Barua, 2017; Sadeghi et al., 2016) recommend BWM over other MCDM approaches where large numbers of criteria are dealt with. In this study, BWM has emerged as the best approach to compute the criteria weights as there are 31 CE indicators. BWM effectively deals with vagueness and bias within the experts' judgements.

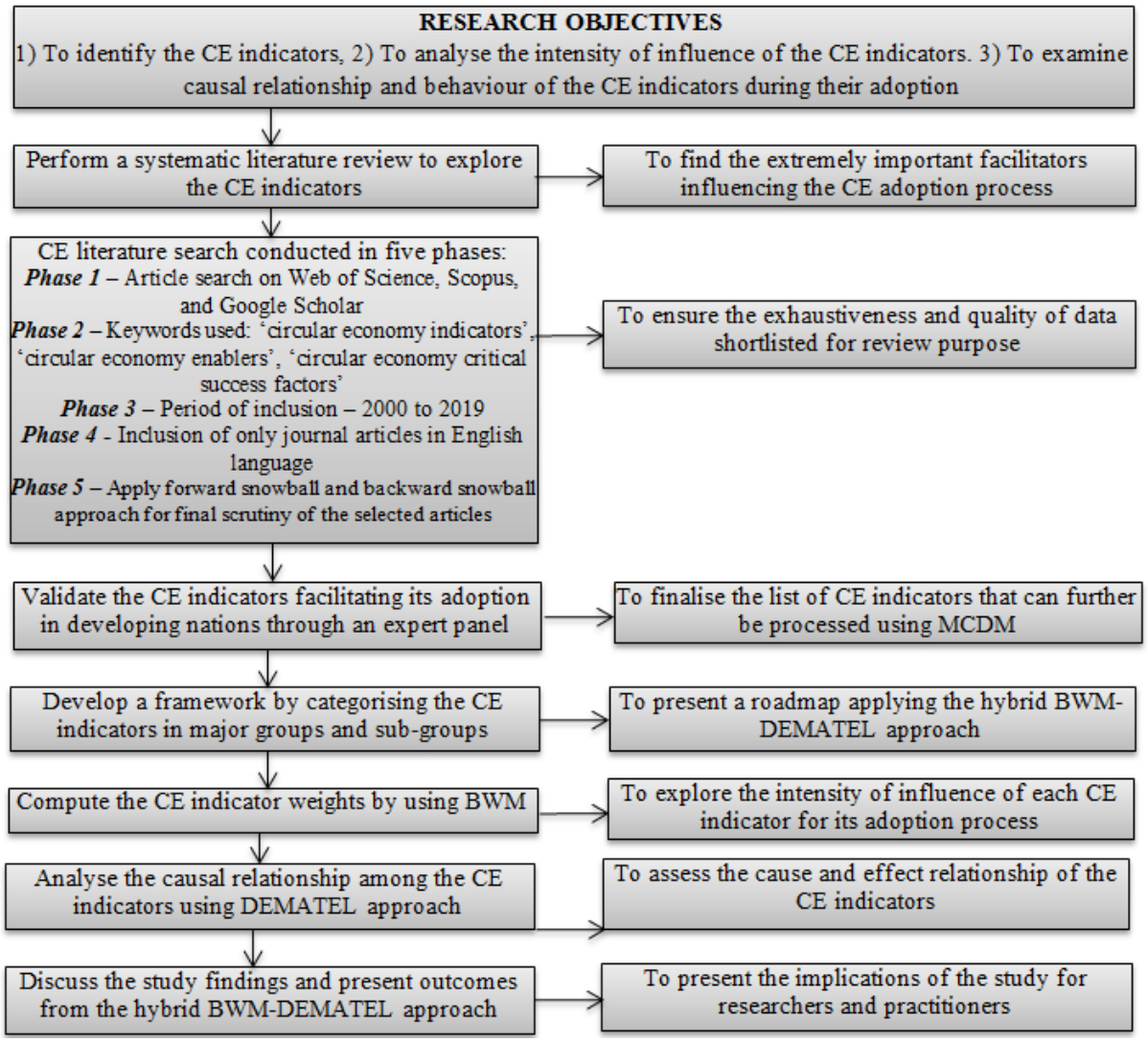


Figure 1: Research methodology

Note: CE- Circular Economy, BWM- Best Worst Method, DEMATEL- Decision Making Trial and Evaluation Laboratory, MCDM- Multi-Criteria Decision Making

The second stage of the two-stage hybrid BWM-DEMATEL approach analyses the causal relationship among the CE indicators. It is significant to assess how one indicator relates to the other. Several MCDM approaches may serve this purpose. Some of these are Analytical Network Process (ANP), Interpretive Structural Modelling (ISM), Fuzzy Cognitive Maps (FCM) and Decision Making Trial and Evaluation Laboratory (DEMATEL) etc. ISM and FCM are preferred in situations where structural hierarchy is required. However, in situations, where the causal relationships among the selected factors need to be examined, DEMATEL emerges as the prime choice. DEMATEL assists in examining the cause and effect factors, which facilitates the practitioners to effectively adopt CE.

4. Development and Testing of the Circular Economy Adoption Framework

4.1 Problem Description

In this study, a case study approach helps provide a theoretical background. The case of a heavy manufacturing company operating in western India is considered. The company is involved in manufacturing of a variety of products, such as motors and hydro turbines, industrial pumps, agriculture and household pumps etc. There are more than 1000 employees in the organisation. The organisation has a turnover of approximately US $10 billion.

The case company has a well-framed organisational mission with an objective of reducing its overall environmental impact and achieving sustainability in business. The company has adopted the CE initiatives, such as carbon neutrality, ISO 14001 and hierarchy of wastes (i.e. rethink and redesign, reduce, reuse, recycle, and dispose) in their business. The management of the company is committed to developing high-quality products and involved in a project titled "*circular economy and sustainability initiatives*". The management seeks to identify possible key indicators for CE implementation and subsequently aim to analyse the indicators for a successful CE adoption process. Additionally, the management is interested to analyse the cause and effect relations within the CE indicators.

To deal with the problem of the case company, an expert panel comprising six members is formed. The panel includes a production and planning manager, procurement manager, general manager, information technology engineer and environmental scientist. The literature reveals that the number of experts between five to eight is sufficient for the application of hybrid BWM-DEMATEL approach (Rezaei, 2016). Unlike other MCDM approaches the selected approach in this study requires less number of decision makers to arrive at the final judgement. Researchers (Ijadi Maghsoodi et al., 2019; Pourhejazy et al., 2019) have used an expert panel comprising four to six members to form case study judgements. Following the same analogy, in this study, a decision panel comprising six experts is formed. This research is employed to a limited setting steered with a case study approach of comparable sample size comprising six experts. However, it sets a ground for future study that could be extended to larger sample to test and validate the outcomes.

The selection of experts is decided based on certain criteria, such as the members' industrial and consultancy experience, decision-making competencies, respective designations and expertise in the domain etc. The experts are contacted for data collection. The framework of the CE indicators is analysed using the hybrid BWM-DEMATEL approach, details of which are provided in the following sections.

4.2 Determining the Circular Economy Indicators' Weights

The experts are initially asked to categorise the CE indicators identified from the literature. The indicators are categorised in five broad groups, viz. managerial indicators, organisational indicators, supply chain indicators, informational and technological indicators, and strategy and policy indicators. The framework developed for the CE adoption process is elucidated in Figure 2.

[Figure 2 about here]

The intensity of influence of the CE indicators is determined using the BWM approach. The steps adopted in BWM are as follows (Rezaei, 2016):

Step 1: Exploring the CE indicators – This step involves identification of the CE indicators influencing its adoption in developing nations. All the indicators are allotted criteria as i_1, i_2, i_3…… i_n.

Step 2: Diagnosing the best and worst indicators – This step involves grouping of the CE indicators across diverse groups and then finding the best and worst indicators for the disparate major groups and each sub-group.

Step 3: Allotment of preference – In this step, a separate table for best and worst comparison is computed through the expert judgements by assigning numerals between 1 and 9. The assignments are performed separately for the main group indicators and sub-group indicators. The best and worst comparison of the major group indicators is illustrated in Tables 2 and 3 respectively. Equation (1) represents the comparison set of Best (A_B) and Worst (A_w) criteria.

$$A_B = (a_{1b}, a_{2b}, a_{3b}\ldots. a_{nb}),\ A_w = (a_{1w}, a_{2w}, a_{3w}\ldots. a_{nw}) \quad (1)$$

Table 2: Best-to-Others (BO) comparisons for the main group indicators

Resp. No.	Best	MG	OG	SP	IT	SC
1	SP	6	3	1	5	2
2	MG	1	4	5	3	6
3	MG	1	4	6	2	5
4	OG	2	1	5	2	4
5	SC	4	5	4	2	1
6	SP	6	4	1	5	2

Note: MG- Managerial Indicators, OG- Organisational Indicators, SP- Strategy and Policy Indicators, IT- Informational and Technological Indicators, SC- Supply Chain Indicators

Table 3: Others-to-Worst (OW) comparisons for the main group indicators

Resp. No.	Worst	MG	OG	SP	IT	SC
1	MG	1	2	6	2	5
2	SC	6	3	2	4	1
3	SP	7	3	1	6	3
4	SP	4	5	1	4	2
5	OG	4	1	2	4	5
6	MG	1	3	6	2	5

Step 4: Computing the CE indicator weights – An objective function along with some constraints is formulated to compute the CE indicator weights,. Equation (2) represents a comparison of each constraint with the best criterion for all values of j. Similarly, equation (3) represents a comparison of each constraint with the worst criterion for all values of j. Equation (4) indicates that the sum of the weights of all the criteria should be equal to 1.

Min ξ

Subject to

$$\left| \frac{wB}{wj} - a_{Bj} \right| \leq \xi, \text{ for all values of j} \quad (2)$$

$$\left| \frac{wj}{ww} - a_{jw} \right| \leq \xi, \text{ for all values of j} \quad (3)$$

$$\sum_j wj = 1 \quad (4)$$

$w_j \geq 0$, for all values of j.

The linear programming model is used for computing weights of the CE indicators. The comparative judgements for the major group indicators are obtained computing the weights using the equations 2 to 4. The local weights obtained for the major group indicators are illustrated in Table 4.

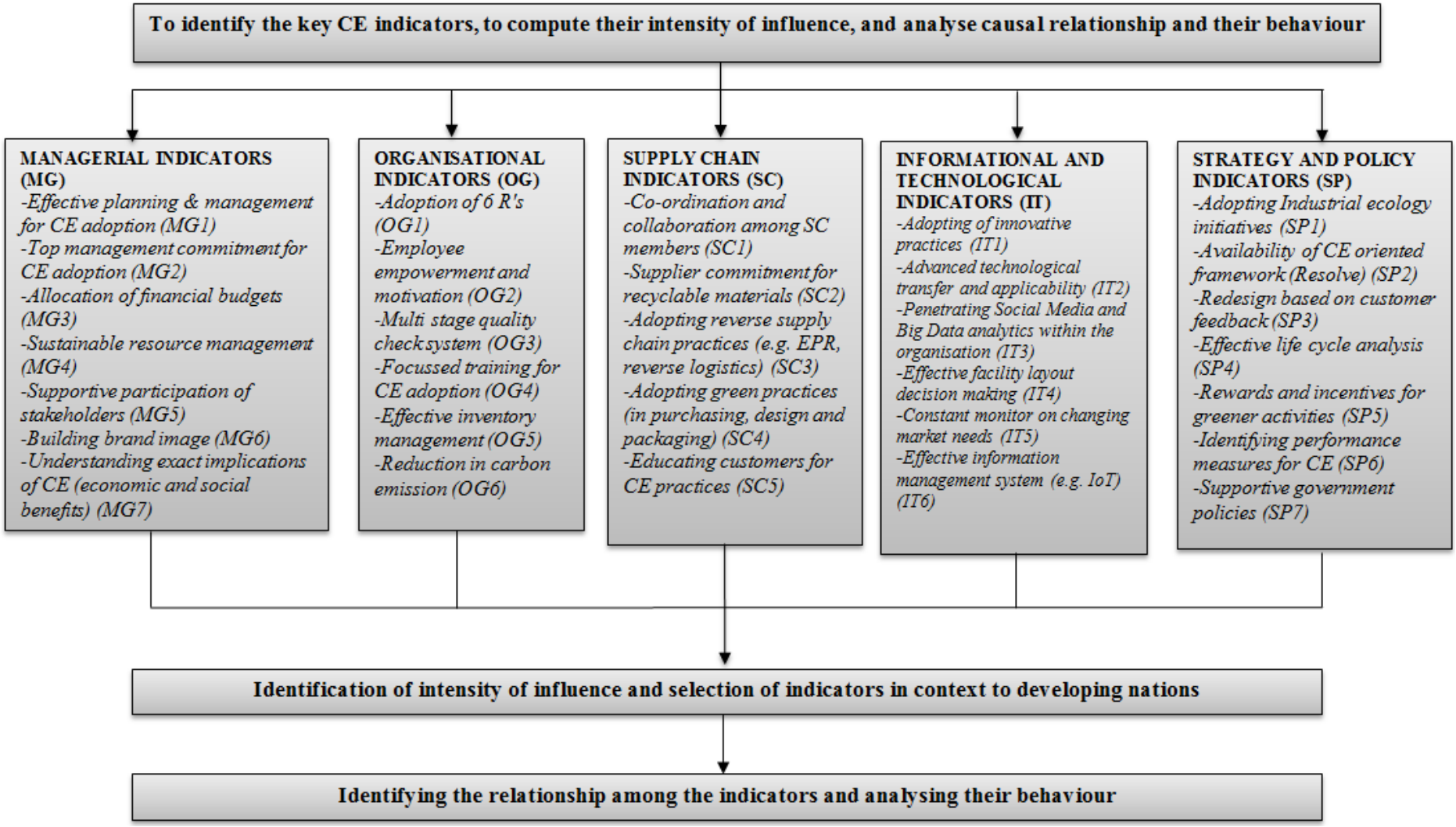


Figure 2: Framework for the CE adoption process

Table 4: Local weights obtained for the main group indicators

Expert number	MG	OG	SP	IT	SC	ξ
1	0.061475	0.163934	0.430328	0.098361	0.245902	0.061475
2	0.487145	0.142084	0.113667	0.189445	0.067659	0.081191
3	0.439883	0.131965	0.058651	0.26393	0.105572	0.087977
4	0.218487	0.386555	0.067227	0.218487	0.109244	0.05042
5	0.19245	0.074019	0.144338	0.473723	0.11547	0.103627
6	0.064103	0.128205	0.448718	0.102564	0.25641	0.064103
Criteria weight	**0.243924**	**0.171127**	**0.210488**	**0.224418**	**0.150043**	**0.074799**

A similar procedure is used while determining local weights of all the sub-group indicators. The values of ξ for all the group and sub-group comparisons are found to be consistent. The global weights are obtained (Table 5) after determining the local weights for all the sub-groups.

Table 5: Global weights of the CE indicators

Indicator	Major group	Sub-group code	Sub-group local weight	Global weight	Rank
Managerial indicators (MG)	0.244	MG 1	0.174	0.042	6
		MG 2	0.192	0.047	4
		MG 3	0.140	0.034	13
		MG 4	0.160	0.039	7
		MG 5	0.113	0.027	22
		MG 6	0.106	0.026	25
		MG 7	0.117	0.029	19
Organisational indicators (OG)	0.171	OG 1	0.265	0.045	5
		OG2	0.121	0.021	28
		OG 3	0.161	0.028	21
		OG 4	0.179	0.031	17
		OG 5	0.072	0.012	30
		OG 6	0.203	0.035	12
Supply chain indicators (SC)	0.150	SC 1	0.240	0.036	9
		SC 2	0.214	0.032	15
		SC 3	0.179	0.027	23
		SC 4	0.177	0.027	24
		SC 5	0.190	0.029	18

Information and technological indicators (IT)	0.224	IT 1	0.213	0.048	3
		IT 2	0.142	0.032	16
		IT 3	0.147	0.033	14
		IT 4	0.160	0.036	10
		IT 5	0.065	0.015	29
		IT 6	0.273	0.061	1
Strategy and policy indicators (SP)	0.210	SP 1	0.115	0.024	26
		SP 2	0.263	0.055	2
		SP 3	0.038	0.008	31
		SP 4	0.132	0.028	20
		SP 5	0.169	0.036	11
		SP 6	0.108	0.023	27
		SP 7	0.174	0.037	8

Note: For the abbreviation of all the subgroup code please refer to Figure 2

The global weights of all the sub-group indicators form a cluster diagram (Figure 3).

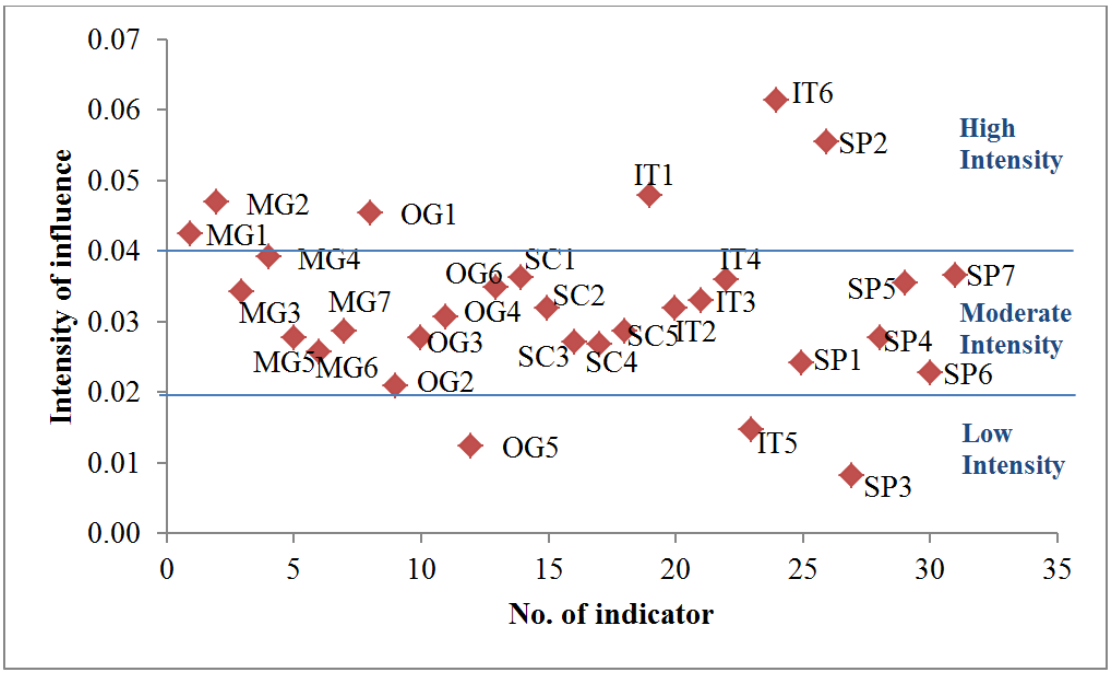


Figure 3: Cluster diagram for the CE indicators

Note: For the abbreviation of all the subgroup code please refer to Figure 2

The cluster diagram represents different intensities of the CE indicators falling in different clusters viz. high intensity, moderate intensity and low-intensity indicators. It is observed that six indicators fall in the high-intensity cluster, twenty-two indicators fall in the moderate-

intensity cluster and three indicators fall under the low-intensity cluster. The low-intensity cluster indicators are 'effective inventory management' (OG5), 'constant monitoring of changing market needs' (IT5), and 'redesign based on customer feedback' (SP3). These results are discussed with the experts, and the indicators found under the low-intensity cluster are excluded for further processing. According to experts, CE concepts are in the very initial stage in developing nations such as India. Both the organisation and its customers are unsure about CE adoption. Hence, at this level, these low-intensity cluster indicators can be dropped from the framework development process.

4.3 Analysing the Causal Relationship of the Circular Economy Indicators

A total of 31 CE indicators are selected at the beginning, which is subsequently filtered to 28 indicators under the five major groups through the BWM approach in the previous stage. The main aim is to analyse the causal relationship among the available CE indicators through the cause and effect indicators. In this regard, the procedure adopted for executing the DEMATEL approach is explained below (Abdullah and Zulkifli, 2015):

Step 1: Defining the CE indicators – All the CE indicators including major and sub-group indicators from the output of the BWM approach are considered as input to this approach. However, the grouping of the indicators is retained as that of the previous stage. Only the indicators dropped in the previous stage are excluded while applying this approach.

Step 2: Development of indirect relation matrix and average matrix – The experts are asked to rate the indicators based on their relationship with the other indicators on a scale of 0 to 4, where, '0 – no influence', '1 – weak influence', '2 –moderate influence', '3 – strong influence', and '4 – extremely strong influence'. Hence, with the input of six available experts, six different matrices are formed for the major group indicators. An average of all these matrices for the major group indicators is determined (in Table 6). A similar procedure is followed for all the sub-group indicators.

Table 6: Average matrix of the major groups of the CE indicators

Major group	MG	OG	SP	IT	SC
MG	0	3.8	3.6	3.6	3.4
OG	2.8	0	3	3.2	2.6
SP	3.2	3.2	0	3.4	3
IT	2.8	3	3.2	0	3.4
SC	2.6	2.4	2.2	3	0

Step 3: Computing normalised direct relation matrix (D) – The average matrix determined in the last step is now converted into a normalised direct relation matrix by using the equation (5):

$$D = M \times S \tag{5}$$

Where, S is computed by using equation (6)

$$\min\left[\frac{1}{\max\sum_{j=1}^{n}|m_{ij}|}, \frac{1}{\max\sum_{i=1}^{n}|m_{ij}|}\right] \tag{6}$$

The normalised matrix found for the major group CE indicators is illustrated in Table 7.

Table 7: Normalised matrix of the major groups of the CE indicators

Major group	MG	OG	SP	IT	SC
MG	0.000	0.264	0.250	0.250	0.236
OG	0.194	0.000	0.208	0.222	0.181
SP	0.222	0.222	0.000	0.236	0.208
IT	0.194	0.208	0.222	0.000	0.236
SC	0.181	0.167	0.153	0.208	0.000

Similarly, this procedure is repeated for computing the normalised matrix for all other sub-group indicators.

Step 4: Development of total relation matrix – The total relation matrix for the CE indicators is found using equation (7).

$$T = D\,(I\text{-}D)^{-1} \qquad \ldots (7)$$

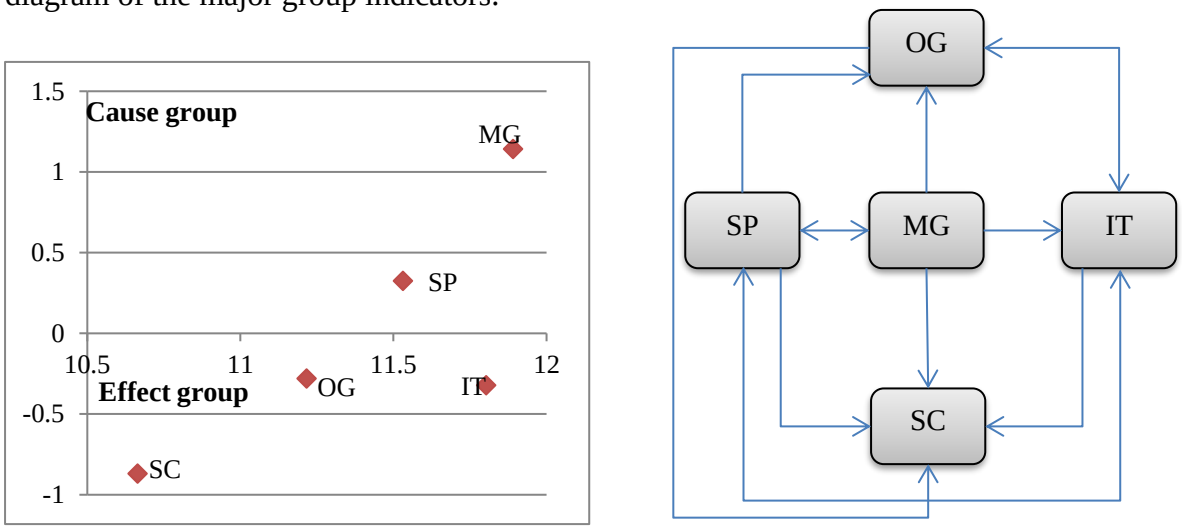
The total relation matrix for the major group indicators is illustrated in Table 8.

Table 8. Total relation matrix of the major groups of the CE indicators.

Major group	MG	OG	SP	IT	SC	ri	ri + cj	ri - cj
MG	1.076	*1.360*	*1.322*	*1.414*	*1.345*	6.517	11.891	1.143
OG	1.066	0.966	1.114	*1.200*	1.122	5.468	11.216	-0.280
SP	*1.161*	*1.229*	1.021	*1.295*	*1.223*	5.928	11.531	0.326
IT	1.111	*1.185*	*1.169*	1.069	*1.208*	5.741	11.803	-0.320
SC	0.961	1.008	0.977	1.084	0.868	4.898	10.664	-0.868
Sum cj	5.374	5.748	5.602	6.062	5.766	***Threshold value = 1.142***		

All the rows and column of the total relation matrix are added together. The row sum (r_i) represents the direct and indirect effect of r_i over other indicators. Similarly, the column sum (c_j) represents the direct and indirect effect experienced by indicator j from all other indicators. However, (r_i - c_j) can be defined as the net effect by which a particular indicator influences the entire system. The positive value of (r_i - c_j) is known as cause indicator while its negative value is termed as effect indicator.

Step 5: Identification of threshold measure – The threshold measure (Table 8) is identified to generate both causal digraph and relationship diagram. Considering all the values above the threshold measure the connections between the indicators are established for generating the relationship diagram. A similar procedure is carried out for computing the total relation matrix for the subgroup indicators. Based on the threshold values and ri, cj values, the causal digraph and relationship diagram are developed. Figure 4 presents the causal digraph and relationship diagram of the major group indicators.



(a) Causal digraph **(b) Relationship diagram**

Figure 4: Causal digraph and relationship diagram for the major group indicators

Figure 4(a) illustrates the causal digraph of major group indicators. It is found that 'managerial indicators' and 'strategy and policy indicators' exist in the cause group cluster. The effect group cluster includes 'informational and technological indicators', 'organisational indicators' and 'supply chain indicators'. The relationship diagram in Figure 4(b) elucidates inter-relationships among other indicators. The managerial indicators and strategic and policy indicators strongly correlate to other major group indicators. The strategic indicators help in developing organisational and supply chain indicators. The strategic indicators are equally dependent on informational and technological indicators. Similarly, the causal digraph and

relationship diagram for the sub-indicators are obtained (shown in Figures A1, A2, A3, A4 and A5 of Appendix A).

5. Results and Discussion

The outcomes from the BWM approach portray that 'informational and technological indicators' (0.244) and 'managerial indicators' (0.243) possess the extreme importance in the CE adoption followed by 'strategy and policy indicators' (0.210), 'organisational indicators' (0.171) and 'supply chain indicators' (0.150). This corroborates with the findings of Lazarevic and Valve (2017) and Lieder and Rashid (2016). Govindan and Hasanagic (2018) emphasised on strategy and policy-related indicators to adopt CE effectively. Among the sub-group indicators, 'effective information management system' (0.061), 'availability of CE oriented framework' (0.055) and 'adopting of innovative quality practices' (0.048) appear to be the most critical indicators strongly affecting CE adoption. However, 'top management commitment for CE adoption' (0.042) and 'adoption of 6R's' are strong facilitators for the CE adoption process. Korhonen et al. (2018b) reported that ignorance of management towards CE adoption and considering the adoption of 6R's on least priority may lead to failure of the CE adoption.

The CE indicators are plotted within clusters based on their calculated weights. Six indicators are found to be in a high-intensity cluster, twenty-two in the moderate-intensity cluster and three indicators in the low-intensity cluster. Based on the discussion with experts, 'effective inventory management' (OG5), 'constant monitoring of changing market needs' (IT5), and 'redesign based on customer feedback' (SP3) are dropped from further assessment. Experts suggest that although these indicators are related to the CE adoption process, in the developing nations' economy context they possess low influence. These indicators must be included after the appropriate assessment when considering CE adoption for the developed nations. Pomponi and Moncaster (2017) indicated that effective inventory management has an indirect effect on the CE adoption process. Therefore, a total of 28 CE indicators are finally considered for the CE adoption framework in the developing nations' economy context. These indicators are taken as input for the second stage of the hybrid approach.

The outputs from the BWM approach are considered as inputs in DEMATEL. DEMATEL generates causal digraphs and relationship diagram for the major group indicators and other sub-group indicators. Among all the major group indicators, managerial indicators and strategy and policy indicators are found to be the cause indicators. These indicators help in developing other indicators, viz. information and technology indicators, organisational indicators and supply chain indicators. Homrich et al. (2018) indicated that managerial indicators are strong

driving factors that assist in developing other indicators for effective CE adoption. Mathur et al. (2012) explained the importance of managerial and strategic indicators considering the case of the Indian manufacturing organisation. They further suggest that by adopting the strategic indicators, the practitioners can execute the organisational indicators more easily. Geng et al. (2012) reported managerial indicators as the most significant indicators for the CE adoption while elucidating a case from China. The relationship diagram (Figure 4b) indicates the influence of managerial and strategic indicators in achieving all other major group indicators. The causal digraph in Figure 4a reveals that for effective implementation of the organisational indicators, it is required to have the strong support of managerial, strategic and informational and technological indicators.

Low penetration of the following indicators reduces the success possibility of the CE adoption, viz. 'effective planning and management for CE adoption', 'top management commitment for CE adoption' and 'supportive participation of stakeholders'. These indicators strongly drive the other indicators. Therefore, it is extremely difficult to adopt CE without the support of top management and stakeholders. This is corroborated in the study of Saavedra et al. (2018) and Whicher et al. (2018). Among the organisational indicators, 'adoption of 6R's' and 'reduction in carbon emission' strongly drive other indicators of its sub-group. This is corroborated in Sarkis and Zhu (2017) when they identify 6R's (i.e. redesign, reduce, recycle, reuse, recover and remanufacturing) as the most essential component for the CE adoption in manufacturing organisations. Within the supply chain indicators, 'co-ordination and collaboration among SC members', 'supplier commitment for recyclable materials', and 'educating customers for CE practices' possess a high impact on other supply chain indicators. Accordingly, suppliers' commitment to supply recyclable materials ensures green practices in purchasing, design and packaging (Zhu et al., 2010).

Among all the informational and technological indicators, 'adopting of innovative practices', 'effective facility layout decision making' and 'effective information management system (e.g. IoT)' possess a strong influence on other indicators in the same group. The results affirm that an effective information system holds a strong relation in achieving other informational indicators. The findings of Kirchherr et al. (2017) corroborate this as they report that poor information flow within an organisation can lead to a failure in the CE adoption process. The findings reveal that within the strategy and policy indicators, 'availability of CE oriented framework', 'rewards and incentives for greener activities', and 'supportive government policies' drive other strategic and policy indicators. Urbinati et al. (2017) reported that the CE oriented framework is responsible for its successful adoption. However, researchers

(Kirchherr et al. 2017; Geng et al. 2012) suggested various frameworks for the CE adoption process and subsequent improvement of the organisational performance.

6. Contributions and Implications

The findings from this study are equally beneficial for researchers, practitioners and policymakers. The findings contribute to theory and practice in the following ways:

- The extant literature on the CE adoption process does not shed any light on the manufacturing sector. This study guides the practitioners in the CE adoption process within the manufacturing organisation. As the study finding guides them to develop the roadmap that improves CE adoption.
- Several studies on CE indicators report a very limited set of indicators facilitating the CE adoption process. This study identifies 31 key indicators that influence the CE adoption process in the context of developing nations' economy. Further, this is a unique study that not only develops a framework for CE adoption but also justifies it through a hybrid BWM-DEMATEL approach. As observed in the literature, very few studies include multi-criteria decision-making treatment for obtaining the inter-relationship of the indicators.
- All the CE indicators cannot be implemented simultaneously. However, if the causal relationship among these indicators is obtained, it will facilitate practitioners and decision-makers of manufacturing companies to plan some effective CE adoption strategies. This study explicitly examines the causal relationship among each set of the major group indicators and sub-group indicators that will assist the practitioners and researchers to understand the behaviour of the indicators.
- The identified CE adoption framework and indicators are in the context of developing nations' economies. However, the same indicators can be employed to developed economies with appropriate modifications by consulting experts. Hence, this can be considered as a unique contribution in context to the developing nations.

6.1 Recommendations for the Developing Economy

Adoption of CE is comparatively easier in the developed nations than the developing nations. Many developing nations, such as China, India, Malaysia, Sri Lanka etc., are initiating various attempts for CE adoption, but could not achieve the success rate as expected. Unavailability of a robust CE oriented framework has been one of the prime reasons behind

the CE adoption failures. Therefore, practitioners are recommended to obtain support from the government. These include the exemption in taxes, rebates and various other incentives to the organisations adopting CE. An effective CE adoption will enhance export possibilities thereby directly contributing to the nation's economy. It is further recommended to adopt industrial ecology initiatives as this will help in improving organisational performance and support sustainability initiatives. Adoption of CE directly relates to sustainability. Therefore, incentives for the adoption of green practices and usage of sustainable resources are recommended. Effective life cycle analysis will help in identifying the disposal period of products, which can support an effective CE adoption process.

7. Conclusions and Scope for Future Research

The manufacturing sector has a strong contribution to building nations' economy, especially in developing countries. This study conducts an exhaustive literature review to identify a unique set of 31 critical indicators facilitating the CE adoption process in the context of developing nations. Further, this study develops a framework for enhancing the CE adoption process through an exhaustive analysis of the indicators. A hybrid BWM-DEMATEL approach is applied to the developed framework to test its feasibility. BWM is adopted to compute the indicator weights. DEMATEL is used to analyse the causal relationship of the indicators through causal digraph and relationship diagram of the major group indicators and sub-group indicators. This study attempts to cover the CE indicators across five major groups among which managerial, informational and technological, and strategic indicators emerge as strongly influencing indicators for the CE adoption process. The results indicate that the managerial and strategic indicators fall in the cause group which facilitate the development of the effect group indicators, viz. information and technological, supply chain and organisational indicators. The case of an Indian manufacturing organisation elucidates in understanding the CE adoption framework, which is extremely useful for developing nations.

Although this study elucidates the CE adoption framework through a case of a manufacturing organisation, CE can be adopted across other industry sectors. Therefore, the same framework can be employed in other business sectors by appropriately tweaking the input indicators. Future research can be conducted through a large scale survey which will strengthen the validity of the CE indicator sets. Future research may adopt other decision-support methods to examine and analyse the CE indicators. Interpretive structural modelling (ISM), fuzzy cognitive map (FCM) and other structural approaches can be adopted to validate the CE indicators and its adoption framework.

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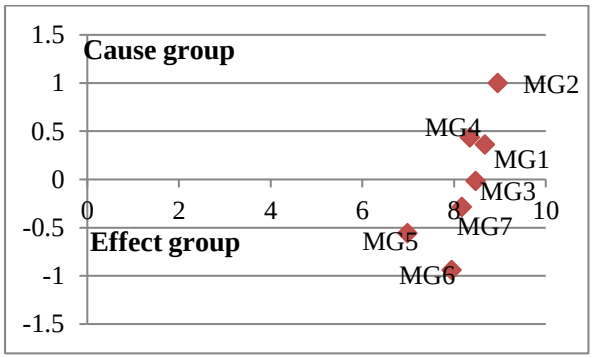
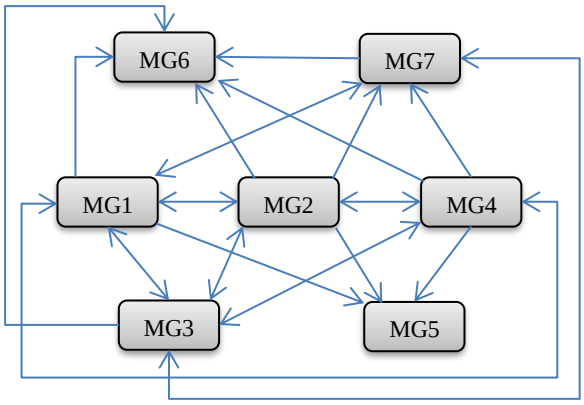
APPENDIX – A

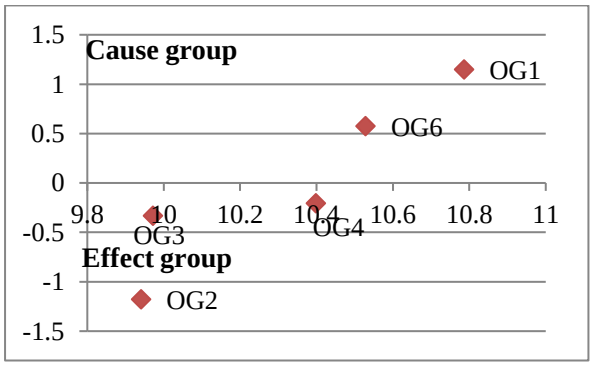
Note: For the abbreviation of all the sub group code in all the figures of appendix please refer Figure 2.

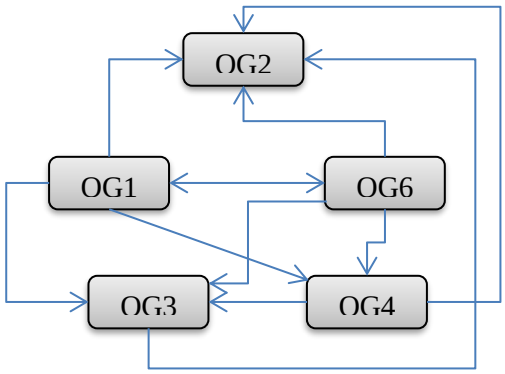




(i) Causal digraph **(ii) Relationship diagram**

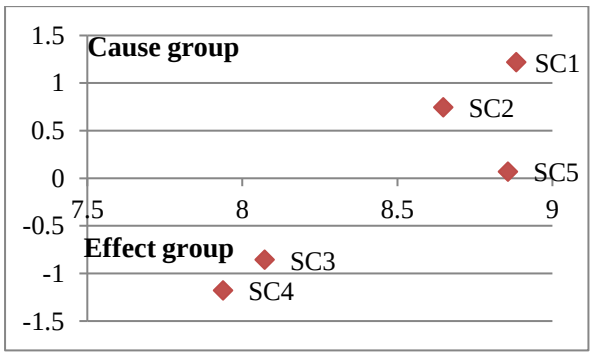
Figure A1: Causal digraph and relationship diagram of managerial indicators

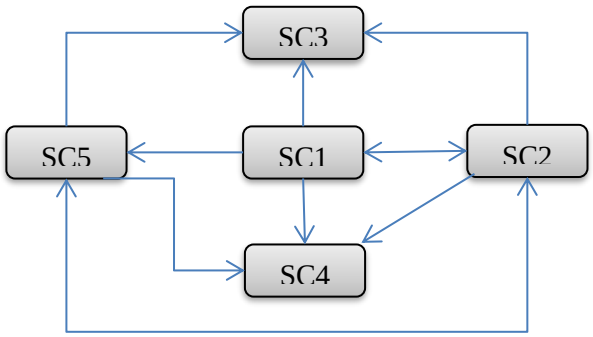




(i) Causal digraph **(ii) Relationship diagram**

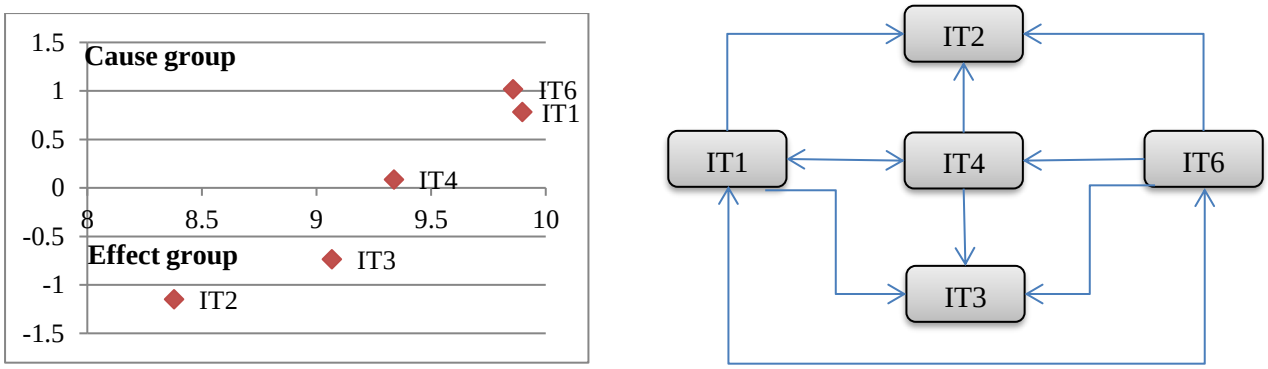
Figure A2: Causal digraph and relationship diagram of organisational indicators





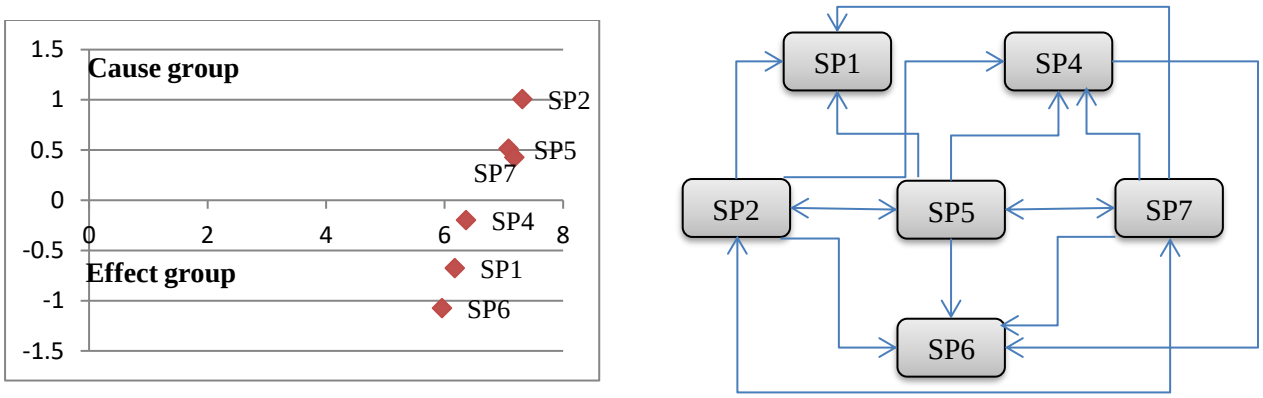
(i) Causal digraph **(ii) Relationship diagram**

Figure A3: Causal digraph and relationship diagram of supply chain indicators



(i) Causal digraph **(ii) Relationship diagram**

Figure A4: Causal digraph and relationship diagram of informational and technological indicators



(i) Causal digraph **(ii) Relationship diagram**

Figure A5: Causal digraph and relationship diagram of strategy and policy indicators

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A Framework to Achieve Sustainability in Manufacturing Organisations of Developing Economies using Industry 4.0 Technologies' Enablers

Abstract: Sustainability has emerged as one of the most important issues in the international market. Ignorance of sustainability aspects has led many manufacturing organisations to face huge financial losses. It has been observed that developed nations have successfully achieved sustainability in their manufacturing sectors. However, the rate of sustainability adoption in developing nations is significantly poorer. The current business trend offers new technologies such as the Internet of Things, Big data analytics, Blockchain, Machine learning, etc. These technologies can be termed under the Industry 4.0 paradigm when considered within a manufacturing context. It is significant to notice that such new technologies directly or indirectly contribute to sustainability. So, it is necessary to explore the enablers that facilitate sustainability adoption. This study aims to develop a framework to improve sustainability adoption across manufacturing organisations of developing nations using Industry 4.0 technologies. Initially, the enablers that strongly influence sustainability adoption are identified through a literature review. Further, a large scale survey is conducted to finalise the Industry 4.0 technologies' enablers to be included in the framework. Based on the empirical analysis, a framework is developed and tested across an Indian manufacturing case organisation. Finally, Robust Best Worst Method (RBWM) is utilised to identify the intensity of influence of each enabler included in the framework. The findings of the study reveal that managerial and economical, and environmental enablers possess a strong contribution toward sustainability adoption. The outcomes of the present study will be beneficial for researchers, practitioners, and policymakers.

Keywords: Sustainability; Manufacturing supply chain; Industry 4.0; Developing nations; New technologies, Empirical study, Robust Best Worst Method (RBWM).

1. Introduction

The constantly changing market needs and limited profit margins have push manufacturing organisations to revisit their existing process structures [1]. For this purpose, business managers constantly look to adopt new technologies for improving their entire supply chain

and achieve sustainability [2]. Even to compete in the international market, it is essential to develop sustainable products. It has become mandatory to consider the environment and societal aspects of manufacturing along with the economic consideration [3]. Hence, organisations are in search of new technologies that could fulfil their sustainability requirements [4]. Several alternatives such as Circular Economy (CE), Internet of Things (IoT), Big Data Analytics (BDA), Cloud Computing (CC), and Blockchain (BC), etc. have turned up to support the manufacturing, service, and healthcare sectors [5].

These technologies are broadly considered under the umbrella of Industry 4.0, which is considered as the next generation of the industrial revolution [6]. Particularly in developing nations, the manufacturing sector plays a strong role in building the nation's economy [7]. Various Multi-National Companies (MNCs) have shown their interest to develop their manufacturing set up in developing nations such as China, India, Thailand, and Brazil due to low manufacturing costs and cheap labour [8]. However, to improve the supply chain structure and achieve sustainability, Industry 4.0 has emerged as the most prominent solution in the present manufacturing scenario [9]. Nevertheless, Industry 4.0 adoption appears to be successful only in large scale organisations [10], whereas SMEs, especially in developing nations, struggle to achieve sustainability effectively [11].

The emerging economies of the world have succeeded in generating financial gains through their manufacturing sector; but, it is important to notice that these nations have been far away from achieving sustainability within their system [12]. Table 1 represents the status of emerging economies in achieving sustainability.

Table 1. Status of emerging economies in achieving sustainability [6][13][14]

S. No.	Country	GDP (Billion US $)	EPI Score (Global rank)	Renewable energy usage	GHGE (Global %)	MCG (%)	HDI (Global rank)	Type of economy
1	United States	20,494	71.19 (27)	14.7%	14.75%	18.9%	0.924 (13)	Developed
2	China	13,407	50.74 (120)	24.5%	27.50%	39.5%	0.752 (86)	Developing
3	Japan	4,971	74.69 (20)	15.0%	2.99%	29.7%	0.909 (19)	Developed
4	Germany	4,000	78.37 (13)	29.0%	1.98%	30.1%	0.936 (5)	Developed
5	United Kingdom	2,828	79.89 (6)	27.9%	1.20%	19.4%	0.922 (14)	Developed
6	France	2,775	83.95 (2)	17.5%	0.97%	28.9%	0.901 (24)	Developed
7	India	2,716	30.57 (177)	16.98%	6.43%	19.0%	0.64 (130)	Developing

8	Italy	2,072	76.96 (16)	37.3%	0.93%	24.0%	0.880 (28)	Developed
9	Brazil	1,868	60.70 (69)	80.4%	2.25%	21.0%	0.759 (79)	Developing
10	Canada	1,711	72.18 (25)	65.0%	1.63%	28.1%	0.926 (12)	Developed

Note: EPI- Environmental Performance Index, GHGE- Green House Gas Emission, MCG- Manufacturing Contribution to GDP, HDI- Human Development Index

Among the top ten emerging economies based on GDP, there are only three developing nations, namely; China, India, and Brazil. Similarly, the United States holds the highest GDP in the world, but its environmental performance index ranks 27th globally and uses only 14.7% of renewable energy resources for consumption. However, the case of developing nations is even worse. China ranks 120th, India 177^{th,} and Brazil- 69th for EPI. The same is the case for the human development index, where these countries rank 86th, 130th, and 79th respectively. It is painful to know that 35% of global greenhouse emissions are generated by these 3 developing countries collectively. Among these nations, the contribution of the manufacturing sector towards GDP is significant. Hence, it is strongly needed to achieve sustainability among developing nations through the manufacturing sector [15].

It is noticed in various studies that some organisations in developed nations such as Germany, the United States of America, the United Kingdom, etc. have already succeeded in achieving sustainability by adopting new technologies, especially Industry 4.0 [16]. Availability of infrastructure and advanced technological setups act as foundations for these nations, whereas these same factors also act as missing elements for developing nations [17]. Several authors [18–20] have reported a generalised set of Industry 4.0 technologies' enablers that smoothens the pathway to sustainability, but the applicability of these enablers is questionable in developing nations. Accordingly, there is an immediate requirement to identify the key Industry 4.0 technologies' enablers leading to sustainability in the context of SMEs of developing nations by considering economic, environmental and societal aspects [21]. The present study attempts to explore the key Industry 4.0 technologies' enablers that directly influence sustainability in manufacturing organisations of developing economies and determine their intensity of influence for achieving sustainability. Hence, a hybrid empirical-decision making approach is adopted in this study.

Based on the above-discussed issues the following objectives have been defined for the present study:

- To identify an exhaustive set of Industry 4.0 technologies' enablers to achieve sustainability as reported by researchers in the academic literature;
- To develop an Industry 4.0 technologies' enablers based framework within the context of manufacturing organisations from developing nations for achieving sustainability;
- To determine the intensity of Industry 4.0 technologies' enablers and assess their adoption influence by employing a decision-making approach.

To achieve the above-defined objectives the following process has been followed. Initially, an exhaustive literature review is carried out to explore the key Industry 4.0 technologies' enablers to achieve sustainability in manufacturing organisations of developing nations. Further, a large scale survey-based empirical analysis by considering the manufacturing industry of India is carried out to validate and confirm the list of enablers included in the study. India is a developing country and one of the fastest growing economies. Finally, Robust Best Worst Method (RBWM) is used to compute the weights of each shortlisted enabler to assess their intensity in achieving sustainability. The findings of the present study are equally beneficial for researchers as well as practitioners. This is a unique study that reports 29 key Industry 4.0 technologies' enablers to achieve sustainability and portray the directions for improving the status of sustainability in manufacturing organisations in developing nations. Policymakers can retrieve essential inputs to improve the policies for manufacturing organisations of developing nations.

2. Literature Review

It is important to explore the existing work before initiating any research [22]. Hence, a systematic literature review was conducted in order to ensure that the data to be reviewed was as relevant as possible. The literature review is presented in the following three sub-sections that include: article selection, industry 4.0 technologies' enablers, and literature gaps.

2.1 Article Selection

It is essential to consider the most relevant articles before conducting a literature review. Similarly, it is important to ensure the comprehensiveness and quality of the collected articles. Thus, the present study utilised a systematic literature review approach as suggested by [23], [24], and [25]. An initial search of articles was conducted on Scopus, Web of Science and Google Scholar databases. The following keywords were used for searching relevant articles, "new technologies and sustainability for industry 4.0" OR "enablers for sustainability" AND "Industry 4.0 technologies' enablers and sustainability". This initial search provided 988

articles. Later on; various other filters were used, e.g. (a) inclusion of only journal articles (393 articles), (b) inclusion of only English language articles (347 articles), (c) removal of duplicate articles across search databases (112 articles), (d) forward snowball and backward snowball technique (64 articles). The forward and backward snowball technique helped in ensuring that the articles that were shortlisted were strictly co-related with the area of research and served its purpose. Furthermore, the final shortlisted articles were studied individually to determine their relevance for the present research. The industry 4.0 enablers addressed in these studies were initially mapped in an excel sheet and later the repeating enablers were eliminated to ensure that the final list only contained unique enablers. The time horizon taken for the study was 2011- October 2019. The authors included research articles from the engineering, mathematics, computer science, decision science, management and accounting fields. Similarly, only journal articles were chosen for the study while all other types of articles that included book chapters, editorial notes, conference articles, short reviews, erratum, etc. were excluded during the article selection process. Articles 'in press' and 'under review' were considered during the initial screening process. The purpose of focusing on journal articles was to ensure the quality of data required for the present research.

2.2 Industry 4.0 Technologies' Enablers to achieve Sustainability

Manufacturing organisations play a vital role in building a nation's economy. Hence, it is essential to explore the critical enablers that lead to manufacturing sustainability. Liu et al. [26] insisted on the adoption of green design and disposal systems that strongly contribute to sustainability. Manufacturing organisations can proof their future not just by meeting the financial targets [27] but also by merging the environment and societal aspects with it [28]. Liu [29] also pointed out "adoption of sustainable energy resource system", "effective sustainability performance metrics", "adoption of industrial ecology initiatives", and "customer awareness for sustainability" as some crucial enablers leading to sustainability in manufacturing organisations. Similarly, it has been observed that manufacturing companies are one of the primary sources for generating pollution through harmful gas emissions [30]. Hence, companies must focus on preventive measures for reducing the emission leading to the pollution of the environment [8].

The role of stakeholders is extremely important in achieving organisational sustainability [5]. It is required for the management to have a strong involvement and commitment towards the adoption of sustainability [31]. However, Moktadir et al. [32] stated that it is necessary to understand the key benefits and long term implications of sustainability to meet organisational

goals. Managers must be aware of sustainability supportive policies [33]. Koplin et al. [31] highlighted the role of management towards sustainability adoption and listed out some critical enablers namely; “Policies of rewards and incentives for sustainability adoption”, “smart budget allocation”, “management engagement for sustainability adoption”. Management holds a strong command over the financial decisions to be made in alignment with organisational goals [34]. Hence, it becomes critical to allocate the budget smartly over different sections of the organisation. Promotion of industry IoT assists organisations to keep track of global advancement and helps in achieving sustainability throughout their process structure [35].

On the other hand, supply chain and logistics have a strong impact on operational and financial performance [36]. Hence, to withstand global competition, it is essential to digitise supply chain activities, which will help in real-time tracking of suppliers. Xu et al. [37] mentioned that it is extremely important to receive sustainable raw materials from a supplier if it is desired to manufacture a sustainable product. Adopting reverse logistics facilitates the reduction of product development costs and improve organisational profit margins [38]. It is desired to promote the adoption of knowledge management in the supply chain to make it more effective and competent to exert strong pressures of meeting sustainability requirements [29]. Some frameworks [39–41] proposed by researchers to achieve sustainability have focussed on the economic and environmental aspects of the organisations; but, have failed to capture the role of supply chain and logistics in achieving overall sustainability. It is necessary to understand that achieving organisational sustainability is not possible without greening the existing supply chain [42].

According to Beekaroo et al. [43], “many organisations struggle to achieve sustainability due to ignorance of the societal aspects”. Adoption of sustainable human resource management and practising health and safety modules within organisation leads to the roadmap towards sustainability. Moktadir et al. [32] portrayed various enablers such as “enhancement of man-machine-material interaction”, “understanding the implications of sustainability”, and “effective product life cycle analysis” for achieving sustainability in manufacturing organisations. Garbie [44] pointed out in their study that organisations should carefully track various stages of the product based on the life cycle analysis to fulfil the desired quality and after-sales service. Furthermore, the adoption of a decentralised system and constant tracking of stock and in-process inventory helps in the smooth running of the entire production system [45]. Managing data security and privacy strengthens sustainability in many aspects [46].

Apart from the organisational prospects, the information and technology showcase a significant contribution in achieving sustainability [14]. Based on the new technology and industrial revolution, the adoption of cyber-physical system has emerged as an important aspect. Similarly, "adoption of machine learning system", "effective execution of process optimisation techniques", "practising advance quality improvement techniques" are some of the critical enablers that smoothen the pathway to sustainability [47]. Lu [48] insisted on the adoption of an advanced information sharing system, which ultimately helps in analysing the existing process data more effectively. "Adoption of additive manufacturing system" and "penetration of flexible manufacturing system" are extremely important to compete with global competitors [44]. It is desired that the manufacturing system should be flexible enough to adapt to the continuous changes desired by customers to sustain their product globally [49]. A detailed list of Industry 4.0 technologies' enablers influencing sustainability adoption are portrayed in Table 2.

Table 2. Industry 4.0 technologies' enablers reported by existing literature to achieve sustainability

S. No.	Industry 4.0 technologies' enablers	Description	Literature support
1	Green design and disposal system	Adoption of environmentally friendly design and disposal system supports sustainability	[32]
2	Adoption of sustainable energy resources system	Enhancing the usage of sustainable and renewable energy resources will ensure improved performance	[28,29]
3	Educating customers for sustainability	Awareness of sustainability concepts among the customers will enhance its adoption rate	[5,32]
4	Adoption of industrial ecology initiatives	Industrial ecology initiatives promote CE and tackle environmental concerns effectively	[26, 37, 40]
5	Adoption of cyber-physical system	Adopting a cyber-physical system will lead to a sustainable future and facilitate advance technology acceptance	[29,41,48]
6	Adoption of a machine learning system	Machine learning system will reduce human interaction and improve precision in the manufacturing organisation	[38,49,50]
7	Adoption of an additive manufacturing system	Additive manufacturing system reduces manufacturing costs and helps in developing sustainable products	[1,51,52]
8	Penetration of the flexible manufacturing system	Flexible manufacturing system assists in quick product modification to meet sustainability and customer requirements	[37,38]

9	Effective sustainability performance metrics	Adoption of sustainability performance metrics ensures tracking of manufacturing activities and aligning sustainability	[48,53]
10	Continuous monitoring of reduction emission	Reduction in emission is an important aspect to protect the environment pollution	[54,55]
11	Adoption of effective process optimisation techniques	Optimisation techniques help in standardising the manufacturing process and design-related activities	[56,57]
12	Adoption of advanced quality improvement techniques	Adopting quality improvement techniques helps in improving the organisational performance	[58]
13	Advanced information sharing systems	Smooth and effective information sharing system helps in building collaboration among the system aligned activities	[1,5]
14	Sustainable human resource management	Sustainable human resource management is an essential aspect to roadmap sustainability by considering human relations and related activities	[51,52]
15	Adoption of health and safety modules	Health and safety measures adopted within the organisation provides stability to employees and develops a sustainable working culture	[29,43]
16	Constant tracking of stock and in-process inventory	Effective monitoring of existing stocks and in-process inventory will ensure uninterrupted functioning of the manufacturing process	[1,5]
17	Adoption of the decentralised system	Adoption of the decentralised system facilitates the tracking of departmental activities and enhance process focus	[28,29]
18	Enhancement of man-machine-material interaction	Improving the man-machine-material interaction will strengthen the sustainability of the final product	[48,53]
19	Adopting reverse logistics	Reverse logistics ensures the execution of corrective actions on product and process development	[37,38]
20	Adoption of sustainability supportive policies	Government offers various sustainability supportive policies for the manufacturing organisations to develop an overall sustainable environment	[1,50]
21	Promoting Industry internet of things	Promotion of industry IoT helps the organisations to compete at the global level and achieve international standards	[32,50]
22	Smart budget allocation	Smart budget allocation helps in distributing the available financial resources effectively among the entire organisational structure	[51,52]
23	Adoption of smart factory components	Adopting smart factory components ensures overall sustainability including economic, environmental and societal concerns	[29,43]
24	Management engagement towards sustainability adoption	It is necessary to have strong involvement of management and positive perception towards sustainability adoption	[1,5]

25	Policies of rewards and incentives for sustainability adoption	Policies of rewards and incentives for sustainability adoption will enhance the employee involvement towards sustainability	[28,29]
26	Managing data security and handling	Industry 4.0 ensures securing the organisational data and using it for improving the operational performance	[37,38]
27	Understanding the implications of sustainability	It is important to understand the exact implications of sustainability and its impact on the near future	[29,43]
28	Effective product life cycle analysis	Design, analysis, production, promotion, and abortion of product should be analysed based on product life cycle analysis	[1,50]
29	Digitisation of supply chain activities	Digitising the supply chain activities improve supply chain performance and boosts sustainability	[48,53]
30	Real-time tracking of suppliers	Real-time tracking of suppliers assists in keeping the inventory stocks at optimum levels	[32]
31	Promoting knowledge management in supply chain	Practising knowledge management in the supply chain improves supply chain sustainability and logistics performance	[51,52]
32	Supplier commitment for sustainable procurement	It is required to have a strong commitment of suppliers to execute sustainable procurement practices to roadmap sustainable product development	[1,5]

2.3 Literature Gaps

Based on the literature reviewed on Industry 4.0 technologies' enablers for sustainability, the following knowledge gaps in the academic literature were identified.

- The existing literature has highlighted several studies [8,34,51] that helped in showcasing the enablers that assist in achieving sustainability across manufacturing organisations. However, very few studies have pointed out the enablers relating to new technologies.
- Researchers [3,37] in the existing literature portrayed a list of enablers influencing sustainability. Nevertheless, these studies have failed to establish a linkage on how these enablers impact the adoption of sustainability.
- Several studies [38,59] based on the enablers for sustainability adoption in manufacturing organisations have only used empirical analysis as a tool for framework validation. Although, it is essential to employ any decision-making approach.
- The mere identification of enablers supporting sustainability in manufacturing organisations is not sufficient [60]. Hence, it is essential to identify the intensity of

influence of each enabler on sustainability adoption through multi-criteria decision-making approaches.

- Various studies [31,43] have shared success stories of new technology adoption across developed nations. However, very few studies were able to succeed in achieving sustainability among manufacturing organisations in developing economies.
- Few studies [61-63] have developed an enabler specific framework and considered only Technology, Organisation and Environment (TOE) to enhance sustainability adoption. However, these frameworks have not been verified and hence, their applicability is questionable.

The above-mentioned gaps suggest the need for research work that highlights the enablers supporting sustainability adoption across manufacturing organisations in developing nations. Furthermore, it is required to determine the intensity of the influence of these enablers in sustainability adoption. These gaps support objectives defined at the beginning of this study.

3. Research Methodology

This study initially conducted a systematic literature review to explore the key enablers based on Industry 4.0 technologies, which supports sustainability adoption. The identified enablers were further tested through a large scale survey to ensure that the selected set of enablers possessed a strong influence on sustainability adoption across manufacturing organisations of developing economies. An empirical analysis was then carried out to group the selected enablers and finalise them. Later, a manufacturing case organisation was selected to conduct a case analysis. An expert panel was formed by including the members of the case organisation. This panel was utilised to categorise the selected enablers. Then, an enabler based framework to enhance sustainability adoption was developed and supplied to the case organisation. The inputs for the RBWM approach were also obtained through the expert panel. The results of the RBWM approach helped in identifying the intensity of each enabler on sustainability adoption.

3.1 Research Methods Adopted for the Study

The present research was underpinned by a mixed method research approach. The methodological flow of the research is illustrated in Figure 1.

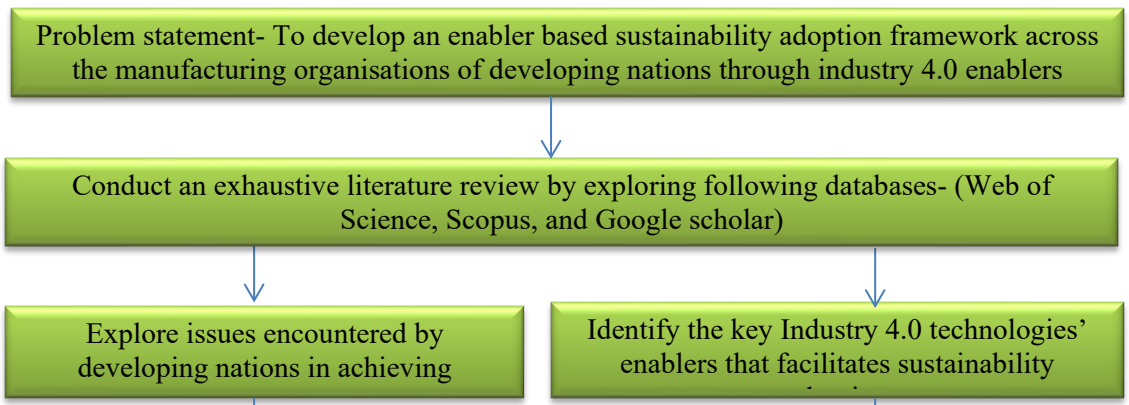

Figure 1. Overall flow of the research methodology that underpinned the present study

3.1.1 Empirical analysis

To provide a strong theoretical foundation for this research work, an empirical analysis which consisted of the combination of both qualitative and quantitative approaches was followed. The main objective of the study was to develop a framework to enhance sustainability adoption across manufacturing organisations of developing nations using Industry 4.0 technologies' enablers. In order to have a better understanding of the enablers, it was essential to perform an empirical analysis. The Statistical Package for the Social Sciences (SPSS) is a software for

editing and analysing data collected from a questionnaire-based survey [64]. Therefore, an investigation through an empirical study was carried out by using SPSS 21.0 to finalise the enablers. Cronbach alpha was used to check the reliability and validity of the collected data [65,66]. Exploratory factor analysis was used to develop a factors structure of the drivers.

3.1.2 Robust-BWM approach

The MCDM literature offers a huge variety of approaches for solving complex decision-making problems [51]. However, the applicability of these approaches depends strictly upon the nature of the problem [29]. In the present situation, it was desired to calculate the weights of enablers influencing sustainability adoption. For this purpose, AHP, SWARA, MOORA and other approaches are available. Nevertheless, Best Worst Method (BWM) offers a better option over these approaches as it uses less paired comparisons and overcomes certain drawbacks of AHP [67]. Furthermore, different variants of BWM are proposed in the existing literature. Among these variants, RBWM is considered to be the most stable as it effectively handles vagueness and uncertainty [68]. It also considers a range of comparisons among two enablers instead of allotting a specific number. This uniqueness of operation enriches the applicability of RBWM for the present case.

4. A Real-World Case Application

This section describes a real-world case application. The details are provided in following subsections.

4.1 Problem Definition and Organisation Description

According to the objectives defined for this study, an automotive manufacturing company was selected as a case organisation. The ABC organisation was established in 1976 and is situated in the central region of India. It holds around 850 employees working in three shifts with an annual turnover of $ 190 million. The organisation has a wide range of clients throughout the country, but they have failed to earn themselves as a brand on the international platform. For this reason, management is constantly working to meet international product standards and achieve sustainability. After a discussion with top management, they agreed to help the authors in developing and testing the framework to achieve sustainability using Industry 4.0 technologies' enablers within their firm.

Initially, an expert panel which consisted of a total of 6 experts was established. This included one top management executive, two project managers, one supply chain and operations head, one R&D head and one warehouse and packaging supervisor. All team members of the expert panel individually held more than 15 years of experience; the two project managers and supply chain head possessed a strong exposure to handling international business while the experts from the warehouse and R&D had handled green and sustainability initiatives in the past. Their expert opinion was sought to develop the questionnaire instrument and perform its content validity. Secondly, inputs for RBWM were also obtained to identify the intensity of the influence of enablers on sustainability adoption.

4.2 Survey Analysis

4.2.1 Questionnaire development and data collection

An empirical study was conducted to check the statistical establishment of all identified Industry 4.0 technologies' enablers to achieve sustainability. A questionnaire was prepared based on a 1-5 scale (i.e. 1 - strongly disagree and 5- strongly agree). The pre-testing of the questionnaire was done with the help of area experts and academics who held large experience in this area. Based on their inputs, the language of some questions was amended and made simpler to understand. After the modification, a final questionnaire was prepared and a small sample was used for pilot testing. The research team initially used a convenience sampling method for data collection but after meeting some respondents, they referred us to the company's staff who were working in the same area. After following this process, the research team was able to collect 247 respondents. However, after the screening process, a total of 230 responses were used to conduct the empirical analysis, which is quite acceptable. The details of the participants' profiles are presented in Table 3.

Table 3. Participants' profiles

Characteristics		**Total**	**Percentage (%)**
Gender	Male	167	72.61
	Female	63	27.39
Education	Undergraduate	50	21.74
	Graduate	74	32.17
	Postgraduate	81	35.22

	Others	25	10.87
Work experience (in years)	0-5	29	12.61
	6-10	48	20.87
	11-15	62	26.96
	16-20	42	18.26
	Above 20	49	21.30
Position	Senior Level Manager	34	14.78
	Medium Level Manager	68	29.57
	Manager	76	33.04
	Others (employee in sourcing, logistics, production, operation, and other services, etc.)	52	22.61
Department	R & D	25	10.87
	Shop Floor	74	32.17
	Warehouse and Logistics	28	12.17
	HR	21	09.13
	Supply Chain	37	16.09
	Others (Marketing, Finance, and other services, etc.)	45	19.57
Type of Manufacturing	Automobile and Automotive Component Manufacturing	79	34.35
	Electronics and Electrical Manufacturing	39	16.96
	Textile and Apparel Manufacturing	26	11.30
	Machine Tools Equipment and Engineering Manufacturing	29	12.61
	Chemical and Pharmaceuticals Manufacturing	27	11.74
	Others (FMCG and Food Manufacturing, etc.)	30	13.04

4.2.2 Measurement of biasness

When primary data is collected, it can be affected by biased views of respondents. To minimise this, the authors kept all the responses opinions anonymous [69]. To make the study objectives more understandable, these were sent to the respondents, alongside a brief description of the study so that they could dedicate more time to filling the questionnaire and provide bias-free responses.

4.2.3 Reliability and validity checks

With the help of reliability and validity tests by using SPSS 21.0, the authors did not only check the accuracy of the collected data but also assessed the 'goodness of a measure'. For measuring

reliability, we used Cronbach's alpha (α) and its recommended values [70]. Field [64] indicates that if the factor loading of each variable is greater than 0.5, there is convergent validity for the data. In this work, the overall Cronbach's alpha (α) value was 0.830, so as per previous literature the data was considered acceptable. Field [64] further reported that if the factor loading of each item is greater than 0.5, it shows both the internal consistency and convergent validity of the instrument. After establishing the factor structure of enablers to achieve sustainability using EFA, the convergent validity of the instrument was measured by calculating the Cronbach alpha value, where the range was between 0.838 and 0.933.

4.2.4 Exploratory Factor Analysis (EFA)

EFA is a multivariate technique that is widely employed to determine the factors structure. With the minimum loss of information, EFA has the ability to reduce the number of variables into a set of structures. In this study, EFA was used to define the factor structure of the identified Industry 4.0 technologies' enablers to achieve sustainability. Before using EFA, the data should be suitable for such purpose. For this, Kaiser-Meyer-Olkin (KMO) and Bartlett's Test of Sphericity were conducted. Eisinga et al. [65] suggest that the KMO value should be greater than the minimum recommended value (0.60) and that the Bartlett's Test of Sphericity to be significant at $p < 0.01$. In this case, the sampling adequacy value for each enabler was above the acceptable value of 0.50. Thus, the analysis showed that the collected data fulfilled the recommended criteria and suitability to apply EFA. Field [64] suggested that with varimax factor rotation, EFA was carried out to determine the factor structure for enablers; an Eigenvalue (>1) was used to obtain the final factor structure. As shown in Table 4, all drivers were structured into five main drivers with a total variance of 71.27%. The factor loading of each main driver under its respective sub-capabilities was in the range of 0.635 - 0.911, above the acceptable level of 0.60. The commonalities range was 0.463 - 0.853, also above the acceptable limit of 0.40. Three enablers, i.e. 'Adoption of an additive manufacturing system', 'Adoption of advanced quality improvement techniques' and 'Constant tracking of in-process and stock inventory' were dropped from further analysis due to low loading as per the acceptable level 0.60 [71].

Table 4. EFA analysis results

Group	Indicator	Loading	Commonalities	Cronbach (α)

Group 1	Adoption of machine learning system	0.911	0.836	0.926
	Adoption of cyber-physical system	0.897	0.815	
	Adoption of effective process optimisation techniques	0.881	0.802	
	Penetration of the flexible manufacturing system	0.872	0.789	
	Adoption advanced quality improvement techniques	0.832	0.714	
	Advanced information sharing systems	0.751	0.598	
	Adoption of additive manufacturing system	0.635	0.472	
Group 2	Continuous monitoring of reduction emission	0.908	0.875	0.933
	Adoption of sustainable energy resources system	0.862	0.778	
	Effective sustainability performance metrics	0.844	0.755	
	Educating customers for sustainability	0.843	0.794	
	Green design and disposal system	0.828	0.710	
	Adoption industrial ecology initiatives	0.751	0.672	
Group 3	Management engagement towards sustainability adoption	0.903	0.843	0.887
	Adoption sustainability supportive policies	0.899	0.844	
	Adoption of smart factory components	0.787	0.658	
	Smart budget allocation	0.762	0.596	
	Promoting Industry internet of things	0.716	0.566	
Group 4	Digitisation of supply chain activities	0.866	0.763	0.838
	Real-time tracking of suppliers	0.864	0.758	
	Adopting reverse logistics	0.744	0.662	
	Supplier commitment for sustainable procurement	0.678	0.509	
	Promoting knowledge management in the supply chain	0.650	0.492	
Group 5	Adoption of health and safety modules	0.904	0.853	0.918
	Sustainable human resource management	0.895	0.828	
	Effective product life cycle analysis	0.868	0.787	

	Enhancement of man-machine-material interaction	0.826	0.779	
	Managing data security and handling	0.781	0.657	
	Understanding the implications of sustainability	0.623	0.463	

4.3 Framework Development

The exploratory factor analysis indicated that out of 32 shortlisted enablers, 29 were found to be suitable for the present problem. These enablers were spread over 5 groups. Thus, the results were further shared with the expert panel to categorise the enablers and develop the framework. Based on the experts' feedback and similarity of the enablers, these groups were named as informational and technological, which contained informational and technological enablers. All environment enablers were in the environmental group. The third group contained all the enablers related to managerial and economical aspects, the supply chain management group contained all the enablers related to supply chain management while the last group contained all enablers related to organisational and social factors. Accordingly, a framework was developed to enhance sustainability in manufacturing organisations. Figure 2 indicates the details of the developed framework. The framework was tested in the case organisation to identify the intensity of influence of the selected enablers in sustainability adoption.

4.4 Multi-Criteria Decision Making Analysis

The framework developed in the previous section was then tested through the RBWM approach. In the RBWM approach, the experts were asked to make the pairwise comparisons major group and subgroup enablers separately [72]. During the process of paired comparison, it was possible for the experts not to be able to overcome the vagueness and fail to handle uncertainty.

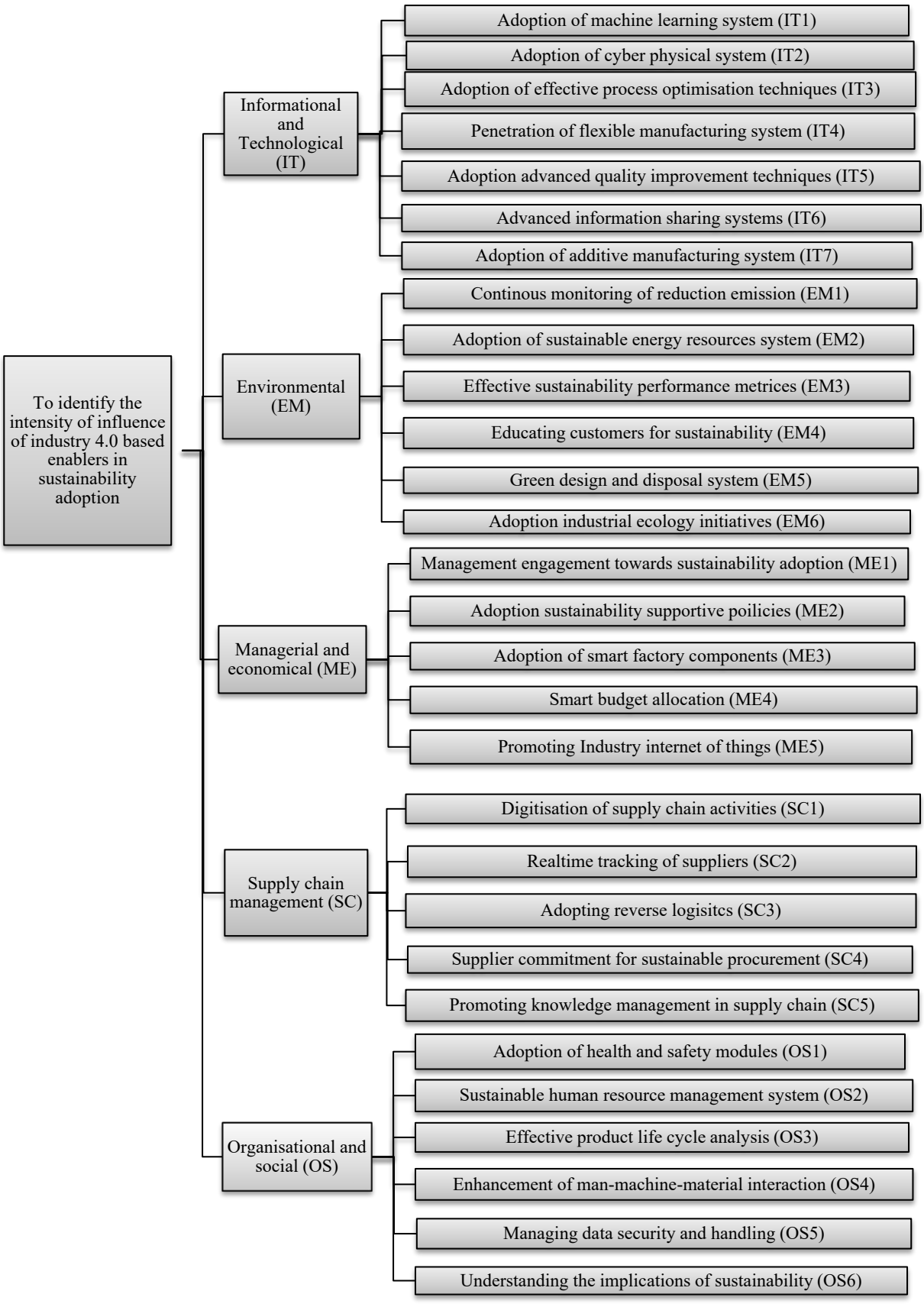

Figure 2. Framework to enhance sustainability adoption

Hence, instead of allotting a crisp value for a comparison of two enablers, a defined range was given. The procedure followed to execute the RBWM is presented below.

Step 1: Finalising the criteria - This step included the finalisation of the criteria that needed to be included for problem-solving. Here, a set of criteria (C_1, C_2, C_3…. C_n) was used to decide between alternatives.

Step 2: Allotment of best and worst criteria - This step included allotting the best and worst criteria across the major group and all the corresponding sub-groups.

$A_B = (a_{b1}, a_{b2}, a_{b3}, \ldots a_{bn})$

$A_W = (a_{w1}, a_{w2}, a_{w3}, \ldots A_{wn})$

Step 3: Determining the paired comparisons - Instead of providing a finite value, a range was provided. For example, the relation between enabler A and enabler B was given in the range of 2.5 and 3.5. Hence, an optimum value within this range was tested rather than allotting a finite value 3.

Step 4: Determining the best solution - To obtain the best solution, the Soyester method was utilised for the present problem. According to the Soyester method, the present problem can be formulated based on the following model.

Min ξ^R

Subject to $W_B - A_{Bj} W_j + A_{Bj} Y_B - \xi^R \leq 0$, $\forall$ j, B

$A_{Bj} W_j - W_B + A_{Bj} Y_{B'} - \xi^R \leq 0$, $\forall$ j, B'

$W_j - A_{jw} W_w + A_{jw} Y_w - \xi^R \leq 0$, $\forall$ j, w

$A_{jw} W_w - W_j + A_{jw} Y_{w'} - \xi^R \leq 0$, $\forall$ j, w'

$-Y_B \leq W_j \leq Y_B$, $\forall$ B, j

$-Y_{B'} \leq W_j \leq Y_{B'}$, $\forall$ B', j

$-Y_w \leq W_w \leq Y_w$, $\forall$ w, j

$-Y_{w'} \leq W_w \leq Y_{w'}$, $\forall$ w', j

$\sum_{j=1}^{n} w_j = 1$

$W, Y \geq 0$,

This approach ensured the protection of uncertainty and helped decision-makers and practitioners predict the best possible influence values of enablers over the sustainability adoption. The comparison ranges, best and worst enablers for the major group provided by the expert panel are shown in Table 5.

Table 5. Best and worst comparisons of major group enablers

Main group enabler	Range	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	Expert 6	Average Weight
Informational and Technological (IT)	B_{max}	2.25	1	7.5	6.5	2.5	3.5	0.191
	B_{min}	1.75	1	6.5	5.5	1.5	2.5	
	W_{max}	4.25	6.5	1	1	5.5	4.5	
	W_{min}	3.75	5.5	1	1	4.5	3.5	
Environmental (EM)	B_{max}	1	2.5	5.5	5.5	1	6.5	0.234
	B_{min}	1	3.5	4.5	4.5	1	5.5	
	W_{max}	8.45	3.5	2.5	2.5	6.5	1	
	W_{min}	7.55	2.5	1.5	1.5	5.5	1	
Managerial and Economical (ME)	B_{max}	4.5	6.5	1	1	6.5	1	0.263
	B_{min}	3.5	5.5	1	1	5.5	1	
	W_{max}	2.15	1	7.5	6.5	1	6.5	
	W_{min}	1.85	1	6.5	5.5	1	5.5	
Supply chain management (SC)	B_{max}	3.5	2.5	3.5	2.5	5.5	5.5	0.152
	B_{min}	2.5	1.5	2.5	1.5	4.5	4.5	
	W_{max}	3.65	4.5	4.5	5.5	2.5	2.5	
	W_{min}	2.35	3.5	3.5	4.5	1.5	1.5	
Organisational and Social (OS)	B_{max}	8.45	4.5	2.5	2.5	4.5	2.5	0.161
	B_{min}	7.55	3.5	1.5	1.5	3.5	1.5	
	W_{max}	1	2.5	5.5	5.5	3.5	5.5	
	W_{min}	1	1.5	4.5	4.5	2.5	4.5	

Similarly, comparisons were made for each subgroup. The final weights of each subgroup enablers are presented in Table 6.

Table 6. Final weights of enablers influencing sustainability adoption

Main Group	Group Weight	Sub-Factor	Local Weight	Global Weight	Global Rank
Informational and Technological (IT)	0.191	IT1	0.083	0.016	26
		IT2	0.321	0.061	4
		IT3	0.213	0.041	10
		IT4	0.203	0.039	11
		IT5	0.045	0.009	28
		IT6	0.091	0.017	25
		IT7	0.042	0.008	29
Environmental (EM)	0.234	EM1	0.086	0.020	22

		EM2	0.318	0.074	1
		EM3	0.256	0.060	5
		EM4	0.045	0.011	27
		EM5	0.185	0.043	8
		EM6	0.110	0.026	19
Managerial and economical (ME)	0.263	ME1	0.239	0.063	3
		ME2	0.258	0.068	2
		ME3	0.144	0.038	12
		ME4	0.188	0.049	6
		ME5	0.170	0.045	7
Supply chain management (SC)	0.152	SC1	0.270	0.041	9
		SC2	0.207	0.032	15
		SC3	0.180	0.027	18
		SC4	0.227	0.035	14
		SC5	0.116	0.018	24
Organisational and social (OS)	0.161	OS1	0.185	0.030	16
		OS2	0.222	0.036	13
		OS3	0.179	0.029	17
		OS4	0.117	0.019	23
		OS5	0.159	0.025	20
		OS6	0.140	0.022	21

5. Study Findings and Discussions

In line with the research objectives of the present study, an exhaustive literature review was conducted to explore the Industry 4.0 technologies' enablers that strongly influence sustainability adoption across manufacturing organisations in developing economies. Later, a manufacturing case organisation was selected to develop and test the framework to enhance the sustainability adoption rate. An expert panel formed within the case organisation was utilised to test the content validity of the questionnaire instrument developed to conduct a large scale survey. The responses obtained through the survey were tested and an exploratory factor analysis was conducted to group similar factors. After conducting the empirical analysis, the findings were utilised to develop an enabler based framework to enhance sustainability adoption.

Further, the RBWM approach was applied to identify the intensity of the influence of enablers on sustainability adoption. The results revealed that among the major group enablers were Managerial and Economical enablers (ME), which obtained the highest weight (0.263),

followed by Environmental enablers (EM- 0.234), Informational and Technological enablers (IT- 0.191), Organisational and Social enablers (OS- 0.161), and Supply Chain Management enablers (SC- 0.152). Khurana et al.'s [73] study support the above results by indicating in their study that managerial and environmental enablers strongly affect sustainability adoption. Among the subgroup of enablers, the adoption of a sustainable energy resource system (EM2- 0.074) held the highest intensity of influence on sustainability adoption, followed by the adoption of sustainability supportive policies (ME2- 0.068), management engagement towards sustainability adoption (ME1- 0.063), adoption of cyber-physical system (IT2- 0.061), and effective sustainability performance metrics (EM3- 0.060). Shankar et al. [2] and Liu et al. [29] also indicated that the adoption of sustainable energy resource systems and consideration of sustainability supportive policies are necessary prerequisites for sustainability adoption.

Among the informational and technological enablers, adoption of cyber-physical system (IT2), adoption of effective process optimisation techniques (IT3- 0.041), and penetration of flexible manufacturing system (IT4- 0.039) emerged as the most prominent enablers that support sustainability. Cai et al. [30] highlighted that if a manufacturing system is rigid, it becomes really difficult for the practitioners to incorporate the changes based on reverse feedback. Similarly, a cyber-physical system transits a manufacturing system towards the next generation and eliminates the chances of errors in the production system. Among the environmental enablers (EM), adoption of sustainable energy resource system (EM2), effective sustainable performance metrics (EM3), and green design and disposal system (EM5- 0.043) were the most critical enablers. The study conducted by Piyathanavong et al. [34] also pointed out that the greening of activities throughout the organisation is essential if the organisation wants to achieve sustainability. They argued that despite adopting greener activities, it is mandatory to have sustainable performance metrics that could monitor and track the activities over sustainability.

Among the managerial and economic enablers, adoption of sustainability supportive policies (ME2), management engagement towards sustainability adoption (ME1), smart budget allocation (ME4- 0.049), and promoting industry internet of things (ME5- 0.045) resulted as the most significant enablers that correlate to sustainability. Niaki et al. [74] insisted on management involvement towards sustainability adoption and stakeholders' participation as an essential component to withstand the business on a global platform. Decisions related to policies, strategies, and finance stands with the management and hence, to penetrate

sustainability effectively their involvement is essential. Among the supply chain management enablers, digitisation of supply chain activities (SC1- 0.041), supplier commitment for sustainable procurement (SC4- 0.035), and real-time tracking of suppliers (SC2- 0.032) turned up as sustainability favouring enablers. Seuring et al. [5] reported that sustainability is extremely difficult to achieve without greening the entire supply chain and logistics. It includes from the idea generation stage and up to after-sales service. Digitisation of supply chain activities helps industrialists in keeping a constant track over the production process and controlling the occurrence of errors with an immediate effect.

Among the organisational and social enablers, sustainable human resource management (OS2- 0.036), adoption of health and safety modules (OS1- 0.030), effective product life cycle analysis (OS3- 0.029), and managing data security and handling (OS5- 0.025) resulted as the most critical enablers that need to be practised by organisations. Xu et al. [37] argued that achieving sustainability in its correct form has always been a debatable topic. Many researchers have discussed the inclusion of economic and environmental aspects to achieve sustainability; but, many of them have missed to capture the social aspect. The contribution of manufacturing organisations towards the handling of social aspects is as important as their contribution to nations' GDPs. Similarly, effective product life cycle analysis helps industrialists to adopt decisions on promotions, modifications, and disposal accurately.

5.1 Study Implications

The present study makes significant contributions to researchers and practitioners working in the sustainability domain. The implications of this study are as follows.

- The literature on sustainability offers a large number of frameworks [16,75] that support sustainability adoption, but the majority of them are generalised. However, the present study develops a framework for sustainability adoption across manufacturing organisations of developing nations using Industry 4.0 technologies' enablers.
- This study identifies a unique set of 29 enablers, based on Industry 4.0 technologies, which contribute to the achievement of sustainability. The identified enablers were verified through experts' opinions. The study can thus be beneficial for industrialists involved in the sustainability adoption process. The exhaustive set of enablers can be utilised by researchers to conduct allied studies in the sustainability domain.

- The majority of sustainability-oriented frameworks [35,76] reported in the literature have not been verified. However, the framework developed in this study was verified empirically and through a multi-criteria decision-making method.
- Researchers in the literature [3,51] have identified the enablers that support sustainability adoption. However, only a few of them have highlighted the intensity of their influence in the adoption process. This study employed the RBWM approach to determine the intensity of each enabler included in the framework.
- The simultaneous adoption of all the enablers is extremely difficult [77]. However, the weights of enablers determined in this study will assist companies involved in sustainability adoption to focus on high-intensity enablers on priority.
- The framework developed in this study was tested in an Indian context. Other developing economies can utilise the present framework by making modifications to it in consultation with the domain experts of that country.

6. Conclusions

This study develops a framework for manufacturing organisations to enhance sustainability adoption. It determines a unique set of 29 Industry 4.0 technologies' enablers that strongly influence sustainability adoption. The study employs a unique combination of empirical and multi-criteria decision-making approaches to solve the present problem. Initially, the study conducts an empirical analysis to finalise the enablers influencing sustainability adoption. Later, a framework was developed and tested in a manufacturing organisation to improve sustainability and compete at an international level. Further, the RBWM approach was utilised to determine the weights of enablers included within the framework. The results reveal that managerial and economical enablers were found to be the most critical for sustainability adoption; while, environmental enablers also possessed a strong influence in achieving overall sustainability. It is important to notice that the adoption of sustainable energy resources systems, adoption sustainability supportive policies and effective sustainability performance metrics were among the top influencing enablers that support sustainability adoption. Accordingly, it is suggested that government policies favouring sustainability adoption through the execution of new technologies will have a positive impact on strengthening nations' economy. Similarly, the promotion of a sustainable energy resource system will create awareness among manufacturing organisations and help them improve their sustainable performance.

6.1 Limitations and Future Research Directions

The present study explored Scopus, Web of Science and Google Scholar to identify the articles and list the key Industry 4.0 technologies' enablers influencing sustainability adoption. Researchers may further increase the number of databases for the literature search in order to identify more articles to support the study as it is possible that some studies that influence sustainability might not have been identified and considered. In this work, an empirical study has been conducted in a single India manufacturing company. Thus, future research can be conducted by considering multiple manufacturing companies and organisations in other industrial sectors and countries. This will increase the reliability and validity of the results obtained from the present study. Similarly, this study highlights the intensity of the influence of enablers towards sustainability adoption. Nevertheless, it does not shed light on the structural relationship among these enablers. Researchers may extend the present study findings by applying various structural techniques such as interpretive structural modelling, decision-making trial and evaluation laboratory, fuzzy cognition maps, analytical network process, etc. to establish the inter-relationships among the enablers included in the developed framework. Finally, the present research is equally beneficial for researchers, practitioners and policymakers. The developed hierarchical framework may be applicable to various Indian manufacturing organisations and other developing countries' manufacturing organisations with marginal or no modifications. The study will, therefore, assist developing nations in achieving sustainability across their manufacturing sector.

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Continuous Issue -36| June– July 2020

SOLAR PASSIVE HOUSE: A REVIEW

Abstract

Houses generally refer to a shelter or building that is meant as a dwelling or place for habitation by human beings.

"Houses" comprise many types of dwellings, ranging from rudimentary huts or nomadic tribes to high -rise buildings.

A significant limitation in fulfilling this need is the spiraling expense of vitality and different changes in atmosphere. Latent sun oriented structures plan to keep up inside warm solace all through the sun's every day and yearly cycles while lessening the necessity for dynamic warming and cooling framework Passive sun powered structure configuration is one piece of green structure. The logical reason for uninvolved sunlight based structure configuration has been created from a blend of climatology, thermodynamics (especially heat move), and human warm solace (for structures to be occupied by people). Explicit consideration is coordinated to the site and area of the residence, the predominant atmosphere, structure and development, sunlight based direction, arrangement of coating and-concealing components, and fuse of warm mass. While these contemplations might be coordinated to any structure, accomplishing a perfect arrangement requires cautious incorporation of these standards.

1. Introduction

New development offers the best open door for consolidating detached sun oriented plan, Passive close planetary system utilize normal vitality streams as the essential methods for reaping sun based vitality, Passive nearby planetary group can give space warming, cooling load evasion, regular ventilation and day lighting.

Passive solar design refers to the use of the sun's energy for the heating and cooling of living spaces. In this methodology, the structure itself or some component of it exploits common vitality attributes in materials and air made by presentation to the sun. Uninvolved frameworks are straightforward, have scarcely any moving parts, and require negligible upkeep and require no mechanical frameworks. Inactive sun powered plan can lessen warming and cooling vitality charges, increment spatial imperativeness and improve comfort.

There are two types of solar design systems: passive and active.

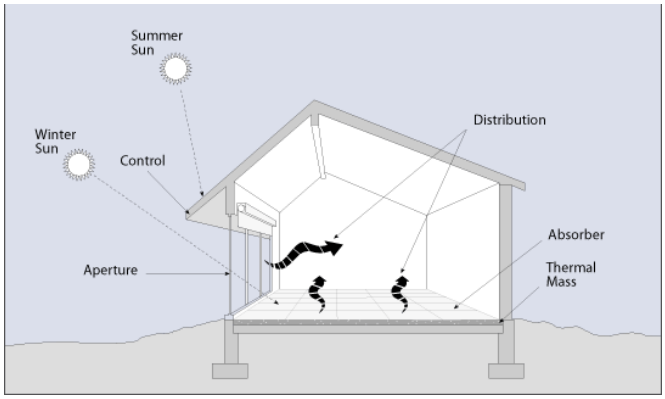
Homes developed as uninvolved sun oriented plan utilize the characteristic development of warmth and air to keep up agreeable temperatures, working with practically no mechanical help. It's called latent sun powered on the grounds that the plan of the home expands the advantages it gets from the sun with standard development highlights. Uninvolved sunlight based exploits nearby breezes and scene highlights, for example, conceal trees and windbreaks, and utilizations a basic framework to gather and store sun powered vitality without any switches or controls.

On the other hand, active solar systems use mechanical devices such as pumps and fans to move heat from collectors to storage or from storage to use. Photovoltaic panels that collect solar energy, turning it into electricity, are also considered an active solar system.

2. Objectives:

1. To control environmental pollution.
2. To preserve the non renewable source of energy like Petrol, diesel etc.
3. To take up energy access programs for rural and remote Areas through solar energy.

3. Elements of Solar Passive House:

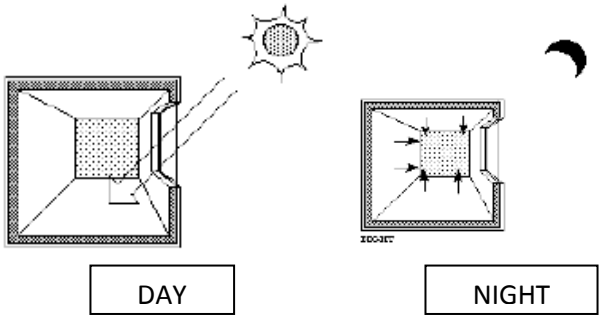


- **Aperture(Collector) :**
  The enormous glass region through which daylight enters the structure. The gap should look inside 30° of genuine south and ought not be concealed by different structures or trees from 9 a.m. to 3 p.m. day by day during the warming season.
- **Absorber:**
  The hard, obscured surface of the capacity component. The surface, which could be a Masonry divider, floor or water compartment, sits in the immediate way of daylight. Daylight hitting the surface is assimilated as warmth.
- **Thermal mass:**
  Materials that retain or store the heat produced by sunlight. While the absorber is an Exposed surface, the thermal mass is the material below and behind this surface.
- **Distribution:**
  Strategy by which sun based warmth flows from the assortment and capacity focuses to various regions of the house. A carefully detached structure will utilize the three characteristic warmth moves Modes-conduction, convection and radiation-solely. In certain applications, fans, Ducts and blowers might be utilized to convey the warmth through the house.
- **Control:**
  Rooftop shades can be utilized to conceal the opening territory during summer months. Different components that control under or potentially overheating incorporate electronic detecting gadgets. Such as a differential indoor regulator that flags a fan to turn on; operable vents and dampers that permits or limits heat stream; low-emissivity blinds; and overhangs.

4. Solar House Heating & Cooling:

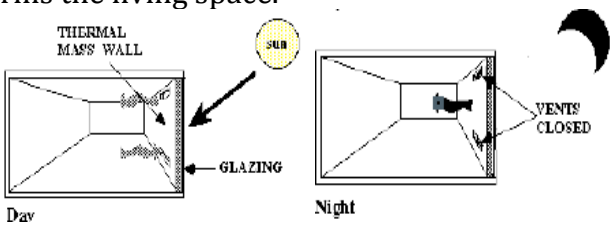
- **Solar House Heating:**
  The goal of passive solar heating systems is to capture the sun's heat within the building's elements and to release that heat during periods when the sun is absent, while also maintaining a comfortable room temperature.

- **Direct Gain:**
  Actual living space is a solar collector, heat absorber and distribution system. South-bound glass concedes sun oriented vitality into the house where it strikes stone work floors and dividers, which assimilate and store the sun powered warmth, which is emanated pull out into the room around evening time. These warm mass materials are regularly dim in shading so as to ingest however much warmth as could be expected. The immediate addition framework uses 60-75% of the sun's vitality striking the windows. For an immediate increase framework to function admirably, warm mass must be protected from the outside temperature to keep gathered sun oriented warmth from disseminating.



- **Indirect Gain:**

Thermal mass is located between the sun and the living space. The thermal mass absorbs the sunlight that strikes it and transfers it to the living space by conduction. The indirect gain system will utilize 30-45% of the sun's energy striking the glass adjoining the thermal mass. The most widely recognized circuitous addition framework is a Trombe divider. The warm mass, a 6-18 inch thick stone work divider, is found quickly behind south-bound glass of single or twofold layer, which is mounted around 1 inch or less before the divider's surface. Sunlight based warmth is consumed by the dividers dull shaded outside surface and put away in the divider's mass, where it transmits into the living space. Sun based warmth relocates through the divider, arriving at its back surface in the late evening or early night. At the point when the indoor temperature falls beneath that of the divider's surface, heat is transmitted into the room. Operable vents at the top and base of a warm stockpiling divider license warmth to convect between the divider and the glass into the living space. At the point when the vents are shut around evening time, brilliant warmth from the divider warms the living space.



- **Solar House Cooling:**

Aloof sunlight based cooling frameworks work by diminishing undesirable warmth gain during the day, delivering non-mechanical ventilation, trading warm inside air for cooler outside air whenever the situation allows, and putting away the coolness of the night to direct warm daytime temperatures. At their most straightforward, latent sun oriented cooling frameworks remember shades or shades for south-bound windows, conceal trees, warm mass and cross ventilation.

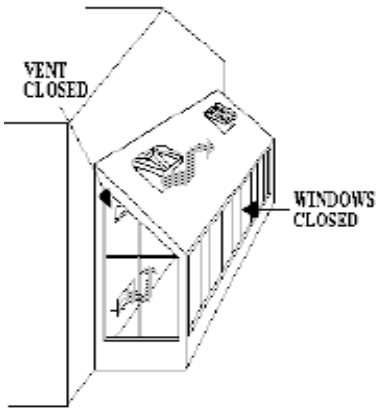
- **Shading:**

To reduce unwanted heat gain in the summer, all windows should be shaded by an overhang or other devices such as awnings, shutters and trellises. If an awning on a south facing window protrudes to half of a window's height, the sun's rays will be blocked during the summer, yet will still penetrate into the house during the winter. The sun is low not too far off during dawn and nightfall, so overhangs on east and west-bound windows are not as successful. Attempt to limit the quantity of east and west-bound windows if cooling is a significant concern. Vegetation can be utilized to shade such windows. Arranging when all is said in done can be utilized to diminish undesirable warmth gain throughout the late spring.

- **Thermal mass:**

Warm mass is utilized in a uninvolved cooling configuration to ingest warmth and moderate inside temperature increments on hot days. During the night, warm mass can be cooled utilizing ventilation permitting it to be prepared the following day to conceivable to assimilate heat once

more. It is utilize a similar warm mass for cooling during the hot season and warming during the virus season.

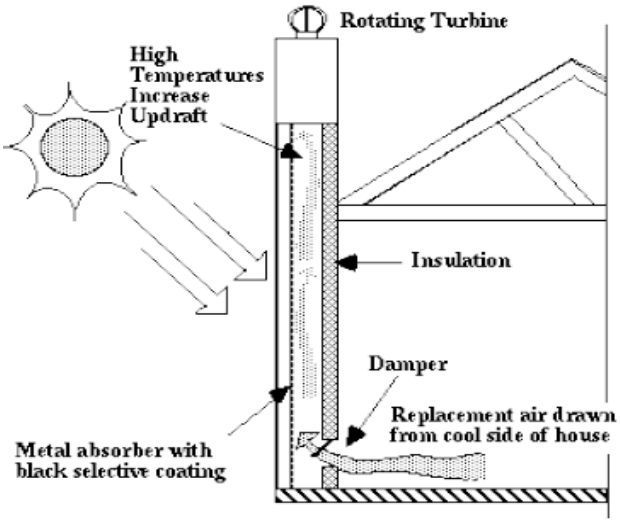


- **Ventilation:**

Characteristic ventilation keeps up an indoor temperature that is near the open air temperature, so it's just a compelling cooling procedure when the indoor temperature is equivalent to or higher than the outside one. The atmosphere decides the best normal ventilation system. In regions where there are daytime breezes and a longing for ventilation during the day, open windows on the structure confronting the breeze and the contrary one to make cross ventilation.

- **Convective Cooling:**

The oldest and simplest form of convective cooling is designed to bring in cool night air from the outside and push out hot interior air. If there are prevailing nighttime breezes, then high vent or open on the leeward side (the side away from the wind) will let the hot air near the ceiling escape. Low vents on the contrary side (the side towards the breeze) will let cool night air clear in to supplant the sight-seeing. At destinations where there aren't winning breezes, it's as yet conceivable to utilize convective cooling by making warm smokestacks. Warm fireplaces are structured around the way that warm air raises; they make a warm or hot zone of air (frequently through sun oriented addition) and have a high outside fumes outlet. The sight-seeing exits the structure at the high vent, and cooler air is attracted through a low vent.



5. Conclusion:

Utilizing a mix of Passive sunlight based vitality and photovoltaic cells can decrease contamination. They can perform easily and discreetly without mechanical or electrical help. Straightforward methods can have an enormous effect in the solace and vitality utilization as the year progressed. The prudent answer for a hotter house in the winter and a cooler house in the late spring is to protect it well, while understanding the development of warmth. It is the hitter arrangement. Cost of Solar System will descend in cost when creation increments.

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Use of Nylon Fiber in Road Construction

New material and construction techniques are required to provide Civil Engineering with alternatives to traditional road construction practices. Traditional techniques have not been able to bear the mixed traffic load for a long time. Therefore the pavement requires overlaying. To overcome this problem fiber inclusion in pavements is adopted nowadays. This presentation highlights on the use of discrete fiber in road construction. Fiber can be obtained easily form the waste we throw away in day to day used like plastics PVCs etc.

The main purpose of this project investigation is to identify the effect of fiber mix (Fiber reinforced bitumen can be defined as a composite material consisting of mixtures of bitumen tar and discontinuous, discrete, uniformly dispersed suitable fiber) used in road construction.

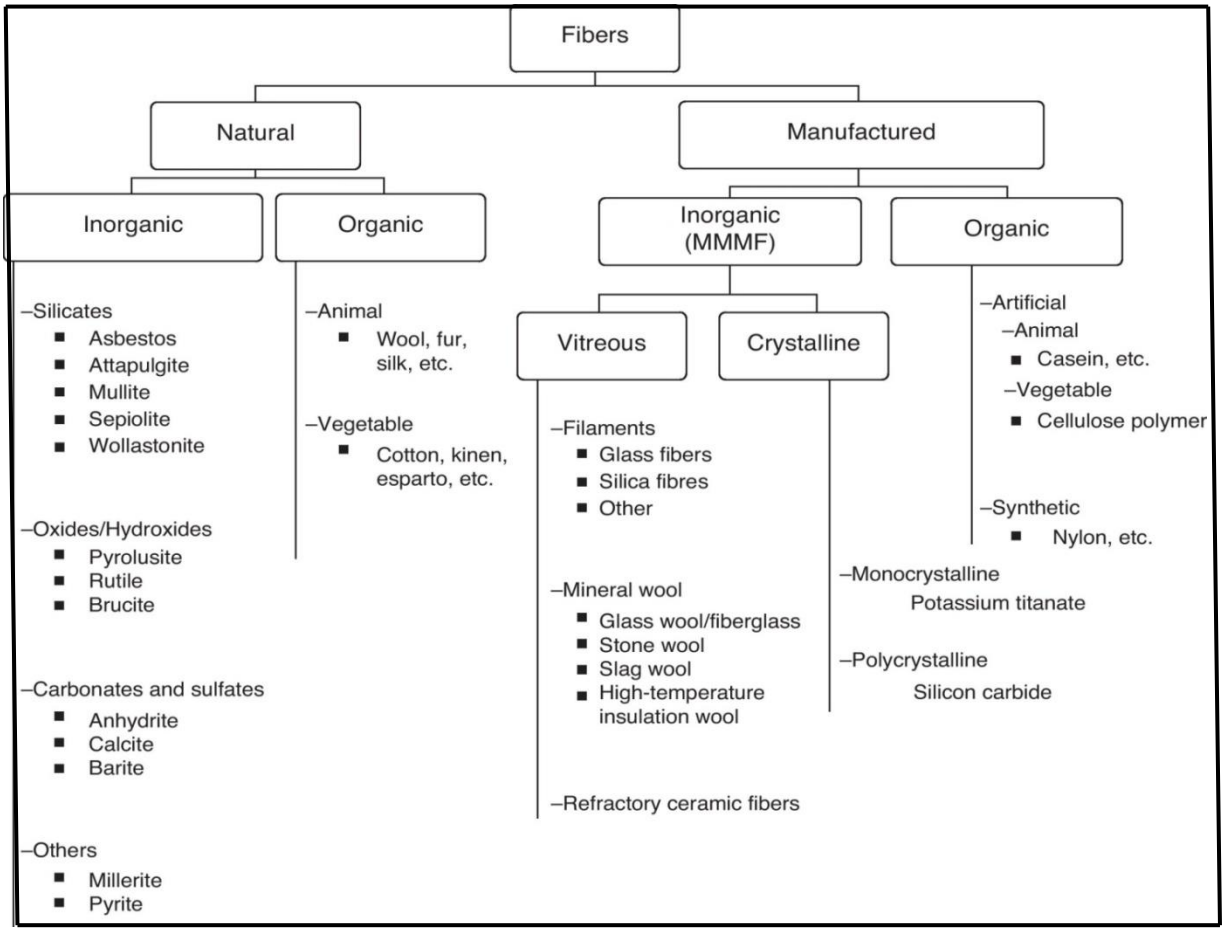
This report describes the laboratory tests conducted on nylon fiber used in road construction material bitumen. The sole purpose is to check whether the fiber mix increase the strength of bitumen or it decreases.

In 80grade bitumen 1, 2 and 3 percentage of nylon fiber was mixed and the length of fiber was divided in 3 cm and 6 cm, so as to make it discrete

The result gives the idea that when the nylon-bitumen mix was tested in ductility test it breaks at nearly approximately 14cm of length which is so much less as compared to 45 cm of normal bitumen and in penetration test it shows 107 mm of penetration which is quite the same to the bitumen only test.

1. Introduction:

Fiber is a small discrete reinforced material produced from steel, polypropylene, nylon, glass, asbestos, coir or carbon in various shape and size. They can be circular or flat. Fiber or fiber (from the Latin fibra) is a natural or synthetic substance that is significantly longer than it is wide. Fibers are often used in the manufacture of other materials. The strongest engineering materials often incorporate fibers, for example carbon fiber and ultra-high-molecular-weight polyethylene. Synthetic fibers can often be produced very cheaply and in large amounts compared to natural fibers continuous meshes, woven fabrics and long wires or rods are not considered to be discrete fiber.

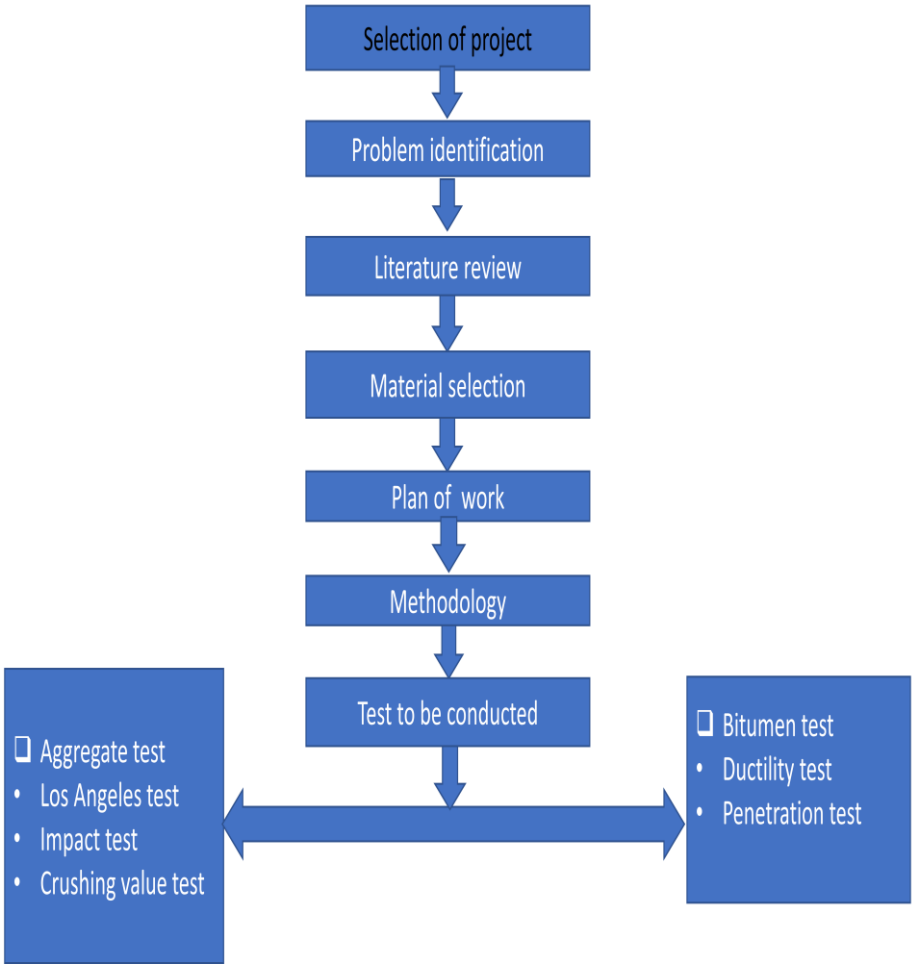


2. Background of the Invention & Literature review:

The purpose of this investigation was to identify and quantify the effect of numerous variables on the performance of fiber-stabilized sand specimens. Laboratory unconfined compression tests were conducted on sand specimens reinforced with randomly oriented discrete fibers to isolate the effect of each variable on the performance of the fiber-reinforced material. Five primary conclusions were obtained from this investigation. First, the inclusion of randomly oriented discrete fibers significantly improved the unconfined compressive strength of sands. Second, an optimum fiber length of 51 mm (2 in.) was identified for the reinforcement of sand specimens. Third, a maximum performance was achieved at a fiber dosage rate between 0.6 and 1.0% dry weight. Fourth, specimen performance was enhanced in both wet and dry of optimum conditions. Finally, the inclusion of up to 8% of silt does not affect the performance of the fiber reinforcement.

This invention relates to a process for producing high-strength yarns or split yarns by slitting an ultra-high molecular weight polyolefin film into tapes and longitudinally stretching the tapes at a high stretch ratio, and also relates to a high-strength, webs-crossed laminate and a process for producing thereof using a meshy web having a unidirectional high-strength as a longitudinal or transverse web in which adjacent yarns remains connected to each other by making slits in a web intermittently or in a shape of perforated line.

3. Methodology:



4. Results and Observations:

4.1 Los Angeles test:

To produce the abrasive action by use of standard steel balls which when mixed with the aggregate and rotated in a drum for specific number of revolution cause impact on aggregate. The %age wear due to rubbing with steel balls is determined and is known as abrasion value.

Sr No.	Description	Sample
1.	Weight of sample , (W_1) gm	5000
2.	Weight of sample retained on 1.70 IS sieve (W_2) gm	4365
3.	Percentage wear (W_2 /W_1) * 100	8.7 %

4.2 Impact test for Aggregate:

This test is done to determine the aggregate impact value of coarse aggregates as per IS: 2386 (Part IV) – 1963. The apparatus used for determining aggregate impact value of coarse aggregates is Impact testing machine.

Sr No.	Description	Sample 1	Sample 2
1.	Weight of sample , (W_1) gm	370 gm	343 gm
2.	Weight of aggregate passing through 2.36mm sieve, (W_2) gm	55 gm	50 gm

3.	Aggregate impact value in % I.V. = (W_2 /W_1) * 100	14.86 %	14.20 %
4.	Average Aggregate crushing Value in %	**14.53 %**	

4.3 Crushing value test for Aggregate:

The aggregate crushing value gives a relative measure of the resistance of an aggregate crushing under gradually applied compressive load. With aggregate crushing value 30 or higher' the result may be anomalous and in such cases the ten percent fines value should be determined instead.

Sr. No.	**Description**	**Sample 1**	**Sample 2**
1	Weight of sample , (W_1) gm	343	352
2	Weight of aggregate passing through 2.36mm sieve, (W_2) gm	57	50
3	Aggregate Crushing = (W_2 /W_1) * 100	16.62 %	14.20 %
4	Average Aggregate crushing Value in %	15.41 %	

4.4 Ductility test for bitumen:

This test is done to determine the ductility of distillation residue of cutback bitumen, blown type bitumen and other bituminous products as per IS: 1208 – 1978.

Type of Bitumen	**Conventional Bitumen**		**Bitumen With Nylon Fiber**	
Reading	**Sample 1**	**Sample 2**	**Sample 1**	**Sample 2**
Initial reading	00	00	00	00
Final reading	41 cm	43 cm	12 cm	16 cm
Ductility	41 cm	43 cm	12 cm	16 cm
Mean value of ductility	**42 cm**		**14 cm**	

4.5 Penetration test for Bitumen:

In this test we examine the consistency of a sample of bitumen by determining the distance in tenths of a millimetre that a standard needle vertically penetrates the bitumen specimen under known conditions of loading, time and temperature.

Type of Bitumen	**Conventional Bitumen**				**Bitumen With Nylon Fiber**			
Sr No.	**Initial reading**	**Final reading**	**Difference**	**Average**	**Initial reading**	**Final reading**	**Difference**	**Average**
1	00	87	-	**93.66**	00	102	---	**109**
2	00	92	5		00	110	8	
3	00	102	10		00	115	5	

5. Conclusion:

The compressive strength of Bituminous mix is one of the most important and useful properties for road construction. In most structural applications bitumen is employed primarily to resist compressive stresses. Therefore, the bituminous mix making properties of various ingredients of mix are usually measured in terms of the compressive strength. The results indicate that the bituminous mix properties were significantly influenced by using fibre. From the penetration test result of

conventional bitumen & Bitumen with Nylon Fiber result, it is clearly show that & Bitumen with Nylon Fiber has highest penetration value with 109 cm and from the ductility test result of conventional bitumen & Bitumen with Nylon Fiber result, it is clearly show that & Bitumen with Nylon Fiber has lowest penetration value with 14 cm, it is evident that for improving the properties of bitumen. In the present investigation, though the available results clearly imply the influence of nylon fibre on the properties of bitumen, it is deemed essential to extend the present studies using different types of aggregate and binders to conclude precisely that the relationships apply irrespective of the constituent types.

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VOC REMOVAL THROUGH BIO FILTRATION USING LAB SCALE MODEL

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ABSTRACT

VOC – Volatile Organic Compound are compound with high vapor pressure and low solubility in water. In industry they are generated in waste gas stream from process with involvement of solvents like toluene, methanol, Iso Propyl Alcohol, Ethyl Acetate etc. Discharging VOC gas into the atmospheric air without any treatment then they are highly dangerous to human health as well as to ecological systems. Many physical and chemical Conventional treatment such as condensation, Scrubber, Incineration, adsorption, absorption are used to treat VOC from waste gas stream.Bbiological treatment for treating VOC is also proved an economic and effective option in industry at large scale level. Objective of the study to controlling VOC emitted from polymers manufacturing industry with the application of Lab-scale up flow bio filtration system. Basic Design & operational parameters such as empty bed residence time (EBRT) of 60-70 s, Media using wood chip (80%) and compost (20%) , Addition of nutrient, Mass loading Rate and removal efficiency (RE) has been studied for effective working. Mainly influencing parameters are pH, Moisture Content, Temperature, Nutrient requirement, EBRT rreviewed. The experiment was performed for three chemicals which are involved on VOC generation in polymer business that are Toluene, Methanol and Epichlorohydrin (ECH).

KEYWORDS: Volatile Organic Compounds, Bio filtration, Elimination Capacity, Empty Bed Residence Time, removal efficiency

I. INTRODUCTION

VOC are now in fall into major pollutant as it is found also in to air through indoor and outdoor source of emission. Most are carcinogenic and lead to photo chemical reactions. Main Source of the Emissions are large scale chemical processes in industry like paints, polymers, intermediates, varnishes and thinners, petroleum products etc. From transportation and biological processes also emit VOCs into air. These VOC gas is harmful to human and environment in many ways. Control on its emission and treatment of waste gas up to standard norms becomes a very necessary for all.

The organic hydrocarbon compound which are easily vaporized recognized as VOC. Technically such compounds are defined as organic compounds which has vapor pressure of 1% at sea level. These compounds may include several aromatic hydrocarbons and considered into the common category due to their similar physical behavior in the atmosphere. Due to its lower boiling point and high vapor pressure they easily vaporized and mixed with the atmospheric air directly.

Toxic volatile organic compounds (VOCs), such as benzene, toluene, Methanol, ethyl benzene, xylenes, and other solvents are air pollutants posing a threat to human health. They are directly associated with emission sources like transportation activity and industrial emission.

Based on nature, There are main three types of treatment techniques – chemically, biologically and physical treatment. Where waste gas flow rate is high and heavy concentration of VOC involved – physio-chemical treatment is suitable. Biological techniques are important where low flow and concentration is low up to 70 – 100 ppm. Main benefit of is Biological method can be operate at normal range of temp. Up to 40 ºC and at atmospheric pressure. Biological processes are very less expensive and simple in operation wise as well as ecologically clean as compared to physio chemical techniques. In this work, we focused on controlling Toluene, Methanol and ECH which is being emitted from polymer manufacturing industry.

II. METHODOLOGY

Basic bio logical process of degradation is shown in Fig. 1. Here Packing media Wood chips and Compost was used in proportion of 80 % & 20 % was used for the experiment.

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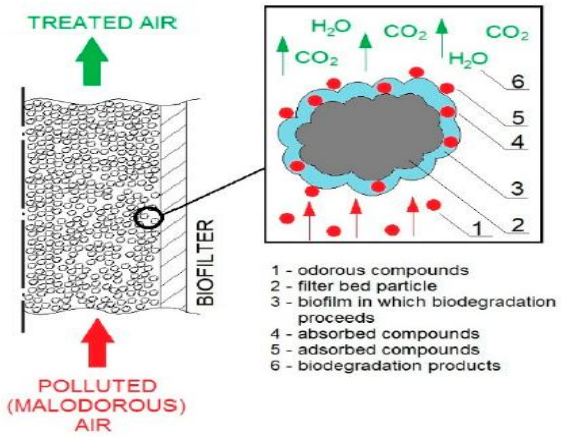

Figure:1 Basic Biological process

2.1 Packing Media Characteristics:

Compost:

Compost in fine shed form which has microorganisms in large diversity, moisture retention capacity is good, pH is 6.5 - 7.5and also contains organic form can be used in mixed proportion with wood chips. Many types of compost available in form of Sewage sludge, Cow dung manure, organic waste from sugar and rise mills, yard waste etc. In study compost from sewage plant is used for treatment.

Wood Chips/pellets:

Saw dust, wood ware or wood chips/pellets which are high in porosity and organic content can be used for mixing with compost. Commercially prepared wood chips or pellets of size 2-3 cm can be used.

Details of use packing media is given in Table : 1

Table 1. Details of used Compost and Wood Chips Medi

Property	Compost	Wood Chips
Moisture content , %	48	14
Porosity, %	72	--
C/N ratio	14.5	107
Microorganisms	Facultative bacteria	--

III. MODELING AND ANALYSIS

Experimental Model:

As shown in Figure 2 – Lab scale Bio filtration model was prepared for the experiment set up. In that model waste gas it means VOC gas will flow from bottom of the tower to top through the inserted packing media. Sample point is given at distance to measure the VOC value.

VOC was measured with the use of VOC gas analyzer of multi Rae Company. Media used in bio filtration is compost (20%) and Wood Chips (80%). Due to its capacity to water retention and organic content and porosity equal flow distribution throughout the bed with temperature around 40 ºC.

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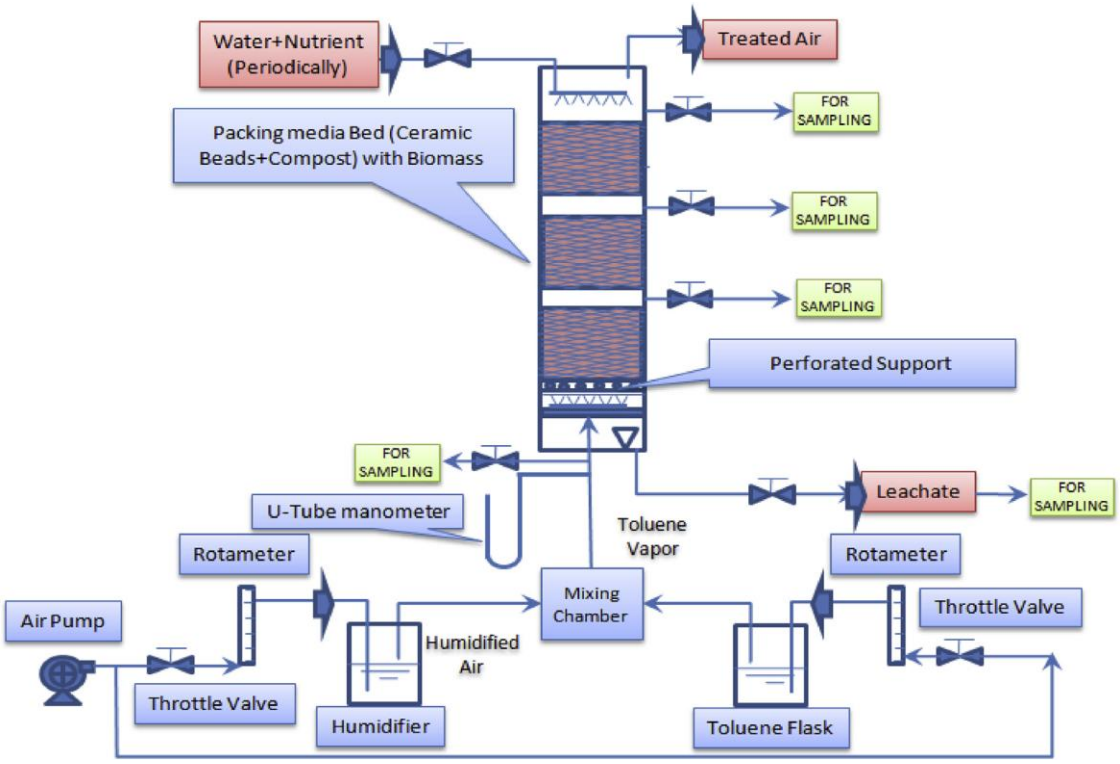

Figure: 2 Schematic diagram of experimental set

A SS Wire Mesh placed at the bottom accommodated the support for packing media for compost. Trial taken with packing media in proportion of 20 and 80 accordingly Compost and Wood Chips. Sampling port of 3 No. were placed with nob valve at equal intervals along the filter bed height of 15 cm. Liquid toluene was vaporized on Heating assembly followed by condenser effect to control temperature and humidified at constant air flow in a mixing chamber before entry to bio filter. Flow in Bio filtration tower was given in up flow mode in counter current direction. Experiment was tried on three types of VOC generating gas of polymer industry which are toluene, Methanol and ECH. Separate chemical was taken in heating assembly to generate VOC. It was mixed with then Air flow to adjust with the flow rate. Pressure drop monitoring gauge was installed I n inlet flow rate. To maintain moisture level in bio filter – water and nutrient spray from the top of the port was done regular interval and leach-ate generated from the tower will be collected at the bottom of the tower will be removed through bottom drain port.

Bio filter was operated in three operational phases and phase wise for removal of toluene, Methanol and ECH Separately. Bio filter was operated at the different flow and EBRT for the all three chemicals and moisture level maintained during experiment.

Detail specification of used bio filter is give in Table 2.

As VOC comes in contact with the bed material it gets degraded with the bacteria and stabilized into simple form.

Bacterial process in filter bed as under:

VOC gas + Media (Microorganisms) $\longrightarrow$ CO_2 (Gas) + H_2O + Bio mass

Table 2. Details of Equipment

Equipment specification	
Column Volume	8 Lit
Size of Bed	7.5 Lit
MOC of column	Poly Acrylic Glass
Sampling port distance, cm	15 (3 nos.)

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Support for media	40-mesh SS wire sieve
EBRT, s	70-90
Bed moisture content, %	50-70
Operating temperature, ºC	32 - 40
pH	6.8- 7.5

IV. RESULTS AND DISCUSSION

Performance of the Bio Filtration with Toluene - 30 %Compost and 70 % Wood Chips packing media used. Flow was maintained - 5 to 7 LPM.

EBRT - 75 Sec at Flow - 6 LPM

Table 3. Details of Toluene Trial

Run	Temperature	Inlet Conc ppm	Outlet Conc ppm	RE %	MC %	MLR g/m3hr	EC g/m3hr
1	40.3	85	65	23.53	54.9	68	16
2	38.2	90	70	22.22	56.4	72	16
3	36.1	97	50	48.45	56.8	77.6	37.6
4	37.5	86	45	47.67	57.5	68.8	32.8
5	38.4	89	41	53.93	58.6	71.2	38.4
6	37.5	88	34	61.36	58.3	70.4	43.2

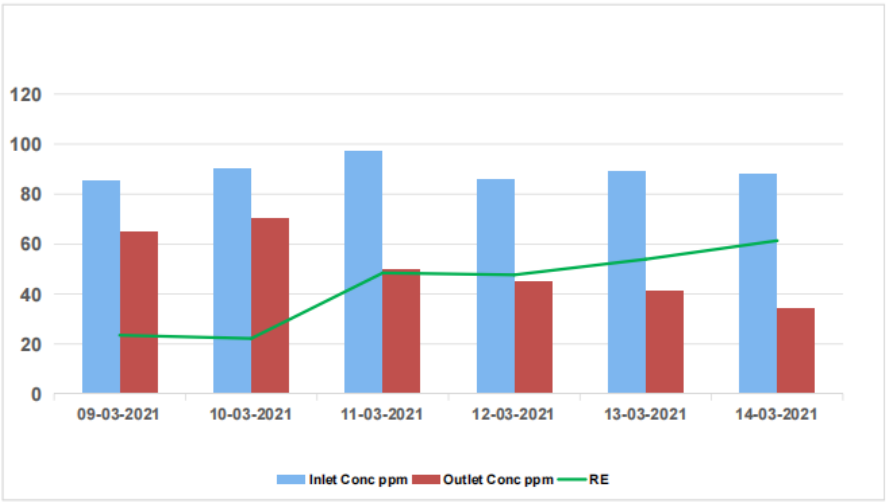

Figure:3 Variation of RE with Toluene Concentration

Performance of the Bio Filtration with ECH - 20 % Compost and 80 % Wood Chips packing media used. Flow was maintained - 5 to 7 LPM

EBRT - 81 Sec at Flow - 5.5LPM

Table 4. Details of ECH Trial

Run	Temperature	Inlet Conc ppm	Outlet Conc ppm	RE %	MLR g/m3hr	EC g/m3hr	MC %
1	40.3	95	58	38.95	70.37	27.41	51.2
2	41.2	98	51	47.96	72.59	34.81	58.6

3	39.6	92	42	54.35	68.15	37.04	57.1
4	36.8	89	34	61.80	65.93	40.74	54.2
5	39.5	95	28	70.53	70.37	49.63	52.6

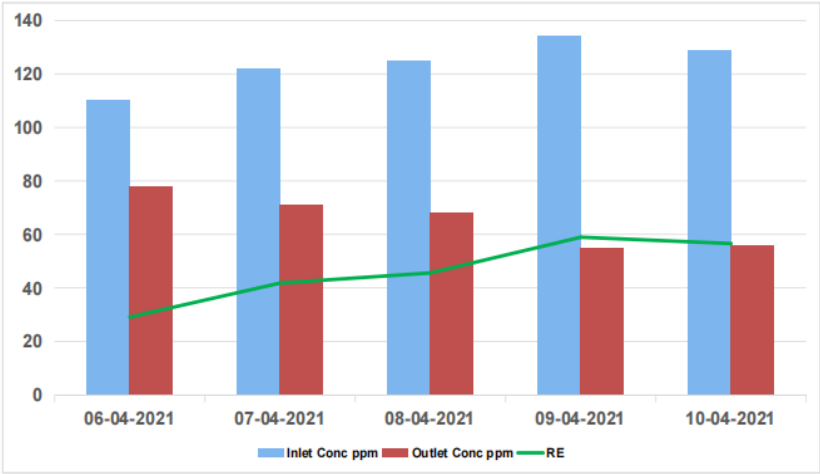

Figure:4 Variation of RE in ECH Concentration

Performance of the Bio Filtration with Methanol - 20 % Compost and 80 % Wood Chips packing media used. Flow was maintained - 5 to 7 LPM.

EBRT - 72 Sec at Flow - 6.2LPM

Table 5. Details of Methanol Trial

Run	Temperature	Inlet Conc ppm	Outlet Conc ppm	RE %	MLR g/m3hr	EC g/m3hr	MC %
1	41.5	110	78	29.09	90.41	26.30	48.5
2	40.5	122	71	41.80	100.27	41.92	53.21
3	39.5	125	68	45.60	102.74	46.85	51.2
4	38.5	134	55	58.96	110.14	64.93	53.5
5	39.5	129	51	60.47	106.03	64.11	58.5

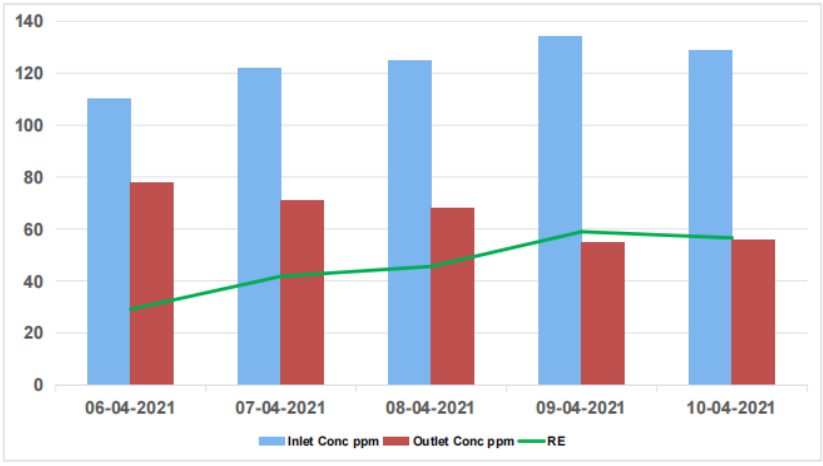

Figure:5 Variation of RE in Methanol Concentration

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Table 6. Summary of All Three Chemicals RE in %

Run	Toluene	ECH	Methanol
1	23.53	38.95	29.09
2	22.22	47.96	41.80
3	48.45	54.35	45.60
4	47.67	61.80	58.96
5	53.93	70.53	60.47

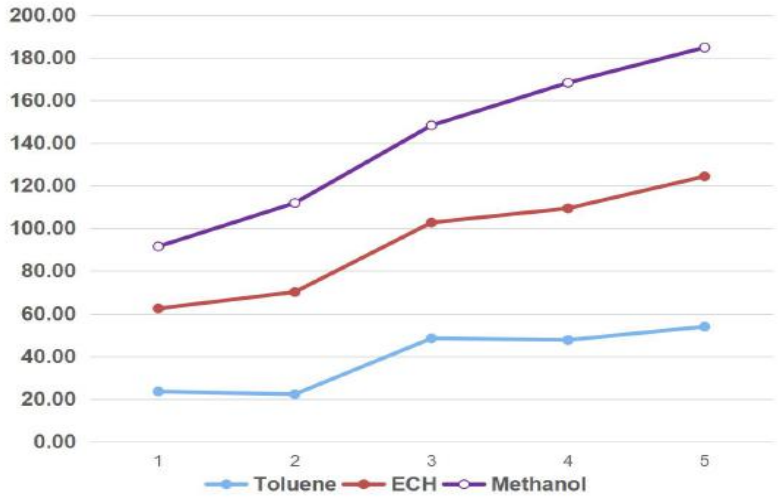

Figure:6 RE Variation in Toluene - ECH - Methanol

Experimental results are summarized in Table - 3-4-5 and represented in trend as shown in fig - 3-4-5.

Removal Efficiency of ECH chemical was high as compared to methanol and toluene. Though it would be high if we mix compound of VOC.

Experiment is performed with EBRT - 70 to 80 Sec. It is variable with the design parameter according to bed volume and design MLR - Mass loading Rate.

Performance of the Bio Filtration can be measured with basic calculation of Removal Efficiency, Elimination Capacity, EBRT and Mass Loading Rate.

These calculation was done as under:

Empty Bed Residence Time (EBRT):

EBRT is the time for that volume the gas retain in the filter bed during given fflow.

The actual gas residence time in the reactor can be calculated as the EBRT divide by the air-filled porosity available to gas flow, but such porosity is rarely known. EBRT is a simplified, relative measure of chemical residence time in a bio filter.

EBRT=(Vm/Q)/60

Where, Vm=biofilter packed bed volume (m3)

Q=Air flow Rate (m3/min)

EBRT=Empty Bed Residence Time(s).

Elimination Capacity (EC):

The elimination capacity is the amount of the pollutant or VOC removed by per volume of filter bed in unit time.

An overall elimination capacity is defined by Eq.

EC=Q (Ci-Ce)/V [g/m3/ h]

Where, Ci= Inlet concentration (ppm)

Ce= Outlet concentration (ppm)

Q=Airflow rate (m3/min)

V= Volume of bed (m3)

Removal Efficiency:

Removal efficiency is the percentage of removed pollutant fraction from the original inlet pollutant.

It is defined as

RE in % = (Ci-Ce)/Ci*100 %

Where, Where, Ci= Inlet concentration (ppm)

Ce= Outlet concentration (ppm)

Summary given Table 6 and In Figure. 6 Shows that RE of ECH was found high. Average RE for all three chemical was observed up to 60%.

However these data indicates that removal efficiency is not merely a function of loading rate, but also of residence time. For the same loading rate, reduced percentage removal occurred when the inlet concentration was lower and the residence time was decreased.

As bio degradation reaction is exothermic in nature will increase the temperature in filter bed. Temperature increase of 3 to 5 ˚C have been observed in many full scale bio filters. Further, Due to exothermic reaction media will get dry out in the center of the bed. Whereas the media near the reactor wall will remain with moisture content. Spraying of water from the top side of bio filtration tower maintain moisture content up to 50 - 60 % and temperature through the bio filtration tower.

V. CONCLUSION

Following conclusions can be drawn after Practical study and Literature Study:

Bio filtration is the more economical and easy to operate technology then physio-chemical process. As it also give effective result with the maintain of basic parameters like moisture, pH and temperature. In experiment Bio filtration was done for the three types of VOC gas - Toluene, ECH(Epichlorohydrin) and Methanol removal at polymer manufacturing industry by adopting media consisting of compost and wood pellets mixture.

In the Lab scale study, a flow rate maintained between 5 to 7 LPM and inlet concentration was maintained 100 – 130 ppm with EBRT 60 to 85 seconds has been investigated and a removal efficiency (RE) of 50 to 60 % for toluene, 50 to 70 % for ECH and 50 to 60 % for Methanol has been achieved with operating temperature ranging from 35 to 40 ˚C and Moisture content 50 to 60 % has been reported. Study also shows major operating problems such as increase in outlet air temperature by 3- 5 ˚C due to exothermic nature of bio degradation reaction as well as it also causes media dry-out problem. This requires continuous monitoring of outlet air temperature and relative humidity.

Study also reveal data that Inlet stream temperature to be controlled with pre condensing effect or Mixing with Air flow rate. In one run – Adding of pre assimilated Bio Culture in ECH gives better result as their oxidation capacity increased with active bio mass. Addition of nutrient can also impact the Bio Degradation process as like in Waste water treatment.

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Integral measures and framework for green lean six sigma implementation in manufacturing environment

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ABSTRACT

Modern organisations are in quest of initiatives that will facilitate them to be sustainable as well as provide a competitive advantage to remain a continuous stakeholder in the global market. Green Lean Six Sigma (GLSS) is an inclusive approach that not only improves environmental sustainability but also leads to improvement in the financial stability of the organisations. To implement the GLSS strategy, it is essential to integrate Green, Lean, and Six Sigma initiatives under the umbrella of GLSS. In this study, GLSS integration has been proposed based on intangible features like enablers, toolsets, etc. Management dedication, participation, and team effort have been recognised as the most remarkable enablers to implement GLSS in the manufacturing sector. Moreover, this study also proposes a five facet GLSS framework for the manufacturing sector to enhance organisational sustainability. The current work will facilitate managers and practitioners to execute a sustainable GLSS programme in manufacturing firms for increased operational excellence as well as environmental sustainability.

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KEYWORDS
Green lean six sigma; Lean Six Sigma; sustainability; framework; Lean; Six Sigma

1. Introduction

Since the last few decades, increasing levels of greenhouse gases have led to unprecedented changes pertains to increased earth surface temperature, changed rain patterns, extinction of rare species and vulnerable human health (Environmental Protection Authority Report, 2020). Climate change due to the increased concentration of greenhouse gases (GHGs) is affecting human health and society, including changes in Lyme disease, West Nile virus, heat- and cold-related deaths and hospitalisations (Kaswan and Rathi 2020). In 2019, the annual GHGs Index was 1.45, which represents a 45% increase in radioactive forcing (a net warming influence) since 1990 (National Centers for Environmental Information, Global Climate report, 2020). Persistent increment in the concentration of GHGs can be attributed to fossil fuel–based energy methods, changed lifestyle, traditional methods of operations, etc. Industrial organisations consume natural resources in an uncontrolled way and release a substantial proportion of pollutants into the atmosphere (Sagnak and Kazancoglu 2016). Moreover, these organisations are not adopting proper waste disposal measures, which further add to environmental degradation. It has been found that industry contributes nearly one-fifth of the total global GHGs (IPCC 2014). Furthermore, increasing concern about sustainability changed quality perception, and demand for sustainable products forced manufacturing industries to adopt sustainable business practices (Sony and Naik 2020). So, it is imperative for industries especially manufacturing to curb their current level of emission. For this, industries have to changes their traditional business practices to sustainable ones. The manufacturing organisations have the inherent capability to adopt environmental-friendly approaches like Green Lean Six Sigma (GLSS) in their operations (Yacob, Wong, and Khor 2019).

1.1 Why green lean six sigma?

Green technology, Lean and Six Sigma are complementary, each approach has the potential to minimise the disadvantages of the others (Sony and Naik 2020). Lean is valued due to its ability to quantify waste, but it is not able to quantify environmental impacts and possible environmental hot spots (Sreedharan et al. 2018). So, at this juncture, green technology fills this gap and estimate the environmental impacts of generated waste. Green technology is employed in operations management to recommend approaches that are conscious of the environmental effects of production and operations (Deif 2011). The key objective of the green manufacturing concept is to reduce resource usage and pollution or to enhance the environmental performance of the organisation (Kaswan and Rathi 2021). Integrated Green Lean (GL) although able to recognise wastes and quantify ecological impacts but not often provide an actual method to reduce the wastes, and defects associated with the process (Garza-Reyes 2015). Six Sigma is a data-driven approach that fills this gap and provides

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a concrete stepwise methodology to reduce waste (Sreedharan et al. 2020). Although Six Sigma reduces wastes through the reduction of defects, it cannot recognise different wastes and environmental impacts (Hussain et al. 2019). Since the last few decades, various strategies have been evolved (Garza-Reyes et al. 2018; Bhat, Gijo, and Jnanesh 2016) to manufacture high specification products, but an individual strategy is not capable to communicate all the points collectively associated with sustainability (Pandey, Garg, and Luthra 2018). So, it is imperative to integrate three unique methodologies under the umbrella of Green Lean Six Sigma (GLSS).

The Integrated GLSS approach aids organisations considerably to cut their energy use (Kaswan and Rathi 2019). Inclusive implementation of GLSS must be gradual, meaning that industries must estimate their strengths and weaknesses, determine priorities, and choose targets for successful implementation (Gholami et al. 2021). Three different dimensions of sustainability such as environmental, economic, and social are vital factors to be considered by any organisation (Ershadi, Taghizadeh, and Molana 2021). GLSS supplements organisations pursuits towards sustainability through, reduce of wastes, environmental footprints and defects. As GLSS is a novel prospect of sustainability, so it is imperative to comprehend different features that foster its integration, so that an inclusive understanding of this approach can be developed. GLSS is a project-based approach, and it has been found that nearly 40% of the projects have failed due to a lack of understanding of GLSS features and implementation framework (Gandhi, Thanki, and Thakkar 2021). In the literature, the study pertains to a framework of GLSS in construction, Jute industry exists (Banawi and Bilec 2014). But no study exists in the literature that provides a dedicated framework of GLSS with a toolset for manufacturing industries. This study provides integral measures and framework of GLSS pertains to the manufacturing industry. The integration among has been established through theoretical constructs and the framework has been supplemented with different toolsets at each stage of realisation of the GLSS project.

1.2 Research questions

Based on the above discussion, this study has proposed the following research questions:

RQ1. What are measures that foster integration among Green, Lean, and Six Sigma?

RQ2. How a dedicated framework of GLSS pertains to manufacturing is realised in a stepwise manner?

RQ3. What will be the implications of a proposed framework for managers and practitioners?

The rest of the article is organised as follows. Section 2 discusses the background for the research and provides a summary of the most significant studies reviewed so far. Section 3 deals with the adopted method for integration and framework of GLSS. Section 4 reports results and discussion and section 5 presents implications driven from the present work. The final section of the paper enumerates the conclusion and future research agenda.

2. Literature review

The literature review comprises three sub-sections. The first sub-section outlines the literature search methodology. The second one present's literature related to GLSS and the final sub-section depicts identified grey areas of research.

2.1 Article selection scheme and study flow

To select pertinent research articles, authors have used the systematic literature review (SLR) technique. It is a technique that validates a rigorous and translucent, process to literature review (Kaswan and Rathi 2021). It comprises a sequence of phases to ensure that significant precision and lucidity can be assured in the process of literature review (Tranfield, Denyer, and Smart 2003). Figure 1 depicts a systematic literature search methodology. SLR comprises of the following five successive phases: (1) Scope formulation, (2) Locating studies, (3) Study selection and Evaluation, (4) Analysis and Synthesis and (5) Reporting and using of results. SLR phases are as follows:

In the first phase, the scope of the study is decided; here, the study has been conducted with the viewpoint of identification of integral measures and exploration of frameworks. The pertinent research articles were searched using prominent databases in a subsequent phase of SLR. Authors have included research articles from the span of 1990 to 2020. In the study selection and evaluation phase, Context-Intervention-Mechanism-Outcome (CIMO) (Rousseau 2012) was employed to decide the inclusion/exclusion aspects of research strings. So, (lean eco-efficiency), (environmental lean), (lean green six sigma) and (lean eco-sustainability) are used as search strings. This methodical research and selection strategy is essential to procure inclusiveness of the literature review. A point of obstruction was reached when the same manuscript occurs continuously. To avoid this problem, search strings criteria were incorporated in 'Manual Check' concept for all the manuscripts depending on the abstracts of the article. This resulted in eradicating those articles that surely did not convey the concept of GLSS. Other search strings like sustainable lean and sustainability lean were also be evaluated. Search results comprised peer-reviewed manuscripts, published in proceedings of international conferences and academic journals.

In the analysis and synthesis phase, many techniques that comprise thematic synthesis, meta-ethnography, ground theory, etc. are used (Garza-Reyes, 2015). Out of these methods, thematic synthesis is regarded as the most suitable technique for the synthesis of the outcomes from SLR. Thematic synthesis includes the methodical coding of data and causing of expressive and systematic themes (Reddy et al. 2021). Reporting phase of SLR reveals that GLSS has acquired significant interest and acceptance within the community of research since 2012 as 84% (52 articles) of the publications liberated in the span from 1990 to 2020 have been made. This indicates that the GLSS concept is a comparatively new and emerging research area. The trend of GLSS publications may be predicted to continue expanding in the upcoming years.

Based on the SLR, authors selected articles and further investigated the same to find out pertinent gaps in the literature. To answer first research question, which pertains to

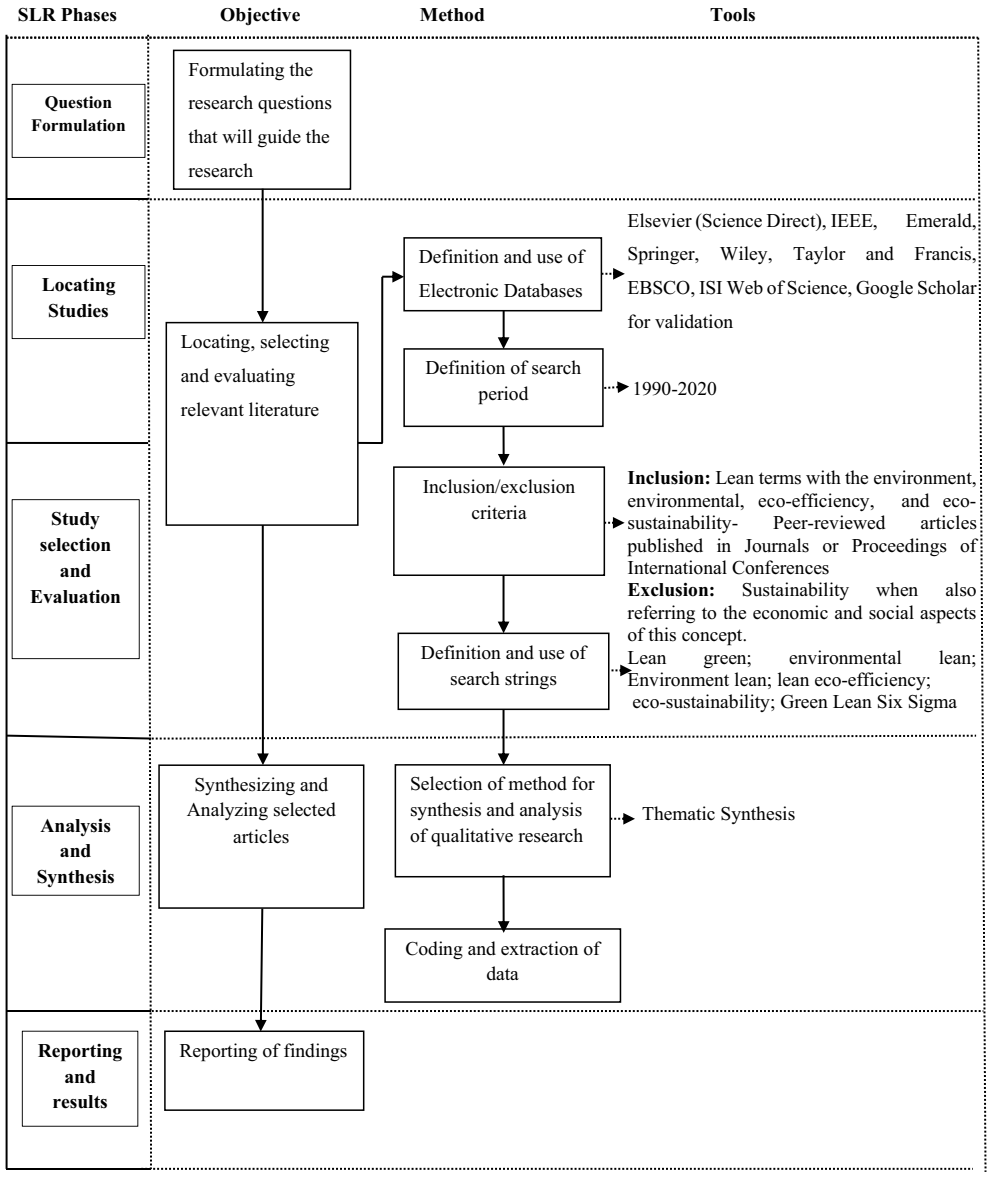

Figure 1. Systematic literature review methodology (adapted from Garza-Reyes, 2015).

integral measures of GLSS, authors identified enablers from literature and formulated theoretical elements (enablers, barriers, tools, etc.)-based model to facilitate the integration of Green technology, Lean and Six Sigma under the head of GLSS. To answer the second research question, authors formulated a five-facet GLSS implementation framework coupled with GLSS tools based on the insight gained from the previous studies. Finally, based on the proposed framework and integral model, theoretical implications and practical implications for potential research and practitioners have been driven.

2.2 Literature pertains to GLSS

Sustainable concerns have progressively acquired significance in the communities and economic discussions over the previous centuries (Chugani et al. 2017). Moreover, in recent years, there is an increasing pressure to enhance the quality, effectiveness and efficiency of products and services (Siegel et al. 2019). Manufacturing sectors contribute nearly one-fifth of carbon emission and it can be mainly attributed to conventional energy methods (Kaswan and Rathi 2021). The Paris agreement acknowledges key requirements to increase collective methods to change the climate effect through the incorporation of sustainable manufacturing operations. So, to remain competitive at the global platform, industrial organisations have to incorporate sustainable operations in their business practices. Green technology is generally employed in operations management to adopt approaches that are conscious of the environmental effects of production and operations (Deif 2011). It is used to enhance environmental performance but it is not able to identify waste and defects associated with process or system (Sony and Naik 2020). Therefore, the answer to this question comes from Lean Six Sigma (LSS), which make the organisation competitive through the reduction of wastes and defects. LSS are two distinct process enhancement approaches (Lean and Six Sigma) that focus on yielding end product profits (Antony 2012; Sreedharan et al., 2018). Lean philosophy makes the

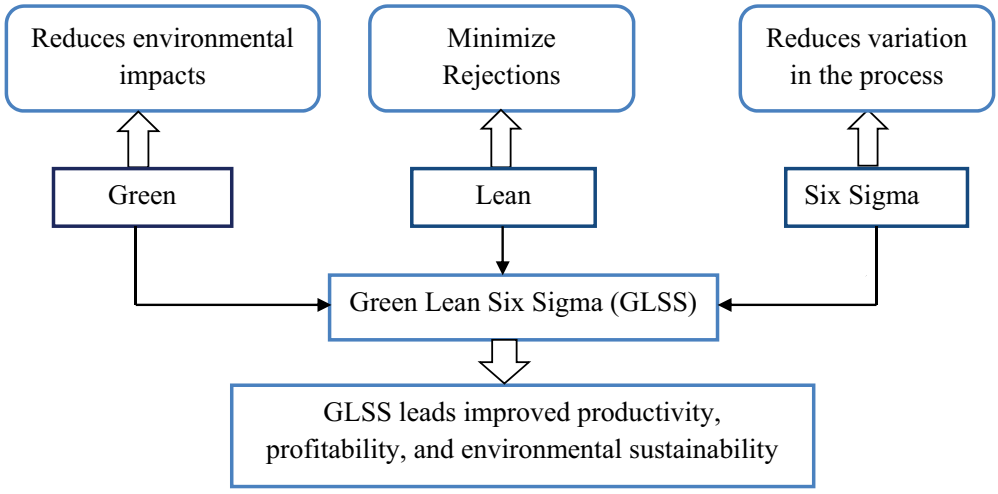

Figure 2. Integrated model of GLSS.

process streamlined and reduces different non-value-added activities (Persis et al. 2020). Six Sigma concept initiates value through compatible process output by recognising and minimising variations in the processes. Effective implementation of LSS approach will facilitate manufacturing sectors to minimise the variation in the process and manufacturing lead time (Albliwi et al. 2014). But LSS strategy is not able to estimate the ecological impacts of the process undertaken. The answer to this question is given by the incorporation of Green technology measures like life cycle assessment. So, it can be deduced from the above discussion that an individual approach is not able to address the modern challenges faced by industries related to sustainability aspects. So answer to this question comes through the integration of Green technology, Lean and Six Sigma under the umbrella of Green Lean Six Sigma. GLSS is a sustainable development approach that mitigates environmental impacts, wastes and defects from the process under consideration (Ershadi, Taghizadeh, and Molana 2021). Figure 2 depicts a simplified model of GLSS.

So, it is imperative to integrate Green technology with LSS pursuits to ensure the sustainability of manufacturing industries. In the literature, no study that prompts integration of Green technology, Lean manufacturing and Six Sigma based on theoretical measures has been reported for the manufacturing sector. Furthermore, as GLSS is a novel prospect of manufacturing, and it has been found that nearly 40% of projects pertain to GLSS have been failed due to a lack of GLSS know-how and framework (Kaswan and Rathi 2020). Although the study pertains to a framework of GLSS in construction, industries have been found in the academic literature (Banawi and Bilec 2014; Zamri et al. 2013). But there is no evidence of a systematic framework of GLSS framework pertains to manufacturing enterprises. Table 1 depicts major research pertains to GLSS that forms the basis for the identification of potential gaps in the research.

2.3 Research gaps

The literature advocates that LSS execution leads to constructive outcomes on the ecological and financial performance of the organisations (Ben Ruben, Vinodh, and Asokan 2017). However, the inclusion and implementation of Green technology with LSS are not deprived of challenges. Lack of finance for clean technologies, poor organisation support system, and unavailability of integral measures along with tools, further hinder effective execution of sustainability-oriented projects. In the literature, few studies exist regarding the framework of GLSS, but they are limited to the construction, jute and mining industries (Zamri et al. 2013; Hussain et al. 2019). There is no evidence of the GLSS framework that can exclusively be applied to the manufacturing industry along with the required toolset at each phase of execution. Moreover, there is no dedicated framework that guides industrial managers and practitioners to execute GLSS along with knowledge of different green metrics and associated toolsets. Furthermore, the study pertains to the integration of Lean with Green technology and Lean with Six Sigma exists but literature lack enough evidence related to the integration of Green technology, Lean and Six Sigma based on commonalities features. So, inclination towards sustainability practices, lack of dedicated execution method, and lack of knowledge base on green technologies measures, provides motivation and avenue for this research work.

3. Methods

In this research work to integrate Green technology, Lean and Six Sigma under the umbrella of Green Lean Six Sigma (GLSS) authors have used theoretical constructs found in the academic literature. For this, author's used enablers or success factors, tools, frameworks modern challenges to the manufacturing as commonalities features to foster integration. To make

Table 1. Major research work pertains to GLSS.

Sr. No.	Author	Year	Description
1	Zamari et al.	2013	Presented a model to analyse the correlation between GLSS and managerial innovation for automobile sectors. The major limitation associated with this study was that the GLSS framework and integration are not presented.
2	Banwai and Bilec	2014	Proposed a framework that integrates GLSS for enhancing the quality and environmental effects in the construction sector. The limitation of this framework was that it did not include manufacturing industries and takes more time for the implementation process.
3	Garza-Reyes	2015	The proposed integration of the green concept with Six Sigma initiative. The drawback was that it has a scarcity of application computation tools in distinct phases.
4	Cherrafi et al.	2016	Carried out the comprehensive review on LSS and sustainability perceptions and explored the prospect of combining GLSS into one approach for dispensing functional excellence. The main drawback of this review was that it is not valid for the manufacturing domain.
5	Sagnak and Kozancoglu	2016	Recommended Six Sigma integration to prevail over the drawbacks of green lean strategy. The proposed framework included measurement system analysis and gauge control-based methodology to assess variation of the process. The limitation of this framework was that it did not propose for GLSS implementation.
6	Cheraffi et al.	2017	Proposed a framework that efficiently assists the industries during the five-stage and sixteen-step process to successfully combine and execute GLSS to enhance environmental sustainability. The drawback of the framework was that empathetic operations may be complicated to execute the GLSS methodology.
7	Sreedharan and Raju	2018	Proposed a GLSS model in the public sector to explore the systematic aspects and hurdles in this sector. This framework lacks the comprehension and evaluation of many green lean wastes.
8	Pandey et al.	2019	Proposed GLSS approach to identify and rank performance improvement enablers in a business organisation. The drawback of this study was that enablers identified only for a specific sector and did not propose a framework.
9	Kaswan and Rathi	2019	Identified GLSS implementation enablers utilising Interpretive Structural Modelling. This model was evolved depends on the judgement of industrial personnel. This model is not certified with the help of other techniques.
10	Hussian et al.	2019	GLSS performance improvement barriers were recognised in the Pakistan construction industry. Modelling and outline were not presented.
11	Kaswan and Rathi	2020	Proposed execution model and framework of GLSS applicable to all industries. But, the application model for the realisation of GLSS in manufacturing at different stages of DMAIC methodology has not been reported.

manufacturing industries more sustainable, authors have proposed a five-step framework of GLSS and embedded different tools of Lean manufacturing, Green technology and Six Sigma. Subsequent sub-sections depict integration measures of GLSS and developed framework that will boost sustainability pursuits of manufacturing organisations.

3.1 Integration perspective of green lean six sigma

GLSS has emerged as a compatible strategy to ensure sustainable development due to its capability to improve productivity and reduces ecological effects (Sony and Naik 2020). Green Lean Six Sigma are three different strategies, but these are collaborative as, these mutually emphasise on mitigation of wastes and optimum resource utilisation (Kumar, Kumar, and Haleem 2015). Therefore, the general ideology and toolsets of these individual strategies can be combined under the umbrella of GLSS. Integration of GLSS can be perceived as the latest prospect to manufacturing sectors for enhancement in sustainable performance. It has been observed that industries that have incorporated GLSS have attained greater performance than those executed independent strategies (Kaswan and Rathi 2020). In the previous studies, there is no evidence of an ordered and congenital practice for the integration of GLSS. For this, the current study presents a conceptual integration model of GLSS based on factual aspects (Enablers, toolset, etc.). Figure 3 illustrates the integration model of GLSS. In this model at the input side are different challenge pertains to the modern manufacturing industries. Operational excellence techniques (Lean, Six Sigma, Lean Six Sigma) have been devised over time horizons to undertake these challenges to ensure organisational competitiveness. As new challenges pertain to social, environmental, uncertain information, and volatile demand comes to fore, organisation have to embed different strategies to realise the advantage of each approach (Ershadi et al. 2020). So, associated challenges with industries foster the integration of different approaches under a single aspect. Furthermore, enablers are the measures that make an organisation ready for the execution of a novel approach and ensure its success. The enablers perform as crucial input which encourages the combination of GLSS, whereas the performances in trade-off supply as output.

It has been found that most of the enablers of the individual approach of Lean, Six Sigma, and Green technology are similar (Cherrafi et al. 2017). In the previous studies, pertains to GLSS, top management support, organisation readiness and effective training have been identified as the most prominent enablers to execute GLSS (Kaswan and Rathi 2020). The same enablers that have been reported in the studies pertain to the individual approach (Aboelmaged, 2011). Therefore, enablers foster the integration of individual Green, Lean, and Six Sigma approaches under the canopy of GLSS. Different tools of Green technology, Lean, and Six Sigma are used concurrently (depicted in framework) and supplement organisational sustainability. For instance, green technology tool, life cycle assessment (LCA), is used to identify potential hot spots, where high emission occurs due to faulty process metrics. LCA provides a solution that leads to saving in a material by altering process parameters and using eco-friendly measures. This will lead to the saving of material and result in the reduction of waste of overprocessing and overproduction that is related to Lean manufacturing. Therefore, the tools of each approach supplement the function aspect from other individual approaches. GLSS tools/techniques will facilitate the organisations to address the challenges on the shop floor and managerial levels. Table 2 depicts production challenges and GLSS tools/techniques associated to overcome the same. This model exhibits the

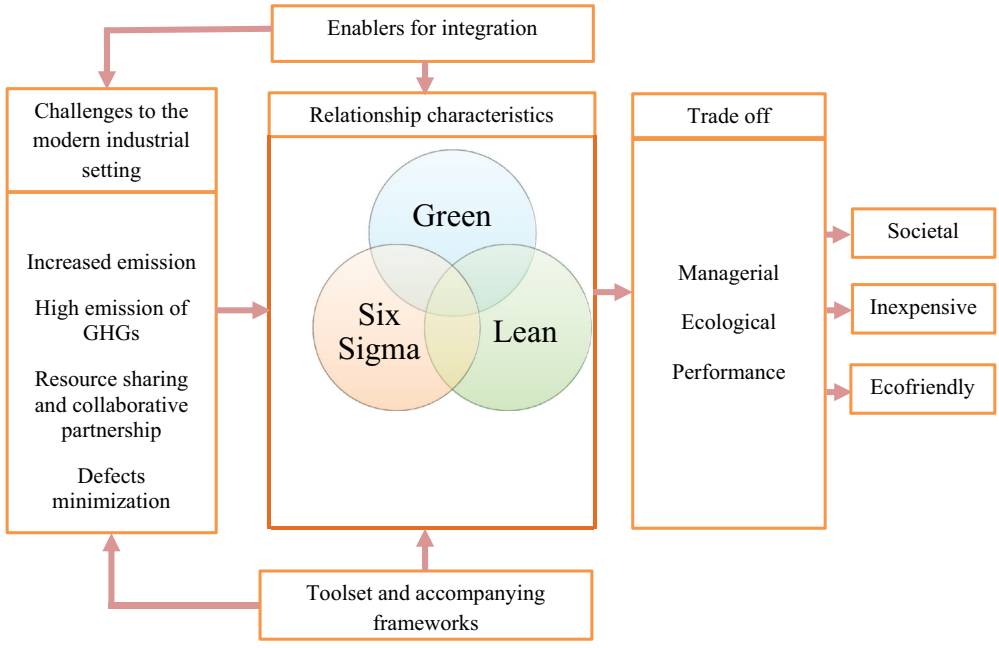

Figure 3. Integration of green lean and six sigma.

Table 2. Production challenges and GLSS tools.

Production Challenge/Problem	GLSS tool/Technique that can help
Batch Tracing	Kanban
Inventory and Equipment	VSM, Poka-yoke, SIPOC
High Emission of GHGs	LCA, VSM
Over Production	Kanban, Capacity Analysis
Defects Minimisation	Poka-yoke, LCA
Training to industrial Personnel	Kaizen, Standardisation
Imperfect by-product	Autonomation
Resource sharing and collaborative partnership	Standardisation
Perspective Plan	Policy Deployment, Hypothesis testing
Quality Control	Automation, Poka-yoke, JIT
Levelled exploitation	Heijunka
Automated Purchase	Kaizen
Materials controlling	5S
Estimating and understanding the relationship between variables	Regression Analysis

theoretical relationship linking these three synergetic strategies. The tools and related GLSS framework work as the assisting mechanism to support GLSS implementation and integration.

3.2. Proposed green lean six sigma framework

The manufacturing sector has employed Lean and Six Sigma strategies in their processes to minimise wastes and process variations. But, due to increasing concerns about sustainability and rigorous policies of the government, organisations have to shift operations dynamics towards eco-friendly methods. So, there is a great need for the inclusion of Green concepts in the LSS that leads to the development of an advanced strategy: GLSS. But to implement this comprehensive GLSS strategy, there is a requirement for a generic framework that dispenses step-by-step directions to attain sustainability. The proposed framework in this study includes a GLSS strategy into DMAIC methodology to attain both functional and environmental benefits (Figure 4). The objective of each step is to monitor and reduce harmful impacts on the environment. The proposed framework of GLSS is executed through the following steps:

Step 1: Selection of suitable sustainability-centred project

The purpose of this step is to choose a suitable project that depends on emission level, the voice of business and customers. GLSS is a project-based strategy and implemented in a step-by-step manner by encompassing every compartment or unit separately (Sony and Naik 2020). The project is categorised as a specific part that is chosen for the commencement of this approach. The GLSS implementation requires significant expenditure and systemic modification in the firm. Therefore, it is essential to choose a suitable project of GLSS that reveals the substantial scope for improvement in sustainability.

For this, an inclusive study of different departments of the industry is carried out. The explicit study of whole industry dispenses wastes, imperfections and related ecological emission levels prevails to distinct sections of manufacturing sectors. The models are prepared for rejection level, imperfections and distinct emissions after many segments. The prioritisation of independent models is accomplished in the succeeding stage to choose a project that reveals substantial capability for enhancement in environmental performance. Also, a high-level SIPOC (Supplier Input Process Output Customer) is to be elevated to dispense transparency on customers, suppliers and input materials required. Tools like Eco QFD and critical to quality (CTQ) are used here to transform sustainably directed customer demand in technical and ecological aspects. Based on the customer demands, simultaneously with business and ecological aspects, a proper project is selected. After recognition of an appropriate project, a charter is developed depending on the scope, program and team of the recognised project. It dispenses a description of roles and responsibilities, objectives of the project, outlines major stakeholders incorporated, and defines a complete control plan of the project.

Table 3. Toolset for GLSS realisation in a manufacturing environment.

GLSS tools	Step 1	Step 2	Step 3	Step 4	Step 5
	Selection of suitable sustainability centred project	Estimation for mapping of the current state of the project	Find out the prominent reason for emission and inefficiencies	Select and implement the best solution	Sustain with an adopted solution and make it mistake-proof
EVSM		√			
LCA		√		√	
Project charter	√				
VOC	√				
VOB	√				
Pareto chart			√		
Cause and Effect diagram			√		
BWM				√	
GRA	√			√	
Pugh matrix				√	
5 whys			√		
7′S				√	
3′R				√	
SOP					√
Solution matrix				√	
DOE				√	
OCAP					√
Brainstorming			√	√	
Performance improvement tool					√

Step 2: Estimation for mapping of the current state of the project

The purpose of this phase is to estimate the present state of the system or project undertaken. Now the performance of the adopted project has been estimated on various indices of GLSS. Based on collected data, sigma level, standard deviation" and C_{pk} of the project are evaluated with help of statistical tools. Further, assessment of carbon dioxide consumption, green energy coefficient, material consumption, etc. tools like life cycle assessment (LCA) environmental value stream mapping (EVSM) are used. To estimate the present stage of wastes, EVSM is treated as a beneficial tool of the lean concept. It dispenses an estimation of 'cycle' time and material consumption covering distinct phases and furnishes effective utilisation of time and funds. EVSM also estimates water, power and material consumption and environmental effects in conjunction with conventional value stream specifications like cycle time, changeover time, uptime, and lead time for all projects. Elaborating an Environmental Current State Map assists in predicting authentic manufacturing circumstances and dispenses awareness about resource consumption from point of view of the environment. Moreover, mapping is also employed in this step to gather details concerning the project to point out crucial input and output variables. Furthermore, LCA has been employed in the assessment process to estimate the ecological effects of every sub-process in distinct ecological influence classes. The integrated LCA and EVSM aid in the analysis of several green and lean measures that dispenses identification of possible hot spots for further improvements.

Step 3: Find out the prominent reason for emission and inefficiencies

The purpose of this step is to identify the major causes associated with wastes, emissions and imperfections in the adopted project. In this phase, firstly, value-added, and non-value-added actions have been recognised from the opinions of both customer and business. After this, the process cycle efficiency is directed to equate outstanding standards to detect how much enhancement is required. At the same time, a project is investigated to recognise the bottlenecks points and restraints in an adopted project. After investigation of the project under concern, the causes for emissions, defects and variations are identified. Here tools, like brainstorming, cause and effect diagram (C&E), five why analysis, life cycle impact assessment, failure mode effect analysis (FMEA), etc. are used. The project team here may use brainstorming sessions to recognise possible reasons for the development of these defects. Life cycle impact assessment has been carried out in this stage to measure the possible ecological effects of every process to identify possible sources for high emission levels. Once the potential causes have been investigated, then the study is constricted to find few pre-eminent causes. Tools like Pareto chart, principal component analysis (PCA), hypothesis, brainstorming and regression analysis are also been employed to unearth crucial root causes. Thus, these steps lead to the identification of main reasons for inefficiencies that require to addressed to improve sustainability measures of the project undertaken.

Step 4: Select and implement the best solution

After identifying major reasons for rejections and inefficiencies, then inherent solutions are suggested, explored and the best solution is implemented to handle pre-eminent causes. Here, assured cause and effect relationships are employed to detect a broad range of possible solutions. The solutions dispensed at the present juncture can be refused derived fuel (RDF), upcycling, anaerobic digestion (AD), and recirculation of water. In this phase, high innovation is required from the personnel of the organisation. Relevant training to the

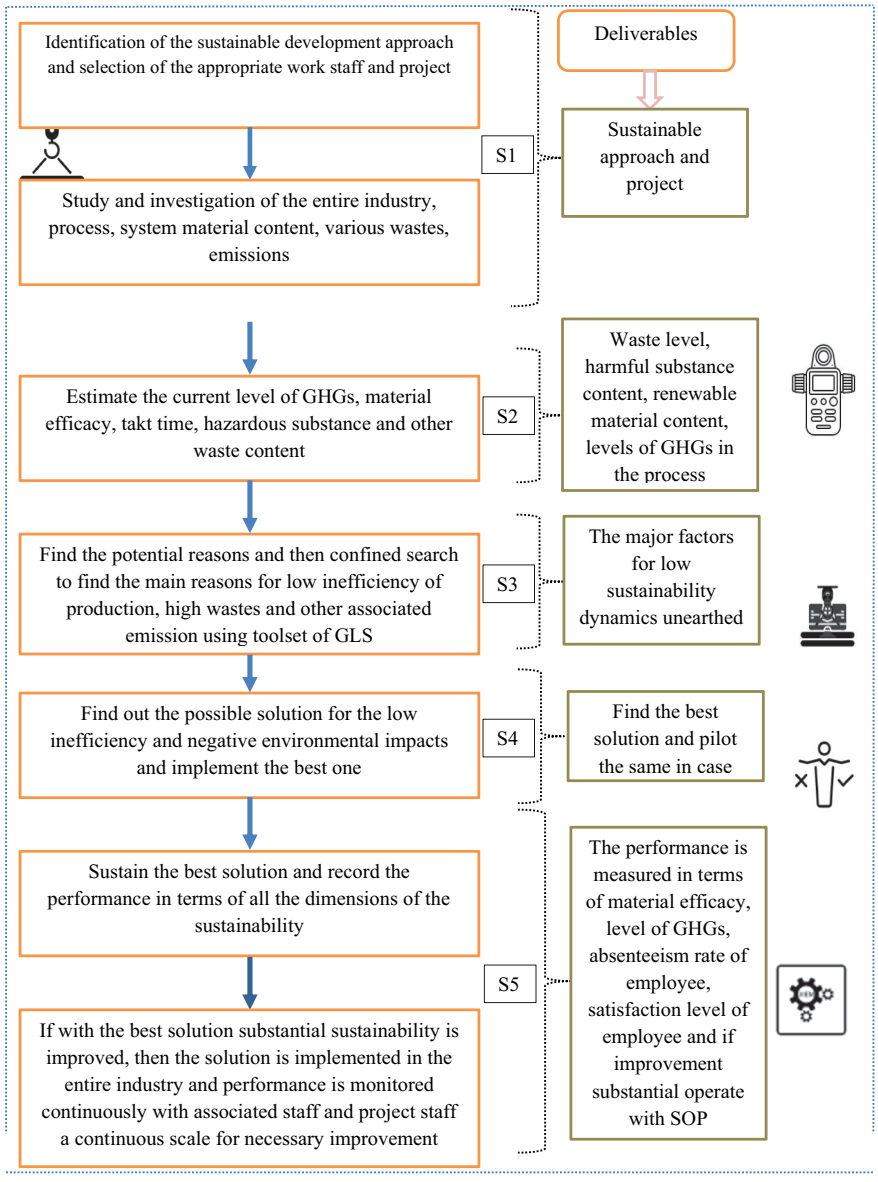

Figure 4. Green lean six sigma framework pertain to manufacturing.

industrial personnel and employees engaged in accomplishing the enhancement activities must be furnished to corroborate the effective execution of the GLSS framework. The feasible solutions are elaborated, standards are established, and elucidations are assessed to find out the best solution. Every origin of particulars like the customer, project sponsors, stakeholders and employed are utilised to propel assessment measures. CTQs, the business concerned, regulatory norms, are the crucial criteria that are used at this stage. Tools like solution matrix, Pugh matrix, Kaizen, and design of experiments (DOE), LCA, etc. are being employed to assess the best possible solutions against criteria.

DOE is carried out in this phase to identify the incredible settings for a merger of factors. Kaizen activities were suggested to improve those activities that do not outline any value based on rejection assortment. These were devised such that both functional and ecological requirements are fulfilled and all-inclusive efficiency gets improved. The Pugh matrix decides robustness and deficiencies of possible solutions so that robustness can be sustained and weakness can be removed. Here, the professionals should be open to adopt or integrate solutions for the determination of the pre-eminent solutions. After choosing the best potential solution, the existing VSM is rephrased to exhibit what practice will seem after changes are devised. The chosen best solution is implemented in the concerned project as a pilot project.

Step 5: Sustain with an adopted solution and make it mistake-proof

The purpose of this step is to sustain or control the best solution if significant enhancement is noticed in the project. This phase confirms that the benefits attained after executing enhancement measures are preserved after the accomplishment of the project. The outcomes acquired after executing enhancements measures must be conveyed to every employee who was engaged in the project. Moreover, a flowchart is prepared to distinctly express the responsibility and jobs of

each person to sustain the improvements. Performance actions must be outlined to assess the performance of the project after enhancements. The outlined typical initiatives which enhance functional and ecological efficiencies are certified with the help of an appropriate control plan. Appropriate training is planned for persons included in the practice to handle modifications made and assist the best solution. Tools like standard operating procedures (SOP), visual management, and Poke Yoke are used to sustain project success. Here, the process is re-explored with the help of EVSM and LCA' to detect the level of rejection and emission metrics. Moreover, control chart, data metrics and control charts are also used to re-evaluate sigma level, $C_{pk'}$, water, power and raw material consumption. If re-evaluated performance specifications are better than in the measuring phase, then adopted solution is retained. Once the success of the pilot solution is sustained, the same can be implemented throughout the industry for improvement in the sustainability of the industry to a greater extent. Therefore, inclusive execution of GLSS provides impetus to sustainability improvement pursuits of the manufacturing industry and enhances competitive advantage at the global platform through the production of sustainable products.

4. Results and discussion

Green Lean strategy has been broadly employed in manufacturing sectors; corresponding, limited work has been done pertains to the execution of GLSS (Hussain et al. 2019; Kumar et al. 2016). It is in its development stage, and manufacturing sectors are resistant to validate this strategy because of cultural differences and repulsion of practical shifts in the work process (Kumar et al. 2016). Once the integration of GLSS has been validated, one can simply communicate the distinct performances of the latest technologies. Enablers are the readiness bases for the manufacturing sectors to execute a novel approach (Laureani and Antony 2012). The industrial managers have taken into the consideration the changeover methods that assist in the effective execution of the new approach (Näslund, 2013). Table 4 represents the enablers for the adoption of GLSS. It is observed that management dedication and participation, team effort and organisational willingness are the key enablers for the effective execution of this strategy. The management dedication, knowledge base of GLSS tools, and assimilation of real-time dataset leads to the sublime success of the GLSS program. The authors have proposed theoretical integration of GLSS that motivates executives to embrace GLSS philosophy in their respective organisations. The study also reveals that the accomplishment of the project in distinct organisations will lead to an improved sigma level of organisation through the reduction in defects. The proposed framework will boost the organisation Green Lean initiative, consequently leads to improved environmental performance in business operations. Moreover, successful execution of the said framework will result in the reduction of material consumption, water usage, and energy utilisation that will enhance environmental efficiency. Besides, parameters that pertain to Lean like, cycle time, lead time, and work in process will significantly reduce through the adoption of the proposed GLSS framework.

The GLSS toolsets also boost the integration and execution of the GLSS strategy. GLSS tools explore hot spots, eliminate rejections, and assists in the best exploitation of resources (Kaswan and Rathi 2021a). Table 3 depcits GLSS toolser for manufacturing industry. The SIPOC chart and EVSM have been found as the most broadly employed tools. Moreover, the most generally employed tools found to be: cause and effect diagram (C&E), process capability and reverse logistics. After the assessment of 18 research manuscripts relates to GLSS, it is observed that most of the research manuscripts used 'lean tools' to obtain lean and green goals. So, manufacturing sectors are inclined towards Lean tools to satisfy environmental measures. The importance of GLSS is enhancing continuously due to its pragmatic impacts on sustainability dynamics. The current work dispenses an integration of GLSS employed on conceptual points and proposed a comprehensive DMAIC-based framework. The developed framework performs as a pilot frame for GLSS execution in a single unit or division of the manufacturing industry. This framework can be expanded in the entire firm after its effective implementation of a pilot project. The proposed framework exhibits the integration of Green and Lean matrices at each step that has been excluded in the prior studies related to Green Lean. Green and Lean actions perform as potential areas for the selection of the project in the first step of the framework of GLSS. To estimate the present situation of the system, in the second step of GLSS execution tools such that EVSM, LCA are employed. The inherent measures for rejections are detected in the third step of 'framework with the help of tools such as LCA and traditional statistical tools. To find probable solutions in the subsequent step of framework' tools like life 'cycle interpretation, EVSM, 5S, Kaizen, etc. are employed. The adopted GLSS framework is sustained for a 'longer span if gains made are significant than the preceding situation of 'project 'under consideration. The proposed framework of GLSS will ensure organisation sustainability through optimum resource utilisation, reduction of wastes, defects, and mitigation of environmental emissions.

5. Implications

The present research work exhibits both theoretical and practical implications. The subsequent subsection depicts the theoretical and practical implications of this research work.

5.1 Theoretical implications

There is a need to scale up the worldwide response to mitigate GHGs emissions through the incorporation of sustainable business practices. GLSS approach mitigates environmental footprint by systematically identifying and mitigating possible hot spots that improves the performance of triple bottom line (social, economic, and environmental). This study develops a thorough knowledge for potential researchers and academia by providing deep insights into integral measures and frameworks. Measures of integration (enablers, barriers, tools, etc) foster the success rate of the GLSS project as they serve as basic know-how before the execution of any sustainability

Table 4. Enablers for adoption GLSS.

Sr. No.	Enablers	Description	References
1	Management dedication and commitment	The participation, support, and vision of the management perform a crucial role in executing the GLSS approach in manufacturing sectors. Management dedication performs a crucial role in the firm's environmental retaliation adequate human, technological and economic resources for executing this strategy.	Bhuiyan and Baghel 2005; Yadav and Desai 2016
2	Allocation of Funds	Funds allocation commences with suitable planning which the manufacturing sectors ready for its objectives and visions for the future. Once the objectives are prepared, the manufacturing sectors require allocating sufficient funds.	Snee 2010
3	Quality of raw material	Quality of raw material is the basis to ensure topmost quality products. A topmost quality product assists the satisfaction of the customers. It will result in improved functional performances, profitability, and the production of high specification products.	
4	Team effort	To attain the objectives of GLSS, every employee of the firm must perform as a group.	Sreedharan et al. 2018; Ben Ruben, Vinodh, and Asokan 2017
5	Prudent interconnection with the retailers	Faithful retailers are necessary with the purpose that raw materials and other components have been provided for some time.	Siegel et al. 2019
6	Proficient training and education programmes	Proficient training and education programs are the most vital needs for executing the GLSS strategy in manufacturing sectors successfully. A rigorously planned training program induced the essential knowledge, skills, and approaches in its employees that are essential for accomplishing the task.	Ravi and Shankar 2005
7	Relating GLSS to business approach	Relating the GLSS concept to business approaches assist the firms to attain prudent business objectives through the utilisation of policy decisions by the management care.	Antony, Gijo, and Childe 2012
8	Culture with effectual correspondence	Change in the culture is crucial for the progress of the manufacturing sectors. The workers associating with any firm should have the liberty of sharing their views to arise with inventive solutions to provide benefits to the organisations.	Hu et al. 2008; Zu, Robbins, and Fredendall 2010
9	Effective Scheduling	Waiting time is a vital problem in manufacturing operations. An effective scheduling system assists in minimising time guiding to curb cost surges, time-preserving, and better performance of the manufacturing sectors.	Maleyeff, Arnheiter, and Venkateswaran (2012)
10	Organizational know-how	Each worker of an organisation must be self-assured with the whole system such that the individual can lay down his or her perceptive attempts for the progress of the organisation.	Kaswan and Rathi 2021
11	Organizational willingness	The business must be in a situation to initiate GLSS in their processes as it needs again transition.	Cherrafi et al. 2017
12	Selection of appropriate tools	Tool selection and technical expertise is key to the execution of the GLSS program	Sony and Naik 2020; Sreedharan et al., 2020
13	Collection of data and performance measures	Collection of data and performance measures is essential for the achievement of the GLSS initiative as 'they dispense support for comparisons.	Habidin and Yusof 2012; Yadav, Seth, and Desai 2018
14	Incorporation beyond the phases of a 'product development 'cycle'	Concurrent engineering conception and incorporation at several phases of product development is necessary to instigate genuine products.	Luthra et al. 2011; Kaswan and Rathi 2020
15	Involvement of suppliers	The involvement of suppliers with the manufacturer is vital for the execution of the GLSS concept. Suppliers are the origin of renovation in the firm. Better involvement of suppliers results in the best quality products.	Kushwaha 2010; Luthra et al. 2011
16	Use of appropriate technology	Advanced technology facilitates organisations to improve the quality of products and enhances the overall environmental performance. It helps the organisation to improve communication, proper utilisation of resources, and minimising paperwork which would result in significant functional performances.	Ravi and Shankar 2005
17	Effective visual system	Visual control helps the organisations to identify those areas where improvements are required to be undertaken.	Shen and Tam 2002
18	Manufacturing facilities with good quality	An accurate, precise, and good quality manufacturing facility assists in the production of high quality and cost-effective products.	Antony, Gijo, and Childe 2012
19	Customer engagement	The customer engagement approach assists the organisations to consummate the business with minimum overheads on human resources. It also minimises the need for middlemen.	Albliwi et al. 2014
20	Green design actions	Green design implies eco-design which targets mitigating the environmental effects yielded by-product at several phases of product chain commencing from taking out of materials to the utilisation of the product.	Vinodh et al., 2011; Yadav et al. 2017

improvement project. Enablers are the promptness measures that make an organisation ready to execute a novel approach. Barriers knowledge base enables researchers to find out the avenues that mitigate the intensity of barriers. Systematic phase-wise toolset provided in this study augment researchers and academicians to adjudge which tool to be implemented at different stages of execution of the GLSS project. The proposed GLSS framework will methodologically facilitate researchers to implement GLSS in manufacturing industries. This will enrich insights on assessment of different metrics, reasons for inefficiencies, identification and implementation of sustainable solutions during the execution of projects related to GLSS and sustainability.

5.2 Practical implications

The proposed framework of GLSS will methodologically facilitate manufacturing industries to implement sustainability improvement initiatives. The developed framework is designed in such a way that each phase contributes to the reduction of wastes and emissions, leads to enhancement in

revenue, making this initiative a worthwhile proposition in the long run. Moreover, this work also furnishes guidelines to industrial personnel for managing the GLSS approach conductive, to secure more flexible, vigorous and methodical processes. The implementation of the GLSS strategy facilitates industrial organisations to achieve organisational and environmental benefits. Further, this study encourages industrial managers and practitioners to recognise possible hot spots that require immediate attention to increase organisational sustainability. This study facilitates the entrepreneurs and ecologists to start sustainable industrial practices like GLSS that leads to reduced ecological damage by promoting: reduce, reuse, recycle, recover and residual management (5'R). Altogether, humanity will be promoted from this study in terms of mitigated emissions and other non-value-added activities through the sequential execution of a sustainable GLSS approach.

6. Conclusions

GLSS has been perceived as a comprehensive strategy that mitigates harmful environmental impacts and provides top-quality environmentally sound products. The purpose of this approach is to enhance metrics like quality, profitability, customer satisfaction, process efficiency and responsiveness. In this research work, GLSS integration has been proposed centred on intangible features like enablers, toolsets, etc. The enablers encourage the integration of the GLSS strategy and related tools and execution techniques to augment GLSS integration. Management commitment and team efforts have been recognised as the most remarkable enablers to execute GLSS strategy in manufacturing industries. The components and the elements of this framework have been presented in such a way that it would fetch high specification eco-friendly products more conveniently when applied in the manufacturing organisations. The proposed GLSS framework dispenses a prospect for the manufacturing enterprises to set up the best practices for defect minimisation and mitigation of environmental impacts.

6.1 Limitations and future scope

Despite several contributions, the present study has a few limitations. Firstly, the proposed GLSS implementation framework takes considerable time during implementation as different tools evolved at different stages of execution. Therefore, the generalisation of outcomes should be taken into consideration just after further studies in distinct manufacturing units. Secondly, limitations associated with this research work is that framework of GLSS has not been tested practically. This drawback imparts motivation for future research directions to implement GLSS in various manufacturing industries. The developed framework must be tested in multi-cultural environments to prospect the contingent and societal impacts on the developed framework. In offing, the proposed framework can be extended by incorporating more sustainability drivers and other associated tools of social sustainability. Further study can also expand GLSS applicability for sustainability improvement by integrating aspects of industry 4.0 and circular economy.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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Mental Workload Detection fromWESAD dataset Using Machine and Deep Learning Model : A Review

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Abstract- Mental stress is one of the major contributors to a variety of health issues. Various measures have been created by scientists and medics to determine the intensity of mental stress in its early phases. To assess mental stress in the workplace, several neuroimaging methods have been developed. One key candidate is the electroencephalogram (EEG) signal, which offers a wealth of information regarding mental states and conditions. We analyse trustworthy heart rate variability (HRV) metrics in order to detect stress in this study.We refer WESAD dataset, an experiment protocol was established including two different sensors which correspond to a range of everyday life conditions.We present our work on the development of a stress detection system based on heart rate by calculating and comparing HRV features from time and frequency domain analysis and classifying these features with the machine learning and deep learning algorithms.

Keywords-Mental Stress,Heart Rate Variability, Machine Learning, Deep learmoing, LSTM, WESAD

I. INTRODUCTION

In the current scenario, mental stress has become a social problem. It affects the daily routine work and economy ofan individual and a nation as well. Stressfulin the working style of human age from twenty-five to forty has the effectiveness of stress in their life. Stress has become the common part of daily life which most people struggle in different stages of life. Mental stress has grown to be a social difficulty and could turn out to be a cause of practical incapacity during hobbies work. Mental stress or pressure has been recognized as one of the major contributing variables that prompt different illnesses. The term pressure is characterized into two sections, for example, positive or negative.

Positive pressure consistently searches for a chance, development like improvement in execution, while negative pressure developes more serious conditions. Mental stress is one of the contributing factors to health problems. It is defined as the human body's response to mental, physical, and emotional stimuli, as controlled by the sympathetic nervous system (SNS) and the hypothalamus–pituitary–adrenocortical axis (HPA axis) [1].

This expression can be applied to both internal (personality structure) and external (problem solving) issues, resulting in a variety of physiological and negative emotional alterations [2]. Acute stress, episodic stress, and chronic stress are the three types of stress identified in the literature [3]. Acute stress is caused by a brief period of exposure and is not damaging. When a stimulus is more frequent for a short period of time, it is called episodic stress [4]. Chronic stress, on the other hand, is the most harmful, as it is caused by long-term stressors [5]. Mental stress has been linked to a variety of disorders, including stroke, cardiovascular disease, cognitive issues, speech abnormalities, and depression, according to various studies [6,7].

1.Wareable Sensor Description

WESAD provides data from two kinds of sensors: chest-worn (RespiBAN) and wrist-worn devices (Empatica E4). For the data collection, we used both a chest- and a wrist-worn devices: a RespiBAN Professional and an Empatica E4, respectively. The RespiBAN itself is equipped with sensors to measure ACC and RESP, and can function as a hub for up to four additional modalities. Using the four analog ports, ECG, EDA, EMG, and TEMP were recorded. All signals were sampled at 700 Hz. The RespiBan was placed around the subject's chest (see Figure 1). The RESP is recorded via a respiration inductive plethysmograph sensor.

The ECG data was recorded via a standard three point ECG. In order to allow the subject to move as freely as possible, the EDA signal was recorded on the rectus abdominis (the abdomen has a high density of sweat glands [8], hence suitable for EDA measurement) and the TEMP sensor was placed on the sternum. The EMG data was recorded on the upper trapezius muscle on both sides of the spine. In order to avoid wireless packet loss, the recorded data was stored locally and transferred to a computer for further processing after the experiment. All subjects wore the Empatica E4 on their non-dominant

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hand. The E4 records BVP (64 Hz), EDA (4 Hz), TEMP (4 Hz), and ACC (32 Hz) are specidfied in Table 1. [9]

Table 1: Empatica E4 data modalities

Data	Sampling	Description
ACC	32Hz	Accelerometer data consists of 3 axis channels
BVP	64Hz	Data from a photoplethysmograph (PPG).
EDA	4Hz	Consists of a tonic (referred to as skin conductance level (SCL)) and a phasic (skin conductance response (SCR)) component.
TEMP	4Hz	Temperature in ˚C

Figure 1 Respi BAN.

2. Application of Stress Detection System

Stress is related to every aspect of human life but is applicable more for people with disabilities. Here are some examples, a stressful situation for a blind person can be as simple as requiring a decision while walking as to whether to change direction, when to cross a street, and how to avoid a sudden obstacle.Firefighters and smoke divers are constantly exposed to stressful situations as they engaged in rescue activities involving fire and poisonous smoke. Any stress in such situations may occur mainly due to lack of knowledge about the affected place, fast-changing conditions, time restrictions, exhaustion, disturbing sights, elevated level of heat, or smoke. This exposure to high-risk environments while performing their jobs, leads to various mental and health problems due to constant physical and psychological stress. A person who has attempted to carry out an attack previously. Such attacks can be avoided by measuring the levels of physiological stress of the suspected person using stress detection systems.

3. Section Organization

These remaining sections of the paper are organized as follows. In the next section, the relation between stress and diseases is presented. Related terminologies are shown in section 3. The proposed methodology for stress management is given in section 4. The obtained result analysis is shown in section 5. Finally, conclude this research article in section 6.

II.STRESS VS DISEASES

Stress will vary vastly from person to person and differs in line with our social and economic circumstances, the surroundings we tend to sleep in, and our genetic makeup.There area unit several things which will result in stress. The death of a beloved, divorce/separation, losing employment, and sudden cash issues area unit among the highest 10 causes of stress in line with one recent survey.But not all life events area unit negative and even positive life changes, like moving to an even bigger house, gaining employment promotion, or occurring vacation are sources of stress. The most significant health problems related to stress are:

1. Depression and anxiety
2. Pain of any kind- Headaches, Stomachache etc.
3. Sleep problems
4. Autoimmune diseases
5. Diabetes
6. Digestive problems, Gastrointestinal problems
6. Skin conditions, such as eczema
7. Heart disease
8. Asthma
9. Weight problems
10. Reproductive issues
11. Thinking and memory problems
12. Alzheimer's
13. Accelerated Aging
14. Premature Death etc.

Hence it is pertinent to be aware of the common warning signs and symptoms of stress overload. Table 2 lists the signs and symptoms of stress overload. Overload of stress can lead to major depression in susceptible people and health problems as mentioned above.

Table 2 Stress Symptoms and Signs

Symptoms	Signs
Cognitive symptoms	Inability to concentrate,Constant worrying,Seeing only the negative, Poor judgment, Memory problems, Anxious or racing thoughts,
Emotional symptoms	Loneliness and isolation, Anxiety and agitation, Moodiness, irritability, or anger, Depression or general unhappiness, Feeling overwhelmed, Other mental or emotional health problems
Physical symptoms	Diarrhea or constipation, Aches and pains, Nausea, Frequent colds or flu, dizziness, Chest pain, rapid heart rate, Loss of sex drive

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Behavioral symptoms	Withdrawing from others, Eating more or less, Sleeping too much or too little, Using alcohol, cigarettes, or drugs to relax, Procrastinating or neglecting responsibilities, Nervous habits (e.g. nail biting), pacing.

III.RELATED WORK

An algorithmic rule for stress level recognition from the graphical record is planned. To validate the algorithmic rule, an associate degree experiment is intended and disbursed, increasingly, people are collecting detailed personal activity data from commercial trackers. Such data should be able to give important awareness about their activity levels. Millions of people track their physical activity and this data is usefull for analysis of stress detection for daily life of human [10]. [11] provides an effective method for the detection of cognitive stress levels using data provided from a physical activity tracker device developed by FITBIT. The major goal of this system was to use sensor technology to identify stress using a machine learning method.

The effect of each stressor was tested separately using logistic regression, and then a combination model was developed and analysed using ordinal logistic regression models such as logit, probit, and complementary log-log. The novelty of this work lies in the fact that a stress detection system should be as non-invasive as possible for the user.In [12] author proposed a system using Internet of Things architecture where we adopted an activity tracker as our sensing device to reduce cumbersome for daily use.Among the total of 17 features extracted from activity tracker, five features belong tosleep data and six features belong to heart rate data that were proposed to develop the stress recognition model.

In the evaluation of our system, we achieved the accuracy as high as 81.70\% on the cross validation and 78.95\% when tested on the test set. In [13] the authors objective is to investigated the mediating role of work and family activity conflicts (WFC) and family and work activity conflict (FWC) on the effects of workload and life style of the family.Using AMOS 20 through bootstrap analysis for indirect effect, this study assessed the above mentioned relationships based on data collected from 258 respondents in the hospitality industry in Quebec. By highlighting the cross-domain effects, the present research contributes to the existing knowledge by testing the mediating role of WFC and FWC in the effects of workload and various resources of social support on job stress social support in job stress.

IV. METHODOLOGY

In the proposed methodology is divided into different levels like dataset description, analysis of various Machine Learning algorithms and Figure 2 illustrates a flow chart of proposed methodology.

1. Dataset Description

WESAD is a publicly accessible dataset for detecting wearable stress and affect. This multimodal dataset contains physiological and motion data collected from 17 people during a lab research using both a wrist- and a chest-worn device. Blood volume pulse, electrocardiogram, electrodermal activity, electromyogram, respiration, body temperature, and three-axis acceleration are among the sensor modalities provided. Furthermore, by covering three separate affective states (neutral, stress, amusement), the dataset bridges the gap between past lab investigations on stress and emotions. In addition, the dataset contains the individuals' self-reports, which were acquired using a variety of standard questionnaires. Details can be found in the readme file for the dataset, as well as in [29]

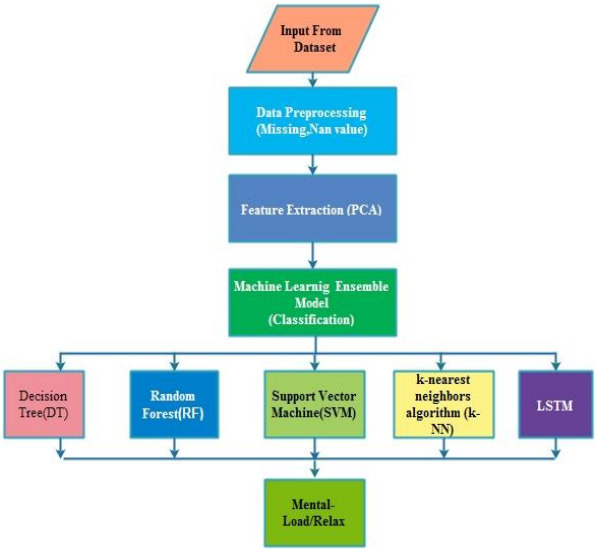

Figure 2 Proposed Flow Chart

Table 3 Dataset Description

Dataset Description	
Data set Characteristics	Multivariate, Time Series
Number of Instances	63000000
Attribute Characteristics	Real
Number of Attributes	12
Missing Values?	In 2 subject, exempted
Number of Subjects	17

2. Machine Learning Algorithm

The Machine Learning (ML) has prompted a new concepts and technologies, including supervised, unsupervised and reinforcement learning, new algorithms for robots, the Internet of Things, analytics tools and many more. The Figure 2 shows the machine learning algorithms based on

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the learning; supervised and unsupervised and problems; classification, regression and clutering. The paper specifies classification problem for stress detection using WESAD dataset. SVM offers high accuracy compared to other classifiers such as logistic regression, and decision trees. It is known for its kernel (linear , polynomial, radial basis function) trick to handle nonlinear input spaces. It is used in a variety of applications such as face detection, intrusion detection, classification of emails, news articles and web pages, classification of genes, and handwriting recognition [14]. SVM is considered to be a machine learning approach, which can be employed in both types of classification and regression problems. It can easily handle multiple, continuous and categorical variables.

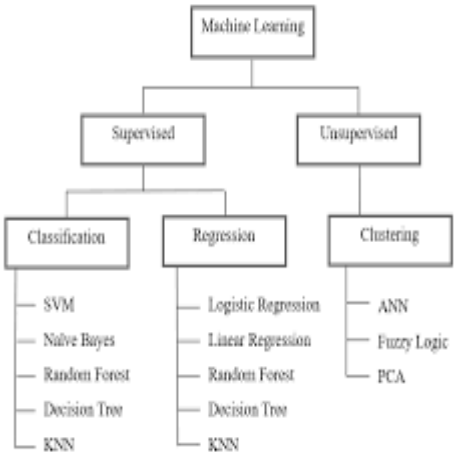

Figure 3 Machine Learning Algorithms

Decision trees are individual learners that are combined. They are one of the most popular learning methods commonly used for data exploration [15]. One type of decision tree is called CART, classification and regression tree.

Random forests is a supervised classification learning algorithm. It is also the flexible and easy to use algorithm. Random forest (or random forests) is an ensemble classifier that consists of many decision trees and outputs the class that is the mode of the class's output by individual decision trees [16]. K Nearest Neighbor(KNN) is a very simple, easy to understand, versatile and one of the topmost machine learning algorithms. KNN is used in a variety of applications such as healthcare, image recognition, finance, political science, handwriting detection and video recognition [17]. KNN is a non-parametric and lazy learning algorithm. Non-parametric means there is no assumption for underlying data distribution. That is, the model structure is determined from the dataset.Lazy algorithm means it does not need any training data points for model generation.

V.CONCLUSION

Machine Learning has been broadened an excessive number of zones of diseases through the outstanding headway of Machine Learning. Heaps of data mining and Machine studying techniques have been applied tothe WESAD dataset for push and loosen up state forecast. In this paper,WESAD dataset was used.The information was recorded from 17subjects, excepted 2 subjects data due to loss of record. Our next step will be to build ML models, we will apply four celebrated AI calculations specifically, Random Forest, K Nearest Neighbor, Support vector machine, and Extra tree classification. Accuracy, precision, recall and F1 socre will be the compairing parameters based on confusion matrix. Our ultimate objective in this study would be to develop a high-accuracy model based on real-time data by overcoming unresolved challenges to alleviate the stress of the users.

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LSTM Based Mental Stress Level Detection using Wearable Sensor Devices

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Abstract- Nowadays, mental stress is a severe problem, particularly among teenagers. The age group that was previously thought to be the most carefree is now under much strain. Nowadays, increased stress causes many new issues, including depression, suicide, heart attack, and stroke. Many physical health issues related to stress can be avoided if mental stress is detected beforehand. When a person is stressed, there are noticeable changes in several bio-signals such as thermal, electrical, impedance, acoustic, optical, and others, and stress levels may be determined using these bio-signals. The paper proposes various machine learning and deep learning algorithms for stress detection on persons using wearable sensing devices, which can help people avoid various stress-related health problems. The data are taken from the WESAD dataset. The paper uses classification algorithms, SVM, DT, kNN and deep learning models; Long Short-Term Memory (LSTM) is applied, and confusion metrics parameters are used to measure performance in terms of accuracy, precision, recall, f1-score.

Keywords- Mental Stress, WESAD, Machine Learning, Deep Learning, LSTM

Introduction

Mental stress is one of the significant contributors to various health issues. Scientists and medics have created various measures to determine the intensity of mental stress in its early phases. Many neuroimaging methods for assessing mental stress in the workplace have been presented in the literature. One key candidate is the electroencephalogram (EEG) signal, which offers a wealth of mental states and circumstances. It is described as the human body's response to mental, physical, and emotional stimuli, as governed by the sympathetic nervous system (SNS) and the hypothalamus-pituitary–adrenocortical axis (HPA axis) [1]. This expression may be applied to both internal (personality structure) and external (problem-solving) issues, resulting in a variety of physiological and negative emotional alterations [2]. The three forms of stress are identified in the literature [3]. Acute stress is caused by a brief exposure period and is not damaging. When a stimulus is more frequent for a short period, it is called episodic stress [4].

On the other hand, chronic stress is the most harmful, caused by long-term stressors [5]. According to various studies, mental stress has been linked to various disorders, including stroke, cardiovascular disease, cognitive issues, speech abnormalities, and depression [6, 7]. Furthermore, stress indirectly affects the human body at several levels, including skin diseases, food habits, insufficient sleep, and decision-making [8–10]. As a result, researchers have devised several ways to assess stress levels early on to avert harmful health and performance repercussions. Subjective measures have traditionally been used to assess stress. Self-report questionnaires [12], such as the perceived stress scale [13, 14], are the most often used technique. The questionnaire score and self-report rating or interview have been established as ground truth in many research to evaluate mental stress levels.

On the other hand, questionnaires are subjective and need the user's undivided attention. As a result, people are often unaware of their actual stress levels. In the technological era, several physiological measurements have been discovered as stress indicators, including heart rate variability (HRV), electro-dermal activity (EDA), electroencephalogram (EEG) [11], electromyogram (EMG), blood pressure, pupil diameter, salivary cortisol, and salivary alpha-amylase [2]. It is necessary that the stress level detected by any indicators be accurate so that the proper measures to overcome the effect on the human lifestyle.

Related Work

This section describes literature related to the study about stress detection by various authors on employing various machine learning models. Ciabattoni et al. [15] proposed a real-time mental stress detection during cognitive tasks performed by an individual. The dataset contains features such as body temperature, GSR, RR intervals, gathered using a smartwatch, applied kNN classification approach and acquired accuracy of 89.8%. Yekta et al. [16] acquired data from Smartphones and wearable sensors, conducted a study on the daily life routine of the subjects and detected stress. The authors studied SVM and kNN machine learning models and PCA feature selection algorithm. Anderson et al. [17] collected data in EEG, ECG, GSR, PPG, EOG questionnaires, collecting data from physiological signals collected across three stimulus types – music, videos, and games. The authors applied kNN and SVM classification techniques and categorized Stimulus Classification and Arousal Classification with 80.6% and 88.9% accuracy, respectively. Sun et al. [18]

gathered data from 20 subjects across various basic activities such as sitting, standing, walking using various sensors. The authors collected data in the form of ECG, GSR, applied decision tree, SVM, naive Bayes classification algorithm and obtained an accuracy of 92.4%. Castaldo et al. [19] proposed a method to explore the extent to which HRV excerpts can be shortened without losing their ability to automatically detect mental stress employing the SVM classification data-driven approach and obtained an accuracy of 88%. Schmidt et al. [22] aimed to improve human-computer interaction (HCI) by detecting a person's affective state based on observables. The authors introduced a new publicly available dataset, WESAD, for wearable stress and affected detection. A multimodal dataset features physiological and motion data, recorded from both a wrist- and a chest-worn device, of 15 subjects during a lab study. Bajpai et al. [20] evaluated the performance of the WESAD dataset by employing the kNN model. The authors' evaluation is based on changing the K-fold cross-validation parameter and the total number of nearest neighbours while classifying data. Hence, the tradeoff between optimum performance and computational cost is achieved by limiting the number of neighbours and controlling the model's complexity. Lai et al. [21] proposed a prototype of intelligent Stress Monitoring Assistant (SMA) for first responders and professionals coping with exposure to extreme physical and psychological stressors such as firefighters, emergency medical technicians and many more; it is the next generation stress detector. SMA is designed using a residual-temporal convolution network to learn data from sensors and detect stress features. In both modes, stress recognition and stress detection, the SMA achieves 86% and 98% accuracy for the WESAD dataset.

Algorithm 1: Proposed algorithm for Mental Stress prediction

Results:	*Mental Stress Recognition using Precision, F1-score, Recall, Sensitivity, Specificity, classification accuracy and Conversion curve;*
Input:	*WESAD Dataset*
Output:	*Classify Stress level*
Procedure:	
Step 1:	*Extract the features from input data:*
	1.1 Clean unnecessary data;
	1.2 Missing Values;
	1.3 Scaling the data(if required)
Step 2:	*Apply Feature selection method;*
Step 3:	*Apply Machine Learning and LSTM Model and compare with the existing model;*
Step 4:	*Generate and store obtained classification accuracy, precision, recall, f1-score, Sensitivity, Specificity and classification accuracy and ROC curve;*
Step 5:	*Repeat Step 3 and Step 4.*

The WESAD

WESAD (Wearable Stress and Affect Detection) dataset [22] is collected from 15 subjects, consisting of 13 male and two female participants. Each subject participates in two hours of data collection protocol with four types of conditions: baseline, amusement, stress, and meditation condition. We used these four conditions data as the classes for the classification task. WESAD provides data from two kinds of sensors: chest-worn (RespiBAN) and wrist-worn device (Empatica E4). In this research work, we use only wrist-worn device data because it is not as intrusive as a chest-worn device, and they state that wrist-worn device data is quite promising to use for the classification process [22].

Proposed Work

The paper proposed Long short-term memory (LSTM), an artificial recurrent neural network (RNN) architecture used in deep learning. Unlike standard feedforward neural networks, LSTM has feedback connections. It can process single data points (images) and entire data sequences (such as speech or video). It is capable of learning long term dependencies in data. This is achieved because the recurring module of the model has a combination of four layers interacting with each other. Algorithm 1 proposes the procedure to predict the individual's stress using the WESAD dataset.

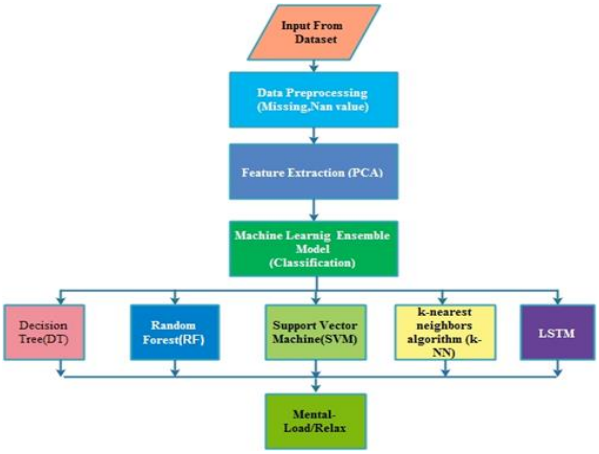

Figure 1: Flow Chart of the Proposed Model

Empirical Results

Different metrics have been used to evaluate the performance of proposed deep learning models on test sets, such as precision, recall, f1-score, and accuracy. The comparison of different models concerning performance metrics by all the applied machine learning algorithms and deep learning model LSTM is depicted in Table 1. Compared to other models, our proposed deep learning model LSTM achieved better accuracy than other machine learning algorithms such as DT, SVM and kNN. The accuracy obtained by LSTM models is 98%.

Table 1: Comparison of different ML models and Proposed Model

Model	Precision	Recall	F1-Score	Accuracy
DT	96	96	96	96
SVM	81	75	77	79
KNN	88	92	90	90.49
PLSTM	97	97	97	98
DT-> Decision tree, **SVM**->Support Vector Machine				
kNN-> k-nearest neighbors, **PLSTM->** Proposed LSTM				
All measurements are in %				

Figure 2 shows the graphical comparison of accuracy after generating confusion matrix on applying Decision Tree (DT), k Nearest Neighbors (KNN), Support Vector Machine (SVM) and LSTM models on the WESAD dataset.

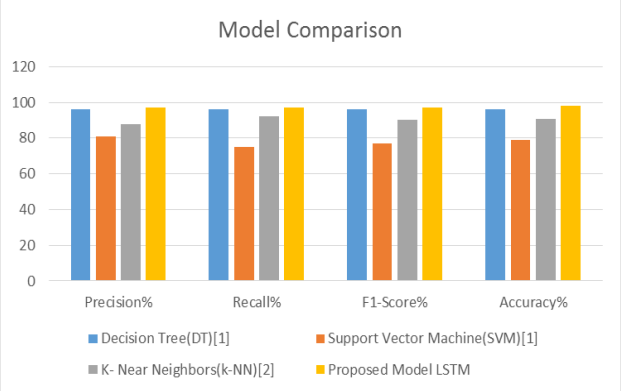

Figure 2: Model Comparison

Conclusion and Future work

Stress is a significant problem in today's society, with social and economic consequences. It is one of the variables that contribute to health issues. It is described as the human body's response to mental, physical, and emotional stimuli, governed by the sympathetic nervous system (SNS) and hypothalamic-pituitary-adrenocortical axis (HPA axis). The research began in a controlled laboratory setting, and the results show a high degree of accuracy in recognizing stress. Our suggested LSTM model attained a 98% accuracy compared to other models. There are still open research difficulties for detecting stress in everyday life, and there is space for development in this field. We will continue to work on the Internet of Things employing high-quality sensing devices and more precise data categorization approaches in the future.

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The J-Generalized P - K Mittag-Leffler Function

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Abstract

We know that the classical Mittag-Leffler function play an important role as solution of fractional order differential and integral equations. We introduce the j-generalized p - k Mittag-leffler function. We evaluate the second order differential recurrence relation and four different integral representations and introduce a homogeneous linear differential equation whose one of the solution is the j-generalized p-k Mittag-Leffler function.
Also we evaluate the certain relations that exist between j-generalized p - k Mittag-leffler function and Riemann-Liouville fractional integrals and derivatives.
We evaluate Mellin-Barnes integral representation of j-generalized p-k Mittag-Leffler Function. The relationship of j-generalized p-k Mittag-Leffler Function with Fox H-Function and Wright hypergeometric function is also establish. we obtained its Euler transform, Laplace Transform and Mellin transform.
Finally we derive some particular cases.

MSC(2011): 33E12, 33B10, 26A33.

Keywords: The j-generalized p - k Mittag-Leffler Function, The p - k Mittag-Leffler Function, Generalized k-Mittag-Leffler Function, Two parameter pochhammer symbol, Two parameter Gamma function.

1 Introduction

The two parameter pochhammer symbol is recently introduce by [9], equation 2.1, in the form,

1.1 Definition

Let $x \in C; k, p \in R^+ - \{0\}$ and $Re(x) > 0, n \in N$, the p - k Pochhammer Symbol (i.e. Two Parameter Pochhammer Symbol), ${}_p(x)_{n,k}$ is given by

$$ {}_p(x)_{n,k} = (\frac{xp}{k})(\frac{xp}{k} + p)(\frac{xp}{k} + 2p).....(\frac{xp}{k} + (n-1)p). \tag{1.1}$$

And the Two Parameter Gamma Function is given by [9], some of it's result are,

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1.2 Definition

For $x \in C/kZ^-; k, p \in R^+ - \{0\}$ and $Re(x) > 0, n \in N$, the p - k Gamma Function (i.e. Two Parameter Gamma Function), ${}_p\Gamma_k(x)$ as

$$ {}_p\Gamma_k(x) = \frac{1}{k} \lim_{n\to\infty} \frac{n! p^{n+1} (np)^{\frac{x}{k}}}{{}_p(x)_{n+1,k}}. \tag{1.2}$$

or

$$ {}_p\Gamma_k(x) = \frac{1}{k} \lim_{n\to\infty} \frac{n! p^{n+1} (np)^{\frac{x}{k}-1}}{{}_p(x)_{n,k}}. \tag{1.3}$$

The integral representation of p - k Gamma Function is given by

$$ {}_p\Gamma_k(x) = \int_0^\infty e^{-\frac{t^k}{p}} t^{x-1} dt. \tag{1.4}$$

$$ {}_p\Gamma_k(x) = (\frac{p}{k})^{\frac{x}{k}} \Gamma_k(x) = \frac{p^{\frac{x}{k}}}{k} \Gamma(\frac{x}{k}). \tag{1.5}$$

$$ {}_p(x)_{n,k} = (\frac{p}{k})^n (x)_{n,k} = (p)^n (\frac{x}{k})_n. \tag{1.6}$$

Also for Generalized p - k Pochhammer Symbol, we have

$$ {}_p(x)_{nq,k} = (\frac{p}{k})^{nq} (x)_{nq,k} = (p)^{nq} (\frac{x}{k})_{nq} = (pq)^{nq} \prod_{r=1}^{q} (\frac{\frac{x}{k} + r - 1}{q})_n. \tag{1.7}$$

$$ {}_p(x)_{n,k} = \frac{{}_p\Gamma_k(x + nk)}{{}_p\Gamma_k(x)}. \tag{1.8}$$

$$ {}_p\Gamma_k(x + k) = \frac{xp}{k} {}_p\Gamma_k(x). \tag{1.9}$$

$$ np\ {}_p(x)_{n-1,k} = {}_p(x)_{n,k} - {}_p(x - k)_{n,k}. \tag{1.10}$$

And

$$ {}_p(x)_{n+j,k} = {}_p(x)_{j,k} \times {}_p(x + jk)_{n,k}. \tag{1.11}$$

The Mittag-Leffler function $E_\alpha(z)$ introduced by Gosta Mittag-Leffler [4] in 1903, defined as

$$ E_\alpha(z) = \sum_{n=0}^{\infty} \frac{z^n}{\Gamma(\alpha n + 1)}. \tag{1.12}$$

Here $z \in C, \alpha \geqslant 0$.

Wiman [2] generalized $E_\alpha(z)$ in 1905 and gave $E_{\alpha,\beta}(z)$ known as Wiman function, defined as

$$ E_{\alpha,\beta}(z) = \sum_{n=0}^{\infty} \frac{z^n}{\Gamma(\alpha n + \beta)}. \tag{1.13}$$

Here $z, \alpha, \beta \in C; Re(\alpha) > 0, Re(\beta) > 0$.

Prabhakar [17] in 1971, gave next generalization of Mittag-Leffler function and denoted as $E^\gamma_{\alpha,\beta}(z)$ and defined as

$$ E^\gamma_{\alpha,\beta}(z) = \sum_{n=0}^{\infty} \frac{(\gamma)_n}{\Gamma(\alpha n + \beta)} \frac{z^n}{n!}. \tag{1.14}$$

Here $z, \alpha, \beta, \gamma \in C; Re(\alpha) > 0, Re(\beta) > 0, Re(\gamma) > 0$.

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Shukla and Prajapati [1] in 2007, gave second generalization of Mittag-Leffler function and denoted it as $E^{\gamma,q}_{\alpha,\beta}(z)$ and defined as,

$$E^{\gamma,q}_{\alpha,\beta}(z) = \sum_{n=0}^{\infty} \frac{(\gamma)_{nq}}{\Gamma(\alpha n+\beta)} \frac{z^n}{n!}. \tag{1.15}$$

Here $z, \alpha, \beta, \gamma \in C; Re(\alpha) > 0, Re(\beta) > 0, Re(\gamma) > 0$ and $q \in (0,1) \cup N$.
The function $E^{\gamma,q}_{\alpha,\beta}(z)$ converges absolutely for all z if $q < Re(\alpha) + 1$ and for $|z| < 1$ if $q = Re(\alpha) + 1$. It is entire function of order $\frac{1}{Re(\alpha)}$.

Gehlot K.S.[8] introduce Generalized k- Mittag-Leffler function in 2012, denoted as $GE^{\gamma,q}_{k,\alpha,\beta}(z)$ and defined for $k \in R; z, \alpha, \beta, \gamma \in C; Re(\alpha) > 0, Re(\beta) > 0, Re(\gamma) > 0$ and $q \in (0,1) \cup N$, as,

$$GE^{\gamma,q}_{k,\alpha,\beta}(z) = \sum_{n=0}^{\infty} \frac{(\gamma)_{nq,k}\, z^n}{\Gamma_k(n\alpha+\beta)(n!)}, \tag{1.16}$$

where$(\gamma)_{nq,k}$ is the k- pochhammer symbol and $\Gamma_k(x)$ is the k-gamma function given by [15]. The generalized Pochhammer symbol is given as,

$$(\gamma)_{nq} = \frac{\Gamma(\gamma+nq)}{\Gamma(\gamma)} = q^{qn} \prod_{r=1}^{q} (\frac{\gamma+r-1}{q})_n,\ if\ q \in N. \tag{1.17}$$

Gehlot K.S.[9], Introduce The p- k Mittag-Leffler function in 2018, denoted by ${}_pE^{\gamma,q}_{k,\alpha,\beta}(z)$ and defined for $k, p \in R^+ - \{0\}; \alpha, \beta, \gamma \in C/kZ^-; Re(\alpha) > 0, Re(\beta) > 0, Re(\gamma) > 0$ and $q \in (0,1) \cup N$.

$${}_pE^{\gamma,q}_{k,\alpha,\beta}(z) = \sum_{n=0}^{\infty} \frac{{}_p(\gamma)_{nq,k}}{{}_p\Gamma_k(n\alpha+\beta)} \frac{z^n}{n!}. \tag{1.18}$$

Where ${}_p(\gamma)_{nq,k}$ is two parameter Pochhammer symbol given by equation (1.1) and ${}_p\Gamma_k(x)$ is the two parameter Gamma function given by equation (1.3).

L.L.Luque [14]in the year 2019, introduce the L-mittag-Leffler function defined for $\alpha, \beta, \gamma \in C; Re(\alpha) > 0, Re(\beta) > 0, Re(\gamma) > 0, j \in N_0$ by the series

$$L^{\gamma,j}_{\alpha,\beta}(z) = \sum_{n=0}^{\infty} \frac{(\gamma)_{n+j}}{\Gamma(n\alpha+\beta)} \frac{z^n}{(n+j)!}, \qquad (z \in C). \tag{1.19}$$

The Fractional Integral operators ([16], Definition 2.1, Page 33) are defined as,

$$(I^{\vartheta}_{0+}f)(z) = \frac{1}{\Gamma(\vartheta)} \int_0^z \frac{f(t)}{(z-t)^{1-\vartheta}} dt, (z > 0), \tag{1.20}$$

and

$$(I^{\vartheta}_{-}f)(z) = \frac{1}{\Gamma(\vartheta)} \int_z^{\infty} \frac{f(t)}{(t-z)^{1-\vartheta}} dt, (z > 0), \tag{1.21}$$

The Fractional Derivative ([16], Definition 2.2, Page 35) are defined as,

$$(D^{\vartheta}_{0+}f)(z) = (\frac{d}{dz})^{[Re(\vartheta)]+1} (I^{1-\vartheta+[Re(\vartheta)]}_{0+}f)(z)$$

$$= \frac{1}{\Gamma(1-\vartheta+[Re(\vartheta)])} (\frac{d}{dz})^{[Re(\vartheta)]+1} \int_0^z \frac{f(t)}{(z-t)^{\vartheta-[Re(\vartheta)]}} dt, (z > 0), \tag{1.22}$$

and

$$(D^{\vartheta}_{-}f)(z) = (-\frac{d}{dz})^{[Re(\vartheta)]+1} (I^{1-\vartheta+[Re(\vartheta)]}_{-}f)(z)$$

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$$= \frac{1}{\Gamma(1-\vartheta+[Re(\vartheta)])}(-\frac{d}{dz})^{[Re(\vartheta)]+1}\int_z^\infty \frac{f(t)}{(t-z)^{\vartheta-[Re(\vartheta)]}}dt, (z>0). \tag{1.23}$$

Where $\vartheta \in C(Re(\vartheta)>0)$.

Wright generalized hypergeometric function [15];

$${}_p\psi_q\left[\begin{array}{c}(\alpha_1,A_1),\ldots,(\alpha_p,A_p);\\ \\ (\beta_1,B_1),\ldots,(\beta_q,B_q);\end{array} z\right] = \sum_{n=0}^{\infty}\frac{\prod_{i=1}^{p}\Gamma(\alpha_i+A_in)z^n}{\prod_{j=1}^{q}\Gamma(\beta_i+B_in)n!}. \tag{1.24}$$

$${}_p\psi_q\left[\begin{array}{c}(\alpha_1,A_1),\ldots,(\alpha_p,A_p);\\ \\ (\beta_1,B_1),\ldots,(\beta_q,B_q);\end{array} z\right] = H^{1,p}_{p,q+1}\left[-z\,\middle|\,\begin{array}{c}(1-\alpha_1,A_1),\ldots,(1-\alpha_p,A_p);\\ \\ (0,1),(1-\beta_1,B_1),\ldots,(1-\beta_q,B_q);\end{array}\right]. \tag{1.25}$$

Where $H^{m,n}_{p,q}[.]$ denotes the Fox H-function.
Euler Beta transform,[6],

$$B[f(z):a,b] = \int_0^1 z^{a-1}(1-z)^{b-1}f(z)dz. \tag{1.26}$$

Laplace transform,([7],equation3.1.1),

$$L[f(z):s] = \int_0^\infty e^{-sz}f(z)dz. \tag{1.27}$$

Mellin transform,([7],equation 4.1.1),

$$M[f(z):s] = \int_0^\infty z^{s-1}f(z)dz = f^*(s), Re(s)>0, \tag{1.28}$$

then

$$f(z) = M^{-1}[f^*(s):x] = \int f^*(s)x^{-s}ds, \tag{1.29}$$

Throughout this paper Let $C, R^+, Re(), Z^-, N_0$ and N be the sets of complex numbers, positive real numbers, real part of complex number, negative integer, whole number and natural numbers respectively.

2 The j-generelized p - k Mittag-Leffler function

In this section we introduce the j-generelized p - k Mittag-Leffler function and prove some of its properties.

2.1 Definition

Let $k,p \in R^+ - \{0\}; \alpha,\beta,\gamma \in C/kZ^-; Re(\alpha)>0, Re(\beta)>0, Re(\gamma)>0$, $j \in N_0$ and $q \in (0,1)\cup N$. The j-generelized p - k Mittag-Leffler function denoted by ${}^j_pE^{\gamma,q}_{k,\alpha,\beta}(z)$ and defined as

$${}^j_pE^{\gamma,q}_{k,\alpha,\beta}(z) = \sum_{n=0}^{\infty}\frac{{}_p(\gamma)_{(n+j)q,k}}{{}_p\Gamma_k(n\alpha+\beta)}\frac{z^n}{(n+j)!}, \qquad z\in C. \tag{2.1}$$

Where ${}_p(\gamma)_{nq,k}$ is two parameter Pochhammer symbol given by equation (1.1) and ${}_p\Gamma_k(x)$ is the two parameter Gamma function given by equation (1.3).

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Particular cases : For some particular values of the parameters $j, p, q, k, \alpha, \beta, \gamma$ we can obtain certain defined and undefined Mittag-Leffler functions:

(a) For $j = 0$ equation (2.1), reduces in the p-k Mittag-Leffler functions defined by [10],

$$ {}^{0}_{p}E^{\gamma,q}_{k,\alpha,\beta}(z) = \sum_{n=0}^{\infty} \frac{{}_{p}(\gamma)_{nq,k}}{{}_{p}\Gamma_{k}(n\alpha+\beta)} \frac{z^n}{n!}, \qquad z \in C. \tag{2.2} $$

(b) For $q = 1$ equation (2.1), reduces in j form of p-k Mittag-Leffler functions defined as,

$$ {}^{j}_{p}E^{\gamma,1}_{k,\alpha,\beta}(z) = \sum_{n=0}^{\infty} \frac{{}_{p}(\gamma)_{(n+j),k}}{{}_{p}\Gamma_{k}(n\alpha+\beta)} \frac{z^n}{(n+j)!}, \qquad z \in C. \tag{2.3} $$

(c) For $q = 1, p = k$ equation (2.1), reduces in j form of k- Mittag-Leffler functions defined as,

$$ {}^{j}_{k}E^{\gamma,1}_{k,\alpha,\beta}(z) = \sum_{n=0}^{\infty} \frac{(\gamma)_{(n+j),k}}{\Gamma_{k}(n\alpha+\beta)} \frac{z^n}{(n+j)!}, \qquad z \in C. \tag{2.4} $$

(d) For $q = 1, j = 0$ equation (2.1), reduces in generalized form of k- Mittag-Leffler functions defined as.

$$ {}_{p}E^{\gamma,1}_{k,\alpha,\beta}(z) = \sum_{n=0}^{\infty} \frac{{}_{p}(\gamma)_{n,k}\, z^n}{{}_{p}\Gamma_{k}(n\alpha+\beta)(n!)}. \tag{2.5} $$

(e) For $p = k, j = 0$ equation (2.1), reduces in Generalized k- Mittag-Leffler functions defined by [8].

$$ {}_{k}E^{\gamma,q}_{k,\alpha,\beta}(z) = \sum_{n=0}^{\infty} \frac{{}_{k}(\gamma)_{nq,k}\, z^n}{{}_{k}\Gamma_{k}(n\alpha+\beta)(n!)} = GE^{\gamma,q}_{k,\alpha,\beta}(z). \tag{2.6} $$

(f) For $p = k, q = 1, j = 0$ equation (2.1), reduces in k - Mittag-Leffler functions defined by [3].

$$ {}_{k}E^{\gamma,1}_{k,\alpha,\beta}(z) = \sum_{n=0}^{\infty} \frac{(\gamma)_{n,k}\, z^n}{\Gamma_{k}(n\alpha+\beta)(n!)} = E^{\gamma}_{k,\alpha,\beta}(z). \tag{2.7} $$

(g) For $p = k$ and $k = 1, j = 0$ equation (2.1), reduces in Mittag-Leffler functions defined by [1].

$$ {}_{1}E^{\gamma,q}_{1,\alpha,\beta}(z) = \sum_{n=0}^{\infty} \frac{(\gamma)_{nq}\, z^n}{\Gamma(n\alpha+\beta)(n!)} = E^{\gamma,q}_{\alpha,\beta}(z). \tag{2.8} $$

(h) For $p = k = q = 1$ equation (2.1), reduces in L-Mittag-Leffler functions defined by [14].

$$ {}_{1}E^{\gamma,1}_{1,\alpha,\beta}(z) = \sum_{n=0}^{\infty} \frac{(\gamma)_{n+j}\, z^n}{\Gamma(n\alpha+\beta)(n+j)!} = L^{\gamma,j}_{\alpha,\beta}(z). \tag{2.9} $$

(i) For $p = k, q = 1, j = 0$ and $k = 1$ equation (2.1), reduces in Mittag-Leffler functions defined by [17].

$$ {}_{1}E^{\gamma,1}_{1,\alpha,\beta}(z) = \sum_{n=0}^{\infty} \frac{(\gamma)_{n}\, z^n}{\Gamma(n\alpha+\beta)(n!)} = E^{\gamma}_{\alpha,\beta}(z), \tag{2.10} $$

(j) For $p = k, q = 1, k = 1, j = 0$ and $\gamma = 1$ equation (2.1), reduces in Mittag-Leffler functions defined by [3].

$$ {}_{1}E^{1,1}_{1,\alpha,\beta}(z) = \sum_{n=0}^{\infty} \frac{z^n}{\Gamma(n\alpha+\beta)} = E_{\alpha,\beta}(z), \tag{2.11} $$

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(k) For $p = k, q = 1, k = 1, \gamma = 1, j = 0$ and $\beta = 1$ equation (2.1), reduces in Mittag-Leffler functions defined by [4].

$$ {}_1E^{1,1}_{1,\alpha,1}(z) = \sum_{n=0}^{\infty} \frac{z^n}{\Gamma(n\alpha + 1)} = E_\alpha(z). \tag{2.12}$$

Theorem 2.1: The j-generelized p - k Mittag-Leffler function defined by equation (2.1) is an entire function of order

$$ \frac{1}{\rho} = Re(\frac{\alpha}{k}) - q + 1. \tag{2.13}$$

Proof: Let R is the radius of convergence of the j-generelized p - k Mittag-Leffler function. The asymptotic Striling formula for Gamma function and factorial are given by,[5]

$$ \Gamma(az + b) = \sqrt{2\pi} e^{-az} (az)^{az+b-\frac{1}{2}} \Big[1 + o(\frac{1}{z})\Big], (arg(az + b) < \pi; \imath\, z \imath\!\rightarrow \infty). \tag{2.14}$$

and

$$ n! = \sqrt{2\pi} e^{-n} (n)^{n+\frac{1}{2}} \Big[1 + o(\frac{1}{n})\Big], (n \in N; n \rightarrow \infty). \tag{2.15}$$

From equation (2.1), we have

$$ {}^{j}_{p}E^{\gamma,q}_{k,\alpha,\beta}(z) = \sum_{n=0}^{\infty} \frac{{}_p(\gamma)_{(n+j)q,k}}{{}_p\Gamma_k(n\alpha + \beta)} \frac{z^n}{(n + j)!} = \sum_{n=0}^{\infty} C_n z^n,$$

since

$$ R = \limsup_{n\rightarrow\infty} \Big|\frac{C_n}{C_{n+1}}\Big|,$$

$$ \Big|\frac{C_n}{C_{n+1}}\Big| = \Big|\frac{{}_p(\gamma)_{(n+j)q,k}}{{}_p\Gamma_k(n\alpha + \beta)} \frac{1}{(n + j)!} \times \frac{{}_p\Gamma_k(n\alpha + \alpha + \beta)(n + 1 + j)!}{{}_p(\gamma)_{(n+1+j)q,k}}\Big|$$

using equations (2.19) and (2.20) of [9], we have

$$ \Big|\frac{C_n}{C_{n+1}}\Big| = (n + 1 + j)\Big|p^{\frac{\alpha-qk}{k}}\Big|\Big|\frac{\Gamma(nq + jq + \frac{\gamma}{k})}{\Gamma(nq + jq + q + \frac{\gamma}{k})}\Big|\Big|\frac{\Gamma(\frac{n\alpha+\alpha+\beta}{k})}{\Gamma(\frac{n\alpha+\beta}{k})}\Big|,$$

using equation (2.15), we have

$$ \simeq \Big|p^{\frac{\alpha}{k}-q}\Big|\Big|q^{-q}\Big|\Big|(\frac{\alpha}{k})^{\frac{\alpha}{k}}\Big|\Big|n^{\frac{\alpha}{k}+1-q}\Big| \rightarrow \infty$$

when,

$$ Re(\frac{\alpha}{k} + 1 - q) > 0,$$

Thus, the j-generelized p - k Mittag-Leffler function is an entire function for $q < Re(\frac{\alpha}{k}) + 1$
To determine the order ρ,

$$ \rho = \limsup_{n\rightarrow\infty} \frac{n \ln n}{\ln(\frac{1}{|C_n|})}, \tag{2.16}$$

$$ \Big|\frac{1}{C_n}\Big| = \Big|\frac{{}_p\Gamma_k(n\alpha + \beta)(n + j)!}{{}_p(\gamma)_{(n+j)q,k}}\Big|,$$

using theorem 2.19 and 2.20 of [9], we have

$$ \Big|\frac{1}{C_n}\Big| = \frac{(n + j)!}{k}\Big|p^{\frac{\gamma}{k}+\frac{n\alpha+\beta}{k}-\frac{\gamma+(n+j)qk}{k}}\Big|\Big|\frac{\Gamma(\frac{\gamma}{k})\Gamma(\frac{n\alpha+\beta}{k})}{\Gamma(\frac{\gamma}{k} + (n + j)q)}\Big|,$$

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By using equation (2.12) and (2.13), we get

$$\left|\frac{1}{C_n}\right| = k^{-1}(2\pi)^{\frac{1}{2}}\left|p^{(\frac{\alpha-qk}{k})n+\frac{\beta}{k}-jq}\right|\left|(\frac{\alpha}{k})^{\frac{n\alpha}{k}+\frac{\beta}{k}-\frac{1}{2}}\right|\left|n^{\frac{n\alpha}{k}+\frac{\beta}{k}-\frac{\gamma}{k}-nq-jq+n+j+\frac{1}{2}}\right|\left|e^{-nRe(\frac{\alpha}{k}+1-q)}\right|$$

taking ln of above equation and put in equation (2.13), we have the order of j-generelized p - k Mittag-Leffler function is given by

$$\rho = \frac{k}{Re(\alpha) - qk + k}.$$

Hence.

Theorem 2.2: The functional relation between the j-generelized p - k Mittag-Leffler function given by equation (2.1) with p - k Mittag-Leffler function defined by [10] and generelized Mittag-Leffler function defined by [1] are given by

$${}^{j}_{p}E^{\gamma,q}_{k,\alpha,\beta}(z) = \left(kp^{jq-\frac{\beta}{k}}\right){}^{j}E^{\frac{\gamma}{k},q}_{\frac{\alpha}{k},\frac{\beta}{k}}(zp^{q-\frac{\alpha}{k}}). \tag{2.17}$$

$$(\frac{d}{dz})^{l}\left[z^{j} \times {}^{j}_{p}E^{\gamma,q}_{k,\alpha,\beta}(z)\right] = {}_{p}(\gamma)_{lq,k}\ z^{j-l}\ {}^{j-l}_{p}E^{\gamma+lqk,q}_{k,\alpha,\beta}(z),\ for\ l<j. \tag{2.18}$$

$$(\frac{d}{dz})^{l}\left[z^{j} \times {}^{j}_{p}E^{\gamma,q}_{k,\alpha,\beta}(z)\right] = {}_{p}(\gamma)_{lq,k}\ {}_{p}E^{\gamma+lqk,q}_{k,\alpha,\beta}(z),\ for\ l=j. \tag{2.19}$$

$$(\frac{d}{dz})^{l}\left[z^{j} \times {}^{j}_{p}E^{\gamma,q}_{k,\alpha,\beta}(z)\right] = {}_{p}(\gamma)_{lq,k}\ {}_{p}E^{\gamma+lqk,q}_{k,\alpha,\beta+l\alpha-j\alpha}(z),\ for\ l>j. \tag{2.20}$$

Proof of equation (2.16)
Using equation (1.5) and (1.6), we get the desired result.
Proof of equation (2.17), (2.18) and (2.19)
Using the equation (2.1), in right hand side of (2.17), we have

$$\frac{d^{l}}{dz^{l}}\left[z^{j} \times {}^{j}_{p}E^{\gamma,q}_{k,\alpha,\beta}(z)\right] = \sum_{n=0}^{\infty}\frac{{}_{p}(\gamma)_{(n+j)q,k}}{{}_{p}\Gamma_{k}(n\alpha+\beta)}\frac{z^{n+j-l}}{(n+j-l)!},$$

using equation (1.11), we have

$$\frac{d^{l}}{dz^{l}}\left[z^{j} \times {}^{j}_{p}E^{\gamma,q}_{k,\alpha,\beta}(z)\right] = \sum_{n=0}^{\infty}\frac{{}_{p}(\gamma)_{lq,k}\ {}_{p}(\gamma+lqk)_{(n+j-l)q,k}}{{}_{p}\Gamma_{k}(n\alpha+\beta)}\frac{z^{n+j-l}}{(n+j-l)!},$$

hence we have,

$$= {}_{p}(\gamma)_{lq,k}\ z^{j-l}\ {}^{j-l}_{p}E^{\gamma+lqk,q}_{k,\alpha,\beta}(z),\ for\ l<j.$$

$$= {}_{p}(\gamma)_{jq,k}\ {}_{p}E^{\gamma+lqk,q}_{k,\alpha,\beta}(z),\ for\ l=j.$$

$$= {}_{p}(\gamma)_{lq,k}\ {}_{p}E^{\gamma+lqk,q}_{k,\alpha,\beta+l\alpha-j\alpha}(z),\ for\ l>j.$$

Theorem 2.3: The following elementary properties are satisfied by the j-generelized p - k Mittag-Leffler function defined by equation (2.1),

$$k\ {}^{j}_{p}E^{\gamma,q}_{k,\alpha,\beta}(z) = p\beta\ {}^{j}_{p}E^{\gamma,q}_{k,\alpha,\beta+k}(z) + zp\alpha\frac{d}{dz}\ {}^{j}_{p}E^{\gamma,q}_{k,\alpha,\beta+k}(z). \tag{2.21}$$

$$pq\ {}_{p}(\gamma)_{q-1,k}\ {}^{j-1}_{p}E^{\gamma+kq-k,q}_{k,\alpha,\beta}(z) = {}^{j}_{p}E^{\gamma,q}_{k,\alpha,\beta}(z) - {}^{j}_{p}E^{\gamma-k,q}_{k,\alpha,\beta}(z). \tag{2.22}$$

$$\sum_{n=0}^{\infty}(x+y)^{n}\ {}^{j}_{p}E^{nqk+k,q}_{k,0,nk+jk+k}(xy) = \sum_{r=0}^{\infty}\frac{{}_{p}\Gamma_{k}(rqk+k)(xyp)^{r}}{{}_{p}\Gamma_{k}(rk+jk+k)} \times {}^{j}_{p}E^{rqk+k,q}_{k,qk,k}(\frac{x+y}{p}). \tag{2.23}$$

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Proof of equation (2.20)
Consider the right hand side of equation (2.20),

$$A \equiv p\beta\ {}^{j}_{p}E^{\gamma,q}_{k,\alpha,\beta+k}(z) + zp\alpha\frac{d}{dz}\ {}^{j}_{p}E^{\gamma,q}_{k,\alpha,\beta+k}(z),$$

using equation (2.1),

$$A \equiv p\beta \sum_{n=0}^{\infty} \frac{{}_{p}(\gamma)_{(n+j)q,k}}{{}_{p}\Gamma_k(n\alpha+\beta+k)}\frac{z^n}{(n+j)!} + zp\alpha\sum_{n=0}^{\infty}\frac{{}_{p}(\gamma)_{(n+j)q,k}}{{}_{p}\Gamma_k(n\alpha+\beta+k)}\frac{nz^{n-1}}{(n+j)!},$$

$$A \equiv p\sum_{n=0}^{\infty}\frac{{}_{p}(\gamma)_{(n+j)q,k}(n\alpha+\beta)}{{}_{p}\Gamma_k(n\alpha+\beta+k)}\frac{z^n}{(n+j)!},$$

using the equation (1.9), we have

$$A \equiv k\ {}^{j}_{p}E^{\gamma,q}_{k,\alpha,\beta}(z).$$

Proof of equation (2.21)
Consider the right hand side of (2.21),

$$A \equiv\ {}^{j}_{p}E^{\gamma,q}_{k,\alpha,\beta}(z) -\ {}^{j}_{p}E^{\gamma-k,q}_{k,\alpha,\beta}(z),$$

using equation (2.1), we have

$$A \equiv \sum_{n=0}^{\infty}\frac{z^n}{{}_{p}\Gamma_k(n\alpha+\beta)(n+j)!}\Big[{}_{p}(\gamma)_{(n+j)q,k} -\ {}_{p}(\gamma-k)_{(n+j)q,k}\Big],$$

using equations (1.10) and (1.11), we have

$$A \equiv pq\ {}_{p}(\gamma)_{q-1,k}\ {}^{j-1}_{p}E^{\gamma+kq-k,q}_{k,\alpha,\beta}(z).$$

Proof of equation (2.22)
Consider the Left hand side of equation (2.22),

$$A \equiv \sum_{n=0}^{\infty}(x+y)^n\ {}^{j}_{p}E^{nqk+k,q}_{k,0,(n+j+1)k}(xy),$$

using equation (2.1), we have

$$A \equiv \sum_{n=0}^{\infty}(x+y)^n\sum_{r=0}^{\infty}\frac{{}_{p}(nqk+k)_{(r+j)q,k}}{{}_{p}\Gamma_k(nk+jk+k)}\frac{(xy)^r}{(r+j)!}, \tag{2.24}$$

now simplifying, by using equation (1.5) and (1.6), we have

$$\begin{aligned}
{}_{p}(nqk+k)_{(r+j)q,k} &= p^{(r+j)q}(nq+1)_{(r+j)q},\\
&= p^{(r+j)q}\frac{\Gamma(nq+(r+j)q+1)}{\Gamma(nq+1))},\\
&= p^{(r+j)q}\frac{\Gamma((r+j)q+1+nq)}{\Gamma((r+j)q+1)}\frac{\Gamma((r+j)q+1)}{\Gamma(nq+1)},\\
&= {}_{p}\Gamma_k(rqk+k)\frac{{}_{p}(rqk+k)_{(r+j)q,k}}{{}_{p}\Gamma_k(nqk+k)},
\end{aligned}$$

then equation (2.23) becomes by rearranging the terms, we have

$$A \equiv \sum_{r=0}^{\infty}\frac{{}_{p}\Gamma_k(rqk+k)(xyp)^r}{{}_{p}\Gamma_k(rk+jk+k)}\sum_{n=0}^{\infty}\frac{{}_{p}(rqk+k)_{(n+j)q,k}}{{}_{p}\Gamma_k(qkn+k)(n+j)!}\Big(\frac{x+y}{p}\Big)^n.$$

This completes the proof.

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3 Fractional Integral and Differentiation of the j-generalized p - k Mittag-Leffler Function

In this section we evaluate certain relations that exist between the j-generalized p - k Mittag-Leffler Function and Riemann-Liouville fractional integrals and derivatives. It has been shown that the fractional integration and differentiation operators of j-generalized p - k Mittag-Leffler Function with power multipliers into the function of the same form. Also point out some special cases.

Theorem 3.1 The left-side Riemann-Liouville Fractional Integral Operator $I_{0^+}^{\vartheta}$ of the j-generalized p - k Mittag-Leffler Function is given by,

$$(I_{0^+}^{\vartheta}[t^{\frac{\beta}{k}-1}\,{}_p^j E_{k,\alpha,\beta}^{\gamma,q}(t^{\frac{\alpha}{k}})])(z) = p^{\vartheta} z^{\frac{\beta}{k}+\vartheta-1}\,{}_p^j E_{k,\alpha,\beta+k\vartheta}^{\gamma,q}(z^{\frac{\alpha}{k}}). \tag{3.1}$$

Where

$k, p \in R^+ - \{0\}; \alpha, \beta, \gamma \in C/kZ^-; Re(\alpha) > 0, Re(\beta) > 0, Re(\gamma) > 0, j \in N_0,\ q \in (0,1) \cup N$ *and* $Re(\vartheta) > 0$.

Proof: Consider left hand side,

$$A \equiv (I_{0^+}^{\vartheta}[t^{\frac{\beta}{k}-1}\,{}_p^j E_{k,\alpha,\beta}^{\gamma,q}(t^{\frac{\alpha}{k}})])(z),$$

by virtue of equation (1.20) and (2.1), we have

$$A \equiv \frac{1}{\Gamma(\vartheta)} \int_0^z \frac{t^{\frac{\beta}{k}-1}}{(z-t)^{1-\vartheta}} \sum_{n=0}^{\infty} \frac{{}_p(\gamma)_{(n+j)q,k}}{{}_p\Gamma_k(n\alpha+\beta)} \frac{t^{\frac{n\alpha}{k}}}{(n+j)} dt,$$

interchanging the order of integration and summation and evaluate the inner integral by substitute $t = zu$ and using the beta function formula, it gives

$$A \equiv \frac{z^{\frac{\beta}{k}+\vartheta-1}}{\Gamma(\vartheta)} \sum_{n=0}^{\infty} \frac{{}_p(\gamma)_{(n+j)q,k}}{{}_p\Gamma_k(n\alpha+\beta)} \frac{z^{\frac{n\alpha}{k}}}{(n+j)!} \frac{\Gamma(\frac{n\alpha+\beta}{k})\Gamma(\vartheta)}{\Gamma(\frac{n\alpha+\beta+k\vartheta}{k})},$$

using the equation (1.5), we have

$$A \equiv p^{\vartheta} z^{\frac{\beta}{k}+\vartheta-1}\,{}_p^j E_{k,\alpha,\beta+k\vartheta}^{\gamma,q}(z^{\frac{\alpha}{k}}).$$

Hence, we get the desired result.

Theorem 3.2 The right-side Riemann-Liouville Fractional Integral Operator I_{-}^{ϑ} of the j-generalized p - k Mittag-Leffler Function is given by,

$$(I_{-}^{\vartheta}[t^{-\frac{\beta}{k}-\vartheta}\,{}_p^j E_{k,\alpha,\beta}^{\gamma,q}(t^{-\frac{\alpha}{k}})])(z) = p^{\vartheta} z^{-\frac{\beta}{k}}\,{}_p^j E_{k,\alpha,\beta+k\vartheta}^{\gamma,q}(z^{-\frac{\alpha}{k}}). \tag{3.2}$$

Where

$k, p \in R^+ - \{0\}; \alpha, \beta, \gamma \in C/kZ^-; Re(\alpha) > 0, Re(\beta) > 0, Re(\gamma) > 0, j \in N_0,\ q \in (0,1) \cup N$ *and* $Re(\vartheta) > 0$.

Proof: Consider left hand side,

$$A \equiv (I_{-}^{\vartheta}[t^{-\frac{\beta}{k}-\vartheta}\,{}_p^j E_{k,\alpha,\beta}^{\gamma,q}(t^{-\frac{\alpha}{k}})])(z),$$

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by virtue of equation (1.21) and (2.1), we have

$$A \equiv \frac{1}{\Gamma(\vartheta)} \int_z^\infty \frac{t^{-\frac{\beta}{k}-\vartheta}}{(t-z)^{1-\vartheta}} \sum_{n=0}^{\infty} \frac{p(\gamma)_{(n+j)q,k}}{{}_p\Gamma_k(n\alpha+\beta)} \frac{t^{-\frac{n\alpha}{k}}}{(n+j)!} dt,$$

interchanging the order of integration and summation and evaluate the inner integral by substitute $t = \frac{z}{u}$ and using the beta function formula, it gives

$$A \equiv \frac{z^{-\frac{\beta}{k}}}{\Gamma(\vartheta)} \sum_{n=0}^{\infty} \frac{p(\gamma)_{(n+j)q,k}}{{}_p\Gamma_k(n\alpha+\beta)} \frac{z^{-\frac{n\alpha}{k}}}{(n+j)!} \frac{\Gamma(\frac{n\alpha+\beta}{k})\Gamma(\vartheta)}{\Gamma(\frac{n\alpha+\beta+k\vartheta}{k})},$$

using the equation (1.5), we have

$$A \equiv p^{\vartheta} z^{-\frac{\beta}{k}} {}_p^j E_{k,\alpha,\beta+k\vartheta}^{\gamma,q}(z^{-\frac{\alpha}{k}}).$$

Hence, we get the desired result.

Theorem 3.3 The left-side Riemann-Liouville Fractional Derivative Operator D_{0+}^{ϑ} of the j-generalized p - k Mittag-Leffler Function is given by,

$$(D_{0+}^{\vartheta}[t^{\frac{\beta}{k}-1} {}_p^j E_{k,\alpha,\beta}^{\gamma,q}(t^{\frac{\alpha}{k}})])(z) = p^{-\vartheta} z^{\frac{\beta}{k}-\vartheta-1} {}_p^j E_{k,\alpha,\beta-k\vartheta}^{\gamma,q}(z^{\frac{\alpha}{k}}). \tag{3.3}$$

Where

$k, p \in R^+ - \{0\}; \alpha, \beta, \gamma \in C/kZ^-; Re(\alpha) > 0, Re(\beta) > 0, Re(\gamma) > 0, j \in N_0,\ q \in (0,1) \cup N$ *and* $Re(\vartheta) > 0.$

Proof: Consider left hand side,

$$A \equiv (D_{0+}^{\vartheta}[t^{\frac{\beta}{k}-1} {}_p^j E_{k,\alpha,\beta}^{\gamma,q}(t^{\frac{\alpha}{k}})])(z),$$

by virtue of equation (1.22) and (2.1), we have

$$A \equiv \frac{1}{\Gamma(1-\vartheta+[Re(\vartheta)])} (\frac{d}{dz})^{[Re(\vartheta)]+1} \int_0^z \frac{t^{\frac{\beta}{k}-1}}{(z-t)^{\vartheta-Re(\vartheta)}} \sum_{n=0}^{\infty} \frac{p(\gamma)_{(n+j)q,k}}{{}_p\Gamma_k(n\alpha+\beta)} \frac{t^{\frac{n\alpha}{k}}}{(n+j)!} dt,$$

interchanging the order of integration and summation and evaluate the inner integral by substitute $t = zu$ and using the beta function formula, it gives

$$A \equiv \frac{z^{\frac{\beta}{k}-\vartheta-1}}{\Gamma(\vartheta)} \sum_{n=0}^{\infty} \frac{p(\gamma)_{(n+j)q,k}}{{}_p\Gamma_k(n\alpha+\beta)} \frac{z^{\frac{n\alpha}{k}}}{(n+j)!} \frac{\Gamma(\frac{n\alpha+\beta}{k})\Gamma(\vartheta)}{\Gamma(\frac{n\alpha+\beta-k\vartheta}{k})},$$

using the equation (1.5), we have

$$A \equiv p^{-\vartheta} z^{\frac{\beta}{k}-\vartheta-1} {}_p^j E_{k,\alpha,\beta-k\vartheta}^{\gamma,q}(z^{\frac{\alpha}{k}}).$$

Hence, we get the desired result.

Theorem 3.4 The right-side Riemann-Liouville Fractional Derivative Operator D_{-}^{ϑ} of the j-generalized p - k Mittag-Leffler Function is given by,

$$(D_{-}^{\vartheta}[t^{-\frac{\beta}{k}+\vartheta} {}_p^j E_{k,\alpha,\beta}^{\gamma,q}(t^{-\frac{\alpha}{k}})])(z) = p^{-\vartheta} z^{-\frac{\beta}{k}} {}_p^j E_{k,\alpha,\beta-k\vartheta}^{\gamma,q}(z^{-\frac{\alpha}{k}}). \tag{3.4}$$

Where

$k, p \in R^+ - \{0\}; \alpha, \beta, \gamma \in C/kZ^-; Re(\alpha) > 0, Re(\beta) > 0, Re(\gamma) > 0, j \in N_0,\ q \in (0,1) \cup N$ *and* $Re(\vartheta) > 0.$

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Proof: Consider left hand side,

$$A \equiv (D_{-}^{\vartheta}[t^{-\frac{\beta}{k}+\vartheta}\ {}_{p}^{j}E_{k,\alpha,\beta}^{\gamma,q}(t^{-\frac{\alpha}{k}})])(z),$$

by virtue of equation (1.23) and (2.1), we have

$$A \equiv \frac{1}{\Gamma(1-\vartheta+[Re(\vartheta)])}(-\frac{d}{dz})^{[Re(\vartheta)]+1}\int_{z}^{\infty}\frac{z^{-\frac{\beta}{k}+\vartheta}}{(t-z)^{\vartheta-[Re(\vartheta)]}}\sum_{n=0}^{\infty}\frac{{}_{p}(\gamma)_{(n+j)q,k}}{{}_{p}\Gamma_{k}(n\alpha+\beta)}\frac{t^{-\frac{n\alpha}{k}}}{(n+j)!}dt,$$

interchanging the order of integration and summation and evaluate the inner integral by substitute $t=\frac{z}{u}$ and using the beta function formula, it gives

$$A \equiv \frac{z^{-\frac{\beta}{k}}}{\Gamma(\vartheta)}\sum_{n=0}^{\infty}\frac{{}_{p}(\gamma)_{(n+j)q,k}}{{}_{p}\Gamma_{k}(n\alpha+\beta)}\frac{z^{-\frac{n\alpha}{k}}}{(n+j)!}\frac{\Gamma(\frac{n\alpha+\beta}{k})\Gamma(\vartheta)}{\Gamma(\frac{n\alpha+\beta-k\vartheta}{k})},$$

using the equation (1.5), we have

$$A \equiv p^{-\vartheta}z^{-\frac{\beta}{k}}\ {}_{p}^{j}E_{k,\alpha,\beta-k\vartheta}^{\gamma,q}(z^{-\frac{\alpha}{k}}).$$

Hence, we get the desired result.

4 Recurrence Relation and Integral Representation of the j-generalized p - k Mittag-Leffler Function

In this section we evaluate the recurrence relations and integral representations of the j-generalized p - k Mittag-Leffler function.

Theorem 4.1 For $k,p\in R^{+}-\{0\};\ \alpha+r,\beta+s+k,\gamma\in C/kZ^{-};\ R(\alpha+r)>0, R(\beta+s+k)>0, R(\gamma)>0, q\in(0,1)\cup N, j\in N_{0}$, we get

$$\begin{aligned}{}_{p}^{j}E_{k,\alpha+r,\beta+s+k}^{\gamma,q}(z)-p\ {}_{p}^{j}E_{k,\alpha+r,\beta+s+2k}^{\gamma,q}(z)=\frac{p^{2}}{k^{2}}\Big[&(\alpha+r)^{2}z^{2}\ {}_{p}^{j}\ddot{E}_{k,\alpha+r,\beta+s+3k}^{\gamma,q}(z)\\&+\Big\{(\alpha+r)^{2}+(\alpha+r)(2\beta+2s+2k)z\Big\}\ {}_{p}^{j}\dot{E}_{k,\alpha+r,\beta+s+3k}^{\gamma,q}(z)\\&+(\beta+s)(\beta+s+2k)\ {}_{p}^{j}E_{k,\alpha+r,\beta+s+3k}^{\gamma,q}(z)\Big],\end{aligned}\tag{4.1}$$

where ${}_{p}^{j}\dot{E}_{k,\alpha,\beta}^{\gamma,q}(z)=\frac{d}{dz}\ {}_{p}^{j}E_{k,\alpha,\beta}^{\gamma,q}(z)$ and ${}_{p}^{j}\ddot{E}_{k,\alpha,\beta}^{\gamma,q}(z)=\frac{d^{2}}{dz^{2}}\ {}_{p}^{j}E_{k,\alpha,\beta}^{\gamma,q}(z)$.

Proof: The j-generalized p-k Mittag-Leffler function, from equation (2.1),

$${}_{p}^{j}E_{k,\alpha+r,\beta+s+k}^{\gamma,q}(z)=\sum_{n=0}^{\infty}\frac{{}_{p}(\gamma)_{(n+j)q,k}\ z^{n}}{{}_{p}\Gamma_{k}(n(\alpha+r)+\beta+s+k)((n+j)!)},$$

using equation (1.9), we have

$${}_{p}^{j}E_{k,\alpha+r,\beta+s+k}^{\gamma,q}(z)=\sum_{n=0}^{\infty}\frac{k}{p}\frac{{}_{p}(\gamma)_{(n+j)q,k}\ z^{n}}{{}_{p}\Gamma_{k}(n(\alpha+r)+\beta+s)\{n(\alpha+r)+\beta+s)\}((n+j)!)},\tag{4.2}$$

and

$${}_{p}^{j}E_{k,\alpha+r,\beta+s+2k}^{\gamma,q}(z)=\sum_{n=0}^{\infty}\frac{{}_{p}(\gamma)_{(n+j)q,k}\ z^{n}}{{}_{p}\Gamma_{k}(n(\alpha+r)+\beta+s+2k)((n+j)!)},\tag{4.3}$$

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using equation (1.9), we have

$$ {}_{p}^{j}E_{k,\alpha+r,\beta+s+2k}^{\gamma,q}(z) = \sum_{n=0}^{\infty} \frac{{}_{p}(\gamma)_{(n+j)q,k}\, z^n}{{}_{p}\Gamma_k(n(\alpha+r)+\beta+s)((n+j)!)} $$

$$ \times \frac{k^2}{p^2} \frac{1}{\{n(\alpha+r)+\beta+s)\}\{n(\alpha+r)+\beta+s+k)\}}, $$

$$ {}_{p}^{j}E_{k,\alpha+r,\beta+s+2k}^{\gamma,q}(z) = \sum_{n=0}^{\infty} \frac{k}{p^2}[\frac{1}{(n(\alpha+r)+\beta+s)} - \frac{1}{(n(\alpha+r)+\beta+s+k)}] $$

$$ \times \frac{{}_{p}(\gamma)_{(n+j)q,k}\, z^n}{{}_{p}\Gamma_k(n(\alpha+r)+\beta+s)((n+j)!)}, $$

$$ {}_{p}^{j}E_{k,\alpha+r,\beta+s+2k}^{\gamma,q}(z) = \frac{k}{p^2}[\frac{p}{k}\, {}_{p}^{j}E_{k,\alpha+r,\beta+s+k}^{\gamma,q}(z) - S], $$

$$ S = \frac{p}{k}\, {}_{p}^{j}E_{k,\alpha+r,\beta+s+k}^{\gamma,q}(z) - \frac{p^2}{k}\, {}_{p}^{j}E_{k,\alpha+r,\beta+s+2k}^{\gamma,q}(z), \tag{4.4} $$

where

$$ S = \sum_{n=0}^{\infty} \frac{{}_{p}(\gamma)_{(n+j)q,k}\, z^n}{{}_{p}\Gamma_k(n(\alpha+r)+\beta+s)\{n(\alpha+r)+\beta+s+k)\}((n+j)!)}, \tag{4.5} $$

applying the simple identity $\frac{1}{u} = \frac{k}{u(u+k)} + \frac{1}{u+k}$; for $u = n(\alpha+r)+\beta+s+k$ to (4.5),we obtain,

$$ S = \sum_{n=0}^{\infty} \frac{k\, {}_{p}(\gamma)_{(n+j)q,k}\, z^n}{{}_{p}\Gamma_k(n(\alpha+r)+\beta+s)((n+j)!)} \times \frac{1}{\{n(\alpha+r)+\beta+s+k\}\{n(\alpha+r)+\beta+s+2k\}} $$

$$ + \sum_{n=0}^{\infty} \frac{{}_{p}(\gamma)_{(n+j)q,k}\, z^n}{{}_{p}\Gamma_k(n(\alpha+r)+\beta+s)\{n(\alpha+r)+\beta+s+2k)\}((n+j)!)}, $$

$$ S = \sum_{n=0}^{\infty} \frac{k\{n(\alpha+r)+\beta+s\}_{p}(\gamma)_{(n+j)q,k}\, z^n}{{}_{p}\Gamma_k(n(\alpha+r)+\beta+s)((n+j)!)} $$

$$ \times \frac{1}{\{n(\alpha+r)+\beta+s\}\{n(\alpha+r)+\beta+s+k\}\{n(\alpha+r)+\beta+s+2k\}} $$

$$ + \sum_{n=0}^{\infty} \frac{\{n(\alpha+r)+\beta+s\}\{n(\alpha+r)+\beta+s+k\}_{p}(\gamma)_{(n+j)q,k}\, z^n}{{}_{p}\Gamma_k(n(\alpha+r)+\beta+s)((n+j)!)} $$

$$ \times \frac{1}{\{n(\alpha+r)+\beta+s\}\{n(\alpha+r)+\beta+s+k\}\{n(\alpha+r)+\beta+s+2k\}}, $$

using equation (1.9), we obtain

$$ S = \sum_{n=0}^{\infty} \frac{k\{n(\alpha+r)+\beta+s\}_{p}(\gamma)_{(n+j)q,k}\, z^n}{\frac{k^3}{p^3}\, {}_{p}\Gamma_k(n(\alpha+r)+\beta+s+3k)((n+j)!)} $$

$$ + \sum_{n=0}^{\infty} \frac{\{n(\alpha+r)+\beta+s\}\{n(\alpha+r)+\beta+s+k\}_{p}(\gamma)_{(n+j)q,k}\, z^n}{\frac{k^3}{p^3}\, {}_{p}\Gamma_k(n(\alpha+r)+\beta+s+3k)((n+j)!)}, $$

$$ S\frac{k^3}{p^3} = \sum_{n=0}^{\infty} \frac{{}_{p}(\gamma)_{(n+j)q,k}\, z^n}{{}_{p}\Gamma_k(n(\alpha+p)+\beta+s+3k)((n+j)!)} $$

$$ \times [n^2(\alpha+r)^2 + 2n(\alpha+r)(\beta+s+k) + (\beta+s)(\beta+s+2k)]. \tag{4.6} $$

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We now express each summation in the right hand side of (4.6) as follows:

$$\frac{d}{dz}[z\,{}_p^j E_{k,\alpha+r,\beta+s+3k}^{\gamma,q}(z)] = \sum_{n=0}^{\infty} \frac{(n+1)\,{}_p(\gamma)_{(n+j)q,k}\,z^n}{{}_p\Gamma_k(n(\alpha+r)+\beta+s+3k)((n+j)!)},$$

$$z\,{}_p^j \dot{E}_{k,\alpha+r,\beta+s+3k}^{\gamma,q}(z) + {}_p^j E_{k,\alpha+r,\beta+s+3k}^{\gamma,q}(z) = \sum_{n=0}^{\infty} \frac{(n+1)\,{}_p(\gamma)_{(n+j)q,k}\,z^n}{{}_p\Gamma_k(n(\alpha+r)+\beta+s+3k)((n+j)!)},$$

$$z\,{}_p^j \dot{E}_{k,\alpha+r,\beta+s+3k}^{\gamma,q}(z) = \sum_{n=0}^{\infty} \frac{n\,{}_p(\gamma)_{(n+j)q,k}\,z^n}{{}_p\Gamma_k(n(\alpha+r)+\beta+s+3k)((n+j)!)}. \tag{4.7}$$

Again

$$\frac{d^2}{dz^2}[z^2\,{}_p^j E_{k,\alpha+r,\beta+s+3k}^{\gamma,q}(z)] = \sum_{n=0}^{\infty} \frac{(n+1)(n+2)\,{}_p(\gamma)_{(n+j)q,k}\,z^n}{{}_p\Gamma_k(n(\alpha+r)+\beta+s+3k)((n+j)!)}, \tag{4.8}$$

and

$$\frac{d^2}{dz^2}[z^2\,{}_p^j E_{k,\alpha+r,\beta+s+3k}^{\gamma,q}(z)]$$

$$= z^2\,{}_p^j \ddot{E}_{k,\alpha+r,\beta+s+3k}^{\gamma,q}(z) + 4z\,{}_p^j \dot{E}_{k,\alpha+r,\beta+s+3k}^{\gamma,q}(z) + 2\,{}_p^j E_{k,\alpha+r,\beta+s+3k}^{\gamma,q}(z), \tag{4.9}$$

from equation (4.8) and (4.9) we have

$$\sum_{n=0}^{\infty} \frac{\{n^2\}_p(\gamma)_{(n+j)q,k}\,z^n}{{}_p\Gamma_k(n(\alpha+r)+\beta+s+3k)((n+j)!)} = z^2\,{}_p^j \ddot{E}_{k,\alpha+r,\beta+s+3k}^{\gamma,q}(z)$$

$$+ 4z\,{}_p^j \dot{E}_{k,\alpha+r,\beta+s+3k}^{\gamma,q}(z) - 3\sum_{n=0}^{\infty} \frac{\{n\}_p(\gamma)_{(n+j)q,k}\,z^n}{{}_p\Gamma_k(n(\alpha+r)+\beta+s+3k)((n+j)!)},$$

using equation (4.7), we have

$$\sum_{n=0}^{\infty} \frac{\{n^2\}_p(\gamma)_{(n+j)q,k}\,z^n}{{}_p\Gamma_k(n(\alpha+r)+\beta+s+3k)((n+j)!)}$$

$$= z^2\,{}_p^j \ddot{E}_{k,\alpha+r,\beta+s+3k}^{\gamma,q}(z) + z\,{}_p^j \dot{E}_{k,\alpha+r,\beta+s+3k}^{\gamma,q}(z), \tag{4.10}$$

applying equation (4.4), (4.7) and (4.10) to (4.6), we get

$$\frac{k^3}{p^3}S = (\alpha+r)^2 z^2\,{}_p^j \ddot{E}_{k,\alpha+r,\beta+s+3k}^{\gamma,q}(z) + \Big[(\alpha+r)^2 + (\alpha+r)(2\beta+2s+2k)\Big]z$$

$$\times\,{}_p^j \dot{E}_{k,\alpha+r,\beta+s+3k}^{\gamma,q}(z) + (\beta+s)(\beta+s+2k)\,{}_p^j E_{k,\alpha+r,\beta+s+3k}^{\gamma,q}(z),$$

Hence.

Theorem 4.2 For $k,p \in R^+ - \{0\}$; $\alpha+r, \beta+s+k, \gamma \in C/kZ^-$; $R(\alpha+r) > 0, R(\beta+s+k) > 0, R(\gamma) > 0, q \in (0,1) \cup N, j \in N_0$, we get

$$\int_0^1 t^{\beta+s+k-1}\,{}_p^j E_{k,\alpha+r,\beta+s}^{\gamma,q}(t^{\alpha+r})dt = \frac{p}{k}\,{}_p^j E_{k,\alpha+r,\beta+s+k}^{\gamma,q}(1) - \frac{p^2}{k}\,{}_p^j E_{k,\alpha+r,\beta+s+2k}^{\gamma,q}(1). \tag{4.11}$$

Proof: Put $z = 1$ in equation (4.4) and (4.5), we have

$$S = \frac{p}{k}\,{}_p^j E_{k,\alpha+r,\beta+s+k}^{\gamma,q}(1) - \frac{p^2}{k}\,{}_p^j E_{k,\alpha+r,\beta+s+2k}^{\gamma,q}(1)$$

$$= \sum_{n=0}^{\infty} \frac{{}_p(\gamma)_{(n+j)q,k}}{{}_p\Gamma_k(n(\alpha+r)+\beta+s)\{n(\alpha+r)+\beta+s+k)\}((n+j)!)}, \tag{4.12}$$

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now consider the integral,

$$A \equiv \int_0^1 t^{\beta+s+k-1}\, {}_p^j E_{k,\alpha+r,\beta+s}^{\gamma,q}(t^{\alpha+r})dt,$$

using the equation (2.1), we have

$$A \equiv \sum_{n=0}^{\infty} \frac{{}_p(\gamma)_{(n+j)q,k}}{{}_p\Gamma_k(n(\alpha+r)+\beta+s)((n+j)!)} \int_0^1 t^{n(\alpha+r)+\beta+s+k-1}dt,$$

$$A \equiv \sum_{n=0}^{\infty} \frac{{}_p(\gamma)_{(n+j)q,k}}{{}_p\Gamma_k(n(\alpha+r)+\beta+s)\{n(\alpha+r)+\beta+s+k)\}((n+j)!)},$$

from equation (4.12), we have the desired result.

Theorem 4.3 For $k,p \in R^+ - \{0\}; \alpha,\beta,\gamma,\delta \in C; R(\alpha) > 0, R(\beta) > 0, R(\gamma) > 0, R(\delta) > 0$ *and* $q \in (0,1) \cup N, j \in N_0$ then

$$p^{\delta}\, {}_p^j E_{k,\alpha,\beta+\delta k}^{\gamma,q}(z) = \frac{1}{\Gamma(\delta)} \int_0^1 u^{\frac{\beta}{k}-1}(1-u)^{\delta-1}\, {}_p^j E_{k,\alpha,\beta}^{\gamma,q}(z\, u^{\frac{\alpha}{k}})du. \tag{4.13}$$

Proof : Consider the right side integral and using equation (2.1), we have

$$A \equiv \frac{1}{\Gamma(\delta)} \int_0^1 u^{\frac{\beta}{k}-1}(1-u)^{\delta-1}\, {}_p^j E_{k,\alpha,\beta}^{\gamma,q}(z\, u^{\frac{\alpha}{k}})du,$$

$$A \equiv \frac{1}{\Gamma(\delta)} \sum_{n=0}^{\infty} \frac{{}_p(\gamma)_{(n+j)q,k}\, z^n}{{}_p\Gamma_k(n\alpha+\beta)((n+j)!)} \int_0^1 u^{\frac{\alpha n+\beta}{k}-1}(1-u)^{\delta-1}du,$$

using the definition of Beta function, we have

$$A \equiv \frac{1}{\Gamma(\delta)} \sum_{n=0}^{\infty} \frac{{}_p(\gamma)_{(n+j)q,k}\, z^n}{{}_p\Gamma_k(n\alpha+\beta)((n+j)!)} \frac{\Gamma(\frac{\alpha n+\beta}{k})\Gamma(\delta)}{\Gamma(\frac{\alpha n+\beta}{k}+\delta)},$$

applying equation (1.5), we have

$$A \equiv \sum_{n=0}^{\infty} \frac{p^{\delta}\, {}_p(\gamma)_{(n+j)q,k}\, z^n}{{}_p\Gamma_k(n\alpha+\beta+\delta k)((n+j)!)} = p^{\delta}\, {}_p^j E_{k,\alpha,\beta+\delta k}^{\gamma,q}(z),$$

Hence.

Theorem 4.4 For $k,p \in R^+ - \{0\}; \beta,\gamma \in C; R(\beta) > 0, R(\gamma) > 0$ *and* $\alpha,q \in N, j \in N_0$, then

$${}_p^j E_{k,k\alpha,\beta}^{\gamma,q}(z) = \frac{{}_p(\gamma)_{jq,k}}{{}_p\Gamma_k(\beta)} \prod_{i=1}^{q} \prod_{l=1}^{\alpha} \frac{\Gamma(b_l)}{\Gamma(a_i)\Gamma(b_l-a_i)} \int_0^1 u^{a_i-1}(1-u)^{b_l-a_i-1} E_{1,j+1}\Big(uz\frac{p^{q-\alpha}q^q}{\alpha^{\alpha}}\Big)du. \tag{4.14}$$

Where $a_i = \dfrac{\frac{\gamma}{k}+qj+i-1}{q}$ and $b_l = \dfrac{\frac{\beta}{k}+l-1}{\alpha}$.

Proof : Using definition of j-generalized p-k Mittag- Leffler function, from equation (2.1),

$$A \equiv {}_p^j E_{k,k\alpha,\beta}^{\gamma,q}(z) = \sum_{n=0}^{\infty} \frac{{}_p(\gamma)_{(n+j)q,k}\, z^n}{{}_p\Gamma_k(nk\alpha+\beta)((n+j)!)},$$

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using relation (1.11),we have

$$A \equiv \sum_{n=0}^{\infty} \frac{{}_p(\gamma)_{jq,k}\, {}_p(\gamma + jqk)_{nq,k}\, z^n}{{}_p(\beta)_{n\alpha,k}\, {}_p\Gamma_k(\beta)((n+j)!)} = \sum_{n=0}^{\infty} D \frac{{}_p(\gamma)_{jq,k}\, z^n}{{}_p\Gamma_k(\beta)((n+j)!)}. \tag{4.15}$$

Where $D \equiv \frac{{}_p(\gamma + jqk)_{nq,k}}{{}_p(\beta)_{n\alpha,k}}$,
using equation (1.6), we have

$$D \equiv \frac{{}_p(\gamma + jqk)_{nq,k}}{{}_p(\beta)_{n\alpha,k}} = \frac{p^{n(q-\alpha)}(\frac{\gamma+jqk}{k})_{qn}}{(\frac{\beta}{k})_{n\alpha}},$$

using the relation given by equation (1.7), we have

$$D \equiv \frac{p^{(q-\alpha)n} q^{qn} \prod_{i=1}^{q} (\frac{\frac{\gamma}{k}+jq+i-1}{q})_n}{\alpha^{\alpha n} \prod_{l=1}^{\alpha} (\frac{\frac{\beta}{k}+l-1}{\alpha})_n},$$

$$let\ a_i = \frac{\frac{\gamma}{k} + jq + i - 1}{q}\ and\ b_l = \frac{\frac{\beta}{k} + l - 1}{\alpha},$$

$$D \equiv (\frac{p^{(q-\alpha)} q^q}{\alpha^\alpha})^n \prod_{i=1}^{q} \prod_{l=1}^{\alpha} \frac{(a_i)_n}{(b_l)_n},$$

$$D \equiv (\frac{p^{(q-\alpha)} q^q}{\alpha^\alpha})^n \prod_{i=1}^{q} \prod_{l=1}^{\alpha} \frac{\Gamma(a_i+n)\Gamma(b_l)}{\Gamma(b_l+n)\Gamma(a_i)},$$

$$D \equiv (\frac{p^{(q-\alpha)} q^q}{\alpha^\alpha})^n \prod_{i=1}^{q} \prod_{l=1}^{\alpha} \frac{\Gamma(b_l)}{\Gamma(b_l-a_i)\Gamma(a_i)} \frac{\Gamma(a_i+n)\Gamma(b_l-a_i)}{\Gamma(b_l-a_i+a_i+n)},$$

using the definition of Beta function, we have

$$D \equiv (\frac{p^{(q-\alpha)} q^q}{\alpha^\alpha})^n \prod_{i=1}^{q} \prod_{l=1}^{\alpha} \frac{\Gamma(b_l)}{\Gamma(b_l-a_i)\Gamma(a_i)} \int_0^1 u^{a_i+n-1}(1-u)^{b_l-a_i-1} du, \tag{4.16}$$

from equation (4.15) and (4.16), we have

$$A \equiv \frac{{}_p(\gamma)_{jq,k}}{{}_p\Gamma_k(\beta)} \prod_{i=1}^{q} \prod_{l=1}^{\alpha} \frac{\Gamma(b_l)}{\Gamma(b_j-a_i)\Gamma(a_i)} \int_0^1 u^{a_i-1}(1-u)^{b_j-a_i-1} \sum_{n=0}^{\infty} \frac{(uz)^n}{(n+j)!} (\frac{p^{(q-\alpha)} q^q}{\alpha^\alpha})^n du,$$

Hence.

Theorem 4.5 For $k, p \in R^+ - \{0\}; \alpha, \beta, \gamma \in C; R(\alpha) > 0, R(\beta) > 0, R(\gamma) > 0$ and $q \in (0,1) \cup N, j \in N_0$ then

$${}^j_p E^{\gamma,q}_{k,\alpha,\beta}(z) = \frac{p^{jq}}{\Gamma(\frac{\gamma}{k})} \int_0^\infty e^{-t}\, t^{(\frac{\gamma}{k}+jq-1)}\, {}^j_p E^{1,0}_{k,\alpha,\beta}(zt^q p^q) dt. \tag{4.17}$$

Proof: Using definition of j-generalized p-k Mittag-Leffler function, equation (2.1), we have

$${}^j_p E^{\gamma,q}_{k,\alpha,\beta}(z) = \sum_{n=0}^{\infty} \frac{{}_p(\gamma)_{(n+j)q,k}\, z^n}{{}_p\Gamma_k(n\alpha+\beta)((n+j)!)},$$

using equation (1.5) and (1.6), we have

$${}^j_p E^{\gamma,q}_{k,\alpha,\beta}(z) = \sum_{n=0}^{\infty} \frac{z^n}{{}_p\Gamma_k(n\alpha+\beta)((n+j)!)} \frac{p^{(n+j)q}\Gamma(\frac{\gamma}{k}+q(n+j))}{\Gamma(\frac{\gamma}{k})},$$

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$$ {}^{j}_{p}E^{\gamma,q}_{k,\alpha,\beta}(z) = \sum_{n=0}^{\infty} \frac{z^n}{{}_p\Gamma_k(n\alpha+\beta)((n+j)!)} \frac{p^{q(n+j)}}{\Gamma(\frac{\gamma}{k})} \int_0^{\infty} e^{-t}\, t^{(\frac{\gamma}{k}+q(n+j)-1)} dt, $$

$$ {}^{j}_{p}E^{\gamma,q}_{k,\alpha,\beta}(z) = \frac{p^{jq}}{\Gamma(\frac{\gamma}{k})} \int_0^{\infty} e^{-t}\, t^{(\frac{\gamma}{k}+jq-1)} \sum_{n=0}^{\infty} \frac{z^n\, p^{qn}\, t^{qn}}{{}_p\Gamma_k(n\alpha+\beta)((n+j)!)} dt, $$

$$ {}^{j}_{p}E^{\gamma,q}_{k,\alpha,\beta}(z) = \frac{p^{jq}}{\Gamma(\frac{\gamma}{k})} \int_0^{\infty} e^{-t}\, t^{(\frac{\gamma}{k}+jq-1)}\, {}^{j}_{p}E^{1,0}_{k,\alpha,\beta}(zt^q p^q) dt. $$

Hence.

5 Integral Transform of the j-generalized P-K Mittag-Leffler Function

In this section we evaluate Mellin-Barnes integral representation of j-generalized p-k Mittag-Leffler function, relationship with Fox H-function and Wright hypergeometric function. Also evaluate Euler Beta Transform, Laplace Transform and Mellin Transform of j-generalized p-k Mittag-Leffler function.

Mellin-Barnes integral representation of the j-generalized p-k Mittag-Leffler function.

Theorem 5.1 Let $k, p \in R^+ - \{0\}; Re(\alpha) > 0, Re(\beta) > 0, Re(\gamma) > 0, and\, q \in (0,1) \cup N, j \in N_0$, then the j-generalized p-k Mittag-Leffler function is represented by the Mellin-Barnes integral as,

$$ {}^{j}_{p}E^{\gamma,q}_{k,\alpha,\beta}(z) = \frac{kp^{jq-\frac{\beta}{k}}}{2\pi i\Gamma(\frac{\gamma}{k})} \int_L \frac{\Gamma(s)\Gamma(1-s)\Gamma(\frac{\gamma}{k}+jq-qs)}{\Gamma(\frac{\beta}{k}-\frac{\alpha s}{k})\Gamma(1+j-s)} (-zp^{q-\frac{\alpha}{k}})^{-s} ds. \tag{5.1} $$

Where $|\, argz\, | < \pi$; the contour integration beginning at $-i\infty$ and ending at $+i\infty$, and indented to separate the poles of the integrand as $s = -n$ for every $n \in N_0$(to the left) from those at $s = \frac{\frac{\gamma}{k}+n}{q}$ for every $n \in N_0$ (to the right).

Proof Consider the integral on right side of equation(5.1) and use the theorem of calculus of residues,

$$ A \equiv \frac{kp^{jq-\frac{\beta}{k}}}{2\pi i\Gamma(\frac{\gamma}{k})} \int_L \frac{\Gamma(s)\Gamma(1-s)\Gamma(\frac{\gamma}{k}+jq-qs)}{\Gamma(\frac{\beta}{k}-\frac{\alpha s}{k})\Gamma(1+j-s)} (-zp^{q-\frac{\alpha}{k}})^{-s} ds $$

$= 2\pi i$[sum of the residues at the poles $s = 0, -1, -2, ...$]

$$ A \equiv \frac{kp^{jq-\frac{\beta}{k}}}{\Gamma(\frac{\gamma}{k})} \sum_{n=0}^{\infty} \underset{s=-n}{Re} \quad (s+n)\Big[\frac{\Gamma(s)\Gamma(1-s)\Gamma(\frac{\gamma}{k}+jq-qs)}{\Gamma(\frac{\beta}{k}-\frac{\alpha s}{k})\Gamma(1+j-s)}\Big](-zp^{q-\frac{\alpha}{k}})^{-s} $$

$$ A \equiv \frac{kp^{jq-\frac{\beta}{k}}}{\Gamma(\frac{\gamma}{k})} \sum_{n=0}^{\infty} \lim_{s\to -n} \Big[\frac{\pi(s+n)}{sin\pi s} \frac{\Gamma(\frac{\gamma}{k}+jq-qs)}{\Gamma(1+j-s)\Gamma(\frac{\beta}{k}-\frac{\alpha s}{k})}\Big](-zp^{q-\frac{\alpha}{k}})^{-s} $$

$$ A \equiv \frac{kp^{jq-\frac{\beta}{k}}}{\Gamma(\frac{\gamma}{k})} \sum_{n=0}^{\infty} \Big[\frac{\Gamma(\frac{\gamma}{k}+jq+qn)}{\Gamma(1+j+s)\Gamma(\frac{\beta}{k}+\frac{\alpha n}{k})}\Big](zp^{q-\frac{\alpha}{k}})^{n} $$

using equations (1.5) and (1.6), we have,

$$ A \equiv {}^{j}_{p}E^{\gamma,q}_{k,\alpha,\beta}(z). $$

Hence.

Relationship with Fox H-function

Theorem 5.2 Let $k, p \in R^+ - \{0\}; Re(\alpha) > 0, Re(\beta) > 0, Re(\gamma) > 0, and\, q \in (0,1) \cup N, j \in N_0$

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then the j-generalized p-k Mittag-Leffler function is given in the form of Fox H-function, as.

$$ {}^{j}_{p}E^{\gamma,q}_{k,\alpha,\beta}(z) = \frac{kp^{jq-\frac{\beta}{k}}}{\Gamma(\frac{\gamma}{k})} H^{1,2}_{2,3}\left[-zp^{q-\frac{\alpha}{k}} \middle| \begin{matrix} (0,1),(1-\frac{\gamma}{k}-jq,q); \\ (0,1),(1-\frac{\beta}{k},\frac{\alpha}{k}),(-j,1); \end{matrix} \right]. \tag{5.2} $$

Proof. Using the equations (5.1) and (1.25), we get the desired result.

Relationship with Wright hypergeometric function

Theorem 5.3 Let $k,p \in R^{+}-\{0\}; Re(\alpha)>0, Re(\beta)>0, Re(\gamma)>0, and\, q \in (0,1)\cup N, j \in N_0$, then the j-generalized p-k Mittag-Leffler function is given in the form of Wright hypergeometric function, as.

$$ {}^{j}_{p}E^{\gamma,q}_{k,\alpha,\beta}(z) = \frac{kp^{jq-\frac{\beta}{k}}}{\Gamma(\frac{\gamma}{k})}\, {}_2\Psi_2\left[\begin{matrix} (1,1)\ (\frac{\gamma}{k}+jq,q); \\ (\frac{\beta}{k},\frac{\alpha}{k})(1+j,1); \end{matrix} zp^{q-\frac{\alpha}{k}} \right]. \tag{5.3} $$

Proof. Using the equations (5.1) and (1.24), we get the desired result.

Euler Beta Transform, Laplace Transform and Mellin Transform of j-generalized p-k Mittag-Leffler function

Theorem 5.4 Let $k,p \in R^{+}-\{0\}; a,b,\sigma \in C; Re(\alpha)>0, Re(\beta)>0, Re(\gamma)>0, Re(\sigma)>0$ and $q \in (0,1)\cup N, j \in N_0$, then Euler Beta Transform of j-generalized p-k Mittag-Leffler function, is given by,

$$ \int_0^1 z^{a-1}(1-z)^{b-1}\, {}^{j}_{p}E^{\gamma,q}_{k,\alpha,\beta}(xz^{\sigma})dz = \frac{kp^{jq-\frac{\beta}{k}}\Gamma(b)}{\Gamma(\frac{\gamma}{k})}\, {}_3\psi_3\left[\begin{matrix} (1,1),(\frac{\gamma}{k}+qj,q),(a,\sigma); \\ (\frac{\beta}{k},\frac{\alpha}{k}),(1+j,1),(a+b,\sigma); \end{matrix} xp^{q-\frac{\alpha}{k}} \right] \tag{5.4} $$

Proof Consider the left side integral and using equation (5.4), we have

$$ A \equiv \int_0^1 z^{a-1}(1-z)^{b-1}\, {}^{j}_{p}E^{\gamma,q}_{k,\alpha,\beta}(xz^{\sigma})dz $$

$$ A \equiv \sum_{n=0}^{\infty} \frac{{}_p(\gamma)_{(n+j)q,k}\, x^n}{{}_p\Gamma_k(n\alpha+\beta)\,(n+j)!} \int_0^1 z^{\sigma n+a-1}(1-z)^{b-1}dz, $$

using definition of Beta function, we have

$$ A \equiv \sum_{n=0}^{\infty} \frac{{}_p(\gamma)_{(n+j)q,k}\, x^n}{{}_p\Gamma_k(n\alpha+\beta)\,(n+j)!} B(\sigma n+a,b) $$

using equation (1.5),(1.6) and (1.24), we have

$$ A \equiv \frac{kp^{jq-\frac{\beta}{k}}\Gamma(b)}{\Gamma(\frac{\gamma}{k})}\, {}_3\psi_3\left[\begin{matrix} (1,1),(\frac{\gamma}{k}+qj,q),(a,\sigma); \\ (\frac{\beta}{k},\frac{\alpha}{k}),(1+j,1),(a+b,\sigma); \end{matrix} xp^{q-\frac{\alpha}{k}} \right]. $$

Hence.

Theorem 5.5 The Laplace transform of j-generalizedp-k Mittag-Leffler function, is given by,

$$ \int_0^{\infty} z^{a-1}e^{-zs}\, {}^{j}_{p}E^{\gamma,q}_{k,\alpha,\beta}(xz^{\sigma})dz = \frac{kp^{jq-\frac{\beta}{k}}\, s^{-a}}{\Gamma(\frac{\gamma}{k})}\, {}_3\psi_2\left[\begin{matrix} (1,1),(\frac{\gamma}{k}+qj,q),(a,\sigma); \\ (\frac{\beta}{k},\frac{\alpha}{k})(1+j,1); \end{matrix} \frac{xp^{q-\frac{\alpha}{k}}}{s^{\sigma}} \right] \tag{5.5} $$

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Where $k, p \in R^+ - \{0\}$; $a, \sigma \in C$; $Re(\alpha) > 0, Re(\beta) > 0, Re(\gamma) > 0, Re(\sigma) > 0$ and $q \in (0,1) \cup N, j \in N_0$, and $|\frac{x}{s^\sigma}| < 1$.

Proof Consider the right side integral and using equation(2.1), we have

$$A \equiv \int_0^\infty z^{a-1} e^{-zs}\, {}_p^j E_{k,\alpha,\beta}^{\gamma,q}(xz^\sigma) dz$$

$$A \equiv \sum_{n=0}^{\infty} \frac{{}_p(\gamma)_{(n+j)q,k}}{{}_p\Gamma_k(n\alpha+\beta)} \frac{x^n}{(n+j)!} \int_0^\infty z^{n\sigma+a-1}\, e^{-zs} dz,$$

using definition of gamma function, we have

$$A \equiv s^{-a} \quad \sum_{n=0}^{\infty} \frac{{}_p(\gamma)_{(n+j)q,k}}{{}_p\Gamma_k(n\alpha+\beta)\,(n+j)!} \Gamma(\sigma n + a)(\frac{x}{s^\sigma})^n$$

using equation (1.5),(1.6) and (1.24), we have

$$A \equiv \frac{k p^{jq-\frac{\beta}{k}}\, s^{-a}}{\Gamma(\frac{\gamma}{k})}\; {}_3\psi_2 \left[\begin{matrix} (1,1), (\frac{\gamma}{k}+qj, q), (a,\sigma); \\ \\ (\frac{\beta}{k}, \frac{\alpha}{k})(1+j,1); \end{matrix} \begin{matrix} \\ \frac{x p^{q-\frac{\alpha}{k}}}{s^\sigma} \\ \\ \end{matrix} \right].$$

Hence.

Theorem 5.6 The Mellin transform of j-generalized p-k Mittag-Leffler function, is given by,

$$\int_0^\infty t^{s-1}\, {}_p^j E_{k,\alpha,\beta}^{\gamma,q}(-wt) dt = \frac{k p^{qj-\frac{\beta}{k}} \Gamma(s)\,\Gamma(1-s)\,\Gamma(\frac{\gamma}{k}+qj-qs)}{\Gamma(\frac{\beta}{k}-\frac{\alpha s}{k})\Gamma(\frac{\gamma}{k})\Gamma(1+j-s)} (\frac{p^{\frac{\alpha}{k}-q}}{w})^s \tag{5.6}$$

Where $k, p \in R^+ - \{0\}$; $a, \sigma \in C$; $Re(\alpha) > 0, Re(\beta) > 0, Re(\gamma) > 0, Re(s) > 0$ and $q \in (0,1) \cup N, j \in N_0$.

Proof Putting z = -wt in equation (5.1), we have

$${}_p^j E_{k,\alpha,\beta}^{\gamma,q}(-wt) = \frac{k p^{jq-\frac{\beta}{k}}}{2\pi i \Gamma(\frac{\gamma}{k})} \int_L \frac{\Gamma(s)\Gamma(1-s)\Gamma(\frac{\gamma}{k}+jq-qs)}{\Gamma(\frac{\beta}{k}-\frac{\alpha s}{k})\Gamma(1+j-s)} (-wtp^{q-\frac{\alpha}{k}})^{-s} ds.$$

$${}_p^j E_{k,\alpha,\beta}^{\gamma,q}(-wt) = \frac{k p^{jq-\frac{\beta}{k}}}{2\pi i \Gamma(\frac{\gamma}{k})} \int_L f^*(s)(t)^{-s} ds. \tag{5.7}$$

where

$$f^*(s) = \frac{\Gamma(s)\Gamma(1-s)\,\Gamma(\frac{\gamma}{k}+jq-qs)}{\Gamma(\frac{\gamma}{k})\Gamma(\frac{\beta}{k}-\frac{\alpha s}{k})\Gamma(1+j-s)} (-wp^{q-\frac{\alpha}{k}})^{-s}$$

using equation (1.28),(1.29) and (5.7), which immediately leads to (3.9).

Particular cases: Putting some particular values of $j, p, q, k, \alpha, \beta, \gamma$ we obtain all the results given by [1], [3],[8],[9],[10],[11],[12],[13]and [14].

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Investigation of Structural Plate with Cracks and Hole under Combined Loading

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Abstract. *Here, XFEM is used to model structural discontinuities like cracks and holes in order to forecast the strength and dependability of the structure under service conditions. By contrasting the numerical outcomes of several issues with the analytical and experimental findings, the method's resilience has been shown. Additionally, XFEM is coupled with a stochastic method to predict the sensitivity of a structure with discontinuities (cracks and holes) under tensile loading conditions in terms of output COVs and fracture strength in terms of mean values of stress intensity factors (SIFs) using input individual and combined randomness in various system parameters. The second order perturbation technique has been utilized in stochastic / perturbation theory to forecast how constructions would fracture. The perturbation technique is also utilized as Taylor series expansion method and yields accurate results if the input randomness is less than twenty percentage.*

Keywords. XFEM, COV, MMSIF, Stochastic, Perturbation

1. Introduction

We are aware that randomness always exists in reality and affects every aspect of a construction, including its geometry, strength, lifespan, susceptibility to damage, and fracture parameters. Even with the finest quality control procedures, randomness in system attributes has a major impact on how the mechanical

component responds to fracture. Therefore, randomness, external loads, material qualities, crack parameters, and geometry must all be taken into account when performing a fracture analysis on a structure. The stochastic fracture analysis increases the safety of structures by offering a reliable prediction of the fracture behaviour of the structure. The reliability evaluation methodologies can aid in the creation of preliminary recommendations for reliable designs. Many scholars have successfully analysed the stochastic fracture behaviour of the structure. Through the use of several numerical examples and the scaled boundary finite element method (SBFEM), Chowdhury et al. [1] completed the shape sensitivity analysis (Rahman and Chen [2]; Reddy and Rao [3]) of stress intensity variables to the crack size and direction. They performed the reliability assessment by Monte Carlo simulations (Chakraborty and Rahman [4, 5]; Choi et al. [6]; Evangelatos and Spanos [7]; Haldar and Mahadevan [8]; Khasin [9]; Lal and Palekar [10]). Some academics have talked about their work using the perturbation technique to forecast the material's stochastic reaction. In this regard, Rahman and Rao [11] introduced a stochastic meshless technique for resolving random material property boundary-value issues in linear elasticity. For the purpose of forecasting stochastic structure response, they created a meshless formulation. Classical perturbation expansions were produced in conjunction with the meshless equations to forecast the response's second-moment characteristics.

The XFEM has been further improved or enhanced by many researchers through coupling the XFEM with another technique to overcome the difficulties faced by the general XFEM. In the direction, a new set of enrichment functions was proposed for solving the Poisson equation in 1D and 2D spaces and was reduced the analysis error by Paweł [12]. The XFEM was coupled with a constitutive law with embedded discontinuity (CLED) approach for modelling of mixed mode cracking in concrete structure for simplifying the numerical implementation (Pietruszczak and Haghighat, [13]). Improved XFEM was developed for 3D and demonstrated better accuracy, convergence and efficiency. It overcomes the linear dependency problem by utilizing an extra degree of freedom free partition of unity approximation which is based on local least-squares fitting with a one-point interpolation constraint (Tian et al., [14]).

Using XFEM and various independent, combined uncorrelated and correlated input random Gaussian variables using SOPT and MCS, Lal and Markad [15] presented mixed mode SIFs and crack propagation analysis of the symmetric angle-ply laminated composite plate with through-thickness arbitrary curve cracks subjected to tensile and shear stress. The stochastic finite element technique is an extension of the MCS with uncertainty in the system parameters, such as materials, geometry, etc. given by Arregui-Mena et al. [16]. The spectral stochastic finite element approach and the perturbation technique (SSFEM). Lal and Markad [10] utilised a C^0 FEM based on higher order shear deformation plate theory was used to evaluate the second order statistics of MMSIFs of single edge V-notched angle-ply laminated composite plates under in-plane tensile load with uncertainty in material parameters, crack opening, and fracture length (HSDT). With the help of FOPT, SOPT, and MCS, the probabilistic evaluation was carried out.

The few researchers predicted how an infinite plate with a separate circular hole and a crack would fracture under tensile force. To the author's knowledge, XFEM with SOPT has not been used to investigate the stochastic fracture behaviour in terms of normalised MMSIFs and corresponding COVs of the infinite plate with various positions of a separate circular hole and a crack with various crack angles under tensile loading with input random parameters such as crack length, normalised radius of the hole, crack angle, and the central distance between separate hole and crack.

By incorporating the individual and combined randomness in the normalised crack length, crack angle, and normalised radius of the hole in an isotropic plate with a hole emanating cracks using SOPT, the stochastic fracture response through the normalised MMSIFs is calculated. Some results are validated with MCS. Present work is also focuesed on effect of combined loading over stochastic fracture response of the structural plate in terms of normalized MMSIFs.

2. Mathematical formulation

The XFEM is useful for modelling discontinuities like fractures, holes or voids, inclusions, interfaces, etc. while including discontinuous functions in the FE mesh. The level set method (LSM) has been successfully

used in conjunction with the XFEM to address these problems by providing further enrichment functions like crack faces and crack tips. Here, the XFEM software is built upon the 2D MATLAB code by Pais [18].

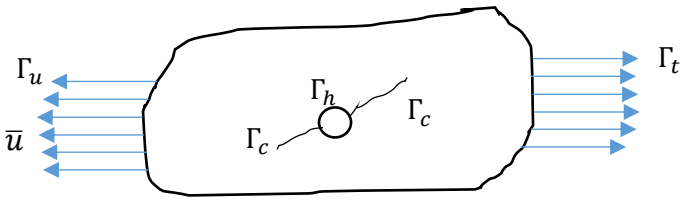


Fig. 1 Area under consideration with cracks, holes, and boundary condition

2.1 Equilibrium equation

The surfaces of cracks Γ_c and holes Γ_h are assumed traction free as are mentioned by Daux et al. [20], and shown in figure 1. The equilibrium equation in the domain Ω is:

$$\tilde{\nabla} \cdot \boldsymbol{\sigma}_t + \mathbf{f}_b = 0 \tag{1}$$

Small strains and displacements are taken into consideration in the current work. Thus, the relationship between strain and displacement illustrates the kinematics equations:

$$\boldsymbol{\varepsilon} = \boldsymbol{\varepsilon}(\mathbf{u}) = \tilde{\nabla}_s \cdot \mathbf{u} \tag{2}$$

Here, $\tilde{\nabla}_s$ is the symmetric part of the gradient operator and $\mathbf{u}$ is a displacement field vector. The boundary conditions for the displacements on the boundary Γ_u are:

$$\mathbf{u} = \bar{\mathbf{u}} . \tag{3}$$

The constitutive relation for elastic material can be shown by Hooke's law as:

$$\boldsymbol{\sigma}_t = \boldsymbol{D} \cdot \boldsymbol{\varepsilon}(\mathbf{u}) \tag{4}$$

where $\boldsymbol{D}$ is Hooke tensor or constitutive matrix for isotropic materials for plane stress and strain conditions in 2D.

The equilibrium equations' weak form is provided by:

$$\int_{\Omega} \boldsymbol{\varepsilon}(\mathbf{u}) : \boldsymbol{D} : \boldsymbol{\varepsilon}(\mathbf{v}) d\Omega = \int_{\Omega} \bar{\mathbf{b}} \cdot \mathbf{v} d\Omega + \int_{\Gamma_t} \bar{\mathbf{t}} \cdot \mathbf{v} d\Gamma \quad \forall \mathbf{v} \in \gamma_0 \tag{5}$$

The linear, FF and bilinear, SS forms of the equation (5) are:

$$FF(\mathbf{v}) = \int_{\Gamma} \bar{\mathbf{b}} \cdot \mathbf{v} d\Omega + \int_{\Gamma_t} \bar{\mathbf{t}} \cdot \mathbf{v} d\Omega \tag{6}$$

$$SS(\mathbf{u}, \mathbf{v}) = \int_{\Omega} \boldsymbol{\varepsilon}(\mathbf{u}) : \boldsymbol{D} : \boldsymbol{\varepsilon}(\mathbf{v}) d\Omega \tag{7}$$

Potential energy (Π) of an elastic body is $\Pi = \frac{1}{2} SS(\mathbf{u}, \mathbf{u}) - FF(\mathbf{u})$ (8)

By applying a variant of the previous equation and substituting $\frac{\partial \Pi}{\partial \mathbf{u}} = 0$, the minimization of the elastic body's potential energy may be solved, and the following set of discrete equations is produced as a result.

$$[\mathbf{K}]\{\mathbf{d}\} = \{\mathbf{f}\} \tag{9}$$

where, $[\mathbf{K}]$ is the global stiffness matrix, $\{\mathbf{d}\}$ are the global degrees of freedom and $\{\mathbf{f}\}$ are the applied loading or force.

$$\mathbf{K}_{ij}^{e} = \begin{bmatrix} \mathbf{K}_{ij}^{uu} & \mathbf{K}_{ij}^{ua} & \mathbf{K}_{ij}^{ub} & \mathbf{K}_{ij}^{ug} \\ \mathbf{K}_{ij}^{au} & \mathbf{K}_{ij}^{aa} & \mathbf{K}_{ij}^{ab} & \mathbf{K}_{ij}^{ag} \\ \mathbf{K}_{ij}^{bu} & \mathbf{K}_{ij}^{ba} & \mathbf{K}_{ij}^{bb} & \mathbf{K}_{ij}^{bg} \\ \mathbf{K}_{ij}^{gu} & \mathbf{K}_{ij}^{ga} & \mathbf{K}_{ij}^{gb} & \mathbf{K}_{ij}^{gg} \end{bmatrix} \tag{10}$$

$$\mathbf{f}_i^e = \left\{ \mathbf{f}_i^u \;\; \mathbf{f}_i^a \;\; \mathbf{f}_i^{b_1} \;\; \mathbf{f}_i^{b_2} \;\; \mathbf{f}_i^{b_3} \;\; \mathbf{f}_i^{b_4} \;\; \mathbf{f}_i^g \right\}^{\mathbf{T}} \tag{11}$$

$$\mathbf{d} = \left\{ \mathbf{u} \;\; \mathbf{a} \;\; \mathbf{b}_1 \;\; \mathbf{b}_1 \;\; \mathbf{b}_1 \;\; \mathbf{b}_1 \;\; \mathbf{g} \right\}^{\mathbf{T}} \tag{12}$$

2.2 XFEM Approximation

XFEM Approximation for Cracks and voids are defined as,

$$\mathbf{u}^{fi}(\mathbf{x}) = \mathbf{u}^{\mathbf{FEM}} + \mathbf{u}^{\mathbf{ENR}} = \sum_{i=1}^{n} \mathcal{N}_i(\mathbf{x}) \left\{ \bar{\mathbf{u}}_i + \sum_{j=1}^{m} \mathbf{F}^j(\mathbf{x}) \mathbf{a}_i^j \right\} \tag{13}$$

Heaviside function for a discontinuous function for the crack and voids defined as,

$$\mathcal{H}_1(\mathbf{x}) = \begin{cases} 1 \text{ for } \boldsymbol{\varphi}(\mathbf{x}) > 0 \\ 0 \text{ for } \boldsymbol{\varphi}(\mathbf{x}) = 0 \\ -1 \text{ for } \boldsymbol{\varphi}(\mathbf{x}) < 0 \end{cases} \quad \text{and} \quad \mathcal{H}_2(\mathbf{x}) = \begin{cases} 1 \text{ for } \chi(\mathbf{x}) > 0 \\ 0 \text{ for } \chi(\mathbf{x}) \le 0 \end{cases} \tag{14}$$

2.3 Level Set Method

For crack, level set method implemented by eq. (15), and for voids by eq. (16). The sign distance function $\phi(\mathbf{x}, \mathrm{t})$ to the curve Γ_c

$$\phi(\mathbf{x}) = \begin{cases} \min\limits_{\mathbf{x}_c \in \Gamma} \left\| \mathbf{x} - \mathbf{x}_c \right\| = d\left(\mathbf{x}, \mathbf{x}_i\right) & \forall \left(\mathbf{x} - \mathbf{x}_c\right) \cdot e_2 \ge 0 \\ \min\limits_{\mathbf{x}_c \in \Gamma} \left\| \mathbf{x} - \mathbf{x}_c \right\| = -d\left(\mathbf{x}, \mathbf{x}_i\right) & \text{otherwise} \end{cases} \tag{15}$$

$$\chi(\mathbf{x},0) = \min_{\mathbf{x}_c^i \in \Omega_c^i} \left\{ \left\| \mathbf{x} - \mathbf{x}_c^i \right\| - \mathrm{r}_c^i \right\} \qquad \text{where, } i = 1, 2, ..., n_c \tag{16}$$

where, d is the absolute distance, $\mathbf{x}_i$ is the point on crack closest to a point x with any point $\mathbf{x}_c$ on the crack surface Γ_c. r_c^i is the radius of the *i*th hole.

2.4 Evaluation of Stress Intensity Factors (SIFs)

For general mixed-mode problems in two dimensions, SIFs and J-integral can be stated as,

$$J = \frac{K_I^2}{E^*} + \frac{K_{II}^2}{E^*} \tag{17}$$

where, $E^* = \begin{cases} E & \text{for plane stress} \\ \dfrac{E}{1-\nu^2} & \text{for plane strain} \end{cases}$ (18)

The J -integral also follows the path-independence and it is explained

$$J = \int_{\Gamma} \left(W n_j - \mathbf{t}_i \cdot \frac{\partial \mathbf{u}_i}{\partial x} \right) d\Gamma \tag{19}$$

where, W is the strain energy density. For the plate of the elastic material, it can explain that $W = (1/2)\boldsymbol{\sigma}_{ij}\boldsymbol{\varepsilon}_{ij}$.

Now, two equilibrium, independent states of a cracked body are considered. Consider the state1, $\left(\boldsymbol{\sigma}_{ij}^{(1)},\boldsymbol{\varepsilon}_{ij}^{(1)},\mathbf{u}_{j}^{(1)}\right)$, corresponds to the present or actual state and state 2, $\left(\boldsymbol{\sigma}_{ij}^{(2)},\boldsymbol{\varepsilon}_{ij}^{(2)},\mathbf{u}_{j}^{(2)}\right)$, is an auxiliary state. Further, $\boldsymbol{\sigma}_{ij}^{(2)}$, $\boldsymbol{\varepsilon}_{ij}^{(2)}$ and $\mathbf{u}_{j}^{(2)}$ are the auxiliary stress field, auxiliary strain filed and auxiliary displacement field, respectively. Thus, superposition of these two states brings another equilibrium state, say, $\left(\boldsymbol{\sigma}_{ij},\boldsymbol{\varepsilon}_{ij},\mathbf{u}_{j}\right)$. Now, we have:

$$\boldsymbol{\sigma}_{ij}=\boldsymbol{\sigma}_{ij}^{(1)}+\boldsymbol{\sigma}_{ij}^{(2)}\quad \boldsymbol{\varepsilon}_{ij}=\boldsymbol{\varepsilon}_{ij}^{(1)}+\boldsymbol{\varepsilon}_{ij}^{(2)}\qquad \mathbf{u}_{j}=\mathbf{u}_{j}^{(1)}+\mathbf{u}_{j}^{(2)} \tag{20}$$

The strain energy densities are:

$$W=W^{(1)}+W^{(2)}\quad W^{(1)}=\frac{1}{2}\boldsymbol{\sigma}_{ij}^{(1)}\boldsymbol{\varepsilon}_{ij}^{(1)}\qquad W^{(2)}=\frac{1}{2}\boldsymbol{\sigma}_{ij}^{(2)}\boldsymbol{\varepsilon}_{ij}^{(2)} \tag{21}$$

$$W=\frac{1}{2}\boldsymbol{\sigma}_{ij}\boldsymbol{\varepsilon}_{ij}=\frac{1}{2}\left(\boldsymbol{\sigma}_{ij}^{(1)}+\boldsymbol{\sigma}_{ij}^{(2)}\right)\left(\boldsymbol{\varepsilon}_{ij}^{(1)}+\boldsymbol{\varepsilon}_{ij}^{(2)}\right)=\frac{1}{2}\left(W^{(1)}+W^{(2)}\right)-\boldsymbol{\sigma}_{ij}^{(1)}\boldsymbol{\varepsilon}_{ij}^{(2)} \tag{22}$$

2.5 Stress intensity factor (SIF)

The Mode-I and Mode-II SIFs are formulated as,

$$K_{I}=K_{I}^{(1)}+K_{I}^{(2)}\quad K_{II}=K_{II}^{(1)}+K_{II}^{(2)} \tag{23}$$

The Mode-I and Mode-II SIFs for the actual state can be obtained by choosing the auxiliary state (state 2), e.g., if auxiliary state 2 is chosen to be state for Mode-I, then the auxiliary state is Mode-I near tip displacement and stress field, then by putting $K_{I}^{(2)}=1$ and $K_{II}^{(2)}=0$ in the equation (23), we have:

$$K_{I}^{(1)}=\frac{M^{(1,\text{Mode I})}E^{*}}{2} \tag{24}$$

Similarly, if auxiliary state 2 is chosen to be state for Mode-II, then the auxiliary state is Mode-II near tip displacement and stress field, then by putting $K_{I}^{(2)}=0$ and $K_{II}^{(2)}=1$ in equation (23), we have:

$$K_{II}^{(1)}=\frac{M^{(1,\text{Mode II})}E^{*}}{2} \tag{25}$$

where, $M^{(1,\text{Mode I})}$ and $M^{(1,\text{Mode II})}$ are interaction integrals.

3. Results and discussion

By incorporating the individual and combined randomness in the normalised crack length $\left(e_1 = a/W\right)$, crack angle $\left(e_2 = \alpha\right)$, and normalised radius of the hole $\left(e_3 = R/W\right)$ in an isotropic plate with a hole emanating cracks using SOPT, the stochastic fracture response through the normalised MMSIFs is calculated. Some results are validated with MCS. The input random variables are indicated by the parameter { e_i (*i*=1, 2 and 3). Furthermore, it is assumed that the input COV for individual and combined randomness in all the parameters is 15% or 0.15 variation of characteristics from their mean values in order to forecast the stochastic MMSIFs of the plate under tensile, shear, and combination (tensile and shear) loadings. The percentage of the input random parameters has been randomly adopted because in perturbation technique, for input COVs < 0.2 or 20 %, the solution can be obtained up to the acceptable accuracy (Stefanou [20]). The normalized MMSIFs in terms of K_I and K_{II} are expressed as:

For Tensile loading

$$K_I = K_{I,\text{mean}} / \left(\sigma\sqrt{\pi a}\right) \text{ and } K_{II} = K_{II,\text{mean}} / \left(\sigma\sqrt{\pi a}\right) \tag{26}$$

For Shear loading

$$K_I = K_{I,\text{mean}} / \left(\tau\sqrt{\pi a}\right) \text{ and } K_{II} = K_{II,\text{mean}} / \left(\tau\sqrt{\pi a}\right) \tag{27}$$

where K_I , K_{II} , $K_{I,\text{mean}}$, $K_{II,\text{mean}}$, σ , τ and λ are normalized Mode-I and Mode-II SIFs, numerical Mode-I and Mode-II SIFs, tensile, shear and combined stresses, respectively and where, $\lambda = \sigma = \tau$.

3.1 Convergence and validation study

The results of Grasa et al. [21] using a first-order perturbation technique (FOPT) on the basis of analytical and XFEM solution for an isotropic edge cracked plate subjected to tensile loading are available and are compared with the mean value of Mode-I SIF using the current perturbation-based SOPT combined with XFEM, and they are in good agreement as shown in Table 1.

Table 1 Validation of SIFs of an isotropic edge cracked plate subjected to tensile loading

Analytical Solution [21]	XFEM with FOPT [21]	% Error	XFEM with SOPT	% Error	XFEM with MCS	% Error
99.8182	98.951	0.87	100.4834	0.67	100.1276	0.31

Rarely are the SOPT findings for the stochastic fracture analysis of the investigated model under various stress situations available in the literature. To validate the current stochastic fracture analysis for a/W= 0.4 with $\alpha = 30^0$, as indicated in Table 2, the current mean and corresponding COV $\{e_i(i=1, 2 \text{ and } 3) = 0.15\}$ of MMSIFs K_I and K_{II} acquired by SOPT are compared with those obtained by MCS.

Table 2 Behaviour of the analyzed model under different loading conditions for normalized crack length (a/W= 0.4) with crack angles ($\alpha = 30^\circ$) through individual randomness in a/W by MCS with different numbers of samples

Total no. of samples	Tensile loading				Shear loading			
	K_I		K_{II}		K_I		K_{II}	
	Mean	COV	Mean	COV	Mean	COV	Mean	COV
9000	0.809	0.121	0.354	0.223	2.527	0.059	1.296	0.125
9500	0.822	0.084	0.342	0.197	2.536	0.051	1.193	0.097
10000	0.828	0.056	0.334	0.167	2.540	0.047	1.128	0.081
10500	0.828	0.056	0.334	0.167	2.540	0.047	1.128	0.081
11000	0.828	0.056	0.334	0.167	2.540	0.047	1.128	0.081

The results obtained by both SOPT and MCS are in very good agreement. In the direct MCS method, the different sets of random samples of random system properties are generated first by direct use of the computer by using Gaussian random number generation. These sets of random samples are substituted in the response equation of MMSIFs and again generated the random samples of MMSIFs. The mean of these random samples gives the mean value of MMSIFs, while the variance of random samples gives the variance of MMSIFs. The optimum numbers of samples are decided on the basis of convergence of mean results. In the present analysis, 10,000 samples are used for satisfactory convergence of the results. Therefore, the 10,000 random samples are used for further computation of results using MCS. In the present study, MCS is used only for validation purpose due to higher consumption of computational time, particularly for fracture problem with very high mesh density.

Fig. 2(a) and 2(b) show the line diagram of an isotropic rectangular plate with the analyzed model with dimensions of length $(2L)$, width $(2W)$, crack length $(2a)$, and hole radius (R) and a central cracked plate without hole with required above-mentioned dimensions, under shear (τ) stress.

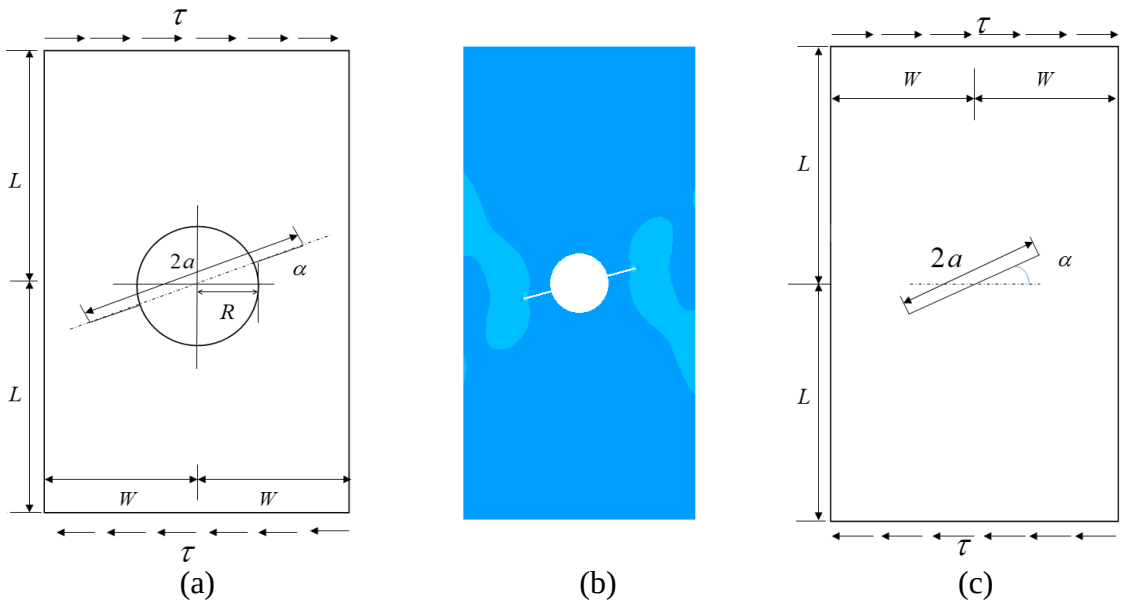
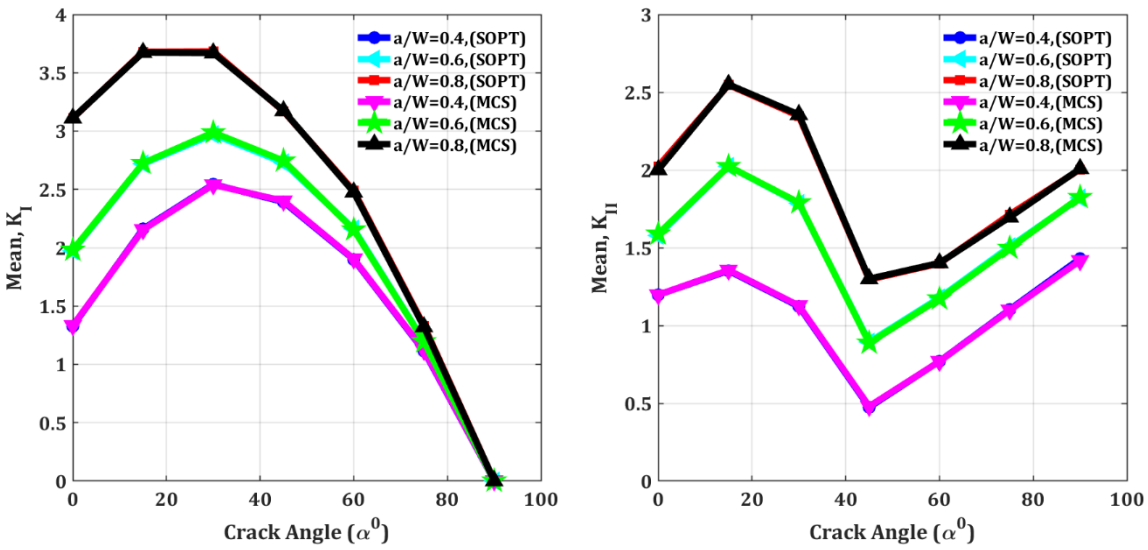


Fig. 2 (a) A line diagram and (b) the stress contour (general) of a plate with radial cracks on a hole and (c) a line diagram of central crack under shear loading

The behaviour of mean values of normalized MMSIFs of the analyzed model under uniform shear loading w.r.t. different crack angles is presented in Fig. 3(a) and 3(b). It is again clear that the SOPT results are in good agreement with those of MCS.

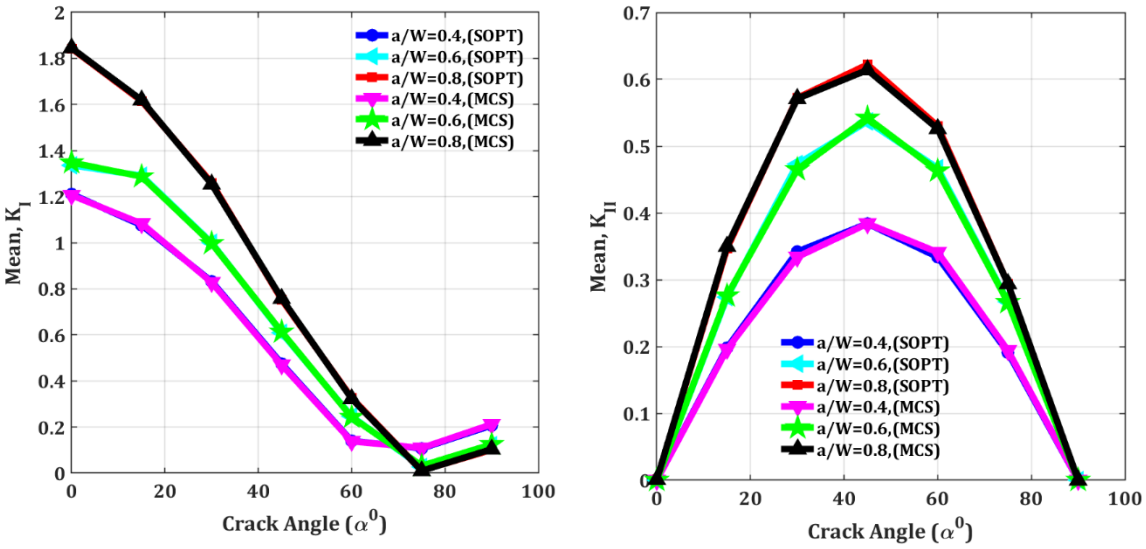


(a) (b)

Fig. 3 The mean values of normalized MMSIFs (a) K_I and (b) K_{II} of a plate under shear loading with individual randomness in e_1, e_2 and e_3

It can be seen that the mean values of K_I are largest at a crack angle α = 30°, and due to the increment in *a/W*, the mean values of K_I starts to dominate at α= 15°. As the crack angle (α) increases from 0° to 30°, the mean values of K_I are increased. Then, these values are continuously decreased to zero at 90° crack angle. Now, the mean values of normalized Mode-II SIFs K_{II} of the analyzed model are maximum at 15° crack angle and are minimum at 45° crack angle. At α = 0° and 90°, the mean values of K_{II} are nearly equal as the normalized crack length increases (*a/W*= 0.8). From crack angle 45° to 90°, the mean values of K_I and K_{II} continuously decrease and increase, respectively.

Fig. 4(a) and 4(b) show the behaviour of the mean values of normalized MMSIFs K_I and K_{II} of the analyzed model under uniform tensile loading with individual randomness { e_i (*i*=1, 2 and 3)} with respect to different crack angles using SOPT and MCS.



(a) (b)

Fig. 4 The mean values of normalized MMSIFs (a) K_I and (b) K_{II} of plate under tensile loading with individual or combined randomness in e_1, e_2 and e_3

It is clear that the SOPT results are in good agreement with those obtained using MCS. It can be seen that the mean values of normalized Mode-I SIFs K_I of the analyzed model are the largest at a crack angle α = 0°, and the SIFs K_I are decreased with increment in the crack angle till 75°. At 90° crack angle, the SIFs K_I for the shorter crack lengths *a/W* are further increased and it is so because the compressive stresses dominant and so the tips of longer crack will get less influence of the buckling, as compared to the shorter ones and the results is the higher SIFs in shorter cracks and the lower SIFs for longer cracks. The mean values of normalized Mode-II SIFs K_{II} of the analyzed model are largest at a crack angle α = 45° and are minimum (zero) at α = 0° and 90°. For the crack angles α and (90◦ -α), the mean values of K_{II} are almost equal if the normalized crack length (a/W = 0.4 and 0.6) is shorter. For the longer cracks (a/W = 0.8), the mean values of K_{II} are not the same.

Fig. 5(a) and 5(b) show the line diagram of the analyzed model with dimensions of length $(2L)$, width $(2W)$, crack length $(2a)$, and hole radius (R) and a central cracked plate without hole with required above-mentioned dimensions, under combined tensile (σ) and shear (τ) stresses.

The behaviour of the mean values of normalized MMSIFs K_I and K_{II} of the analyzed model w.r.t. different crack angles using SOPT is predicted and compared with the deterministic values of normalized MMSIFs K_I and K_{II} of the plate with a central crack without any hole with the same geometrical properties subjected to combined loading, as shown in Fig. 6(a) and 6(b).

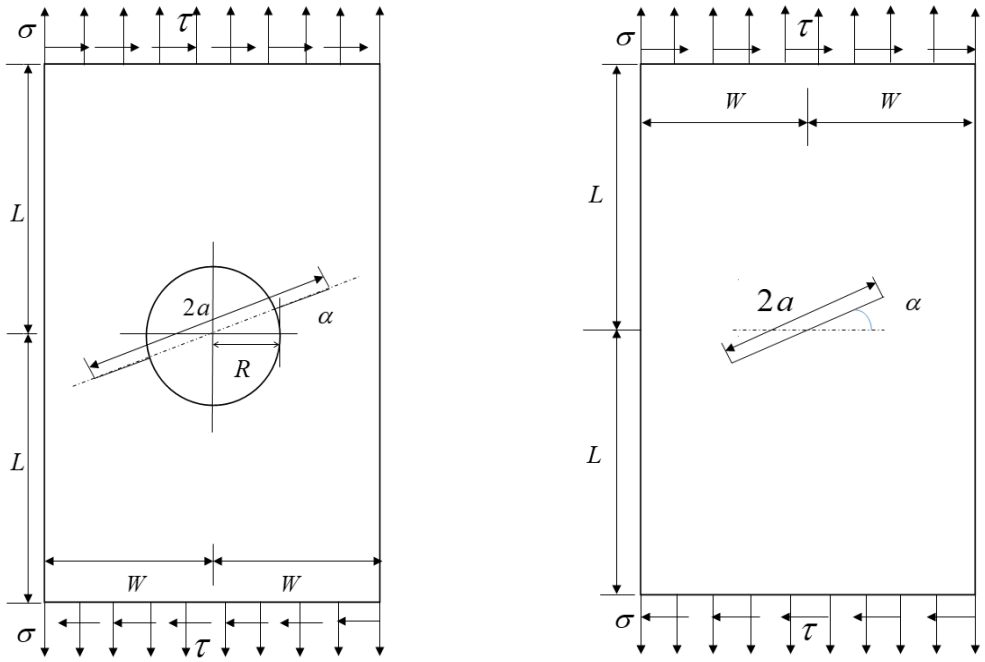


Fig. 5 Line diagrams of the plates with (a) hole emanating radial cracks and (b) a central crack subjected to combined loadings

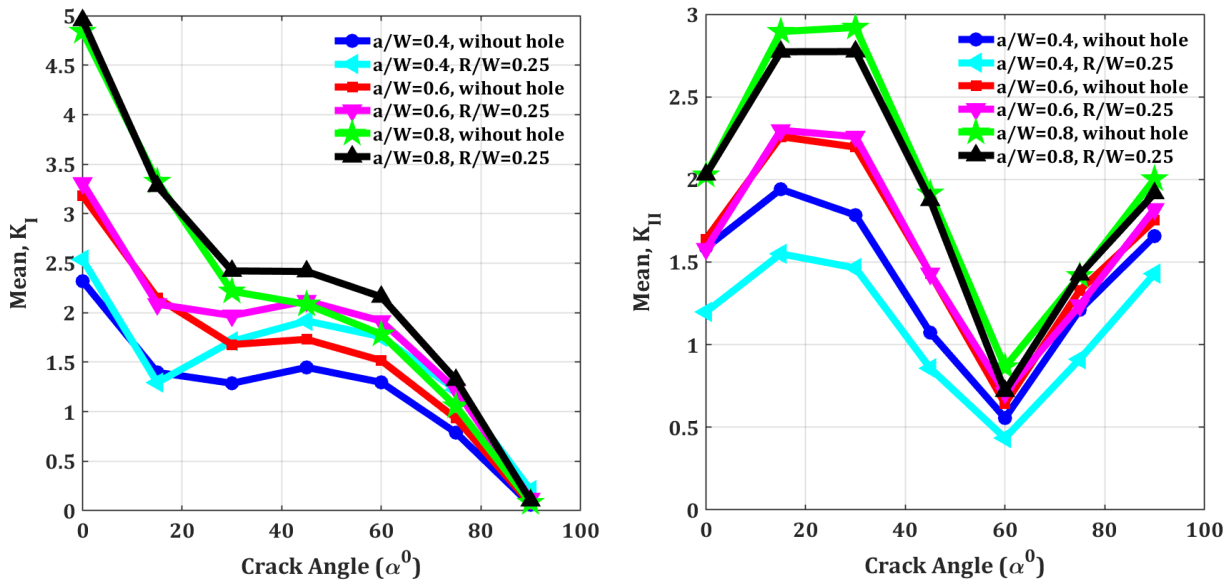
It can be seen that the mean values of normalized Mode-I SIFs K_I are highest at crack angle α = 0°. Also, as the crack angle (α) is increased, the mean values of K_I are decreased from 0° to 90° crack angle. At 90° crack angle, the mean values of K_I are zero. For the crack angle 15°, the mean values of K_I are increased for shorter crack length (a/W = 0.4) because due to combined loading the stress concentration on the periphery of the hole, from where the cracks are emanating, will be maximum and the stress concentration zone will be upper and lower parts of the sides of the hole and crack. As the crack makes an angle of 30°, the tip of the crack will be much nearer to the stress concentration zone and more stresses will be on a crack tip, therefore, the mean values of K_I are continuously increased till angle 45° and remain

critical. After 45° angle, the crack tips gradually leave the stress concentration zone till angle 90°. But, for longer crack, the crack tip remains somewhat away from the periphery of the hole. That is why the stress concentration zone becomes unable to produce much effect on the crack tip. If the length of the emanating cracks is very large, then the hole becomes the part of crack only.

The mean values of normalized Mode-II SIFs K_{II} are highest at a crack angle α = 15° but as a/W increases, the values of K_{II} start to dominate at α = 30°. From crack angles 30° to 60° and 60° to 90°, the mean values of K_{II} decreased and increased, respectively. Now, the mean values of normalized Mode-II SIFs K_{II} of an isotropic plate with a hole emanating radial cracks are the largest at 15° crack angle and are minimum at 60° crack angle.

At 90° crack angle, the mean value of K_I is zero because here, the effect of K_I is completely ineffective under the shear and combined loading. The mean values of normalized MMSIFs K_I and K_{II} of an isotropic plate with a hole emanating radial cracks subjected to combined and shear loadings are much higher as compared to those are under tensile loading. So, it can be concluded that the combined loading is much critical as compared to tensile and shear loading for the present problem.

Under all types of loading conditions, the gaps between the graphs, for the mean values of normalized MMSIFs K_I and K_{II} and the deterministic values of MMSIFs $K_{I,\text{det}}$ and $K_{II,\text{det}}$, are decreased as (a/W) is increased. It is so because the smaller crack with the hole has the influence on stress concentration as well as it works as a small edge crack on the periphery of the hole, whereas for the larger crack, the hole works as a part of the crack only or the role of the hole is just like a crack. Also, the mean values of normalized MMSIFs K_I and K_{II} are increased with increment in a/W.



(a) (b)

Fig. 6 Comparison of the behavior of the mean and deterministic values of normalized MMSIFs (a) K_I and (b) K_{II} of the plate with a hole and without hole with central cracks of different lengths subjected to combined loading

At the crack angles α = 0° and 90°, the mean values of K_{II} for a plate emanating radial cracks are nearly equal to the deterministic values of $K_{II,\det}$ for the cracked plate without hole with the increment in normalized crack length (a/W = 0.8). At 60° crack angle, the mean values of K_{II} are nearly equal to the deterministic values of normalized Mode-II SIFs $K_{II,\det}$ of an isotropic cracked plate without a hole.

4. Conclusions

The fracture behaviour of the plate with discontinuities subjected to shear and combined loading conditions are much more critical as compared to tensile loading. Hence, proper control of these types of loading will increase the reliability of structures. The input random variables such as normalized crack length, crack angle, and normalized radius of the hole show much influence on the stochastic fracture behavior of the plate with discontinuities. So, the reliability and safety in a structure can be enhanced by controlling the input random variables properly.

Under tensile loadings, the plate is the least critical and sensitive when the geometry (hole emanating cracks) at the centre position and is the most critical and sensitive when the geometry is either side of the central part of the plate. Under shear and combined loadings, the plate is the least critical and sensitive when the geometry is below the central part of the plate and is the most critical and sensitive when the geometry is above the central part of the plate.

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Investigation of Structural Plate with Cracks and Hole under Combined Loading

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Abstract. *Here, XFEM is used to model structural discontinuities like cracks and holes in order to forecast the strength and dependability of the structure under service conditions. By contrasting the numerical outcomes of several issues with the analytical and experimental findings, the method's resilience has been shown. Additionally, XFEM is coupled with a stochastic method to predict the sensitivity of a structure with discontinuities (cracks and holes) under tensile loading conditions in terms of output COVs and fracture strength in terms of mean values of stress intensity factors (SIFs) using input individual and combined randomness in various system parameters. The second order perturbation technique has been utilized in stochastic / perturbation theory to forecast how constructions would fracture. The perturbation technique is also utilized as Taylor series expansion method and yields accurate results if the input randomness is less than twenty percentage.*

Keywords. XFEM, COV, MMSIF, Stochastic, Perturbation

1. Introduction

We are aware that randomness always exists in reality and affects every aspect of a construction, including its geometry, strength, lifespan, susceptibility to damage, and fracture parameters. Even with the finest quality control procedures, randomness in system attributes has a major impact on how the mechanical

component responds to fracture. Therefore, randomness, external loads, material qualities, crack parameters, and geometry must all be taken into account when performing a fracture analysis on a structure. The stochastic fracture analysis increases the safety of structures by offering a reliable prediction of the fracture behaviour of the structure. The reliability evaluation methodologies can aid in the creation of preliminary recommendations for reliable designs. Many scholars have successfully analysed the stochastic fracture behaviour of the structure. Through the use of several numerical examples and the scaled boundary finite element method (SBFEM), Chowdhury et al. [1] completed the shape sensitivity analysis (Rahman and Chen [2]; Reddy and Rao [3]) of stress intensity variables to the crack size and direction. They performed the reliability assessment by Monte Carlo simulations (Chakraborty and Rahman [4, 5]; Choi et al. [6]; Evangelatos and Spanos [7]; Haldar and Mahadevan [8]; Khasin [9]; Lal and Palekar [10]). Some academics have talked about their work using the perturbation technique to forecast the material's stochastic reaction. In this regard, Rahman and Rao [11] introduced a stochastic meshless technique for resolving random material property boundary-value issues in linear elasticity. For the purpose of forecasting stochastic structure response, they created a meshless formulation. Classical perturbation expansions were produced in conjunction with the meshless equations to forecast the response's second-moment characteristics.

The XFEM has been further improved or enhanced by many researchers through coupling the XFEM with another technique to overcome the difficulties faced by the general XFEM. In the direction, a new set of enrichment functions was proposed for solving the Poisson equation in 1D and 2D spaces and was reduced the analysis error by Paweł [12]. The XFEM was coupled with a constitutive law with embedded discontinuity (CLED) approach for modelling of mixed mode cracking in concrete structure for simplifying the numerical implementation (Pietruszczak and Haghighat, [13]). Improved XFEM was developed for 3D and demonstrated better accuracy, convergence and efficiency. It overcomes the linear dependency problem by utilizing an extra degree of freedom free partition of unity approximation which is based on local least-squares fitting with a one-point interpolation constraint (Tian et al., [14]).

Using XFEM and various independent, combined uncorrelated and correlated input random Gaussian variables using SOPT and MCS, Lal and Markad [15] presented mixed mode SIFs and crack propagation analysis of the symmetric angle-ply laminated composite plate with through-thickness arbitrary curve cracks subjected to tensile and shear stress. The stochastic finite element technique is an extension of the MCS with uncertainty in the system parameters, such as materials, geometry, etc. given by Arregui-Mena et al. [16]. The spectral stochastic finite element approach and the perturbation technique (SSFEM). Lal and Markad [10] utilised a C^0 FEM based on higher order shear deformation plate theory was used to evaluate the second order statistics of MMSIFs of single edge V-notched angle-ply laminated composite plates under in-plane tensile load with uncertainty in material parameters, crack opening, and fracture length (HSDT). With the help of FOPT, SOPT, and MCS, the probabilistic evaluation was carried out.

The few researchers predicted how an infinite plate with a separate circular hole and a crack would fracture under tensile force. To the author's knowledge, XFEM with SOPT has not been used to investigate the stochastic fracture behaviour in terms of normalised MMSIFs and corresponding COVs of the infinite plate with various positions of a separate circular hole and a crack with various crack angles under tensile loading with input random parameters such as crack length, normalised radius of the hole, crack angle, and the central distance between separate hole and crack.

By incorporating the individual and combined randomness in the normalised crack length, crack angle, and normalised radius of the hole in an isotropic plate with a hole emanating cracks using SOPT, the stochastic fracture response through the normalised MMSIFs is calculated. Some results are validated with MCS. Present work is also focuesed on effect of combined loading over stochastic fracture response of the structural plate in terms of normalized MMSIFs.

2. Mathematical formulation

The XFEM is useful for modelling discontinuities like fractures, holes or voids, inclusions, interfaces, etc. while including discontinuous functions in the FE mesh. The level set method (LSM) has been successfully

used in conjunction with the XFEM to address these problems by providing further enrichment functions like crack faces and crack tips. Here, the XFEM software is built upon the 2D MATLAB code by Pais [18].

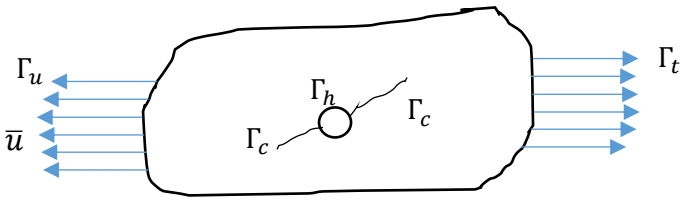


Fig. 1 Area under consideration with cracks, holes, and boundary condition

2.1 Equilibrium equation

The surfaces of cracks Γ_c and holes Γ_h are assumed traction free as are mentioned by Daux et al. [20], and shown in figure 1. The equilibrium equation in the domain Ω is:

$$\tilde{\nabla} \cdot \boldsymbol{\sigma}_t + \mathbf{f}_b = 0 \tag{1}$$

Small strains and displacements are taken into consideration in the current work. Thus, the relationship between strain and displacement illustrates the kinematics equations:

$$\boldsymbol{\varepsilon} = \boldsymbol{\varepsilon}(\mathbf{u}) = \tilde{\nabla}_s \cdot \mathbf{u} \tag{2}$$

Here, $\tilde{\nabla}_s$ is the symmetric part of the gradient operator and $\mathbf{u}$ is a displacement field vector. The boundary conditions for the displacements on the boundary Γ_u are:

$$\mathbf{u} = \bar{\mathbf{u}} . \tag{3}$$

The constitutive relation for elastic material can be shown by Hooke's law as:

$$\boldsymbol{\sigma}_t = \boldsymbol{D} \cdot \boldsymbol{\varepsilon}(\mathbf{u}) \tag{4}$$

where $\boldsymbol{D}$ is Hooke tensor or constitutive matrix for isotropic materials for plane stress and strain conditions in 2D.

The equilibrium equations' weak form is provided by:

$$\int_{\Omega} \boldsymbol{\varepsilon}(\mathbf{u}) : \boldsymbol{D} : \boldsymbol{\varepsilon}(\mathbf{v}) d\Omega = \int_{\Omega} \bar{\mathbf{b}} \cdot \mathbf{v} d\Omega + \int_{\Gamma_t} \bar{\mathbf{t}} \cdot \mathbf{v} d\Gamma \quad \forall \mathbf{v} \in \gamma_0 \tag{5}$$

The linear, FF and bilinear, SS forms of the equation (5) are:

$$FF(\mathbf{v}) = \int_{\Gamma} \bar{\mathbf{b}} \cdot \mathbf{v} d\Omega + \int_{\Gamma_t} \bar{\mathbf{t}} \cdot \mathbf{v} d\Omega \tag{6}$$

$$SS(\mathbf{u}, \mathbf{v}) = \int_{\Omega} \boldsymbol{\varepsilon}(\mathbf{u}) : \boldsymbol{D} : \boldsymbol{\varepsilon}(\mathbf{v}) d\Omega \tag{7}$$

Potential energy (Π) of an elastic body is $\Pi = \frac{1}{2} SS(\mathbf{u}, \mathbf{u}) - FF(\mathbf{u})$ (8)

By applying a variant of the previous equation and substituting $\frac{\partial \Pi}{\partial \mathbf{u}} = 0$, the minimization of the elastic body's potential energy may be solved, and the following set of discrete equations is produced as a result.

$$[\mathbf{K}]\{\mathbf{d}\} = \{\mathbf{f}\} \tag{9}$$

where, $[\mathbf{K}]$ is the global stiffness matrix, $\{\mathbf{d}\}$ are the global degrees of freedom and $\{\mathbf{f}\}$ are the applied loading or force.

$$\mathbf{K}_{ij}^{e} = \begin{bmatrix} \mathbf{K}_{ij}^{uu} & \mathbf{K}_{ij}^{ua} & \mathbf{K}_{ij}^{ub} & \mathbf{K}_{ij}^{ug} \\ \mathbf{K}_{ij}^{au} & \mathbf{K}_{ij}^{aa} & \mathbf{K}_{ij}^{ab} & \mathbf{K}_{ij}^{ag} \\ \mathbf{K}_{ij}^{bu} & \mathbf{K}_{ij}^{ba} & \mathbf{K}_{ij}^{bb} & \mathbf{K}_{ij}^{bg} \\ \mathbf{K}_{ij}^{gu} & \mathbf{K}_{ij}^{ga} & \mathbf{K}_{ij}^{gb} & \mathbf{K}_{ij}^{gg} \end{bmatrix} \tag{10}$$

$$\mathbf{f}_i^e = \left\{ \mathbf{f}_i^u \;\; \mathbf{f}_i^a \;\; \mathbf{f}_i^{b_1} \;\; \mathbf{f}_i^{b_2} \;\; \mathbf{f}_i^{b_3} \;\; \mathbf{f}_i^{b_4} \;\; \mathbf{f}_i^g \right\}^{\mathbf{T}} \tag{11}$$

$$\mathbf{d} = \left\{ \mathbf{u} \;\; \mathbf{a} \;\; \mathbf{b}_1 \;\; \mathbf{b}_1 \;\; \mathbf{b}_1 \;\; \mathbf{b}_1 \;\; \mathbf{g} \right\}^{\mathbf{T}} \tag{12}$$

2.2 XFEM Approximation

XFEM Approximation for Cracks and voids are defined as,

$$\mathbf{u}^{fi}(\mathbf{x}) = \mathbf{u}^{\mathbf{FEM}} + \mathbf{u}^{\mathbf{ENR}} = \sum_{i=1}^{n} \mathcal{N}_i(\mathbf{x}) \left\{ \bar{\mathbf{u}}_i + \sum_{j=1}^{m} \mathbf{F}^j(\mathbf{x}) \mathbf{a}_i^j \right\} \tag{13}$$

Heaviside function for a discontinuous function for the crack and voids defined as,

$$\mathcal{H}_1(\mathbf{x}) = \begin{cases} 1 \text{ for } \boldsymbol{\varphi}(\mathbf{x}) > 0 \\ 0 \text{ for } \boldsymbol{\varphi}(\mathbf{x}) = 0 \\ -1 \text{ for } \boldsymbol{\varphi}(\mathbf{x}) < 0 \end{cases} \quad \text{and} \quad \mathcal{H}_2(\mathbf{x}) = \begin{cases} 1 \text{ for } \chi(\mathbf{x}) > 0 \\ 0 \text{ for } \chi(\mathbf{x}) \le 0 \end{cases} \tag{14}$$

2.3 Level Set Method

For crack, level set method implemented by eq. (15), and for voids by eq. (16). The sign distance function $\phi(\mathbf{x}, \mathrm{t})$ to the curve Γ_c

$$\phi(\mathbf{x}) = \begin{cases} \min\limits_{\mathbf{x}_c \in \Gamma} \left\| \mathbf{x} - \mathbf{x}_c \right\| = d\left(\mathbf{x}, \mathbf{x}_i\right) & \forall \left(\mathbf{x} - \mathbf{x}_c\right) \cdot e_2 \ge 0 \\ \min\limits_{\mathbf{x}_c \in \Gamma} \left\| \mathbf{x} - \mathbf{x}_c \right\| = -d\left(\mathbf{x}, \mathbf{x}_i\right) & \text{otherwise} \end{cases} \tag{15}$$

$$\chi(\mathbf{x},0) = \min_{\mathbf{x}_c^i \in \Omega_c^i} \left\{ \left\| \mathbf{x} - \mathbf{x}_c^i \right\| - \mathrm{r}_c^i \right\} \qquad \text{where, } i = 1, 2, ..., n_c \tag{16}$$

where, d is the absolute distance, $\mathbf{x}_i$ is the point on crack closest to a point x with any point $\mathbf{x}_c$ on the crack surface Γ_c. r_c^i is the radius of the *i*th hole.

2.4 Evaluation of Stress Intensity Factors (SIFs)

For general mixed-mode problems in two dimensions, SIFs and J-integral can be stated as,

$$J = \frac{K_I^2}{E^*} + \frac{K_{II}^2}{E^*} \tag{17}$$

where, $E^* = \begin{cases} E & \text{for plane stress} \\ \dfrac{E}{1-\nu^2} & \text{for plane strain} \end{cases}$ (18)

The J -integral also follows the path-independence and it is explained

$$J = \int_{\Gamma} \left(W n_j - \mathbf{t}_i \cdot \frac{\partial \mathbf{u}_i}{\partial x} \right) d\Gamma \tag{19}$$

where, W is the strain energy density. For the plate of the elastic material, it can explain that $W = (1/2)\boldsymbol{\sigma}_{ij}\boldsymbol{\varepsilon}_{ij}$.

Now, two equilibrium, independent states of a cracked body are considered. Consider the state1, $\left(\boldsymbol{\sigma}_{ij}^{(1)},\boldsymbol{\varepsilon}_{ij}^{(1)},\mathbf{u}_{j}^{(1)}\right)$, corresponds to the present or actual state and state 2, $\left(\boldsymbol{\sigma}_{ij}^{(2)},\boldsymbol{\varepsilon}_{ij}^{(2)},\mathbf{u}_{j}^{(2)}\right)$, is an auxiliary state. Further, $\boldsymbol{\sigma}_{ij}^{(2)}$, $\boldsymbol{\varepsilon}_{ij}^{(2)}$ and $\mathbf{u}_{j}^{(2)}$ are the auxiliary stress field, auxiliary strain filed and auxiliary displacement field, respectively. Thus, superposition of these two states brings another equilibrium state, say, $\left(\boldsymbol{\sigma}_{ij},\boldsymbol{\varepsilon}_{ij},\mathbf{u}_{j}\right)$. Now, we have:

$$\boldsymbol{\sigma}_{ij}=\boldsymbol{\sigma}_{ij}^{(1)}+\boldsymbol{\sigma}_{ij}^{(2)}\quad \boldsymbol{\varepsilon}_{ij}=\boldsymbol{\varepsilon}_{ij}^{(1)}+\boldsymbol{\varepsilon}_{ij}^{(2)}\qquad \mathbf{u}_{j}=\mathbf{u}_{j}^{(1)}+\mathbf{u}_{j}^{(2)} \tag{20}$$

The strain energy densities are:

$$W=W^{(1)}+W^{(2)}\quad W^{(1)}=\frac{1}{2}\boldsymbol{\sigma}_{ij}^{(1)}\boldsymbol{\varepsilon}_{ij}^{(1)}\qquad W^{(2)}=\frac{1}{2}\boldsymbol{\sigma}_{ij}^{(2)}\boldsymbol{\varepsilon}_{ij}^{(2)} \tag{21}$$

$$W=\frac{1}{2}\boldsymbol{\sigma}_{ij}\boldsymbol{\varepsilon}_{ij}=\frac{1}{2}\left(\boldsymbol{\sigma}_{ij}^{(1)}+\boldsymbol{\sigma}_{ij}^{(2)}\right)\left(\boldsymbol{\varepsilon}_{ij}^{(1)}+\boldsymbol{\varepsilon}_{ij}^{(2)}\right)=\frac{1}{2}\left(W^{(1)}+W^{(2)}\right)-\boldsymbol{\sigma}_{ij}^{(1)}\boldsymbol{\varepsilon}_{ij}^{(2)} \tag{22}$$

2.5 Stress intensity factor (SIF)

The Mode-I and Mode-II SIFs are formulated as,

$$K_{I}=K_{I}^{(1)}+K_{I}^{(2)}\quad K_{II}=K_{II}^{(1)}+K_{II}^{(2)} \tag{23}$$

The Mode-I and Mode-II SIFs for the actual state can be obtained by choosing the auxiliary state (state 2), e.g., if auxiliary state 2 is chosen to be state for Mode-I, then the auxiliary state is Mode-I near tip displacement and stress field, then by putting $K_{I}^{(2)}=1$ and $K_{II}^{(2)}=0$ in the equation (23), we have:

$$K_{I}^{(1)}=\frac{M^{(1,\text{Mode I})}E^{*}}{2} \tag{24}$$

Similarly, if auxiliary state 2 is chosen to be state for Mode-II, then the auxiliary state is Mode-II near tip displacement and stress field, then by putting $K_{I}^{(2)}=0$ and $K_{II}^{(2)}=1$ in equation (23), we have:

$$K_{II}^{(1)}=\frac{M^{(1,\text{Mode II})}E^{*}}{2} \tag{25}$$

where, $M^{(1,\text{Mode I})}$ and $M^{(1,\text{Mode II})}$ are interaction integrals.

3. Results and discussion

By incorporating the individual and combined randomness in the normalised crack length $\left(e_1 = a/W\right)$, crack angle $\left(e_2 = \alpha\right)$, and normalised radius of the hole $\left(e_3 = R/W\right)$ in an isotropic plate with a hole emanating cracks using SOPT, the stochastic fracture response through the normalised MMSIFs is calculated. Some results are validated with MCS. The input random variables are indicated by the parameter { e_i (*i*=1, 2 and 3). Furthermore, it is assumed that the input COV for individual and combined randomness in all the parameters is 15% or 0.15 variation of characteristics from their mean values in order to forecast the stochastic MMSIFs of the plate under tensile, shear, and combination (tensile and shear) loadings. The percentage of the input random parameters has been randomly adopted because in perturbation technique, for input COVs < 0.2 or 20 %, the solution can be obtained up to the acceptable accuracy (Stefanou [20]). The normalized MMSIFs in terms of K_I and K_{II} are expressed as:

For Tensile loading

$$K_I = K_{I,\text{mean}} / \left(\sigma\sqrt{\pi a}\right) \text{ and } K_{II} = K_{II,\text{mean}} / \left(\sigma\sqrt{\pi a}\right) \tag{26}$$

For Shear loading

$$K_I = K_{I,\text{mean}} / \left(\tau\sqrt{\pi a}\right) \text{ and } K_{II} = K_{II,\text{mean}} / \left(\tau\sqrt{\pi a}\right) \tag{27}$$

where K_I , K_{II} , $K_{I,\text{mean}}$, $K_{II,\text{mean}}$, σ , τ and λ are normalized Mode-I and Mode-II SIFs, numerical Mode-I and Mode-II SIFs, tensile, shear and combined stresses, respectively and where, $\lambda = \sigma = \tau$.

3.1 Convergence and validation study

The results of Grasa et al. [21] using a first-order perturbation technique (FOPT) on the basis of analytical and XFEM solution for an isotropic edge cracked plate subjected to tensile loading are available and are compared with the mean value of Mode-I SIF using the current perturbation-based SOPT combined with XFEM, and they are in good agreement as shown in Table 1.

Table 1 Validation of SIFs of an isotropic edge cracked plate subjected to tensile loading

Analytical Solution [21]	XFEM with FOPT [21]	% Error	XFEM with SOPT	% Error	XFEM with MCS	% Error
99.8182	98.951	0.87	100.4834	0.67	100.1276	0.31

Rarely are the SOPT findings for the stochastic fracture analysis of the investigated model under various stress situations available in the literature. To validate the current stochastic fracture analysis for a/W= 0.4 with $\alpha = 30^0$, as indicated in Table 2, the current mean and corresponding COV $\{e_i(i=1, 2 \text{ and } 3) = 0.15\}$ of MMSIFs K_I and K_{II} acquired by SOPT are compared with those obtained by MCS.

Table 2 Behaviour of the analyzed model under different loading conditions for normalized crack length (a/W= 0.4) with crack angles ($\alpha = 30^\circ$) through individual randomness in a/W by MCS with different numbers of samples

Total no. of samples	Tensile loading				Shear loading			
	K_I		K_{II}		K_I		K_{II}	
	Mean	COV	Mean	COV	Mean	COV	Mean	COV
9000	0.809	0.121	0.354	0.223	2.527	0.059	1.296	0.125
9500	0.822	0.084	0.342	0.197	2.536	0.051	1.193	0.097
10000	0.828	0.056	0.334	0.167	2.540	0.047	1.128	0.081
10500	0.828	0.056	0.334	0.167	2.540	0.047	1.128	0.081
11000	0.828	0.056	0.334	0.167	2.540	0.047	1.128	0.081

The results obtained by both SOPT and MCS are in very good agreement. In the direct MCS method, the different sets of random samples of random system properties are generated first by direct use of the computer by using Gaussian random number generation. These sets of random samples are substituted in the response equation of MMSIFs and again generated the random samples of MMSIFs. The mean of these random samples gives the mean value of MMSIFs, while the variance of random samples gives the variance of MMSIFs. The optimum numbers of samples are decided on the basis of convergence of mean results. In the present analysis, 10,000 samples are used for satisfactory convergence of the results. Therefore, the 10,000 random samples are used for further computation of results using MCS. In the present study, MCS is used only for validation purpose due to higher consumption of computational time, particularly for fracture problem with very high mesh density.

Fig. 2(a) and 2(b) show the line diagram of an isotropic rectangular plate with the analyzed model with dimensions of length $(2L)$, width $(2W)$, crack length $(2a)$, and hole radius (R) and a central cracked plate without hole with required above-mentioned dimensions, under shear (τ) stress.

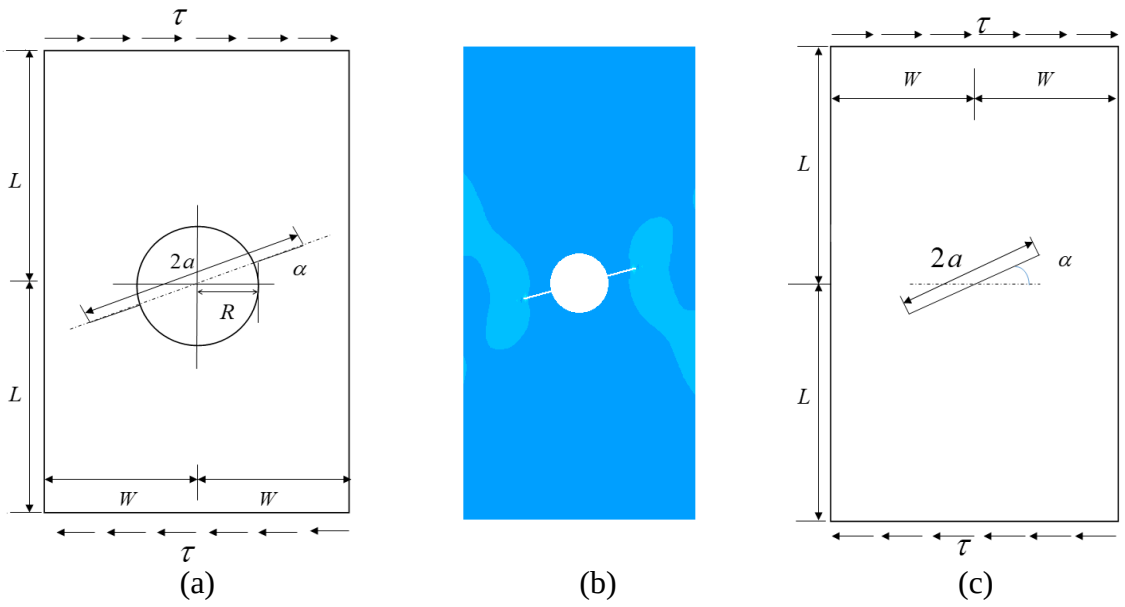
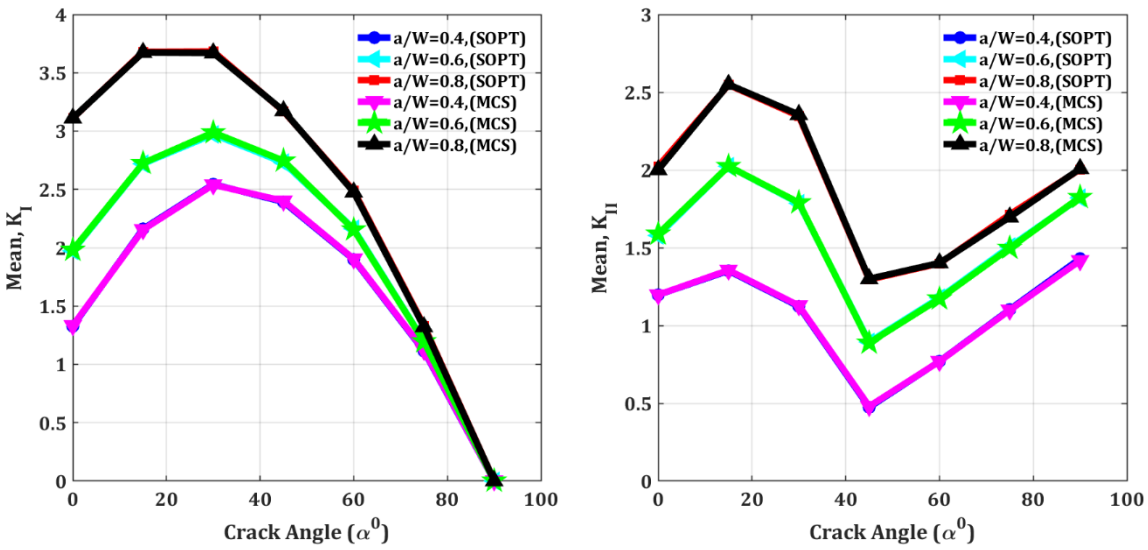


Fig. 2 (a) A line diagram and (b) the stress contour (general) of a plate with radial cracks on a hole and (c) a line diagram of central crack under shear loading

The behaviour of mean values of normalized MMSIFs of the analyzed model under uniform shear loading w.r.t. different crack angles is presented in Fig. 3(a) and 3(b). It is again clear that the SOPT results are in good agreement with those of MCS.

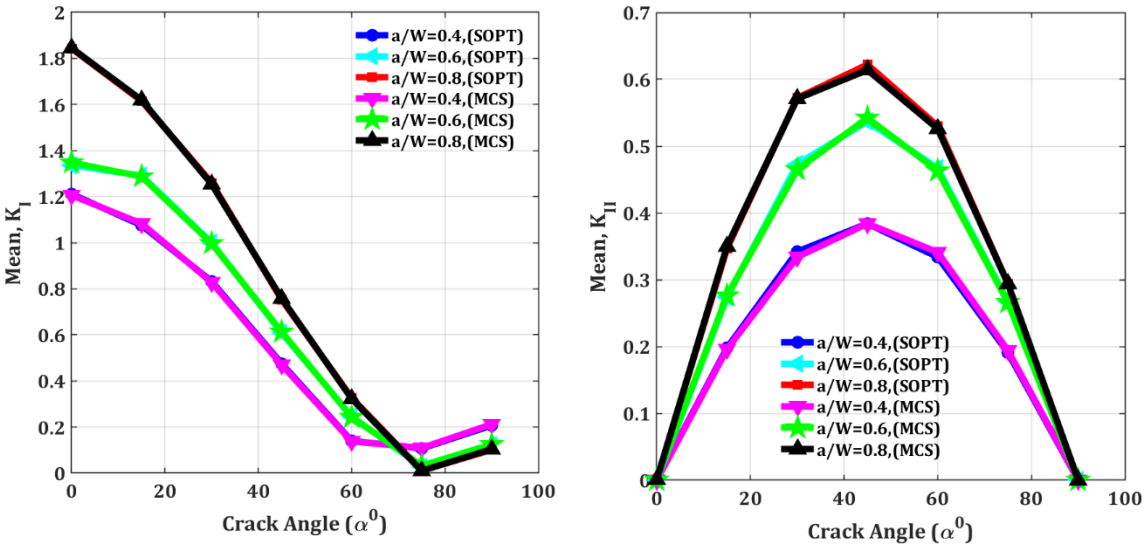


(a) (b)

Fig. 3 The mean values of normalized MMSIFs (a) K_I and (b) K_{II} of a plate under shear loading with individual randomness in e_1, e_2 and e_3

It can be seen that the mean values of K_I are largest at a crack angle α = 30°, and due to the increment in *a/W*, the mean values of K_I starts to dominate at α= 15°. As the crack angle (α) increases from 0° to 30°, the mean values of K_I are increased. Then, these values are continuously decreased to zero at 90° crack angle. Now, the mean values of normalized Mode-II SIFs K_{II} of the analyzed model are maximum at 15° crack angle and are minimum at 45° crack angle. At α = 0° and 90°, the mean values of K_{II} are nearly equal as the normalized crack length increases (*a/W*= 0.8). From crack angle 45° to 90°, the mean values of K_I and K_{II} continuously decrease and increase, respectively.

Fig. 4(a) and 4(b) show the behaviour of the mean values of normalized MMSIFs K_I and K_{II} of the analyzed model under uniform tensile loading with individual randomness { e_i (*i*=1, 2 and 3)} with respect to different crack angles using SOPT and MCS.



(a) (b)

Fig. 4 The mean values of normalized MMSIFs (a) K_I and (b) K_{II} of plate under tensile loading with individual or combined randomness in e_1, e_2 and e_3

It is clear that the SOPT results are in good agreement with those obtained using MCS. It can be seen that the mean values of normalized Mode-I SIFs K_I of the analyzed model are the largest at a crack angle α = 0°, and the SIFs K_I are decreased with increment in the crack angle till 75°. At 90° crack angle, the SIFs K_I for the shorter crack lengths *a/W* are further increased and it is so because the compressive stresses dominant and so the tips of longer crack will get less influence of the buckling, as compared to the shorter ones and the results is the higher SIFs in shorter cracks and the lower SIFs for longer cracks. The mean values of normalized Mode-II SIFs K_{II} of the analyzed model are largest at a crack angle α = 45° and are minimum (zero) at α = 0° and 90°. For the crack angles α and (90◦ -α), the mean values of K_{II} are almost equal if the normalized crack length (a/W = 0.4 and 0.6) is shorter. For the longer cracks (a/W = 0.8), the mean values of K_{II} are not the same.

Fig. 5(a) and 5(b) show the line diagram of the analyzed model with dimensions of length $(2L)$, width $(2W)$, crack length $(2a)$, and hole radius (R) and a central cracked plate without hole with required above-mentioned dimensions, under combined tensile (σ) and shear (τ) stresses.

The behaviour of the mean values of normalized MMSIFs K_I and K_{II} of the analyzed model w.r.t. different crack angles using SOPT is predicted and compared with the deterministic values of normalized MMSIFs K_I and K_{II} of the plate with a central crack without any hole with the same geometrical properties subjected to combined loading, as shown in Fig. 6(a) and 6(b).

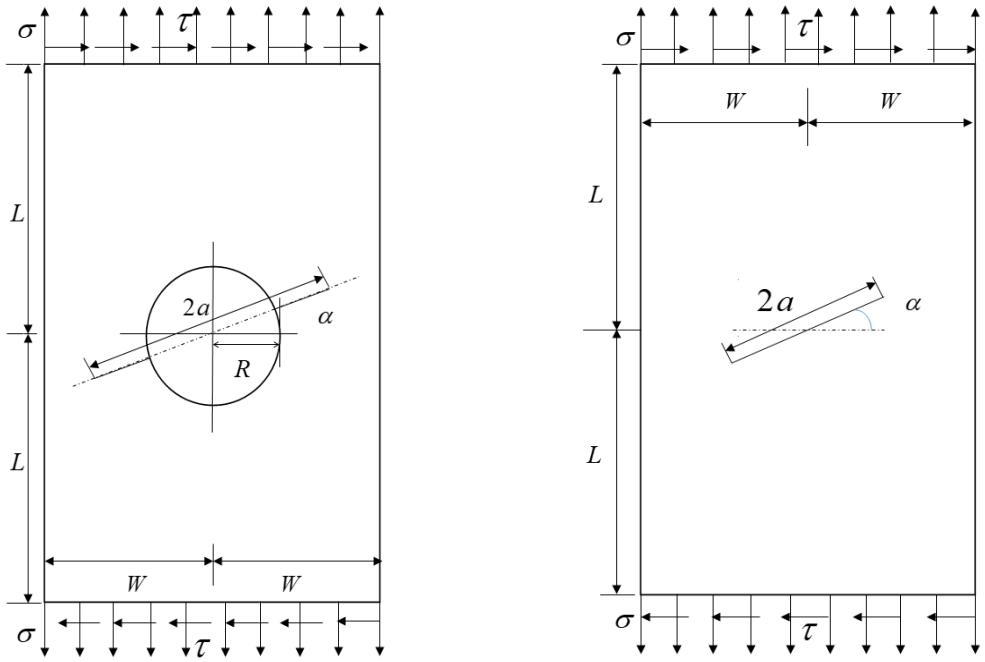


Fig. 5 Line diagrams of the plates with (a) hole emanating radial cracks and (b) a central crack subjected to combined loadings

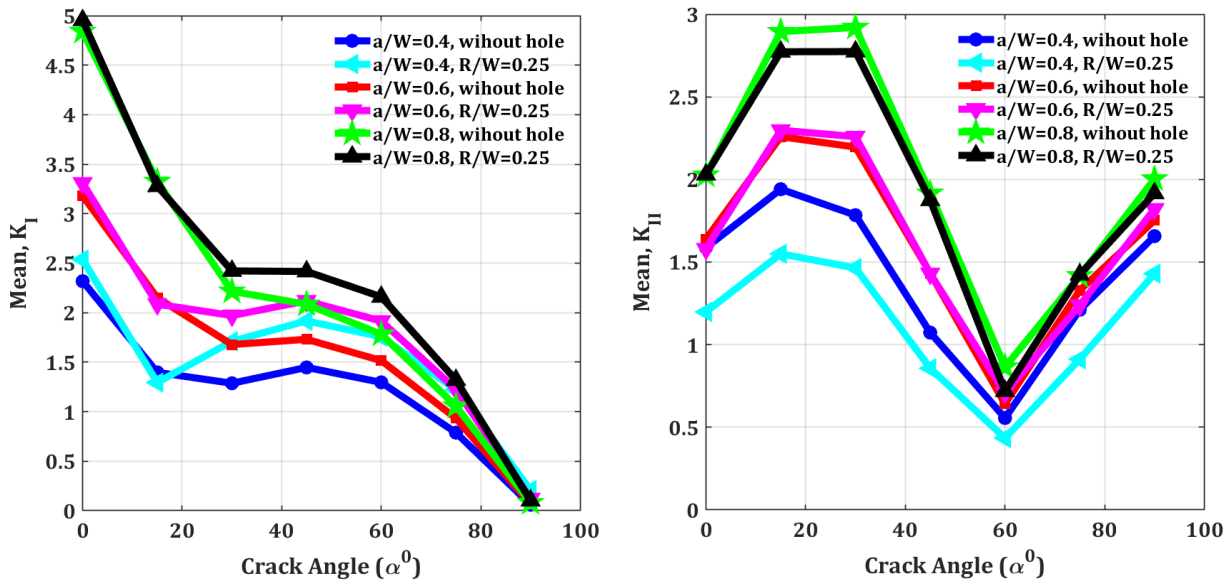
It can be seen that the mean values of normalized Mode-I SIFs K_I are highest at crack angle α = 0°. Also, as the crack angle (α) is increased, the mean values of K_I are decreased from 0° to 90° crack angle. At 90° crack angle, the mean values of K_I are zero. For the crack angle 15°, the mean values of K_I are increased for shorter crack length (a/W = 0.4) because due to combined loading the stress concentration on the periphery of the hole, from where the cracks are emanating, will be maximum and the stress concentration zone will be upper and lower parts of the sides of the hole and crack. As the crack makes an angle of 30°, the tip of the crack will be much nearer to the stress concentration zone and more stresses will be on a crack tip, therefore, the mean values of K_I are continuously increased till angle 45° and remain

critical. After 45° angle, the crack tips gradually leave the stress concentration zone till angle 90°. But, for longer crack, the crack tip remains somewhat away from the periphery of the hole. That is why the stress concentration zone becomes unable to produce much effect on the crack tip. If the length of the emanating cracks is very large, then the hole becomes the part of crack only.

The mean values of normalized Mode-II SIFs K_{II} are highest at a crack angle α = 15° but as a/W increases, the values of K_{II} start to dominate at α = 30°. From crack angles 30° to 60° and 60° to 90°, the mean values of K_{II} decreased and increased, respectively. Now, the mean values of normalized Mode-II SIFs K_{II} of an isotropic plate with a hole emanating radial cracks are the largest at 15° crack angle and are minimum at 60° crack angle.

At 90° crack angle, the mean value of K_I is zero because here, the effect of K_I is completely ineffective under the shear and combined loading. The mean values of normalized MMSIFs K_I and K_{II} of an isotropic plate with a hole emanating radial cracks subjected to combined and shear loadings are much higher as compared to those are under tensile loading. So, it can be concluded that the combined loading is much critical as compared to tensile and shear loading for the present problem.

Under all types of loading conditions, the gaps between the graphs, for the mean values of normalized MMSIFs K_I and K_{II} and the deterministic values of MMSIFs $K_{I,\text{det}}$ and $K_{II,\text{det}}$, are decreased as (a/W) is increased. It is so because the smaller crack with the hole has the influence on stress concentration as well as it works as a small edge crack on the periphery of the hole, whereas for the larger crack, the hole works as a part of the crack only or the role of the hole is just like a crack. Also, the mean values of normalized MMSIFs K_I and K_{II} are increased with increment in a/W.



(a) (b)

Fig. 6 Comparison of the behavior of the mean and deterministic values of normalized MMSIFs (a) K_I and (b) K_{II} of the plate with a hole and without hole with central cracks of different lengths subjected to combined loading

At the crack angles α = 0° and 90°, the mean values of K_{II} for a plate emanating radial cracks are nearly equal to the deterministic values of $K_{II,\det}$ for the cracked plate without hole with the increment in normalized crack length (a/W = 0.8). At 60° crack angle, the mean values of K_{II} are nearly equal to the deterministic values of normalized Mode-II SIFs $K_{II,\det}$ of an isotropic cracked plate without a hole.

4. Conclusions

The fracture behaviour of the plate with discontinuities subjected to shear and combined loading conditions are much more critical as compared to tensile loading. Hence, proper control of these types of loading will increase the reliability of structures. The input random variables such as normalized crack length, crack angle, and normalized radius of the hole show much influence on the stochastic fracture behavior of the plate with discontinuities. So, the reliability and safety in a structure can be enhanced by controlling the input random variables properly.

Under tensile loadings, the plate is the least critical and sensitive when the geometry (hole emanating cracks) at the centre position and is the most critical and sensitive when the geometry is either side of the central part of the plate. Under shear and combined loadings, the plate is the least critical and sensitive when the geometry is below the central part of the plate and is the most critical and sensitive when the geometry is above the central part of the plate.

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An Experimental Study On Ultra High Performance Concrete Using Micro Fine And GGBS

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Abstract- *The researchers and scientists have been constantly working on the development of the concrete. As per today's requirement of industry, it is essential to have good performance and durability of concrete for RCC structures. Two decades ago, the scientist has developed the ultra-high-performance concrete. The research and development have been into the progress on how to improve the durability, performance of concrete and make it more environment friendly. In the present study, the aim is to develop concrete mix incorporating ground granulated blast furnace slag and microfine. Ultra high-performance concrete usually provides the compressive strength more than 60 Mpa with good performance during service life of concrete. We have incorporated waste material like GGBS and microfine in the concrete so that impact of waste material on the environment can be reduced.*

Keywords- Compressive Strength, Durability, GGBS, Microfine, Performance etc.

I. INTRODUCTION

Concrete is the essential material in Construction industry. Concrete is the highest consumed material in the world after water. The use of concreting per day is on very high. As the population of the world is increasing, the smart material is required to fulfil the requirement of infrastructure with great durability. The rapid development on Ultra High-performance concrete has been going from last 20 years rigorously. The frequent use of UHPC (ultra high-performance concrete) is limited because it has very high cost and skilled labor is required for using it. One more material which has been used in this process is microfine. These are the material which is found as a byproduct of steel and iron manufacturing industry. These materials having cementitious property that is why these materials are used as a replacement of cement.

As per the past studies done on this topic, these materials are capable to provide bonding and strength in between all the ingredients of the concrete. Still there are many pros and cons in using it.

While we adding these materials, the good performance can be seen in the dance concrete. Construction industry requires both the thing Higher strength and good performance as well.

Ultra high-performance concrete having high modulus of Elasticity and reduces deflection in the concrete. There are many disadvantages of Ultra High performance Concrete. Due to inadequate research in this field, it is very difficult to identify proportion of material in the mix design as per UHPC requirement. Material selection is the also having the main factor on which performance of concrete depends.

Along with the GGBS and microfine, the scientists have used various admixtures different type of fibres various industrial waste to improve the mechanical and chemical properties of concrete material.

While designing the ultra-performance concrete we must keep into our mind the impact of sulphate and chloride attack on the concrete.

II. EXPERIMENTAL STUDY

The waste material used in this study isGround Granulated Blast Furnace Slag (GGBS) and Microfine. These are the waste materials by product of steel industry. Both material having some cementitious property that attracts researchers to incorporate these materials into the concrete mix. Effective outcome could be achieved by proper selection of materials, inspection, quality control and required proportion of all ingredient of concrete. The Ordinary Portland Cement is used having 53 Grade to meet the optimum requirement. The Typical Chemical Composition of GGBS is mentioned below:

Compound	Quantity Present (%)
Calcium Oxide	40-45 %
Silica	35-40 %
Magnesia	8-10 %
Alumina	10-15 %

The Typical Physical composition of GGBS are mentioned below:
Color: Off White
Specific Gravity: 2.85
Bulk Density: 1060-1160 kg/m3 (Loose)
1275-1375 kg/m3 (vibrated)
Fineness: >360 m2/kg

Typical Physical Composition of Microfine:
Fineness: >560 m2/kg
Compressive Strength: >18 (in N/mm2 at 28 Days)
Initial Setting: 140 minutes
Final Setting: 190 minutes Grain Density: 2.75 kg/m3

Table 5.1 Experimental Result Obtained for OPC 53 Grade

Property of Cement	Result Obtained	Value Specified by IS 12269:2013
Fineness	1.60 %	< 10 %
Standard Consistency	35 %	Range 25-35 %
Initial Setting Time	31 minutes	30 min
Final Setting Time	580 minutes	600 min

Table2 Experimental Result Obtained of Fine and Coarse Aggregate (20mm & 10mm)

Sr. No.	Characteristic Properties	Artificial Sand	CA (10mm)	CA (20 mm)
1	Fineness modulus	3.17	3.5	2.65
2	Silt Content	15.25%	NA	NA
3	Surface absorption	4.2%	2.23%	1.50%
4	Specific gravity	2.55	2.78	2.85

III. RESULTS AND DISCUSSION

Table3Slump Values on different trials

No. of Trial	Mix Design	Slump Value (mm)	Average Slump Value (mm)	Workability
1	M 50 (W/C = 0.35) + GGBS (30%) and Microfine (10%)	107	113	Good
2		118		
3		112		
4	M 40 (W/C = 0.35) + GGBS (30%) and Microfine (10%)	105	112	Good
5		119		
6		114		

Table4 Split Tensile Strength Results on different trials

Mix Design	Split Tensile Strength (N/mm2)		
	7 Days	14 Days	28 Days
M 50 (W/C = 0.35) + GGBS (30%)& Microfine (10%)	5.6	7.2	7.9
M 40 (W/C = 0.35) + GGBS (30%) & Microfine (10%)	4.5	5.8	6.8

Table 4 Flexural Strength Test Results on different trials

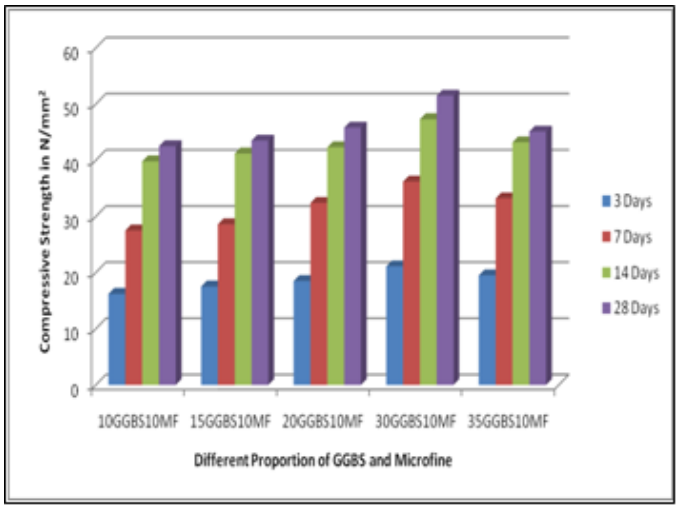
Mix Details	Flexural Tensile Strength (N/mm2)		
	7 Days	14 Days	28 Days
M50 (W/C=0.35) + GGBS(30%)andMicrofine(10%)	5.7	7.5	9.6
M40 (W/C=0.35) + GGBS(30%)andMicrofine(10%)	4.5	6.6	6.8

Table6Pulse Velocity Test Observations

Spot No.	Pulse Velocity (Km/Sec)		Concrete Quality (Grading)
	Direct Method	Semi Direct Method	
1	4.05	4.00	Good
2	4.25	3.95	
3	3.80	3.91	
4	4.17	4.20	
5	4.3	3.99	

Table7Compressive Strength Observations for M40 and M50 Grade of concrete

Mix	W/C	GGBS (%)	MF (%)	Compressive Strength in (N/mm2)			
				3 days	7 days	14 days	28 days
M50	0.35	10	10	15.2	26.5	40.8	41.5
		15	10	18.5	29.6	40.2	42.5
		20	10	19.5	33.4	43.3	46.8
		30	10	20.1	35.2	48.3	**52.5**
		40	10	20.5	31.2	44.2	46.1
M40	0.35	10	10	11.2	22.2	32.4	32.5
		15	10	12.5	22.4	31.6	36.1
		20	10	13.2	24.4	33.5	39.0
		30	10	17.1	26.4	38.5	**43.2**
		40	10	13.1	23.2	34.2	38.5



Graph 1 Compressive Strength results comparison for M40 Grade of Concrete

IV. CONCLUSIONS

The Following conclusion can be given as an outcome of this study:

1. GGBS and Microfine both are very good cementitious material and have ability to improve compressive strength and durability of concrete.
2. The Best outcome found when we add 30% GGBS and 10% Microfine as a replacement of Cement. Further, the results go down if we increase the amount of waste material.
3. The Split and Flexural Strength result found maximum at replacement of cement by 30% GGBS and 10% Microfine.
4. NDT Test (Rebound Hammer and Ultrasonic Pulse Velocity Test) results show that dispersion of ingredient of concrete and mixing bond with GGBS and microfine was very good.
5. This study shows that if we continue doing research on this material, would have great results in future. This would have direct benefit not only in construction industry but also for environmental protection also.

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Transformation of the transport system with reference to Navi-Mumbai

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***Abstract*—**
India, one of the economies with the fastest growth rates in the world, is expanding at a rate of 7% annually. The nation is striving hard to alter itself over the next few decades, with a population that is also expanding. The Indian government has public transit improvement high on its priority list. Even though private vehicle ownership in India is rising and producing significant traffic issues in big areas like Navi-Mumbai, there are numerous initiatives to upgrade and modernize transport systems. At least 1.42 billion people, or around 35.87% of the population of the country, are estimated to live in urban areas, according to the World Bank's collection of Development Indicators 2022. Even while the amount of urbanization may appear to be low in percentage terms, there are a huge number of people living in cities. India's urban population currently outnumbers the populations of Brazil and the United States combined. India's level of urbanization is predicted to rise even more, and by 2030, there should be around 600 million people living in cities. Sadly, there is a rising quantity of traffic on the streets of our cities nowadays, which is increasing the time it takes for goods to be transported as well. This traffic is also a big factor in problems like air and noise pollution, traffic accidents, and serious health hazards for locals. Technology will be crucial in identifying mobility gaps and altering current transport systems in order to create an inclusive, safer, and more sustainable city of the future. we are solving the transportation problem with the help of dual simplex and two-phase methods. Here we are solving this problem with the help of the Branch and Bound Method of Integer Programming Problem by using R software and we are comparing the obtained optimal solution with the Vogel Approximation Method.

Keywords— Congestion, collision, Pollution, Transportation, Urbanization, R, VAM

I. INTRODUCTION:

Navi Mumbai is also known as the twin city of Mumbai. This city was designed by renowned urban planner and architect Charles Correa, structural engineer Pravina Mehta, and engineer Shirish Patel. It is situated in the western suburbs of Mumbai. A freshly constructed township called Navi Mumbai is a well-planned metropolis with a robust infrastructure for its time.

In early 1964, Navi Mumbai was designed as a diversion from the unending traffic congestion in Mumbai and the city's rapidly expanding population. A 343.70 square km area from Thane to Raigad was included in the development plan for Navi Mumbai created by CIDCO. In addition, the idea received official approval from the Maharashtra government in August 1979. The site was chosen because it would be simpler to relocate the population because it was across the harbour from Bombay Island. Making livable spaces and a mass transit system was crucial.

The following were the primary drivers of the relocation:

1. Bombay's deterioration of older buildings
2. Better and more affordable housing amenities in Navi Mumbai.
3. More employment opportunities are available in Navi Mumbai.
4. Shorter distances for commuting

One cannot dispute the fact that most of Navi-Mumbai's population relies on public services when discussing the transportation infrastructure of a large and well-known city in India like Navi-Mumbai. However, given the current traffic jams on the roads, the time it takes for products to be transported is now also a problem. Apart from a few sections during the morning and evening rush hours, Navi Mumbai is a planned city and does not experience significant traffic congestion in some areas. Additionally, the Sion-Panvel Highway experiences heavy traffic during any hour of the day as a result of the significant increase in vehicle traffic.

India's Navi-Mumbai has traditionally had a strong transit infrastructure. In order to fulfill the rising demand for transport services, both rail and buses have greatly expanded but still for goods transport is by road only. Although the present administration is working to meet the minimum requirements for public transportation as well as for trucks, tempos and other means of goods transport but land restrictions are the main problem impeding further development programs and concepts in this particular sector. Cause of transport system:

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The main causes of traffic bottlenecks in Navi Mumbai are several. Among the most frequent causes are:

1. Heavy traffic on main thoroughfares and highways as a result of dense population and rising vehicle ownership.
2. Insufficient infrastructure for alternate means of transportation and a lack of public transit choices.
3. Roadwork and construction that causes lane closures and detours.
4. Ineffective local government agency coordination and traffic management.
5. Inadequate land use planning and unplanned urban growth.

It is crucial to remember that several additional factors, such as weather conditions, accidents, and special events, can also contribute to traffic bottlenecks. The time of day and day of the week can also affect traffic patterns and congestion levels.

II. OBJECTIVE:

The main objective is to minimize expenses and maximize profit. The starting site is where transportation issues originate, and the destination is where they are conveyed to move the goods at the lowest possible cost without compromising supply and demand.

III. LITERATURE REVIEW COST MINIMIZING TRANSPORTATION PROBLEM:

A better VAM approach was put out by Korukoglu and Balli (2011) for the transportation issue. Phase-II of the simplex technique was employed by Sharma et al. (2011) to address the transportation issue. solving the transportation issue using the integer programming problem that Gaurav Sharma et al. (2012) described. Sudhakar et al. (2012) suggested a novel method for identifying the best solution to the transportation challenge. For TP of Three Variables, Rekha (2013) suggested optimisation approaches. An algorithm was created by Mollah Mesbahuddin Ahmed et al. (2014) to identify an initial basic workable solution for both the balanced and unbalanced TP.Rekha et al. developed a max min penalty solution to the transportation cost minimization problem in 2014.A solution to the transport problem's degeneracy was put out by Sarbjit Singh in 2015.

To calculate the shortest travel time, Sharif Uddin (2012) used a transportation algorithm. The time-minimizing TP with fractional bottleneck objective function was discussed by Jain and Saksena in 2012. Pavel Kolman (2015) put forth a fresh approach to cut down on the amount of time required to move materials from collection points to processing facilities.

For the purpose of solving a MOTP with fuzzy coefficients, Surapati and Roy (2008) investigated a fuzzy goal programming approach based on priorities. Fuzzy logic-guided non-dominated sorting genetic algorithm was used by Lau et al. (2009) to resolve the MOTP, which is concerned with the optimisation of vehicle routing when numerous items, multiple consumers, and different depots are considered. To identify the ideal compromise solution of a problem, Lohgaonkar and Bajaj (2010) used the fuzzy programming technique with linear and non-linear membership functions. The time-minimizing TP with fractional bottleneck objective function was discussed by Jain and Saksena in 2012. Pavel Kolman (2015) put forth a fresh approach to cut down on the amount of time required to move materials from collection points to processing facilities.

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IV. FORMULATION TRANSPORTATION PROBLEM:

Given p origins and q destinations, the transportation problem can be formulated as the following linear programming problem model:

Minimize: $\sum_{r=1}^{p}\sum_{k=1}^{q} crkxrk$

Subject to constraint:

$$\sum_{k=1}^{q} xrk \leq ar \quad \text{r= 1, 2,…, p}$$

$$\sum_{r=1}^{p} xrk \leq bk \quad \text{k= 1,2,…,q}$$

$xrk \geq 0$ for all r and k

Where xij is the number of units shipped from origin r to destination k and crk is the cost of shipping one unit from origin r to destination k. The amount of supply at origin r is ar and the amount of destination k is bk. The objective is to determine the unknown xrk that will be the total transportation cost while satisfying all the supply and demand constraints

V. NUMERICAL EXAMPLES:

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From Navi-Mumbai, specifics of the numerical problem have been gathered. Since the contributor wanted to keep the company's details private, we have not included them here.

Tables: Both table details were gathered for a month

Table :1

Plants	Supply [Heavy Vehicles]
A	20
B	50
C	50
TOTAL	120

Table 1 represents the quantity available in these plants

Table:2

Warehouses	Demand
X	10
Y	6
Z	14
TOTAL	30

Table 2 represents the demand for warehouses in various places.

VI. FORMULATION AND TABLES:

We create a transportation issue for XYZ Company since it is the primary resource. To find the best option and reduce the cost of transportation, we use the transportation model as shown below.

Table:3

TO/FROM	X	Y	Z	SUPPLY
A	8	10	20	20
B	40	30	55	50
C	20	25	35	50
DEMAND	10	6	14	30/120

If we can see the problem, Σ ar= 120, Σ bk = 30. Since Σar ≠ Σbk the problem is a type of unbalanced. Firstly, will balance the problem by adding a dummy warehouse "D". So will add 90 quantities with zero cost as a dummy.

Table:4

TO/FROM	X	Y	Z	D	SUPPLY
A	8	10 **6**	20 **14**	0	20
B	40	30	55	0 **50**	50
C	20 **10**	25	35	0 **40**	50
DEMAND	10	6	14	90	120

From Vogel's Approximation method [VAM], we find several occupied cells is 6 which is equal to m+n-1. Then we get the initial feasible solution as X12 =06, X13=14, X24 =50, X31=10, X34=40

The Optimistic transportation cost is Rs 540,000

VII. LINEAR PROGRAMMING PROBLEM FORMULATION OF TP:

Now we are converting the transportation problem into a Linear programming problem by using table 4

Minimize:

Z=8X11+10X12+20X13+40X21+30X22+55X23+20X31+ 25X32+35X33

Subject to constraint:

X11 + X12 + X13 ≤ 20 ……(I)
X21 + X22+ X23 ≤ 50 ……(II)
X31 + X32 + X33 ≤ 50……(III)
X11 + X21 + X31 ≥ 10……(IV)
X12 + X22 + X32 ≥ 6……...(V)
X13 + X23+ X33 ≥14 ……(VI)
X11, X12, X13, X21, X22, X23, X31, X32, X33 ≥ 0

Firstly, we change the problem in integer programming and using r Software on Integer Programming Formulation of Transportation Problem we are getting the optimal solution of our transportation problem which solving for Albert David Company to reduce transportation cost Rs 540,000 at X12 = 6, X13 = 14, X31 = 10

VIII. CONCLUSION:

We have proven the exclusivity and existence of the best possible solution to the transportation issue for the XYZ Company. This has been demonstrated through the development of the transportation problem into an integer programming problem, the application of the discussed methods in the paper, which produces the same optimal

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solution, and the articulation of the problem's optimality requirements. Additionally, the Branch and Bound approach yields the same outcome as VAM.

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Transformation of the transport system with reference to Navi-Mumbai

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***Abstract*—**
India, one of the economies with the fastest growth rates in the world, is expanding at a rate of 7% annually. The nation is striving hard to alter itself over the next few decades, with a population that is also expanding. The Indian government has public transit improvement high on its priority list. Even though private vehicle ownership in India is rising and producing significant traffic issues in big areas like Navi-Mumbai, there are numerous initiatives to upgrade and modernize transport systems. At least 1.42 billion people, or around 35.87% of the population of the country, are estimated to live in urban areas, according to the World Bank's collection of Development Indicators 2022. Even while the amount of urbanization may appear to be low in percentage terms, there are a huge number of people living in cities. India's urban population currently outnumbers the populations of Brazil and the United States combined. India's level of urbanization is predicted to rise even more, and by 2030, there should be around 600 million people living in cities. Sadly, there is a rising quantity of traffic on the streets of our cities nowadays, which is increasing the time it takes for goods to be transported as well. This traffic is also a big factor in problems like air and noise pollution, traffic accidents, and serious health hazards for locals. Technology will be crucial in identifying mobility gaps and altering current transport systems in order to create an inclusive, safer, and more sustainable city of the future. we are solving the transportation problem with the help of dual simplex and two-phase methods. Here we are solving this problem with the help of the Branch and Bound Method of Integer Programming Problem by using R software and we are comparing the obtained optimal solution with the Vogel Approximation Method.

Keywords— Congestion, collision, Pollution, Transportation, Urbanization, R, VAM

I. INTRODUCTION:

Navi Mumbai is also known as the twin city of Mumbai. This city was designed by renowned urban planner and architect Charles Correa, structural engineer Pravina Mehta, and engineer Shirish Patel. It is situated in the western suburbs of Mumbai. A freshly constructed township called Navi Mumbai is a well-planned metropolis with a robust infrastructure for its time.

In early 1964, Navi Mumbai was designed as a diversion from the unending traffic congestion in Mumbai and the city's rapidly expanding population. A 343.70 square km area from Thane to Raigad was included in the development plan for Navi Mumbai created by CIDCO. In addition, the idea received official approval from the Maharashtra government in August 1979. The site was chosen because it would be simpler to relocate the population because it was across the harbour from Bombay Island. Making livable spaces and a mass transit system was crucial.

The following were the primary drivers of the relocation:

1. Bombay's deterioration of older buildings
2. Better and more affordable housing amenities in Navi Mumbai.
3. More employment opportunities are available in Navi Mumbai.
4. Shorter distances for commuting

One cannot dispute the fact that most of Navi-Mumbai's population relies on public services when discussing the transportation infrastructure of a large and well-known city in India like Navi-Mumbai. However, given the current traffic jams on the roads, the time it takes for products to be transported is now also a problem. Apart from a few sections during the morning and evening rush hours, Navi Mumbai is a planned city and does not experience significant traffic congestion in some areas. Additionally, the Sion-Panvel Highway experiences heavy traffic during any hour of the day as a result of the significant increase in vehicle traffic.

India's Navi-Mumbai has traditionally had a strong transit infrastructure. In order to fulfill the rising demand for transport services, both rail and buses have greatly expanded but still for goods transport is by road only. Although the present administration is working to meet the minimum requirements for public transportation as well as for trucks, tempos and other means of goods transport but land restrictions are the main problem impeding further development programs and concepts in this particular sector. Cause of transport system:

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The main causes of traffic bottlenecks in Navi Mumbai are several. Among the most frequent causes are:

1. Heavy traffic on main thoroughfares and highways as a result of dense population and rising vehicle ownership.
2. Insufficient infrastructure for alternate means of transportation and a lack of public transit choices.
3. Roadwork and construction that causes lane closures and detours.
4. Ineffective local government agency coordination and traffic management.
5. Inadequate land use planning and unplanned urban growth.

It is crucial to remember that several additional factors, such as weather conditions, accidents, and special events, can also contribute to traffic bottlenecks. The time of day and day of the week can also affect traffic patterns and congestion levels.

II. OBJECTIVE:

The main objective is to minimize expenses and maximize profit. The starting site is where transportation issues originate, and the destination is where they are conveyed to move the goods at the lowest possible cost without compromising supply and demand.

III. LITERATURE REVIEW COST MINIMIZING TRANSPORTATION PROBLEM:

A better VAM approach was put out by Korukoglu and Balli (2011) for the transportation issue. Phase-II of the simplex technique was employed by Sharma et al. (2011) to address the transportation issue. solving the transportation issue using the integer programming problem that Gaurav Sharma et al. (2012) described. Sudhakar et al. (2012) suggested a novel method for identifying the best solution to the transportation challenge. For TP of Three Variables, Rekha (2013) suggested optimisation approaches. An algorithm was created by Mollah Mesbahuddin Ahmed et al. (2014) to identify an initial basic workable solution for both the balanced and unbalanced TP.Rekha et al. developed a max min penalty solution to the transportation cost minimization problem in 2014.A solution to the transport problem's degeneracy was put out by Sarbjit Singh in 2015.

To calculate the shortest travel time, Sharif Uddin (2012) used a transportation algorithm. The time-minimizing TP with fractional bottleneck objective function was discussed by Jain and Saksena in 2012. Pavel Kolman (2015) put forth a fresh approach to cut down on the amount of time required to move materials from collection points to processing facilities.

For the purpose of solving a MOTP with fuzzy coefficients, Surapati and Roy (2008) investigated a fuzzy goal programming approach based on priorities. Fuzzy logic-guided non-dominated sorting genetic algorithm was used by Lau et al. (2009) to resolve the MOTP, which is concerned with the optimisation of vehicle routing when numerous items, multiple consumers, and different depots are considered. To identify the ideal compromise solution of a problem, Lohgaonkar and Bajaj (2010) used the fuzzy programming technique with linear and non-linear membership functions. The time-minimizing TP with fractional bottleneck objective function was discussed by Jain and Saksena in 2012. Pavel Kolman (2015) put forth a fresh approach to cut down on the amount of time required to move materials from collection points to processing facilities.

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IV. FORMULATION TRANSPORTATION PROBLEM:

Given p origins and q destinations, the transportation problem can be formulated as the following linear programming problem model:

Minimize: $\sum_{r=1}^{p}\sum_{k=1}^{q} crkxrk$

Subject to constraint:

$$\sum_{k=1}^{q} xrk \leq ar \quad \text{r= 1, 2,…, p}$$

$$\sum_{r=1}^{p} xrk \leq bk \quad \text{k= 1,2,…,q}$$

$xrk \geq 0$ for all r and k

Where xij is the number of units shipped from origin r to destination k and crk is the cost of shipping one unit from origin r to destination k. The amount of supply at origin r is ar and the amount of destination k is bk. The objective is to determine the unknown xrk that will be the total transportation cost while satisfying all the supply and demand constraints

V. NUMERICAL EXAMPLES:

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From Navi-Mumbai, specifics of the numerical problem have been gathered. Since the contributor wanted to keep the company's details private, we have not included them here.

Tables: Both table details were gathered for a month

Table :1

Plants	Supply [Heavy Vehicles]
A	20
B	50
C	50
TOTAL	120

Table 1 represents the quantity available in these plants

Table:2

Warehouses	Demand
X	10
Y	6
Z	14
TOTAL	30

Table 2 represents the demand for warehouses in various places.

VI. FORMULATION AND TABLES:

We create a transportation issue for XYZ Company since it is the primary resource. To find the best option and reduce the cost of transportation, we use the transportation model as shown below.

Table:3

TO/FROM	X	Y	Z	SUPPLY
A	8	10	20	20
B	40	30	55	50
C	20	25	35	50
DEMAND	10	6	14	30/120

If we can see the problem, Σ ar= 120, Σ bk = 30. Since Σar ≠ Σbk the problem is a type of unbalanced. Firstly, will balance the problem by adding a dummy warehouse "D". So will add 90 quantities with zero cost as a dummy.

Table:4

TO/FROM	X	Y	Z	D	SUPPLY
A	8	10 **6**	20 **14**	0	20
B	40	30	55	0 **50**	50
C	20 **10**	25	35	0 **40**	50
DEMAND	10	6	14	90	120

From Vogel's Approximation method [VAM], we find several occupied cells is 6 which is equal to m+n-1. Then we get the initial feasible solution as X12 =06, X13=14, X24 =50, X31=10, X34=40

The Optimistic transportation cost is Rs 540,000

VII. LINEAR PROGRAMMING PROBLEM FORMULATION OF TP:

Now we are converting the transportation problem into a Linear programming problem by using table 4

Minimize:

Z=8X11+10X12+20X13+40X21+30X22+55X23+20X31+ 25X32+35X33

Subject to constraint:

X11 + X12 + X13 ≤ 20 ……(I)
X21 + X22+ X23 ≤ 50 ……(II)
X31 + X32 + X33 ≤ 50……(III)
X11 + X21 + X31 ≥ 10……(IV)
X12 + X22 + X32 ≥ 6……...(V)
X13 + X23+ X33 ≥14 ……(VI)
X11, X12, X13, X21, X22, X23, X31, X32, X33 ≥ 0

Firstly, we change the problem in integer programming and using r Software on Integer Programming Formulation of Transportation Problem we are getting the optimal solution of our transportation problem which solving for Albert David Company to reduce transportation cost Rs 540,000 at X12 = 6, X13 = 14, X31 = 10

VIII. CONCLUSION:

We have proven the exclusivity and existence of the best possible solution to the transportation issue for the XYZ Company. This has been demonstrated through the development of the transportation problem into an integer programming problem, the application of the discussed methods in the paper, which produces the same optimal

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solution, and the articulation of the problem's optimality requirements. Additionally, the Branch and Bound approach yields the same outcome as VAM.

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Green Lean Six Sigma for sustainability improvement: a systematic review and future research agenda

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Green Lean Six Sigma for sustainability improvement: a systematic review and future research agenda

Abstract

Design/ Methodology/ Approach: To do a systematic analysis of the literature, a systematic literature review methodology has been used in this research work. 140 articles from the reputed databases were identified to explore hidden aspects of GLSS. Exploration of articles in different continents, year-wise, approach-wise, and journal-wise, were also done to find the execution status of GLSS.

Purpose: The main purpose of this article is to explore different aspects of the Green Lean Six Sigma approach, application status, and potential benefits from a comprehensive review of the literature and provides an avenue for future research work. The study also provides a conceptual framework for GLSS.

Findings: The study depicts that GLSS implementation is increasing year by year, and it leads to considerable improvement in all dimensions of sustainability. Enablers, barriers, tools, and potential benefits that foster the execution of GLSS in industrial organizations are also identified based on a systematic review of the literature.

Originality: The study's uniqueness lies in that study is the first of its kind that depicts the execution status of GLSS, and its different facets, explores different available frameworks and provides avenues for potential research in this area for potential researchers and practitioners.

Keywords: Lean Six Sigma; Green Lean Six Sigma; Sustainability; Enablers; Barriers; Framework

1. Introduction

Over the last few decades, economic change, sustainable product demands, governmental policy toward climate change, and market influence have led to a surge in the level of competition. The human-driven actions and fast industrial development have raised the temperature of the earth's surface by 1.5 °C in many world regions (IPCC, 2014). The industrial sectors contribute about 35% of the worldwide emissions of greenhouse gases (GHGs) (Thirupathi et al., 2019). This can be credited to the conventional approaches to production acquired by manufacturing sectors in most countries (Wang et al., 2019). The increase in global emission of GHGs has led to severe health problems in different parts of the world (Kwon, 2020; Jacobson, 2008). Therefore, emissions related to industry and other

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man-made actions and their health impacts have compelled the manufacturing sectors to implement sustainable production methods. Furthermore, because of the pressure of strict government policies on climate change and the motive of the Paris pact, industrial sectors have to implement sustainable practices. Therefore, the manufacturing sectors are expanding massive investments in research and development to evolve other ways of manufacturing high-specification eco-friendly products (Sharma et al., 2016). In several manufacturing areas, various ideas and strategies have been fostered during the previous decades like green manufacturing, value engineering, Six Sigma, lean six sigma (LSS), and green lean Six sigma (GLSS) to attain functional excellence in the organization (Pandey et al., 2018).

Organizations employ the lean concept to create value by improving the process through the identification and removal of different wastes (Garza-Reyes et al., 2016). However, the Lean approach reduces waste but cannot address process variations and ecological effects. Thus, the requirement of Six Sigma and Green technology was observed to manufacture high-quality eco-friendly products at a lower cost. The green concept was more associated with thinking about protecting natural resources through manufacturing and significantly related to sustainability (Zhu et al., 2018; Huo et al., 2019). It is a novel approach that minimizes harmful environmental impacts and focuses on the cost-effectiveness of an organization by producing high-specification eco-friendly products (Haapala et al., 2013; Yadav and Gahlot, 2022). However, this approach conveys the ecological problems but does not minimize variations in the process. Therefore, the requirement of Six Sigma was felt to manufacture a process with a lesser variation. The six sigma concept generates value through reliable process output by recognizing and minimizing variations (Kazancoglu et al., 2018; Shokri, 2017; Silich et al., 2012). This approach minimizes process variation but does not reduce negative environmental impacts and related wastes in the process (Sun et al., 2017). Lean and Six Sigma are two widely adopted methods that lead to the improved sustainable performance of an organization (Arnheiter and Maleyeff, 2005; Antony et al., 2019). In recent years, there has been a vivid development in LSS. Success stories of LSS execution and consequent enhancements in industrial sectors throughout the globe have been exhibited in academic journals (Shah et al., 2008; Pepper and Spedding, 2010). But LSS is also not able to address societal and ecological issues associated with the process and industrial organizations. The integrated GLSS approach focuses on enhancing resource efficiency and mitigating harmful environmental effects and aims to improve the customer's overall satisfaction level (Chaudhary & Mudimela, 2022).

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As GLSS is much devoted to enhancing the green performance of the industries, so, this approach will be helpful to attain two targets of the COP 26 conference (Deif, 2011). As GLSS is a novel methodology, it is essential to consider different theoretical elements related to this approach like readiness measures, barriers, potential benefits, and a review of available GLSS frameworks/methods. In the literature, there is no evidence on the study occurs that dispense a thorough exploration of GLSS literature, in conjunction with different theoretical elements related to this approach. The current study's objective is to opt for GLSS approach implementation in manufacturing sectors by discerning the research gaps and methods utilized by distinct researchers and practitioners. This study answers the following research questions:

RQ1: What are the different facets (enablers, barriers, tools, benefits) of GLSS that foster to promote, and adopt this sustainable approach?

RQ2: What are the current status of the implementation of GLSS, gaps in the studies, and possible avenues for future research?

This manuscript is categorized into seven sections. Section 1 represents the introduction part of the current work. Section 2 depicts SLR, a literature survey concerning Lean, Six Sigma, Green, LSS, and GLSS, and different theoretical elements related to this approach. Section 3 reports the adopted research methodology in the current study. Section 4 presents a descriptive analysis of the chosen manuscript in detail. Section 5 highlights outcomes from the existing literature gaps recognized and the future direction of the current research. Section 6 presents the purposed GLSS framework, and section 7 presents the conclusion, implications, and limitations of the recent research.

2. Literature Review

This section first outlines the literature research methodology. Then the literature was surveyed according to the points of view of Lean, Green, Lean-Green, Six Sigma, LSS, and GLSS approach, respectively.

2.1 Literature Search Methodology

To do a literature review, the authors have followed the systematic literature review (SLR) methodology. SLR provides an explicit view of the literature review and the uniqueness of the study. There are three different phases to realizing the SLR. In the first phase of SLR, the study's objectives are identified. The main objective of the present research work is to find out the current status of the implementation of GLSS and suggest future research dimensions. Based on the research objective, in the second step of locating the relevant studies, different

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electronic databases (EDB) Springer, Elsevier, Taylor and Francis, Emerald, Inderscience, Scopus, and Google Scholar databases were searched. After that, the search strings or keywords were used. In this study research papers were identified using the keywords Lean, Six Sigma, Lean-Green, Lean Six Sigma, Green Lean Six Sigma, Sustainability, barriers, framework, manufacturing, etc. To select pertinent articles related to the study, firstly, the authors used the chosen keywords in the reputed database to identify all the articles. The exclusion criteria of the study directly related to the theoretical concept of Lean, Six Sigma, and LSS were neglected. Further, all articles related to conferences, book chapters, and unpublished data were neglected. This leads to the final selection of the 140 articles pertinent to the research work. By using search strings, we identified 140 articles. Once the 140 articles have been identified, the authors critically investigate all the articles to identify different facets related to the Green Lean Six Sigma implementation and other hidden areas that are not explored to date. Figure 1 depicts the systematic literature review methodology.

2.2 Lean manufacturing

This concept was acquainted with Toyota Production System and acquired recognition after the book titled "The Machine That Changed the World" was published (Womack et al., 1990). It is a systematized approach to identify and remove wastes of all non-value-added actions by consistent enhancement that high-performance manufacturing sectors have executed to obtain extraordinary outcomes (Chugani et al., 2017; Antony et al., 2016). The mitigation or minimization of any waste will boost efficiency, decrease costs, and initiate the organization's more unassuming on the global market (Kaswan and Rathi, 2021b; Galeazzo et al., 2014). In manufacturing sectors as well as for the service sectors, lean strategy has been demonstrated a significant methodology for the development of an organization (Raci & Shankar, 2005). Rathi et al. (2021) proposed an integrated framework model for the GLSS approach. They recommended that the green concept must be connected with the lean concept to minimize the harmful effects of lean. The pragmatic applications of lean are employed on the participation of employees through utilizing tools and methods like Kaizen, Kanban, 5S, poka-yoke, and value stream mapping (VSM) (M. Singh et al., 2021; Jurado and Fuentes, 2014).

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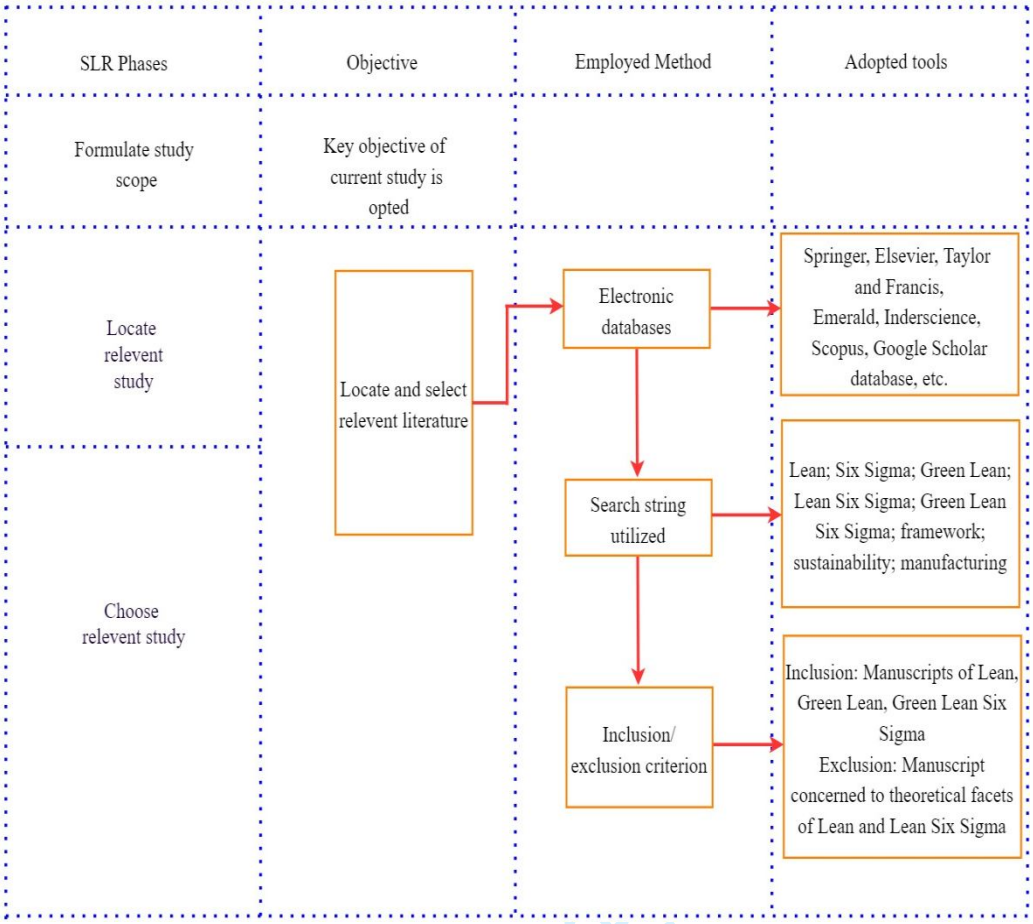

Fig. 1. Systematic literature review methodology

2.3 Green technology

Green technology is employed to minimize pollution and waste by reducing natural resource use. This concept also uses the 3'R technique (reduce, reuse, recycle) to mitigate waste and emissions. Most companies have launched the "Go Green" mission statement to mitigate the harmful environmental impacts of their operations (Gaikwad and Sunnapwar, 2020). Llorach and Roncero (2020) recommended that this concept is a vital innovation to upgrade eco-business and sustainable growth. The waste generation rate, energy consumption levels, and contamination levels are continuously increasing in organizations (Gandhi et al., 2018). That is why the government initiates strict rules and regulations on the industries to adopt green technology in their operations. The pragmatic application of green manufacturing is employed on discipline and appropriate training to the employees by utilizing various practices such as waste recycling, life cycle assessment (LCA), green designing and packing, etc. (Rehman and Shrivastava, 2013; Vinodh et al., 2011).

According to Garza-Reyes (2015), green manufacturing as an ideology determines, measures, evaluates and controls ecological waste by solving product and process problems. Digalwar

et al. (2017) identified and developed the structural interrelationship between distinct variables for the effective execution of GM. The study reveals that top management commitment has the most significant driving power for executing this strategy. According to Kazancoglu et al. 2018), green manufacturing includes several environmental strategies in the form of, green purchasing, green packaging, and green design. According to Prasad et al. (Prasad et al., 2016) ecological strategies in the form of eco-labeling, environmental management system (EMS), and ecological regulations have created a huge demand for green manufacturing in industrial sectors. Karuppiah et al. (2020) identified twenty-five barriers to the execution of GM in Indian SMEs through a comprehensive literature review and expert opinions. The recognized barriers are further ranked using DEMATEL, ANP, and TOPSIS techniques. Gedam et al. (2021) identified eleven barriers to the execution of GM through the literature review and consultation with industrial personnel. Further, the identified barriers are ranked by using the ISM-DEMATEL methodology.

2.4 Green Lean

The difference between lean and green wastes is that first is about non-value-added activities, and the second is about needless utilization of water, electricity, and natural assets (Mollenkopf et al., 2010; Ferreira et al., 2020). Gadekar, A. and Gadekar (2014) introduced an incorporated framework for these practices for attaining both financial and ecological sustainable performance in an organization. Pampanelli et al. (2014) believed that the green and lean concept could decrease resource utilization from 40 to 60 percent on a normal and could diminish the total expense of energy needed for manufacturing. Garza-Reyes (2015) carried out a systematic review of the existing literature on green and lean. This review aims to contribute by stimulating researchers to study further this field in-depth, which will assist in a better understanding of the compatibility and impact on organizational performance of lean and green strategies. Lu et al. (2019) presented a framework in the construction sector to assess greenhouse gas emissions. Yadav et al. (2021) developed a framework for visualizing and evaluating the manufacturing process performance. This framework will facilitate the industrial sectors to overcome challenges related to integrating and executing green and lean approaches.

2.5 Six Sigma

Six Sigma emphasizes continuous and breakthrough enhancements to minimize the cost of production, improve the satisfaction level of customers, and predictably produce high-quality products and services (Noone et al., 2010; Thomas et al., 2009). It is a closely controlled approach that minimizes variation in the process so that defects are minimized to less than

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3.4/M opportunities (Rathi et al., 2022b; Kumaravadivel and Natarajan, 2013). SS methodologies were not confined to enhancement impacts on the shop floor, but they also affected distinct aspects of manufacturing sectors (Haikonen et al., 2004; Fatemi and Franchetti, 2016). Schroeder et al. (2008) dictated that SS group members employ advanced root cause analysis methods and acquire outstandingly more control and investigation concerning an issue compared to any other quality enhancement strategy. Mehrjerdi (2011) determined SS DMAIC methodology application that included describing the problem to the control of the method to improve output. The key objective of SS is to attain the quality of products by enhancing the process and mitigating source causes of defects (P. Kumar et al., 2017). Antony et al. (2005) presented an analysis on the status of SS execution in SMEs of United Kingdom. This method tries to estimate prevailing execution measurements and explores how the needed and optimal concert level could be accomplished (Mudimela and Chaudhary, 2020).

2.6 Lean Six Sigma

The term "LSS" was first utilized in the beginning phase of the 2000s. Several authentications accessible in the existing literature have upheld the probability of incorporating LSS and their significant effects on the performance of the manufacturing sectors (Drohomeretski et al., 2014; Chaudhary et al., 2020). Arnheiter and Maleyeff (2005) tried to eradicate Six Sigma and Lean drawbacks by incorporating them that encouraged incorporation. Shahin and Alinavaz (2008) attempted to exhibit the different and relative methodologies of LSS. The unified effect of Six Sigma and lean tools dispenses the best solution for the industrial sector at reasonable costs. Sunder (2016) proposed an LSS model for shareholder management in the Banking and economic sector and also employed the LSS philosophy in service areas like retail banks and acquired a profit of INR 1.6m.

Snee (2010) momentarily clarified the survey of 16 years of LSS and discovered eight significant attributes, which were the functioning component for effective execution. Antony Antony (2011) emphasized the crucial transformation between Six Sigma and Lean for process excellence execution in manufacturing sectors by accompanying the views of academicians and experts throughout the world. Drohomeretski et al. (2014) studied the execution of Lean, Six Sigma, and LSS to investigate the explanations that encouraged the industrial sectors to embrace such enhancement strategies and recognized that cost minimization was the critical cause for industries to execute these approaches. Albliwi et al. (2015) carried out a systematic literature review (SLR) on this concept for industrial sectors and depicts distinct issues like profits, encouraging factors, approaching aspects, and

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drawbacks. Case study-based research can be carried out to recognize the prospects for LSS projects and major performance pointers of higher-education sectors (Sunder, 2016). Antony et al. (2017) illuminated the execution of LSS from the previous fifteen years and recognized the basic elements of the same like the involvement of top leaders, dedicated management leadership, cooperative organizations, dedicated management leadership, and a complete strategy to enhancement incorporating the area of utilization and techniques employed.

Prashar and Antony (2018) carried out an SLR on LSS in the food industry. The study reveals that human factors and food industry characteristics were recognized as the key barriers to implementing the LSS strategy. Singh and Rathi (2019) carried out a study to exhibit a comprehensive review of the benefits and critical challenges of the execution of LSS in business organizations and disperse literature in terms of many organizations wise, research methodology wise, and journal-wise. Gupta et al. (2020) carried out a study exploring the existing literature concerning the LSS concept. Big Data Analysis (BDA) has been employed in each phase of LSS. Shokri and Li (2020) represent a synthesis of present literature published in 2010 to dispense a general comprehension of the sustainable execution of LSS projects as far as task approaches instead of results. The study reveals that geographically and methodically comprehensive research works have been carried out on the integration of green manufacturing and LSS.

2.7 Green Lean Six Sigma

Every tool of GLSS can reduce the drawbacks of other tools; it implies it corresponds to one another that influences value addition because of its capacity to distinguish the wastage and assess its ecological effect (Shokri and Li 2020; Rathi et al., 2021). Banawi and Bilec (2014) proposed a framework that integrates GLSS to enhance the quality and ecological effects in the construction sector. They accomplished excellent outcomes as diminished waste in the quantity cover measure by executing the presented framework. Kumar et al. (2015) dissected the combining philosophy taken on by the manufacturing sectors through interviews, questionnaires, sustainably employed overviews, and workshops. This study also presented a framework for recognizing barriers, drivers, and key execution measures of the GLSS approach.

Cherrafi et al. (2016) evaluated the existing literature on LSS and sustainability and recommended future investigation directions and possibilities for academic scholars and practitioners. They recognized the advantages of incorporating the LSS and sustainability. Cherrafi et al. (2017) reviewed 450 organizations (which incorporated SMEs and global companies) for recognizing the crucial elements of GLSS. The researchers proposed that

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more research can be leaned toward discovering the main components that affect the GLSS. Kumar et al. (2016) recognized Twenty-One GLS barriers in the automobile sector of India through the literature review. Further, they were modeled by the ISM technique. Cherrafi et al. (2017) proposed a theoretical framework and equated results in four distinct sectors, which directed case organizations in executing the GLSS strategy. Ben Ruben et al. (2017) developed a framework for assessing the concert of Lean sustainable systems established on aspects recognized by adaptive neuro-fuzzy interface systems. Erdil and Arani (2019) presented a model, inspecting each of the three components of sustainability and embedded sustainability objectives in LSS projects.

Siegel et al. (2019) suggested a generic framework for the execution of Green and Lean in the context of Indian SMEs. This research focused on success factors, challenges, tools and techniques, sustainability measures, frameworks, and advantages of Green Lean in SMEs. Kaswan and Rathi (2020b) proposed the integration and framework of GLSS. The integration of GLSS was developed dependent on hypothetical fundamentals and the framework was developed dependent on the DMAIC methodology. Sony and Naik (2020) suggested that GLSS integration will develop a robust approach and assist the manufacturing sectors to be sustainable. They also proposed a generic implementation framework, and this is the first study in which it has been tested practically. Kaswan et al. (2021) carried out a study on the review of GLSS strategy along with readiness aspects, failure factors, integration, and execution framework. This study investigates grey areas of GLSS and dispenses a methodical path to integrate Green, Lean, and Six Sigma under the umbrella of GLSS.

2.7.1 Critical success factors for executing GLSS strategy

Critical success factors are imperative for implementing any type of strategy in the manufacturing sector (Rungasamy et al., 2002).

Habidin and Yusof (2013) recognized the following critical success factors to execute LSS:

(1) Leadership
(2) Structured improvement process
(3) Quality information and analysis
(4) Supplier relationship
(5) Customer focus
(6) Focus on metric

Cherrafi et al. (2017) recognized the following critical success factors to execute the GLSS strategy effectively:

(1) Organizational Readiness to execute GLSS approach

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(2) The project is chosen, and prioritization

(3) A commitment of higher management and Employees

(4) Communication

(5) Resource and skills to facilitate execution

M. Singh & Rathi (2019) identified 16 success factors to implement LSS strategy in MSMEs (Micro-small and medium enterprises). Out of 16 critical success factors, 10 CFs are prioritized using BWM (Best Worst Method). Raval et al. (2021) identified 10 CFs for effective implementation of LSS strategy in manufacturing sectors. The study reveals that top management is the most critical success factor and should execute in a step-wise methodology under the drawbacks of available resources.

2.7.2 Barriers and drivers for integration of GLSS strategy

GLSS approaches are influenced by the assortment of drivers and barriers to their execution; thus, it is important to find out the significant drivers and barriers of this incorporation. Due to increasing demand and scarcity of resources, the cost of raw materials, energy, and resources continuously enhances day by day in organizations (Diaz-Elsayed et al., 2013; Kaswan et al., 2019). Wong & Wong (2014) believed that this is intricate to predict manufacturing costs therefore industrial organizations require higher material proficiency to achieve improved functional performance. As per Luo (2013), each one of the manufacturing sectors is forced by consumers, controllers, contestants, and shareholders to assess and adjust their methods to enhance societal and ecological development.

To implement the GLSS approach in the organization, it is imperative to identify the performance improvement GLSS barriers. Outcomes from the literature reveal that only a few works had been done regarding the identification of GLS barriers. Kumar et al. (2016) recognized Twenty-One GLS barriers in the automobile sector of India through the literature review. Further, they were modeled by the ISM technique. Cherrafi et al. (2017) identified fifteen GLS barriers from systematic literature review (SLR). Then, they were validated through ISM and MICMAC analysis. Hussain et al. (2019) recognized twenty-four barriers in the construction sector. Then, the ISM technique was employed to establish the relationship between these barriers. C. Singh et al. (2021) identified twelve barriers by reviewing the literature. Using the DEMATEL technique, a cause-and-effect diagram was developed to identify the critical barriers. Singh et al. (2021) identified 16 barriers to implementing LSS strategy in MSMEs through opinion and experts and authenticated through statistical reliability theory. Further, they are modeled by using the ISM technique.

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The study reveals that concerning management barriers are the most critical barriers. Furthermore, obtained results were validated through structural equation modeling (SEM).

2.7.3 Benefits of Green, Lean, and Six Sigma Integration

GLSS is commercial methodologies and processes that might help the industrial sectors. Different researchers intimated that executing these methodologies might successfully impact the company's performance (Dües et al., 2013). As per Miller et al. (2010), GLSS can have a more significant, positive effect on central concern performance (financial, societal, and ecological) when carried out together as opposed to independently. The significance of this integration will be in industrial organizations where exclusively GLSS methodologies have been carried out to acquire sustainable advantages for industrial organizations.

2.7.4 Tools, techniques, and methods

Several researchers propose numerous tools that help manufacturing sectors to eliminate waste (Langenwalter, 2006; G. Yadav and Desai, 2017). These tools and techniques of LSS include LCA, JIT, TPM, Kaizen, VSM, 5S, C&E diagram, QFD, etc. These tools have been modified and expanded to gain more ecological and societal development (Kaswan and Rathi, 2020a). But these tools and techniques should be painstakingly chosen and should be fitted with the manufacturing sector's set-up (EPA, 2003). Table 1 depicts the effect of distinct LSS tools on the environment.

Table 1. Effect of distinct LSS tools on environment concern

LSS Tools	Obtained Environmental Benefits	References
Life Cycle Assessment	LCA technique will facilitate the organizations to search for the most accessible life cycles which are helpful for mitigation of harmful impacts	Paolotti et al. (2016); Kamei et al. (2013); Kaswan and Rathi (2021b)
Kaizen	Kaizen is a continuous improvement process that has a positive environmental impact as the enhancement activities protect to minimize the scarps that also directly mitigate resource consumption.	Vinodh et al. (2011); Chiarini and Vagnoni (2015); Torielli et al. (2010)
Value Stream Mapping	This technique has a pragmatic impact on the ecological concert. Its objective is to recognize waste in the value stream so that wasteful activities can be minimized. Its future map is used to eliminate environmental impacts	Kaswan et al. (2021a); Yadav et al. (2022)
5S	5S activities provide a safer working environment and eliminate all-inclusive resource consumption	Bae et al. (2007); Wilson (2010); Costa et al. (2018)

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	as systematization has been retained in the industries.	
Cause and Effect Diagram	This diagram is used to recognize possible root causes of the problem or condition to improve the environmental performance of the organization.	Loon et al. (2014); Kennet (2008); Rios et al. (2019)
Quality Function Deployment (QFD)	Customer needs can be incorporated with environmental necessities to convert them into practical needs.	Garibay et al. (2010); Klochkov et al. (2016); Erdil and Arani (2019)

2.7.5 Review of existing frameworks, models, and methods

Researchers have developed several frameworks, models, and methods to integrate Green, Lean, and Six Sigma. Table 2 depicts the interpretation of framework, models, and methods and Table 3 depicts prominent research regarding Green Lean Six Sigma in different industries.

Table 2. Interpretation of frameworks, models, and methods

Authors	Research Stream	Framework/Model/Method	Major Contribution	Drawbacks
Duarte and Cruz-Machado (2013)	Green and Lean	Projected and implemented model	Developed a model for executing lean and sustainability strategies. This presents how and when green and lean approaches can be synergetic and companionable with the help of the tools and principles of these two approaches.	The major limitation of this model was that it was not corroborated in a real-life environment.
Zhang and Awasthi (2014)	Six Sigma and Sustainability	Development of framework	Presented a framework that integrates Six Sigma and sustainability. It completely describes imperative steps to attain exactly sustainable development.	The main drawback of this framework was that it did not emphasize economic development.
Caiado et al. (2018)	Green, Lean, and Six Sigma	Proposed and integrated framework	This article provides a comprehensive GLSS framework seeking to assist practitioners in standardizing it in several types of services by identifying nine critical factors for its execution.	This study's major drawback was that the developed framework was not tested practically and restricted only to service sectors.
Subrata Talapatra (2019)	Green, Lean, and Six Sigma	Proposed and implemented framework	Presented and executed GLSS framework for jute industry to reduce defects, carbon footprints, and energy utilization.	The proposed framework completely emphasized jute industry and did not include societal aspects.
Kaswan and Rathi (2020b)	Green, Lean and Six Sigma	Proposed and implemented framework	The purpose of this manuscript is to incorporate and prosper DMAIC dependent GLSS framework. This developed framework provides a path for GLSS implementation by an appropriate preference for the task.	The major drawback of the current study was that the framework of GLS has not been tested practically.

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			The research work exhibits that several sustainability actions had been assessed with the assistance of exclusive GLSS indices and a toolset.	
Shokri and Li (2020)	Green, Lean and Six Sigma	Exploring the Green effect on LSS	The objective of this article is to implement a green strategy in LSS ventures in industrial organizations. This manuscript also distinguishes under which situations the yield of LSS developments with reasonable advantages is more ecologically sound.	The main limitation of this work was that the present model is extremely distracted to describe the decision in LSS.
Gholami et al. (2021)	Green, Lean and Six Sigma	Proposed and implemented framework	Presented and executed GLSS framework to improve organizational sustainability dependent on DMAIC methodology	The major drawback associated with this study was that the proposed framework had not considered the application of lean.

Table 3. depicts prominent research regarding Green Lean Six Sigma in different industries

Authors, Year	Sector	Major contribution	Limitations
Izzaida et al. (2013)	Automotive Industry	Established the interrelationship between Green Lean Six Sigma (GLS) and Management Innovation (MI). It also explores how GLS can be encouraged and have a practical effect on establishing MI to obtain better performances in the automotive sector. This outcome minimizes waste generation, process variation, and environmental impacts in this sector.	GLSS framework and integration have not been presented.
Banawi and Bilec (2014)	Construction Industry	Presented a framework and integrates Green, Lean, and Six Sigma in a commonsense strategy to improve the quality and ecological impacts of the construction process. This framework provides a comprehensive, multi-phase approach for the improvement in-process and minimization of the life cycle ecological effects in the construction process.	This framework did not incorporate manufacturing industries and takes more time for the execution process.
Garza-Reyes (2015)	Manufacturing Industry	Presented the DMAIC methodology of the Six Sigma strategy to display that the Systematic Literature Review (SLR) stipulates that integration of Green Lean may have expected similar drawbacks as the independent green and lean strategies, but these may be enhanced with the help of this strategy.	This methodology has a scarcity of application computation tools in various phases.
Cherrafi et al. (2016)	Manufacturing Industry	Proposed a framework that methodically leads manufacturing sectors by a five-phase and sixteen steps processes to integrate and implement this strategy effectively to improve sustainability performance. The study reveals that average resource consumption and cost of energy or mass stream reduce from 20 to 40% and 7-12%, respectively, after executing this approach.	This framework was that sensitive operations may be elaborated to enhance by this methodology.

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Mangla et al. (2017)	Automobile Industry	Recognized barriers in GLS product development (GLSPD) from consultation with industrial personnel and an all-embracing literature review. Twenty-one barriers are recognized and authenticated by the brainstorming sessions. Then, Interpretive Structural Modeling (ISM) was employed to initiate a hierarchical model of these barriers in implementing the GLSPD process in the automobile sector.	GLS framework was that it did not analyze properly.
Ruben et al. (2018)	Manufacturing Industry	Represented the effective execution of the LSS framework with environmental considerations to pledge the minimization in defects and ecological impacts. The study exposes that internal defects have been reduced from 16000 PPM to 5000 PPM. Environmental impacts were also reduced from 42Pt to 33 Pt.	The LSS framework could be employed only automotive component organizations and definite manufacturing sectors working with analogous manufacturing operations.
Powell et al. (2017)	Food Industry	Climaxed the application of LSS and evaluates the impacts of LSS on environmental sustainability in food processing industries. This outcome minimizes process variation, rejections, and ecological effects.	Only one case company had been considered to carry out the research work.
Zhu et al. (2018)	Health care Industry	Proposed a systematic framework dependent on an outdated DEF meta modal that recommends specific measures and synergies between Lean and Green approaches. These outcomes in reducing the waste generation in the hospital operations and successfully related greening to lean abilities may reduce environmental impacts within the hospitals.	The presented frameworked had not been tested practically.
Sreedharan et al. (2018)	Public sector	Dispensed the GLS modal for public sectors. This modal improves the efficient brilliance of public sector assistance like telecommunication, construction, and health care. GLS is integrated with supply chain management to eliminate obstacles resist by public sectors, leading to process enhancement.	This framework lacks the comprehension and evaluation of many green lean wastes.
Kaswan and Rathi (2019)	Manufacturing Industry	Recognized GLS enablers and modeling is done with the help of Interpretive Structural Modelling (ISM) and methodically determines the relationship between these enablers. Further, Impact Matrix Cross-Reference Multiplication Applied to a Classification (MICMAC) analysis has been utilized to classify these enablers for better interpretation. The study exposes that twelve GLS enablers hindering the implementation of this approach are recognized and modeled.	The application model for the realisation of GLSS in manufacturing at distinct phases of DMAIC methodology has not been reported.
Sony and Naik (2020)	Mine Industry	Presented a framework for implementing this strategy within the organization to attain the green goal through the DMAIC process of the five aspects of the environmental exhibition. In this paper, a case study approach is employed to implement the GLS framework to reduce the level of graphite and dust pollution in cast mines.	The key limitation related with this study was that a single case study was predicted as being an execution framework. It grasps a substantial time for execution and analysis, taking into consideration various variables.
Siegel et al. (2019)	Manufacturing SMEs	Proposed a conceptual framework for a collective green lean approach and sustainability for small-medium enterprises. The result requires that the most general incitement to green lean implementation is a shortage of matrices and evaluation.	Six Sigma concepts were not incorporated for the minimization of variations in the manufacturing operations.

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Hussain et al. (2019)	Construction Industry	Identified barriers to the GLS construction process through the literature survey and the opinion of the experts. Further, these barriers were authenticated by brainstorming sessions. The study reveals that there will be a reduction in wastage generation process variation and environmental impacts after implementing this strategy in the construction industry.	The implications of this work may not be appropriate for other industries that may have other valid issues.
Kaswan and Rathi (2020)	Manufacturing Industry	Proposed integrated and progress DMAIC dependent GLSS framework. The proposed framework provides a pathway for GLSS implementation by a suitable preference for the project. The study exposes that many sustainability measures have been assessed with the help of unique GLS indices and toolsets.	The framework of GLS has not been tested practically.
Shokri and Li (2020)	Manufacturing Industry	Implemented green strategy into lean six sigma approach projects in manufacturing sectors. It also recognized under which circumstances the output of LSS projects with prudent benefits are more environmentally sound. This results in achieving greener, customized, and economic–oriented outcomes.	The present model is extremely distracted to describe the decision in LSS.
Prashar (2020)	Pharmaceutical Industry	Minimization in electricity utilization, minimization in the emission of tons of CO2 per kilowatt-hour of energy	The presented framework is probed by research actions within a single commercial element of a large multinational industry majority drugs.
Yadav et al. (2021)	Manufacturing Industry	Presented integrated and developing the GLSS framework in the manufacturing environment. Integration of the GLSS approach has been presented on intangible features like enablers, toolsets, etc. This article also presents a five-facet GLSS framework for an industrial organization to increase organizational sustainability. The major drawback of this study was that the GLSS framework had not been authenticated with the help of a case study.	GLSS framework had not been authenticated with the help of a case study.
Kaswan and Rathi (2020)	Manufacturing Industry	Critically reviewed the GLSS strategy simultaneously with readiness measures, failure factors, integration, and implementation of the framework. This study also presents a methodical GLSS framework with the related toolsets to encourage industrial managers and practitioners to execute this sustainable strategy.	GLSS framework had not been probed practically.
Gholami et al. (2021)	Chemical Industry	Minimized consumption of chemicals and energy in the operations by 28 and 21%, cost saving in operations.	The proposed framework had not considered the application of lean.
Rathi et al. (2022a)	Manufacturing Industry	Developed a framework for GLSS for capacity waste reduction in the fastening component industry.	The framework formed from the literature and to consult with the industrial personnel. Furthermore no techniques and actions were dispensed to modify defects level, societal sustainability of considered industry.

2.8 The significance of digitization regarding Lean and Green

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Lean and Green technologies are augmented by the incorporation of digital technologies like Industry 4.0 (I4.0). Dalenogare et al. (2018) integrated Lean with digital technologies and found that digital technologies can overcome the limitations of Lean especially when the product are differs in terms of variety. They also suggested that I4.0 must be incorporated after Lean is implemented, as Lean creates the process baseline, and then this process baseline can be automated and digitized. The same has been supported by Wang et al. (2019) who proposed that it is easier for the industry to incorporate digital technologies measures after they have already incorporated Lean measures. Although the integration of Lean and digital technologies is still in its infancy, initial evidence suggests integration of the two approaches leads to improvement in metrics related to waste, costs, and productivity of the organizations. Also, it has been found that digital technologies moderates the effect of Lean practices on the operational efficacy of the industry (Huo et al., 2019).

Integration of Lean aspects with Green technology also comes with many difficulties. As stated by Powell et al. (2017) and Ershadi et al. (2021), it tends to focus primarily on economic aspects of sustainability and overlook environmental ones due to a large number of environmental metrics. The inclusion of green metrics also involves many stakeholders such as the customer, organization, government, NGOs, etc. The wide spectra of constituents have different interests and sometimes conflicting ones that lead to difficulty in data gathering and further investigation. Thus, there is a need for big data and further examination of the same is required to make effective judgments on green measures of sustainability. Lean integration with digital technologies like Big data and the Internet of things (IoT) will make the workplace “smarter”, enhance decision capability, and ensure improved environmental sustainability of the industry. IoT-based systems can be used to make the workplace more responsive and reduce hazards, as they provide quick information exchange and communication to achieve smart recognition, position, and tracing (Patel & Keyur, 2016). Green technology coupled with digital technologies is further augmented by the adoption of artificial intelligence (AI), contributing to reduced workplace accidents and less human intervention in the system (Cheng et al., 2020; Kaswan et al., 2022). The adoption of other smart technologies, such as 3D printing, further supplements GLSS's pursuits to realize a product with reduced environmental damage (Spears & Gold, 2016). GLSS is further augmented by other digital technologies, such as collaborative and autonomous mobile robots (COBOT and AMR), augmented reality (AR), and digital automation with sensors, making systems more responsive, reducing lead time, and supporting adaptation to self-decision-making in a complex environment (Djuric et al., 2016).

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3. Research Methodology

In the current study, a comprehensive literature review regarding the GLSS approach has been carried out. To select pertinent research articles, the authors have used the systematic literature review (SLR) technique. SLR is a process for recognizing, assessing, and correlating the existing body of concluded and registered studies carried out by researchers, scholars, and practitioners (M. Singh & Rathi, 2019; Rathi et al., 2022b). After developing the SLR, the theoretical background of Lean, Green, Lean-Green, Six Sigma, LSS, and GLSS have been discussed. After that, different theoretical elements related to GLSS like CSFs, barriers, potential benefits, and a review of available GLSS frameworks/methods have been explained in this methodology. Thereafter, a descriptive analysis of published articles has been carried out. It presents the year-wise analysis of articles, journal-wise analysis of articles, continent-wise distribution of articles, and approach-wise distribution of articles to explore different facets of the GLSS approach. From the comprehensive review of the articles, potential research gaps have been identified for fostering the research plan. The analysis carried out provides several directions for future scope in the GLSS field. The current research presents both theoretical and practical implications for practitioners and researchers. Figure 3 depicts the adopted research methodology.

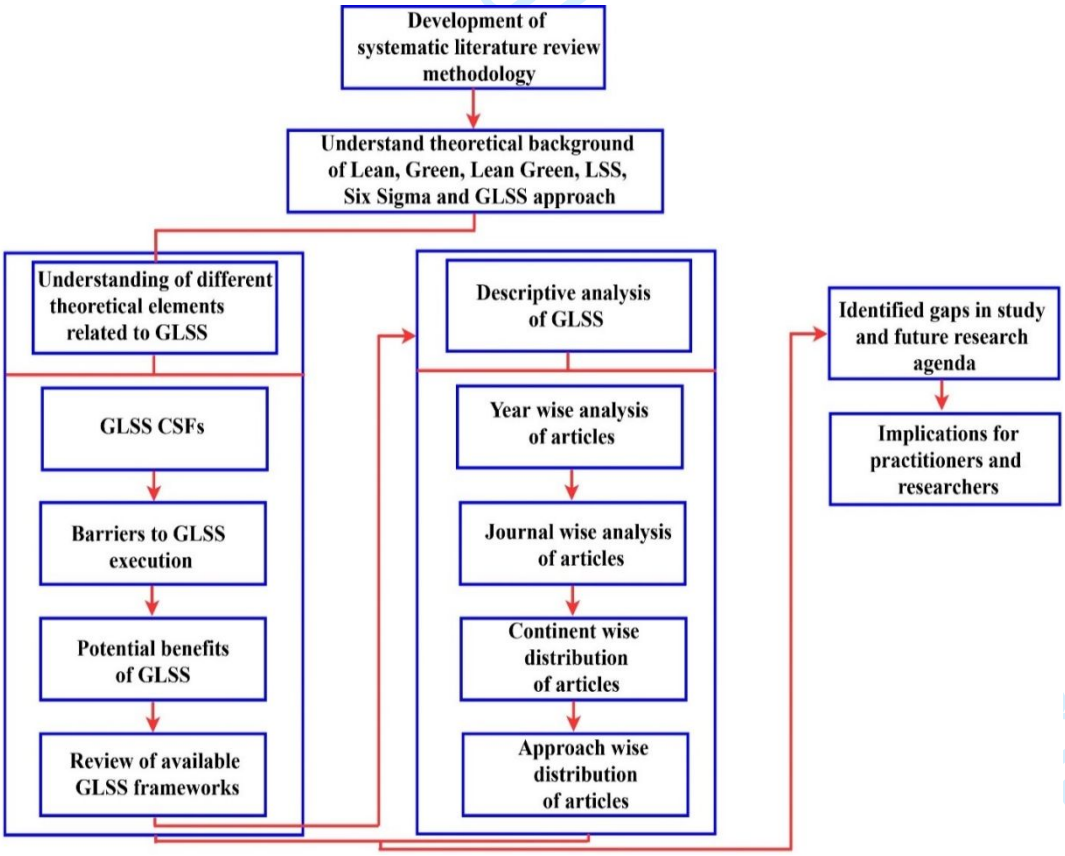

Fig. 3. Adopted research methodology

4. Descriptive Analysis

4.1 Categorization of manuscripts according to the year of publication

Figure 4 exhibits the categorization of manuscripts according to the year of publication over the period from 2005 to 2021 in which 140 articles were studied. This was reorganized from the studies of (Parmar & Desai, 2020) and (Gaikwad & Sunnapwar, 2020), where the manuscripts selected were plotted by the year, they were published. This indicates how the manuscripts were published and if the research is for sure depending on the current data. It shows the growing tendency of research manuscripts published throughout the previous span of the period. The manuscripts on Green, Lean, and Six Sigma continuously increased after 2015. It is apparent from the graph that the greatest number of manuscripts were published in 2021, dispensing better evidence of research developed on current information. Then more manuscripts were published in 2020 and after that, more manuscripts were published in the year 2018 and 2019 on GLSS, respectively. A relatively less number of manuscripts were published in the year 2007 and 2012. Furthermore, the distribution of manuscripts of GLSS was found on seven continents of our world. Out of 270 research articles, 119 were contributed by Asia, followed by Europe and North America. Figure 5 outlines the continent-wise distribution of publications.

4.2 Categorization of manuscripts journal wise

Figure 6 shows the categorization of several manuscripts in the journal publications. It is observable that the *Journal of Cleaner Production* contributed to a large portion of the manuscripts (24) published in this field. This is maybe because of the way that most research papers talk about ecological issues in this journal and as such, hold a lot of pertinence towards this research study. International Journal of Lean Six Sigma (11) likewise dispenses a lot of manuscripts in this field. Then after that, research papers (9) were published in each international journal of Six Sigma and competitive advantage, *International Journal of Quality and Reliability Engineering*, and *International Journal of Production Economics* respectively. It can be assumed that research on the integration of GLSS is expected to be published in a variety of well-reputed journals.

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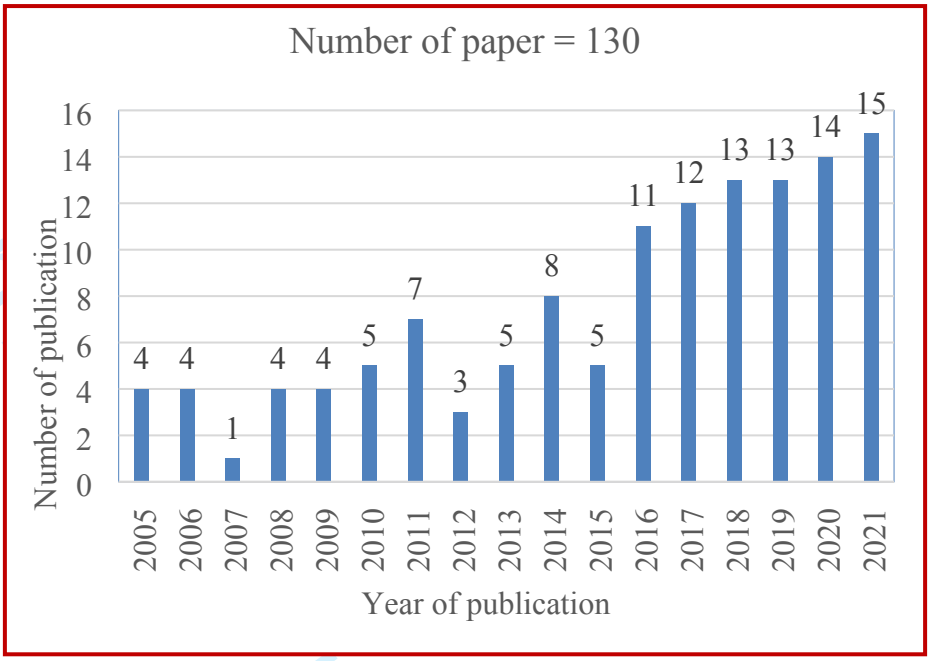

Fig. 4. Distribution of publications per year across the period studied

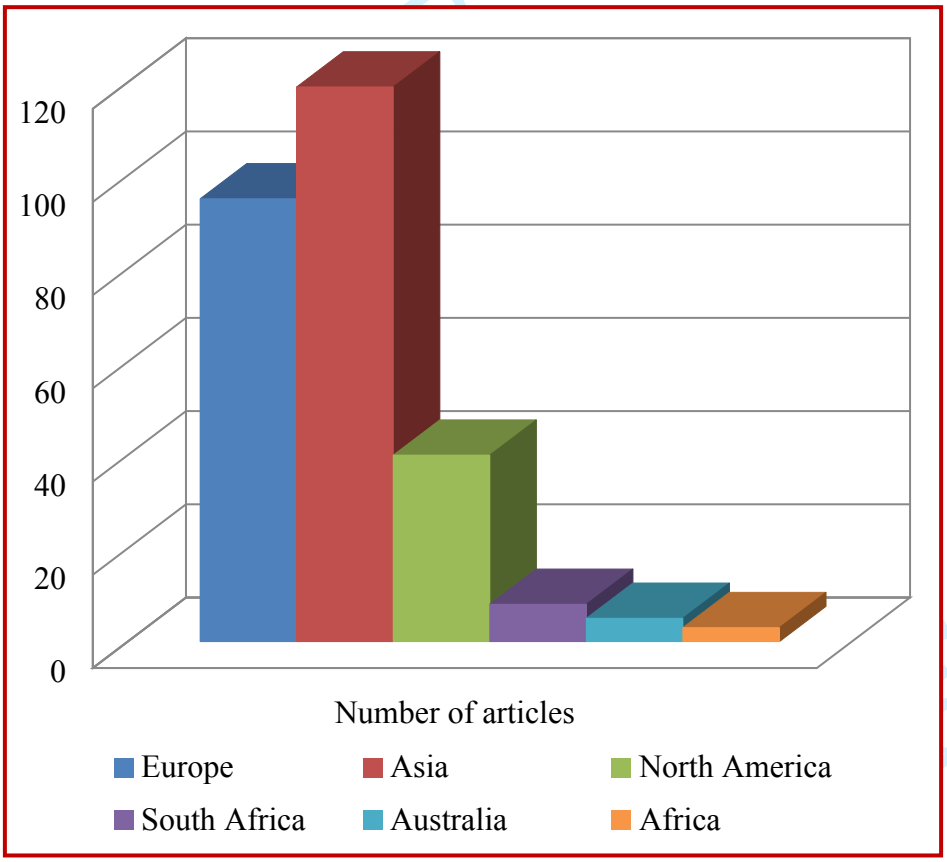

Fig. 5. Continent wise distribution of publications

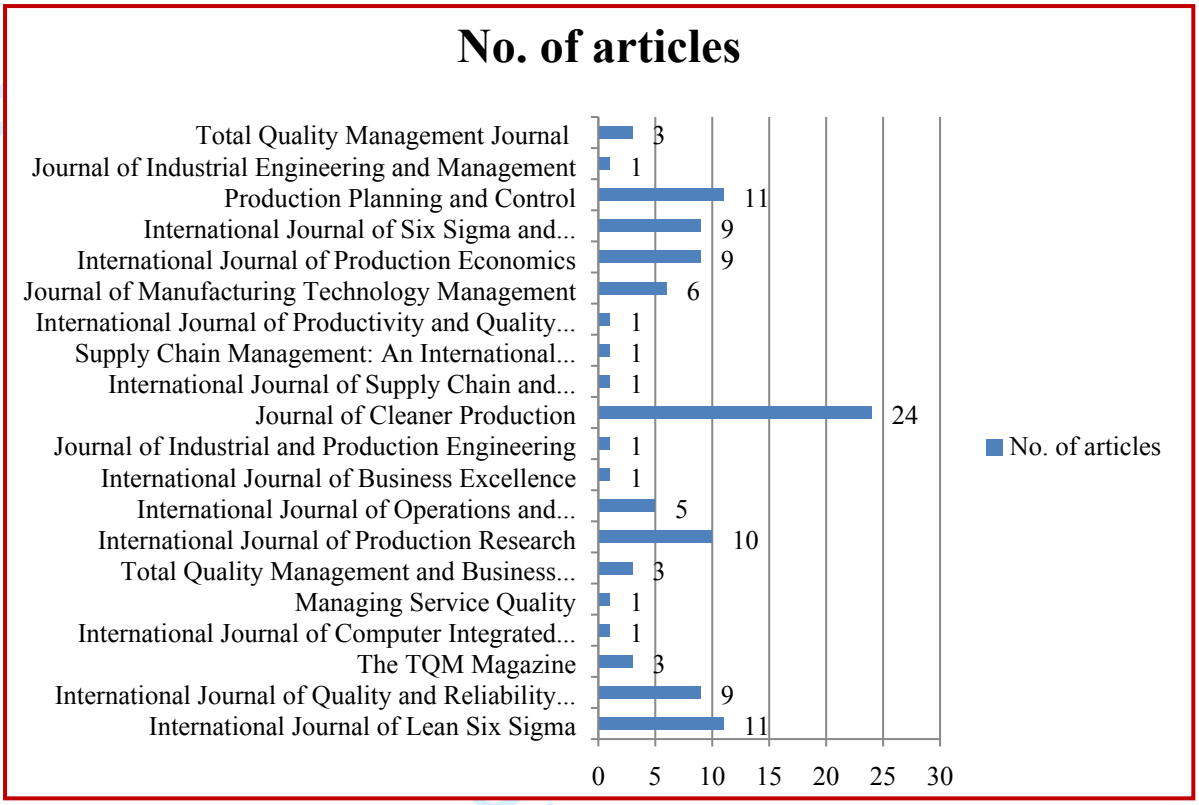

Fig. 6. Categorization of manuscripts journal wise

4.3 Approach-wise categorization of articles

Figure 7 illustrates the distribution of published papers for Green, Lean and Six Sigma separately and incorporated strategies of LSS, Green-Lean, and GLSS.

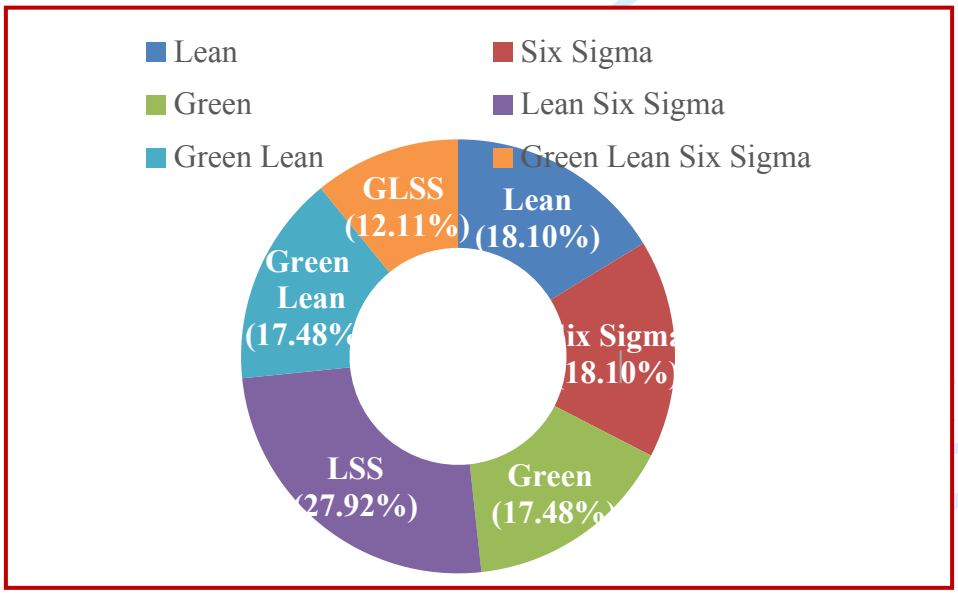

Fig. 7. Approach-wise categorization of articles

The study reveals that 29.92 percent of manuscripts are published on LSS, 18.10% of research papers are published on Lean and Six Sigma separately, 17.48% of manuscripts are published on integrated Green-Lean strategy and 12.11% of the manuscripts are published on the integration of GLSS strategy. Referring to Figure 4, it is perceived that most of the research has been done in the field of LSS (27.92%) when contrasted with Green-Lean (17.48%). So, limited research has been carried out on integrating the GLSS (12.11%) approach, which requires the future direction and importance of the research work.

5. Identified research gaps and future scope of the research

In this review, the existing literature on GLSS published during the time of 2005 to 2021 is assessed to separate hypothetical components from fostering an integrated framework. The encouraging or adverse results on the environment because of GLSS execution cannot seem to be investigated in all industrial organizations. Hence, there is a requirement for the integration of similar approaches. The study reveals that research in the area of GLSS is in the increasing phase. To motivate researchers in the area of GLSS and provide appropriate directions, we feature the gaps in the existing literature for fostering the research plan. The analysis carried out gives numerous directions for future scope in the GLSS field.

5.1 Performance measurement system

In this review, this is tracked down that few kinds of research examined performance measurement, yet the performance measurement in Green, Lean, and Six Sigma was analyzed separately. According to the sustainability perspective, there is an unavailability of a unified measurement and metrics system to evaluate the incorporated performance of these three approaches.

5.2 Integrated framework, model, and methods

The corroborative interrelationship among GLSS has encouraged organizations to utilize three kinds of approaches to enhance their functional performance (EPA, 2003). Banawi and Bilec (2014) proposed a framework for incorporating three strategies for the construction sector to mitigate environmental effects. Cluzel et al. (2010) proposed an eco-plan strategy that intends to incorporate the GLSS approach for ecological evaluation and enhancement. The encouraging or adverse results on climate because of GLSS execution presently cannot seem to be investigated in all industrial organizations. According to Park and Linich (2008) “LSS can be a significant part of Green that assist any organization with boosting sustainable performance”. The study reveals that there is a lack of research in the area of integration of

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three approaches just as various issues that are general to the vast majority of business models. These frameworks allude to the requirement of robust leadership, support of higher management, and involvement of every worker for continuous enhancement exertion to provide top-quality performance (Pampanelli et al., 2014). Everyone's methods/framework depend on the organizational culture of TQM.

5.3 Application of GLSS in SMEs

Small and Medium Enterprises (SMEs) are considered the backbone of any nation's economy. In general, this sector accounts for the most significant portion of established enterprises (Saleh and Ndubisi, 2006). India is one of the developing nations whose economy majorly depends on the SME sector (Siegel et al., 2019). Despite its great role in economic growth, it faces dynamic environmental, competitiveness, and continuous improvement (Gandhi et al., 2018). SMEs are incredibly accountable for carbon emissions (M. Singh et al., 2021). This sector is responsible for 70 percent of industrial pollution resulting in $32 billion in environmental costs (NPC, 2013; MoEF, 2012). It also consumes 6 percent of total energy consumption (Haeri & Rezaei, 2019). SMEs are the primary source of CO_2 emission (117.98 million tons/year) in India (Ministry of the Environment, 2020; Krolczyk et al., 2020).

5.4 Service Sector

The potential of GLSS has not been explored to its full potential in the service sector. As per Vargo and Lusch (2008), the service sector is a critical portion of our economy that could be observed as a significant under-investigated influent.

5.5 Societal aspect

Integration of GLSS methodologies results from societal change that should include the shareholders. The review recognizes that the interrelationship between these three approaches and societal performance is not completely examined in academic research. Also, social performance (safety, health, staff assurance, expertise, etc.) appears to be obscure. Consequently, there is a requirement to concentrate on the human side more extensively and take a look at the administrative difficulties of dispatching, driving, and making persons for GLSS exertion.

6. Proposed framework for GLSS execution

Figure 8 depicts the GLSS execution framework proposed by the authors for minimizing defects and environmental impacts for the considered manufacturing organization. The GLSS framework evolved dependent on three design dimensions. The first design dimension comprised the activity of studying the characteristics, the main cause for development, and appropriateness of the several GLSS execution frameworks pointed up in the last section.

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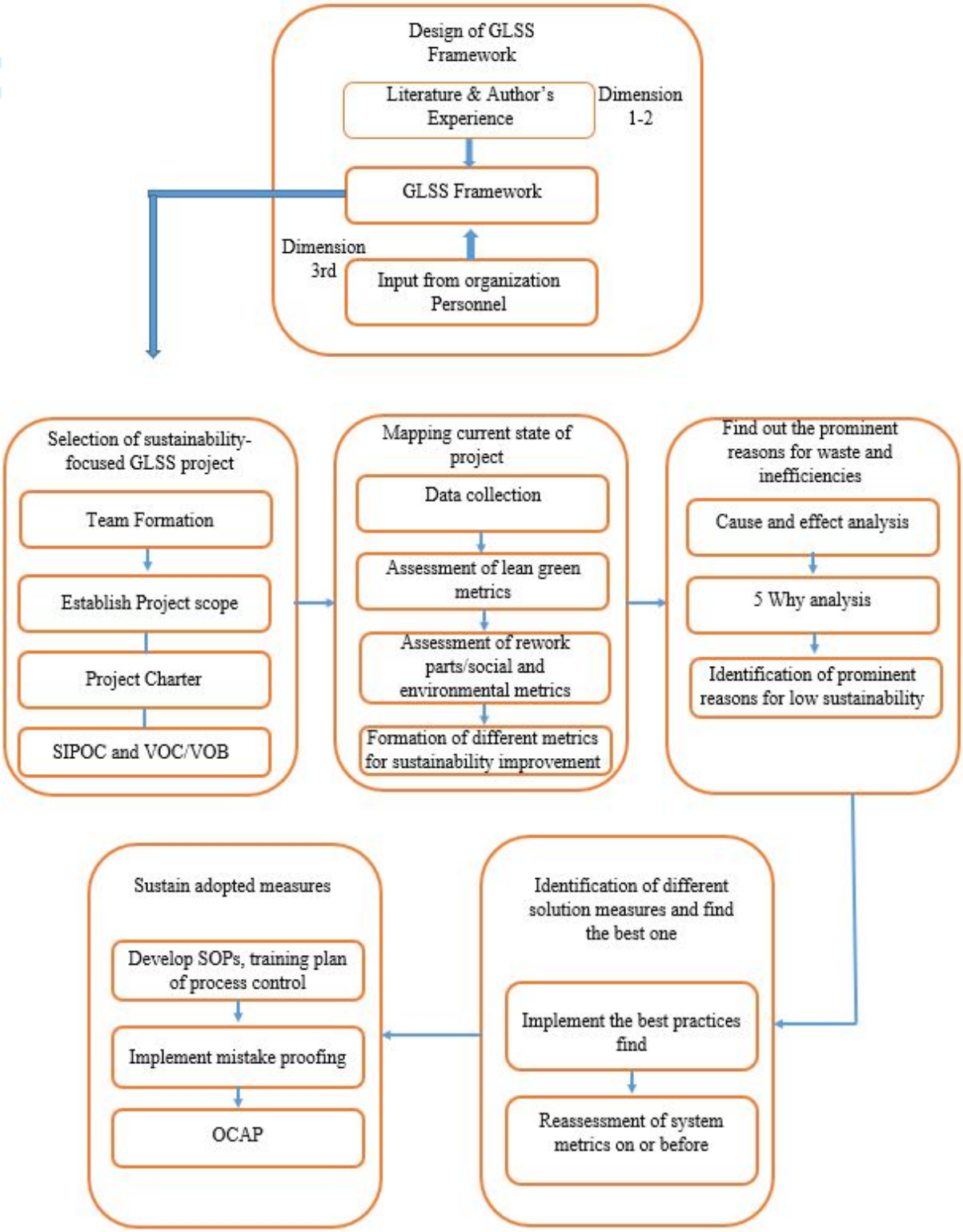

Fig.8: Proposed framework and adopted methodology

This secured the incorporation of the most current and specific conceptual knowledge into the developed GLSS framework. The second design dimension incorporated using the substantial theoretical and industrial revel of the authors as specialists, industrial practitioners, and academic researchers to help the development of the proposed framework.

Garza-Reyes et al. (2016) recommend that experience of practitioners performs a crucial role while developing conceptual frameworks which are needed to be implemented in the industry.

Lastly, the third design dimension incorporated the consideration of appropriate inputs from the industry. Thus, the authors discussed this with a team of experts. Consequently, 40 experts were recognized from several departments of the selected industry, other industries, and academicians. From this group, 18 industrial experts agreed to dispense their feedback about the GLSS framework. The expert panel comprised general managers, senior managers, master black belts, project leaders from the selected industry, and experts from an academic background. Each expert that was included in the panel had more than eighteen years of industrial and academic experience. The experts dispensed valuable feedback and criticism to improve the applicability and maturity of the GLSS framework. Afterward, the developed framework was probed in a leading manufacturing industry. The purpose was to gather appropriate observations, evaluate weaknesses, and regulate the framework.

The proposed framework was developed to inscribe problems associated with ecological and quality measures of projects and enhance the functional dynamics of industrial sectors. Every step of the attainment of the GLSS framework has several activities that minimize waste and related ecological impacts. So, the current study's unique contribution lies in supporting industrial sectors to compute several functional, environmental, and societal measures and dispense ways to enhance and sustain the same for improved organization competitiveness. The conceptual facets of the developed GLSS framework are discussed below:

Step 1: This step of the developed framework is concerned with recognizing and delineating the adopted project. The scope of the project is considered to explore ecological, social, and quality implications. The requirements, preferences, and presumptions of the business and customers are clearly stated in terms of VOB and VOC to recognize the expectations from the product being manufactured. This has been recognized from VOB and VOC analysis that the firm needed high-level customer satisfaction, capacity usage, and worker engagement while customers want high specification eco-friendly products at a reasonable cost. In this step, the subsequent process of manufacturing, SIPOC diagram, and project charter dispenses a complete understanding of several aspects of the adopted GLSS project.

Step 2: In this step, data collection was carried out to represent the current state of the system and data corresponding to defects and inefficiencies. Moreover, EVSM analysis was employed to evaluate the current state of the project concerned to lead time, raw material consumption, water consumption, etc. LCA was also utilized in this phase of the GLSS

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framework to estimate the current environmental impacts of the process. The data prevails to rework was also gathered to find out shop's critical to rework problems.

Step 3: This phase focuses on recognizing the root causes of waste and inspecting the problems and process inefficiencies. Based on the measure phase, reasons for inefficient material handling, rework, low environmental performance, and enhancement in societal sustainability are recognized. When the potential causes are recognized, then the search is dispersed to obtain crucial contributors to waste and inefficiencies.

Step 4: In this phase, several solutions are recommended and the best solutions are recognized and implemented to mitigate the root causes of waste and inefficiencies. Each suggested solution has been executed in such a way that an appropriate recording can be done to compare with previous results. The training has been provided to employees and managers of the organization from time to time for the effective execution of the GLSS approach.

Step 5: In this step of GLSS implementation, enhancements obtained are registered to sustain the improvement actions. Now, the enhanced process is handed over to the process owner along with the whole procedure for sustaining the gains. This step confirms that gains attained from the enhancements made are sustained after the accomplishment of the GLSS project. In the beginning, it is imperative to document and regulate the process to represent a perfect image of the improvements made and how to maintain these improvements.

Summary of the review

The objective of this review is to explore different aspects of the Green Lean Six Sigma approach, application status, and potential benefits from a comprehensive review of the literature and provides an avenue for future research work. This review proposes a five-facet GLSS framework to minimize overall defects and environmental impacts simultaneously to enhance the functional and environmental performance of the organization. The study depicts that GLSS implementation is increasing yearly, leading to considerable improvement in all dimensions of sustainability. Enablers, barriers, tools, and potential benefits that foster the execution of GLSS in industrial organizations are also identified based on a systematic review of the literature. The study's uniqueness lies in that study is the first of its kind that depicts the execution status of GLSS, and its different facets explore different available frameworks and provide avenues for potential research in this area for possible researchers and practitioners. The implementation of the proposed framework assisted in enhancing the sigma level of the case industry and also minimized the overall environmental impacts. The contribution of the present review pretends two-fold, first, the GLSS framework has been suggested to direct in conducting the activities of implementation of this program. The

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presented framework dispenses a prospect to the industrial sectors to enhance ecological wastes, improved capacity usage, and handling of items, along with enhancement in social subtleties by the deployment of tools like LCA, SLCA, EVSM, Kaizen, etc. Second, this work exhibits the empirical benefits of using the projected GLSS by its effective execution framework in an industrial environment by methodical insertion of Green technology, Lean, and Six Sigma tools. The present review accommodated the organization to understand its present level of environmental effects and aided it to detect further minimizing CO_2 emissions by the integration of more green technology measures. This framework also had a constructive impact on societal significance as enhancements were perceived to relate to the health of humans (as an outcome of minimized ecological effects) and shopfloor safety (after the deportment of the 7S). The industrial sectors were also encouraged to share their profit in Corporate Social Responsibility (CSR) activities.

7. Conclusions and limitations of the research

Ecological and societal facets have become tactical needs for companies and customary preferences of productivity and profitability to sustain in this competitive market. GLSS has been demonstrated to be one of those incorporated strategies that need additional investigation and further exploration. The current manuscripts dispense a similar effort of investigating different perceptions of the GLSS area. The several philosophies used by academic researchers and experts have been clarified, and gaps for future research are distinguished. In all, 140 research papers from the period from 2005 to 2021 were taken into consideration for literature review.

In the current study, the study of manuscripts was done dependent on: critical success factors for the implementation of the GLSS approach, performance improvement barriers, frameworks/models/methods of GLSS. Year of journals and publication journals were also taken into consideration for the analysis of the paper. The analysis of these distinct classifications gives a better comprehension of the GLSS field and upgrades the knowledge base. The study reveals that 29.92% of manuscripts are published on LSS, 18.10 % of research papers are published on Lean and Six Sigma separately, 17.48% of manuscripts are published on the integrated Green-Lean strategy and 12.11% of the manuscripts are published on the integration of GLSS strategy. It is perceived that most of the research has been carried out in the field of LSS (27.92%) when contrasted with Green-Lean (17.48%). So, limited research has been done on the integration of the GLSS (12.11%) approach, which requires the future direction and application of the research work. The categorization of chosen

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manuscripts also investigates several future research directions for academic researchers and practitioners. This shows that research in the area of GLSS is in the increasing phase.

The present study is the first of its kind that provides a better understanding of different theoretical elements related to the GLSS approach. This study provides different theoretical elements like GLSS critical success factors (CSFs), barriers to GLSS implementation, potential benefits of this approach, and a review of available GLSS frameworks. The existing literature lacks any evidence about the different theoretical elements related to this approach for effective implementation. Thereafter, a descriptive analysis of published articles has been carried out. From the comprehensive review of the articles, potential research gaps have been identified for fostering the research plan. The analysis carried out provides several directions for future scope in the GLSS field. The current research presents both theoretical and practical implications for practitioners and researchers. More research should be started in developing countries like India these nations to recognize GLSS barriers for the developing nations and outline to eliminate these barriers.

The present study might have some drawbacks because of the scarcity of accessibility of pertinent and adequate literature on the subject matter. Although, restricted data is accessible about linking GLSS techniques in industrial sectors. The research is based on a survey analysis that may not provide accurate results. In this study, there are some leading journals were considered for analysis. In the literature, only papers, papers in the press, review papers, and quality papers like international conference papers and conference review papers are taken into consideration to maintain the quality of the manuscript. Online reports, thesis, and books are excluded during the choice of research papers; appropriately, it is well might be probable that some of the research manuscripts might have been left remaining to cover in this literature review.

Theoretical and practical Implications

To assist the industrial practitioners to employ three approaches instantaneously in an environment when linking among GLSS methods in manufacturing sectors has not been instituted. Thus, instantaneously employment of these three approaches encourages the manufacturing industries to improve their functional and environmental performance. This review also encourages ecologists and entrepreneurs to initiate sustainable industrial methods like GLSS that reduce ecological damage by recommending the 5'R technique. Furthermore, the academic audience can employ these bits of knowledge to grow their comprehension of the ideas and might be urged to explore to apportion a specific and explicit hypothesis on the

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GLSS approach. Finally, insights on GLSS grey areas will enable project managers and practitioners to develop a GLSS framework for improved operational and environmental efficacy. Society will also be benefitted from the current study by getting eco-friendly products at reasonable costs.

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A framework for the systematic implementation of Green Lean Six Sigma to improve performance in the manufacturing industry

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Abstract: Green Lean Six Sigma (GLSS) is an all-inclusive methodology that assists the optimal utilisation of resources, minimises waste, and imparts the pathway for sustainable development. This study proposes a novel five facet GLSS framework for the manufacturing industry to improve performance in terms of different sustainability dimensions. The framework has been designed based on three key dimensions: insights from literature, the experience of authors, and inputs from the case organisation members. The framework is validated in an Indian automotive component manufacturing organisation. From the effective implementation of the proposed GLSS framework, defects were minimised from 18,000 ppm to 7,000 ppm and environmental impacts were brought down from 44.70 Pt to 32.70 Pt. This study facilitates industrial managers and practitioners to adopt the GLSS approach to improve sustainability dynamics in the manufacturing industries.

Keywords: Lean; Six Sigma; green manufacturing; Green Lean Six Sigma; GLSS; framework; sustainability.

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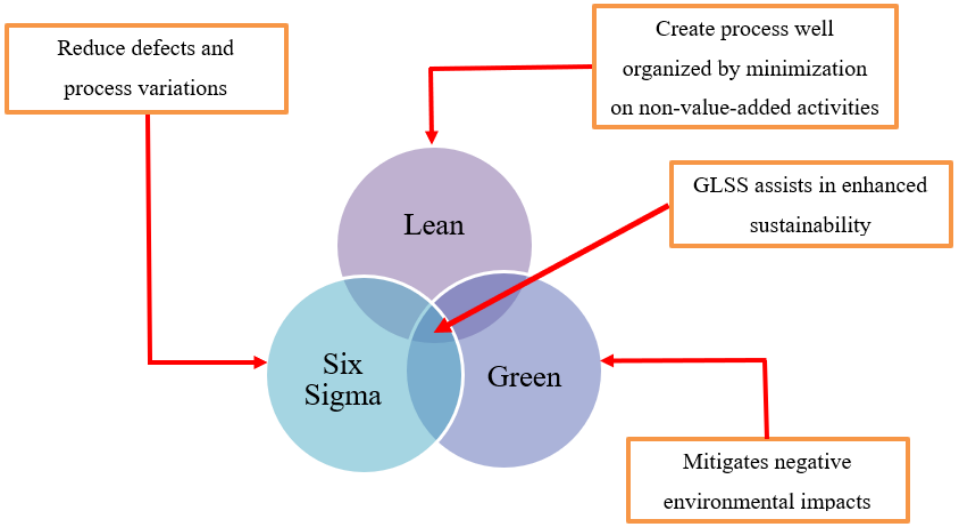
1 Introduction

In an era of high competition to stay in the business, manufacturing organisations have to change their functional dynamics from traditional to eco-friendly. The human being-driven actions and quick industrial development have raised global surface temperatures to 1.5°C in several regions of the globe (Rathi et al., 2022a). Industrial organisations contribute to about 30% of greenhouse gas emissions (GHGs) (Kaswan and Rathi, 2021). This can be attributed to the conventional methods of operations adopted by manufacturing organisations (Kaswan et al., 2021). The enhanced level of GHGs will result in a surge of more than 20,000 deaths annually per °C (Jacobson, 2008). Thus, to persist competitive in the market and obey the environmental pacts the manufacturing sectors have to reduce their present level of emissions by implementing sustainable practices (Yadav and Gahlot, 2022). Therefore, the manufacturing sectors are expanding

massive investment in research and development to evolve other ways of manufacturing high-specification eco-friendly products (Shokri and Li, 2020). In many manufacturing arenas, several methods have been proposed in the past such as green manufacturing, total quality management, value engineering, lean manufacturing, Six Sigma, Lean Six Sigma (LSS), Green Lean Six Sigma (GLSS) to attain functional excellence (Garza-Reyes et al., 2018).

GLSS strategy assists in the success of the organisation by methodical minimisation of wastes, GHGs, and process variation (Gupta et al., 2020). This approach discourses the contemporary problems of the organisation by the methodical implementation of related tools at distinct phases of the product attention (Kaswan and Rathi, 2020). Figure 1 illustrates the integration model of GLSS.

Figure 1 Integration model of GLSS (see online version for colours)



Source: Rathi et al. (2022b)

LSS leads to improvement in the performance related to economical dimensions of the sustainability but do not contribute considerably towards to ecological dimension (Rathi et al., 2022b). Further, LSS also not incorporate social aspects related to the sustainability that is also a pioneer aspect to remain competitive at the global platform (Mohan et al., 2022). Inclusion of green aspects fills this gaps and leads to the sustainable development of the manufacturing enterprises. In addition, there is a demand to incorporate societal facets into GLSS practices to focus on healthy work environment and exceptionally hard work practices. Furthermore, manufacturing sectors in developing countries seek to reduce operating prices and throttle overall in their ability to convert into durable goods. In literature no study related to GLSS that improve production rate environmental metrics and social metrics have been reported. For this research work tends to answer research question: How to construct a comprehensive framework to execute GLSS in the manufacturing environment and test the same for improvement in environmental, social and economical metrics? The proposed framework includes ecological aspects, life cycle assessment (LCA) procedures, social facets, and primary LSS tools in distinct phases. Every step of this framework comprises a set of specified

activities that focus on reducing wastes and related environmental impacts. This framework assists the organisation in obtaining ecological benefits and operational improvement. The unique contribution of the article lies in proposing GLSS framework for a manufacturing industry to enhance performance dynamics. The proposed model was prepared based on three unique dimensions and has capability to improve manufacturing industry performance in terms of reduction of defects level, improve work space utilisation, and also provides measures to ascertain social sustainability.

2 Literature review

The green technology encourages manufacturing sectors to reduce their environmental impacts (Garza-Reyes, 2015). An abundance of literature has focused on the effects of green technologies like LCA, environmental management system (EMS), and design for environmental (DFE), on ecological performance (Al-Sheyadi et al., 2019). These techniques have pragmatic results in satisfying regulatory needs, and fulfilling customers' wants of environmentally-sound products (Prasad et al., 2016). This strategy aims to mitigate harmful ecological effects like hazardous wastes, air emissions, pollution, health prospect to human beings, and environment and power and resource conservation (Kaswan et al., 2022). The lean concept is employed to minimise waste in almost every section of the industry (Thakur and Mangla, 2019). Industries execute this strategy to generate value for consumers by reducing waste and lead time and enhancing process flow (Singh et al., 2021a, 2021b). These tools will facilitate organisations in attaining functional performance along with achieving environmental objectives (Erdil and Arani, 2019). Six Sigma concept is employed to minimise the defects up to 3.4 parts per million opportunities, and the word 'sigma' is utilised to express variations. The primary aim of this approach is to reduce variations and defect mitigation (Andersson et al., 2006). Even though minimising environmental waste is not the prime aim of this strategy, it can attain environmental performance like decreasing air emissions, electricity consumption, and wastewater (Chugani et al., 2017). However, Six Sigma does not directly address issues related to environmental and social sustainability (Rathi et al., 2022c).

An unrequired movement of raw material, work-in-process, and finished products are assessed as waste from both green and lean points of view regarding electricity consumption, gaseous emission, and excessive utilisation of resources (Prashar and Antony, 2018). The correlation between green and lean not only attains the environmental benefits but also minimises cost by waste reduction (Shokri and Li, 2020). Deployed on the common purpose of waste reduction, these have been integrated into a common approach (Campbell and Sigalov, 2022). Moreover, Lean and Six Sigma have been integrated into a joint strategy to achieve environmental benefits by minimising waste (Kaswan and Rathi, 2021). The substantial general features of LSS are waste reduction, continuous enhancement, and satisfaction to the customers (Yadav et al., 2020). The correlation between these three approaches of GLSS can be better realised by their intrinsic features of satisfaction of customers by waste minimisation and value addition (Ershadi et al., 2021). Every approach in GLSS overcomes the drawbacks of another system to impart value by recognising and eliminating wastes that positively impact the organisation's environmental performance (Yadav and Gahlot, 2022). In terms of the ecological impacts of these approaches, the green concept primarily emphasises environmental sustainability and resource conservation as of its key aspects (Gandhi

et al., 2018). Lean preserves resources by minimising waste, so, is identified as an 'eco-friendly technique' (Yadav and Desai, 2017). Identically, Six Sigma describes defects as waste material, area employed, safety matters, and electricity utilised (Gedam et al., 2021).

Table 1 Major studies related to GLSS

Sr. no.	*Author*	*Year*	*Description*	*Limitations*
1	Zhang and Awasthi	2014	Presented a framework that integrates Six Sigma and sustainability. It completely describes imperative steps to attain exactly sustainable development.	The main drawback of this framework was that it did not emphasise economic growth.
2	Ng et al.	2015	Proposed a methodology for executing green and lean manufacturing employed on its metrics.	The major limitation associated with this study was that the tools and techniques that were utilised in this case observation; can not be used for other case research
3	Cherrafi et al.	2016	Proposed a framework that efficiently leads the industries by five-stages and 16-step processes to successfully combine and execute the GLSS strategy to enhance their environmental performance.	The key drawback associated with this model was that delicate operations could be elaborated to enhance by this method.
4	Ben Ruben et al.	2017	Presented an LSS framework with ecological considerations to simultaneously minimise all-inclusive defects and ecological effects to enhance the organisation's functional and environmental performance. This framework is deployed on the DMAIC cycle of the Six Sigma strategy. The LSS framework is authenticated with the help of a case study that is carried out in an Indian automotive component manufacturing industry. The study reveals that internal defects were dropped down from 16,000 ppm to 6,000 ppm, and ecological effects were also minimised from 42 Pt to 32 Pt.	The major limitation of this study was that the LSS framework can be employed only for automotive component organisations and definite industrial sectors working with analogous industrial operations
5	Caiado et al.	2018	This manuscript presents a critical review of LSS approaches and underlines their significance to attain sustainable services. This article also provides a comprehensive GLSS framework seeking to assist practitioners to detect the way of standardising it in several types of services, by identifying nine critical factors for its execution.	The major drawback of this review was that LSS methodology was restricted only to service sectors.

Table 1 Major studies related to GLSS (continued)

Sr. no.	*Author*	*Year*	*Description*	*Limitations*
6	Talapatra and Gaine	2019	Presented and executed GLSS framework for jute industry to reduce defects, carbon footprints and energy utilisation.	The proposed framework completely emphasised jute industry and did not include societal aspects.
7	Kaswan and Rathi	2020	This manuscript is concerned with the integration and development of the GLSS framework. GLSS integration was presented dependent on conceptual factors, and the GLSS framework was presented dependent on DMAIC methodology. The developed framework imparts a way to implement the GLSS approach by a proper selection of the project.	The major drawback of the current study was that the framework of GLS has not been tested practically.
8	Yadav et al.	2021	This article is concerned with integrating and developing the GLSS framework in the manufacturing environment. Integration of the GLSS approach has been presented on intangible features like enablers, toolsets, etc. This article also presents a five facet GLSS framework for an industrial organisation to increase organisational sustainability.	The major drawback associated with this study was that the GLSS framework had not been authenticated with the help of a case study.
9	Kaswan and Rathi	2021	The purpose of this manuscript is to critically review the GLSS strategy simultaneously with readiness measures, failure factors, integration, and implementation of the framework. This study also presents a methodical GLSS framework with the related toolsets to encourage industrial managers and practitioners to execute this sustainable strategy..	The limitation of this study was that the GLSS framework had not been probed practically
10	Rathi et al.	2022b	Develop framework for GLSS for capacity waste reduction in the fastening component industry	The key drawback associated with this study was that the framework formed from the literature and to consult with the industrial personnel. Furthermore no techniques and actions were dispensed to modify defects level, societal sustainability of considered industry.

Previous studies have emphasised theoretical frameworks, but these have required pragmatic validation and experimental substantiation. Ruben et al. (2018) presented 'framework' of LSS with ecological features but could not discourse on how proposed 'framework' can be accepted by small-scale establishments. Furthermore, presented GLSS framework did not take into consideration the social facets of sustainability.

Gholami et al. (2021) employed this approach to enhance the functionality and ecological facets nonetheless presented framework wants practical authenticity in utilising LSS tools and LCA toolsets. Thus, past studies claim the research for the GLSS framework is non-specific, employed in a distinct context, and includes all facets of sustainability. Furthermore, several projects have a high prospect of execution failure of LSS sustainable frameworks (Singh et al., 2021a, 2021b). Thus, contribute to production literature; this study contributes to the restricted body of knowledge in the fields of GLSS and sustainability by developing and executing an GLSS framework that industrial organisations can use to enhance performance dynamics. Table 1 depicts major research work pertaining to GLSS.

2.1 Research gaps

The literature shows that execution of 'LSS' assists to positive results on environmental and economic concert. But, incorporation and execution of Green approach with this concept are not divested of tasks. Scarcity of finance for environmentally sound technology projects, lack of support from top management, shortage of assets, inaccessibility of equipments and practices, and over-focus on profits, further avert powerful execution of sustainability-orientated initiatives. GLSS literature reveals that focuses has been limited to ecological and financial aspects of sustainability but that the social component was not noted. Furthermore, industrial sectors in emerging countries require to open the restrain their ability for minimising functional costs and providing high specification ecological products. In the literature, there is no evidence of a committed GLSS framework that assists in the mitigation of environmental impacts and increased capacity utilisation together with improved social facets. Therefore, the noted literature gaps have dispensed path for the current study.

3 Proposed framework for GLSS execution and adopted methodology

GLSS framework was evolved dependent on three design dimensions. The first design dimension comprised of action of perusing characteristics, the main cause for development, and appropriateness of several GLSS execution frameworks pointed up in last section. This secured merger of utmost recent and specific conceptual knowledge in developed GLSS framework.

Lastly, the third design dimension incorporated the consideration of appropriate inputs from the industry. The professionals dispensed valued feedback and criticism to improve pertinency and adulthood of framework of GLSS. Afterward, the developed framework was probed in an automotive component manufacturing industry.

The GLSS framework was developed to inscribe problems associated with ecological and quality actions of projects and enhance functional subtleties of industrial sectors. Every step of the attainment of the GLSS framework has several activities that minimise waste and related ecological impacts. The conceptual facets of the developed GLSS framework are discussed below:

Step 1 This step of developed framework is concerned with recognising and delineating the adopted project (Section 4.1). The scope of the project is considered to explore ecological, social, and quality implications. The requirements, preferences, and presumptions of the business and customers are clearly stated in terms of VOB and VOC to recognise the expectations from the product being manufactured. This has been recognised from VOB and VOC analysis that the firm needed high-level customer satisfaction, capacity usage, and worker engagement while customers want high specification eco-friendly products at a reasonable cost. In this step, the subsequent process of manufacturing, SIPOC diagram, and project charter dispenses a complete understanding of several aspects of the adopted GLSS project.

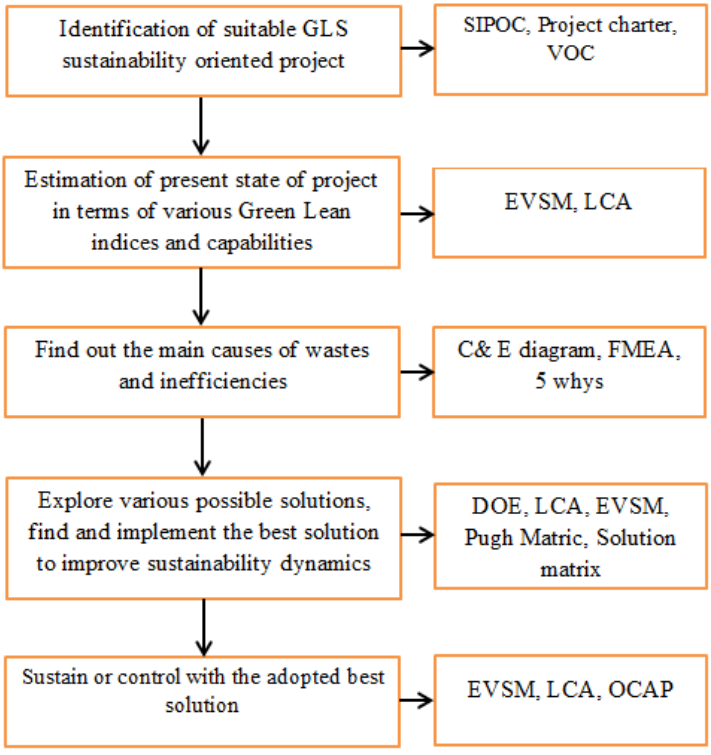
Step 2 In this step, data collection was carried out to represent present state of the system and data corresponding to defects and inefficiencies (Section 4.2). Moreover, EVSM analysis was employed to evaluate the current state of the project concerning lead time, raw material consumption, water consumption, etc. LCA was also utilised in this phase of the GLSS framework to estimate the current environmental impacts of the process. The data prevailing to rework was also gathered to find out shop's critical to rework problems.

Step 3 This phase focuses on recognising the root causes of waste and inspecting the problems and process inefficiencies (Section 4.3). Based on the measure phase, reasons for inefficient material handling, rework, low environmental performance, and enhancement in societal sustainability are recognised. Tools like brainstorming, C&E, 'FMEA and 5 why analysis are' deployed at this stage to determine probable reasons for defects. When the potential reasons are recognised, then the quest is dispersed to obtain crucial contributors for wastes and inefficiencies.

Step 4 In this phase, several solutions are recommended and the best solutions are recognised and implemented to mitigate root causes of waste and inefficiencies (Section 4.4). Each suggested solution has been executed in such a way that an appropriate recording can be done to compare with previous results. The training has been provided to employees and managers of the organisation from time to time for the effective execution of the GLSS approach. Tools such as DOE, Kaisen, and other process enhancement methods are deployed for planning the enhancement activities associated with productivity and quality.

Step 5 In this step of GLSS implementation, enhancements obtained are registered to sustain the improvement actions (Section 4.5). Now, the enhanced process is handed over to the process owner along with the whole procedure for sustaining the gains. This step confirms that gains attained from the enhancements made are sustained after the accomplishment of the GLSS project. In the beginning, it is imperative to document and regulate the process to represent a perfect image of the improvements made and how to maintain these improvements.

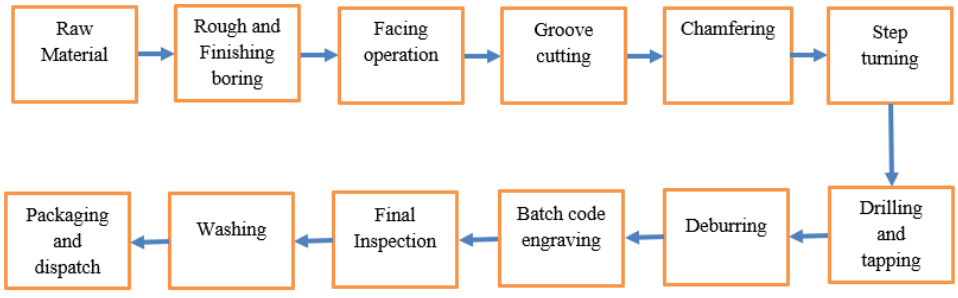
Figure 2 GLSS framework (see online version for colours)



4 Application and validation of the proposed GLSS framework

The work is carried out in a major automotive component manufacturing industry which is situated at Gurugram, Haryana (India). The considered organisation produces about 35 kinds of vehicle axle assembly components. The company is certified with ISO: 9001.2008 and QS 14001 certification. The automotive component banjo-type axle housing are selected to carry out the current study. A banjo-type axle housing comprises a hollow central member with a pair of hollow tubes extending outward. Such axle assemblies comprise several components that are adjusted to transmit power from one engine of the vehicle to the wheels thereof. The banjo-type axle housing is made up of mild steel and weighs about 45 kg as a finished product. The banjo-type axle housing required more quality and rework concerns as compared to other produced components. The concerned organisation was highly motivated to mitigate environmental impacts of this component. The manufacturing sequence of banjo-type axle housing is depicted in Figure 3. As can be seen in Figure 3, the manufacturing process begins with the flange rough and finishing boring operation.

Figure 3 Manufacturing sequence of banjo-type axle housing in the adopted organisation (see online version for colours)



4.1 Selection of sustainability-focused GLSS project

As previously indicated, the implementation of the GLSS project requires a well-committed team having several skills for manufacturing operations. In this current study, the team involved a specialist, a controller from the higher management, and five managerial members. In this step, the subsequent process of manufacturing, SIPOC diagram, and project charter dispenses a complete understanding of several aspects of the adopted GLSS project. A meeting was also arranged by the higher management of the industry to direct the workers about the requirement of the adopted project and its outputs. This assists in imparting appropriate consciousness and understanding about the project to the workers. The management of the selected firm outlined its concern for production waste, minimisation of emission for manufacturing of banjo-type axle housing, and evaluation of the social sustainability of the firm. The company produces 6,000 vehicle assembly components per month and about 72,000 components in a year. The total established capacity of business unit was 150,000 parts per annum. Based on significant data of the previous four years, it is observed that the firm was working at 56.8% of the total capacity that implying that there was about 48% of production waste. The company possessed a considerable level of ecological emission with 28.20 Pt, and there was no initiative to evaluate the social sustainability of the industry.

Crucial parameters for production waste were recognised in this subsection to consult with experts and industrial visits. Then radar chart is constructed to illustrate the percentage contribution of parameters in the production waste of the selected firm (Figure 5).

The radar chart outlines that inefficient material handling (39%), inefficient manpower movements and space usage (27%), ecological issues combined with social issues (18%), and rework (11%) were the significant contributing features for production waste of adopted organisation. The time utilised for material handling activities in several units was evaluated to recognise crucial units concerns to inefficient material handling. Shop-wise material handling time was evaluated in this subsection to detect key shops responsible for poor material handling. The previous 24 months' data refers to the time taken to find items and equipment in several shops that were collected. A Pareto chart is plotted to find out the shops that were incredibly accountable for the production waste of the considered organisation. The horizontal axis of this chart illustrates several shops/sections in the industry. The times adapted in the material have been delineated by the several bars conforming to every shop/section of the concerned organisation.

Figure 4 High-level SIPOC diagram (see online version for colours)

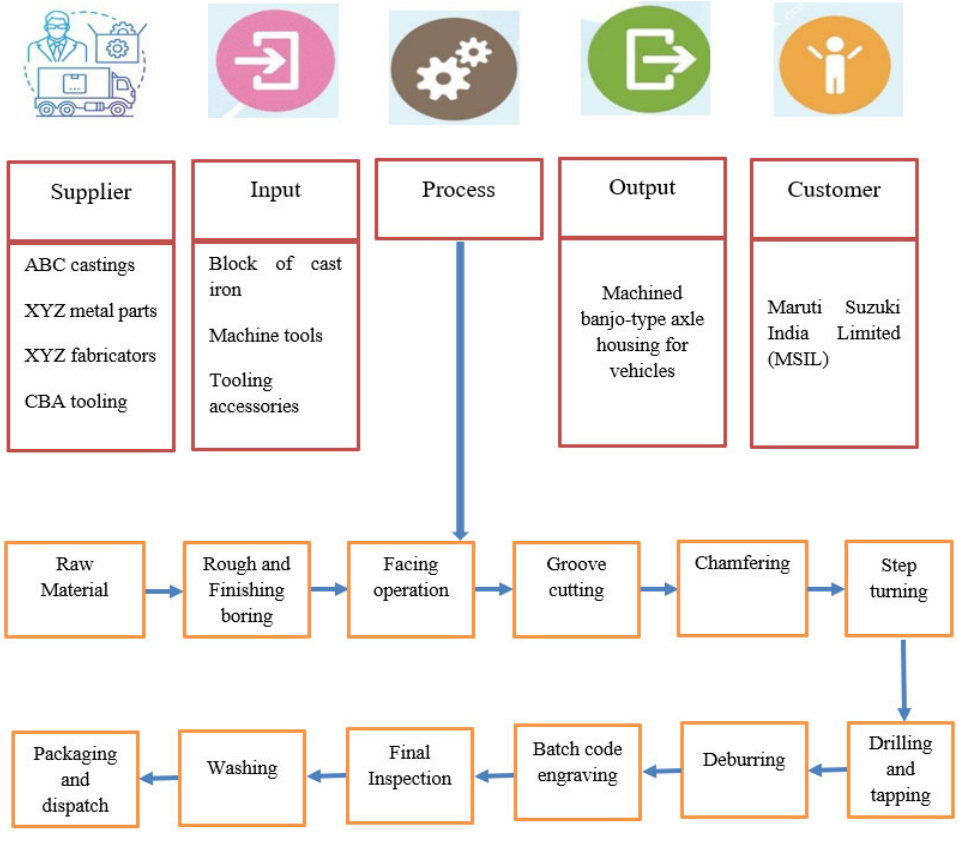


Figure 5 Crucial parameters for production waste (see online version for colours)

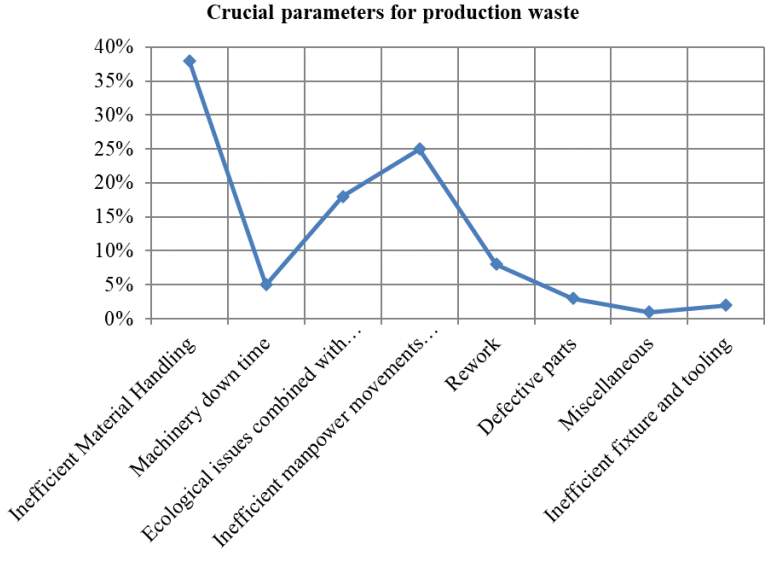
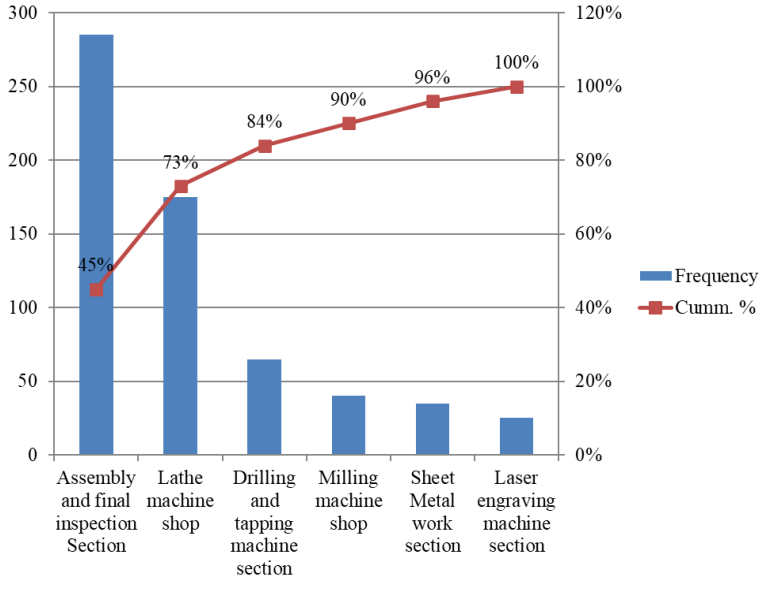


Figure 6 Pareto chart for poor material handling time for several shops/section (see online version for colours)



The Pareto chart indicates that the assembly and 'final inspection section and lathe shop are the key contributors to poor material handling and production waste of selected industry'.

4.2 Estimation for mapping of the current state of the project

An environmental current state mapping has been developed to impart higher insight into the current manufacturing operations. Environmental value stream mapping (EVSM) includes details concerning power consumption, water consumption, material consumption, environmental impacts, and conventional value stream criteria, such as cycle time, change over time, uptime, and lead time for every manufacturing process. Formulating an EVSM (Figure 7) assists in predicting the real manufacturing context and dispenses understandings on the resource consumption from the point of view of the environment, and leads to the development of critical process metrics (Table 2).

An open LCA (Figure 8) was carried out to compute current environmental impacts for the manufacturing process under consideration. The environmental impacts of process were estimated dependent on dataset of raw material, power, and water consumption. The environmental impacts were computed in Pt that indicates strength of impacts. These are assessed for entire process as well as independent processes. In EVSM, the estimated environmental impacts for each process are indicated in the boxes below water consumption line. The overall environmental impacts for present industrial processes considering the stakeholder were found to be 44.70 Pt. Stakeholders considered were cast iron, lubricating oil, water, electricity, groove cutting, chamfering process, drilling and tapping process, deburring and boring process.

Figure 7 Environmental current state value stream mapping (see online version for colours)

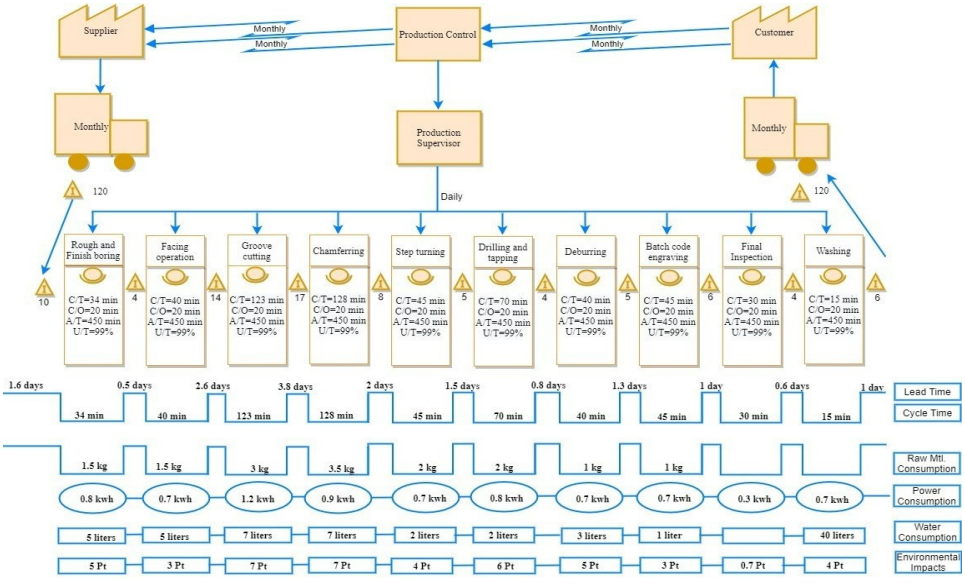
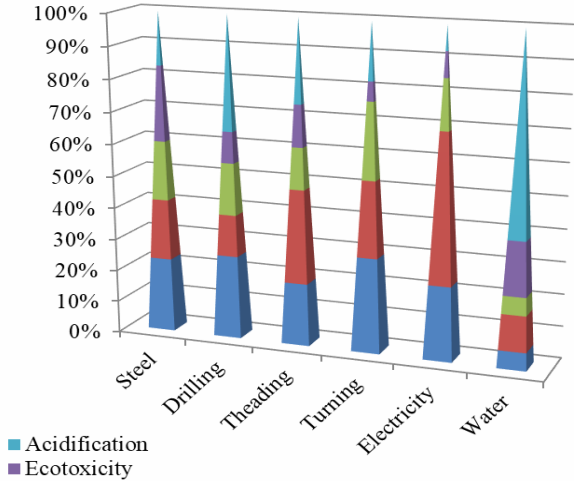


Table 2 Identified EVSM critical process metrics

Critical process metric	*Units*
Total cycle time	570 min
Process lead time	16.7 days
Raw material consumption	15.50 kg
Power consumption	7.5 kWh
Water consumption	72 litres
Environmental impacts	44.70 Pt

Figure 8 Current environmental impact using LCA (see online version for colours)



Further, for computing the current sigma level of the manufacturing process, a sample size of 1,000 units was taken into consideration. The number of defects detected was 18 units. For above-indicated number of defects, DPMO were calculated as 18,000 ppm. The current sigma level of the manufacturing process after matching the attained ppm value with the standard process sigma table was obtained as 3.65.

Figure 9 Shops/section-wise number of parts needed rework (see online version for colours)

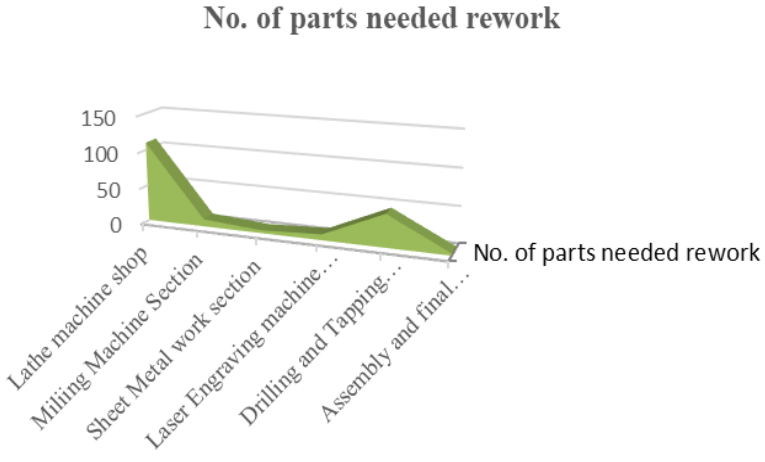
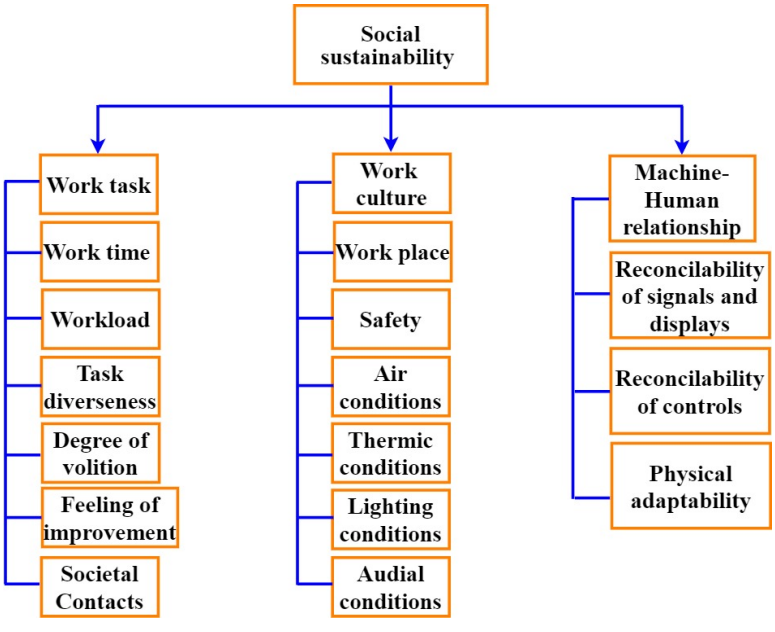


Figure 10 The suggested indicators for social sustainability assessment (see online version for colours)



An intensive analysis of distinct shops/sections of concerned organisation had been done by the project team to gather monthly data associated with the number of parts needing rework in distinct shops of industry. Figure 9 illustrates a plot of the section wise number of parts that needed rework. It is clear from Figure 9 that there are mainly two shops/sections that is a lathe machine shop and a drilling and tapping machine section that contributed to reworking in the considered organisation's processes.

To ascertain societal sustainability is crucial concern in worldwide supply chains to defend workers of the organisation from harassment and dispense a better work atmosphere (Venkatesh et al., 2020). Social sustainability estimations have been assumed to be a lesser consideration by industrial organisations, particularly in emerging economies such as India. In the current research work, a societal sustainability assessment model to evaluate the social sustainable performance has been presented (Figure 10).

Social sustainability has been divided into three categories: work task, work culture, and human-machine relationship. The work task aspect of the social sustainability assessment model includes work time, workload, task diverseness, degree of volition, the feeling of improvement, and societal contacts. The work culture aspect of the social sustainability assessment model includes workplace, safety, air conditions, thermic conditions, lighting conditions, and audial conditions. The machine-human relationship aspect of the social sustainability assessment model comprises reconcilability of signals and displays, reconcilability of controls, and physical adaptability.

In the current study, novel inventory societal performance data was collected by a questionnaire-based survey. The samples were obtained from workers, engineers, managers, and local government officers. It was observed that concerned organisations had marginal sustainability and contributes to society. There is a need to improve work task and machine-human relationship aspects of the social sustainability assessment model of considered organisation.

In this step, the gathered data, and the current state map of the project are used to recognise the weak sections where further analysis was needed. These identified areas are given below:

- inefficient material handling: Final assembly and inspection section
- inessential worker movement and space usage: the whole industry
- rework needed: Lathe machine section and drilling and tapping machine section
- environmental footprints: the whole industry
- societal sustainability: societal and confined community.

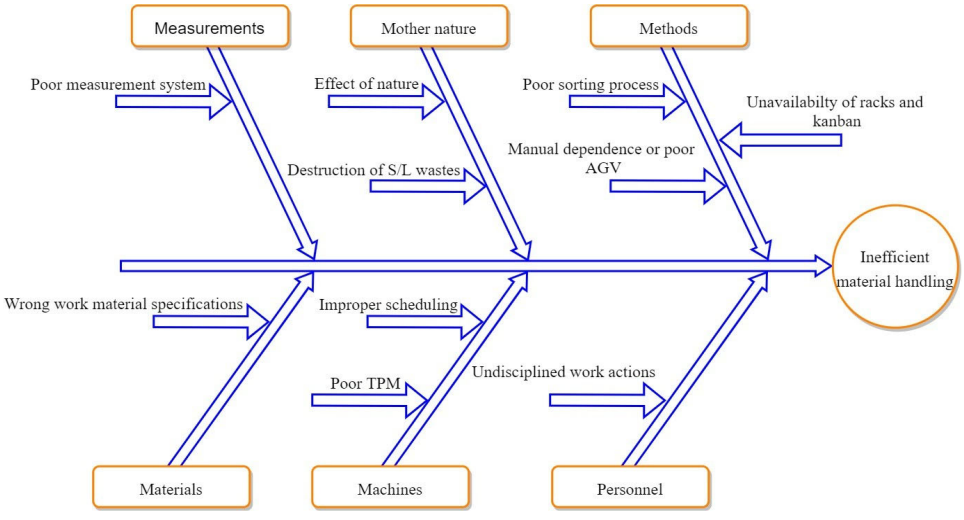
The priortised areas incorporating critical quality characteristics were further assessed to recognise possible causes in the succeeding steps.

4.3 Find out the prominent reason for waste and inefficiencies

The cause-and-effect diagram was instituted focused on inefficient material handling in final inspection and assembly section in selected industry (refer to Figure 11). Personnel, machines, methods, materials, mother nature, and measurements are the key categories that were taken into consideration for further investigation of potential causes. The

brainstorming sessions were also organised with the low, middle, and top managers of concerned organisation.

Figure 11 Cause and effect diagram of inefficient material handling in the assembly section (see online version for colours)



It has been found that there are ten factors that were greatly accountable for inefficient material handling in the considered organisation (Table 3). Further, grey relational analysis (GRA) was employed to find critical causes/factors among the identified factors. Table 4 illustrates the ranks of causes/factors accountable for inefficient or poor material handling. It was observed 'by GRA analysis that unavailability of racks and Kanban system and poor sorting process' were most crucial causes/factors accountable for poor or inefficient material handling and thus actions were required to overcome these.

Table 3 Causes/factors accountable for poor or inefficient material handling

Sr. no.	*Factors accountable for poor or inefficient material handling*	*Labels*
1	Poor sorting process	W1
2	Destruction of S/L wastes	W2
3	Effect of nature	W3
4	Wrong work material specifications	W4
5	Poor TPM	W5
6	Improper scheduling	W6
7	Unavailability of racks and Kanban system	W7
8	Poor measurement system	W8
9	Manual dependence or poor AGV	W9
10	Undisciplined work actions	W10

Table 4 Prioritisation of poor or inefficient material handling factors/causes by GRA

Label	*CR1*	*CR2*	*CR3*	*CR4*	*GRG*	*Rank*
W1	0.982	0.621	0.991	1	0.898	2
W2	0.543	0.432	0.421	1	0.599	5
W3	0.343	0.352	0.664	0.374	0.433	9
W4	0.383	0.524	0.534	0.623	0.516	8
W5	0.374	0.519	0.687	0.512	0.523	7
W6	0.549	0.412	0.424	0.991	0.594	6
W7	0.799	1	0.991	0.872	0.915	1
W8	0.472	0.362	0.343	0.442	0.404	10
W9	0.642	0.762	0.991	0.567	0.74	3
W10	0.372	0.612	1	0.434	0.604	4

Five why was also used for analysis for rework, inessential worker movement, and space usage. This tool dispenses methodical analysis for obtaining root causes of the problem and aims only on the regarding reasons. In the current study, team members of the project discuss with section heads, section supervisors, workers, and machine operators for computing the root causes of rework and inessential worker movement and space usage. Figure 12 depicts the prime root cause for rework issues.

Figure 12 Five why analysis for rework (see online version for colours)

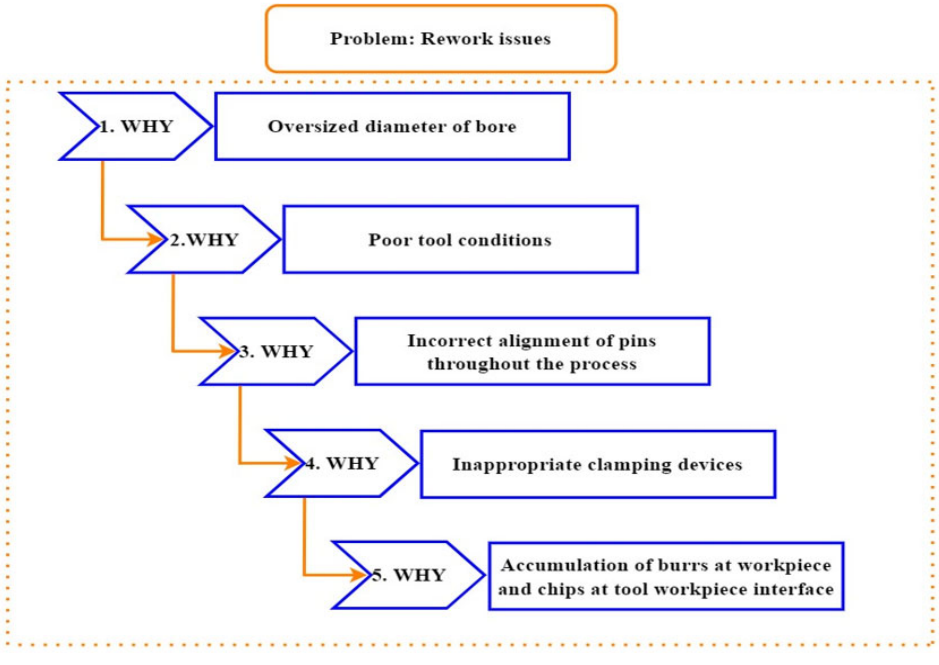


Figure 13 Five why analysis for inessential worker movements and space usage (see online version for colours)

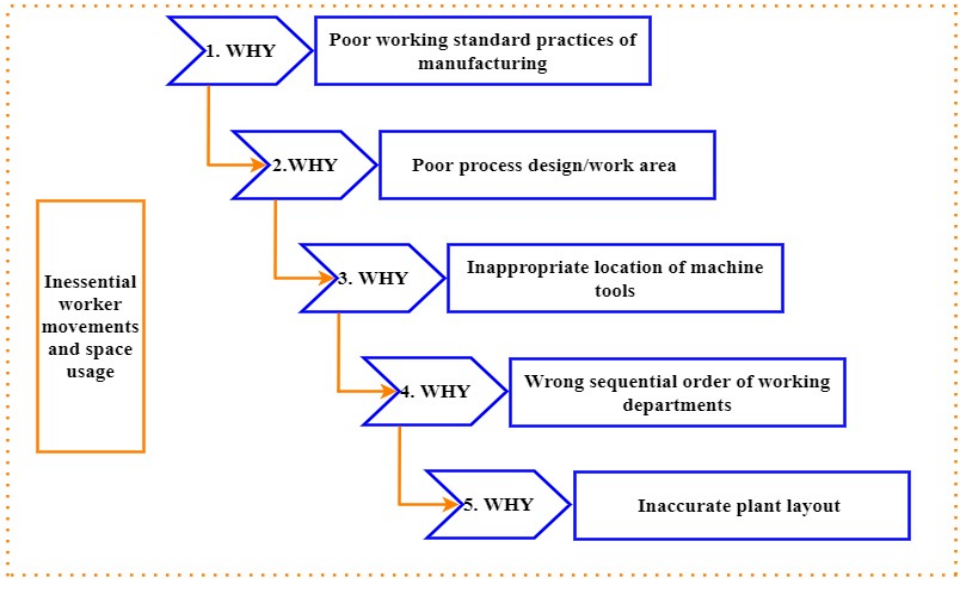


Table 5 Identified prominent reasons for waste and inefficiencies

Sr. no.	*Encountered problem*	*Key areas*	*Prominent reasons for waste and inefficiencies*
1	Inefficient material handling	Final assembly and inspection section	Unavailability of racks and Kanban system, poor sorting process, manual dependence, or poor AGV
2	Inessential worker movement and space usage	whole industry	Inaccurate plant layout
3	Rework needed	Lathe machine section and drilling and tapping machine section	Accumulation of burrs at workpiece and chips at tool-workpiece interface
4	Excessive water, power, and raw material (consumption)	Overall plant	Poor tool conditions, inaccurate machining parameters, lack availability of appropriate cleaning and recirculation system
5	Societal performance	Societal and confined community	Locality investment, new employment in the whole plant, majority of deployment from the local region

The team of the project also carried out a five why analysis for inessential worker movement and space usage. It was observed from the analysis (Figure 13) inaccurate plant layout resulted in inessential worker movement and space usage.

Furthermore, the team of the project crucially inspected several departments of the concerned organisation and organised distinct brainstorming sessions with industrial managers and employees, and recognised that key sources for low ecological performance were water, power, and material consumption. This was recognised that for enhanced societal sustainability, considered organisation must work out on humanity and resident communal facets. With the help of the cause and effect diagram and five why analysis, the list of prominent reasons for waste and inefficiencies at the selected organisation is shown in Table 5. In the next step of the GLSS framework, several actions were executed to enhance the sustainability dynamics of the considered industry.

4.4 Select and implement the best solution

After executing enhancement activities, pilot tests are carried out to register the concert of the improved design, and cost-benefit study is accomplished to assess the complete investments initiated from the project.

Figure 14 Final assembly and inspection section before and after the implementation of 7S technique (see online version for colours)

(a) (b)

A brainstorming sessions was conducted with experts dispense suggestions on how to employ 5S techniques for minimising the inefficient material handling in final assembly and inspection section of considered organisation. In the current study, the 7S tool, (5S + Sustainability + Safety) was adopted to enhance the sustainability dynamics of the company. 7S techniques were also used to create a sorted out, safe, clean, accident-free, and eco-friendly workplace in the concerned organisation. Here 7S stands for Seri, Seiton, Seso, Seiketsu, SeJizoku kanosei, and SeiAnzen which implies sort, simplify, shine, standardise, sustain, sustainability, and safety, respectively. In the Seri step, all the parts and equipment were sorted out as per their operating frequency. After sorting, the replanning of all the parts and equipment was done to streamline the flow of material. The structure of the final assembly and inspection section before and after the implementation of the 7S technique is shown in Figure 14. This technique assists in the daily saving of about 145 minutes in finding the parts/components to assemble one product. Furthermore, the workplace was cleaned appropriately to create a healthy

working environment and reduce air pollution. The assumed work actions were standardised to make a compatible means of executing tasks accomplished daily, incorporating sort, set in order, and shine. Standardise compel methods and process more pragmatical and rigorous to create right things, the right way and right time. The visual process control system was also incorporated to encourage employees and other members of the organisation to retain things at assigned places. The work standards were decided such as regular checking of the first aid kits and reforming the environmental rules and regulations for sustainability.

To certify sustainability and safety in the adopted industry, separately from the 5S technique, probes for mitigation of accidents, also enclosing the areas of machine tools liable to high-temperature chips were accomplished.

Kaizen activities

To minimise various non-value-added activities in the considered organisation, several kaizen activities were suggested and executed. These activities have been mapped out in a manner that can improve the productivity and ecological sustainability of an organisation. These were also mapped out to minimise work issues, setup time, and improve the social sustainability of the considered organisation.

Enhancements concerned with the cutting of raw material and lathe section

Initially, overhead crane systems were used to transport the raw materials bars to a devoted slicing system in the lathe machine shop of considered organisation. The raw material bar was inserted in the devoted fixture and positioned on cutting machine to be cut into small pieces after dispensing appropriate clamping and location. The clamping and setting work takes more time as the size of bar size changes. Therefore, there is great requirement to impart quick change over and minimisation of set up time. For this purpose, exploration and practicability of three possible techniques were carried out. Table 6 outlines the analysis of techniques for set up time minimisation.

Table 6 Exploration of set up techniques

Technique	*Explanation*	*Adopted feasibility*
Modularisation of equipment	Create changes in prevailing fixtures to encounter operational needs	Time minimised for setting up but demands quick moderation
Modification in equipment	Accomplish redesigning of fixtures and substituted existing one with an improved one	This assists in huge reduction in set up time by reshaping and enhancements in the prevailing fixture
Advance part preparedness	Fortified with a batch devoted fixture to minimise changeover time	This could be employed for the short time period when handling and total manufacturing cost is high

Enhancements prevailing to rework issues

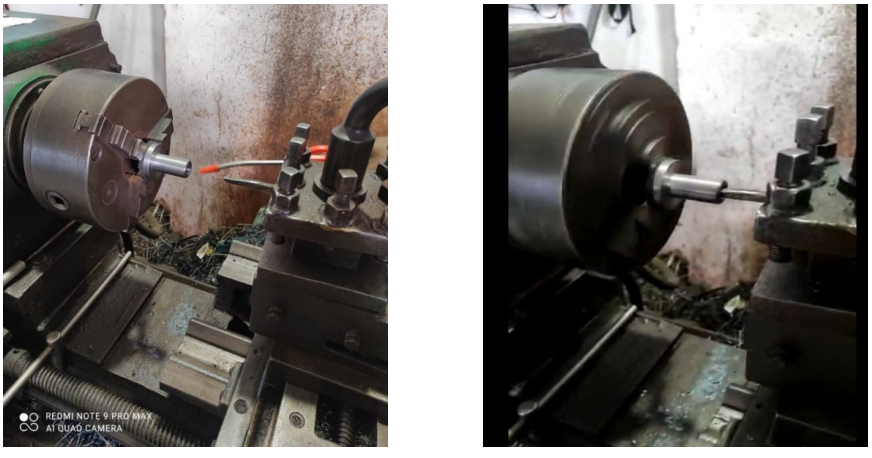
In the previous step, this has been recognised that the accumulation of burrs at the workpiece and chips at the tool-workpiece interface was a crucial aspect behind the

rework concerning problems in the section of the lathe machine. To assist, in appropriate tool conditioning the carbide tool has been substituted and locators have been imparted and pins positioned accurately to minimise the disarticulation of parts. The pressurised air guns have been included to reduce the chips and burrs from the W/P and interface areas. This will assist in improvement in tool life and minimisation of rework problems. Figure 15 shows lathe machine tools before and after the assimilation of an air pressure gun to eradicate burrs at the tool-workpiece interface.

Enhancements to improve social dynamics

Obtaining brilliance in ecological, health, protection, employment, and community engagement should be a part of the value conception plan to sustain the world market. This has been observed from the LCA technique that the considered company was straggling in the constraints of community and employment investment. However, the selected organisation shows a societal sustainability level but to improve the existing one, to a better level, the company must include measures to improve community and employment investment facets. As powerful community performance in lengthy turn forces stakeholder value conception, concerned organisations ought to capitalise more inside the community closer to the non-profit sectors. Enlarging community investment in conjunction with the measurement of final results finished will cause approach enrichment, enhanced social resource engagement, culture constructing, and enterprise technology for the selected company. The selected company ought to include actions for training, education, and skill development as a part of commercial societal responsibility. Such types of actions will improve the manufacturing sector to recruit probable talents from the local community that only improve social sustainability but also assist in enhanced efficiency of the organisation.

Figure 15 Lathe machine tool before and after assimilation of air pressure gun (see online version for colours)



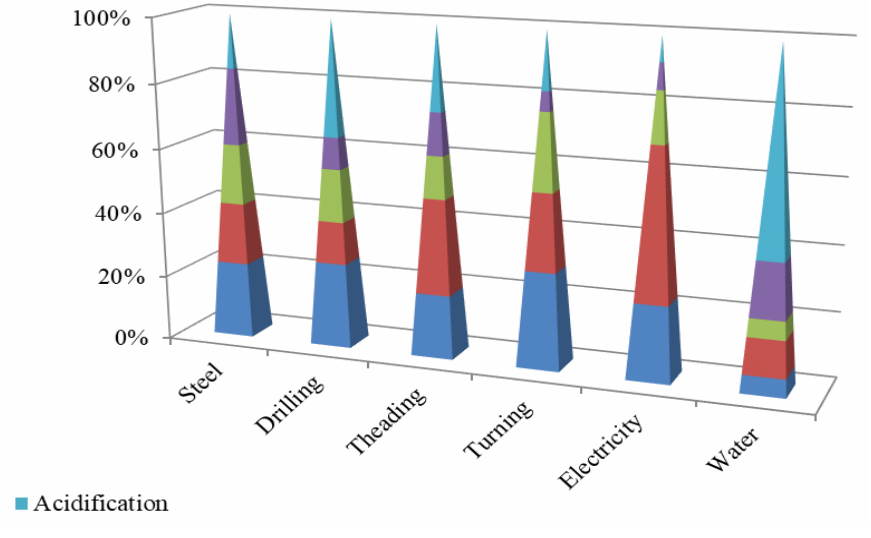
(a) (b)

Table 7 Proposed actions for minimising the overall environmental effects

Aspects	*Executed actions*	*Proposed actions*
Raw material consumption	Excessive scrap was minimised by changing machining parameters	Utilisation of different materials with lesser environmental impacts as related to cast iron
	The weight of input raw material was minimised by altering the product features	
Water consumption	The washing machine is situated with a closed-loop circulating water system to minimise coolant consumption	Adopt normal methods of cleaning with usage of steam to diminish coolant consumption
	The surface of the water tank was bordered through a smooth material to circumvent loss from the condensation	
Power consumption	Experiments and investigations were carried out milling, deburring, and turning machines tools to minimise power consumption by optimising the features of feed rate, spindle speed and authorising electrical units	Electrical power management system (EPMS) has been incorporated to recognise and modify energy waste
	Energy storage and recovery stoppage elements were mounted in the machine tools to attain energy efficacy	

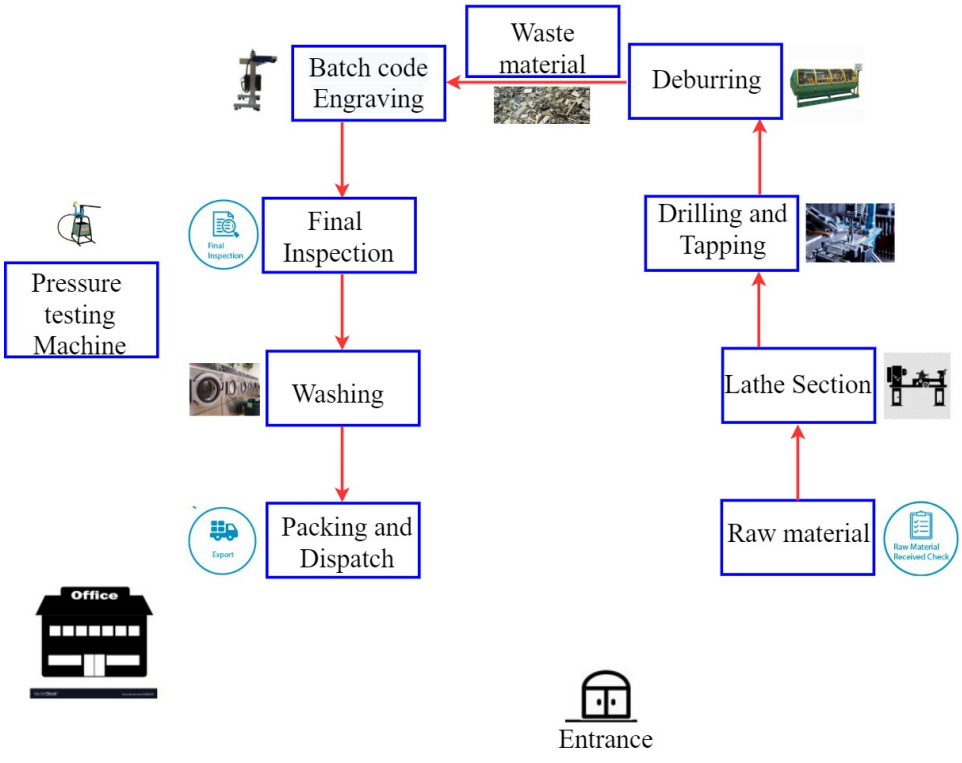
The mitigation in overall environmental effect has been attained by a corresponding reduction in the usage of raw material, consumption of lubricant, and power utilisation. The enhancement activities were recommended and applied for each factor. Table 7 illustrates the executed activities and proposed actions for each ecological factor to improve the environmental sustainability of the industry.

Figure 16 Lifecycle assessment after inclusion of environmental impacts mitigation measures (see online version for colours)



After the incorporation of power-saving actions, power consumption reduces from 7.5 kWh to 6.1 kWh. The saving in the overall power consumption of the organisation leads to reduction in the overall cost of product. The water consumption was also minimised from 72 litre to 60 litre because of the amalgamation of the proper water circulation system and uncomplicated coating for water tank. In perspective of material sustainability, several analyses and tests were carried out for vehicle assembly parts to get the proper design. The raw material consumption was brought down from 15.50 kg to 12.50 kg through understanding with improved specifications for the product. After the incorporation of the execution methods, the overall environmental impacts were again assessed by LCA technique and it obtained to be 32.70 Pt which was 44.70 Pt earlier. Figure 16 illustrates the LCA after the inclusion of the environmental impact removal aspects. Furthermore, the possibility still occurs for the mitigation in the environmental impacts by the utilisation of substitute material and minimisation of material consumption.

Figure 17 Plant layout before analysis (see online version for colours)



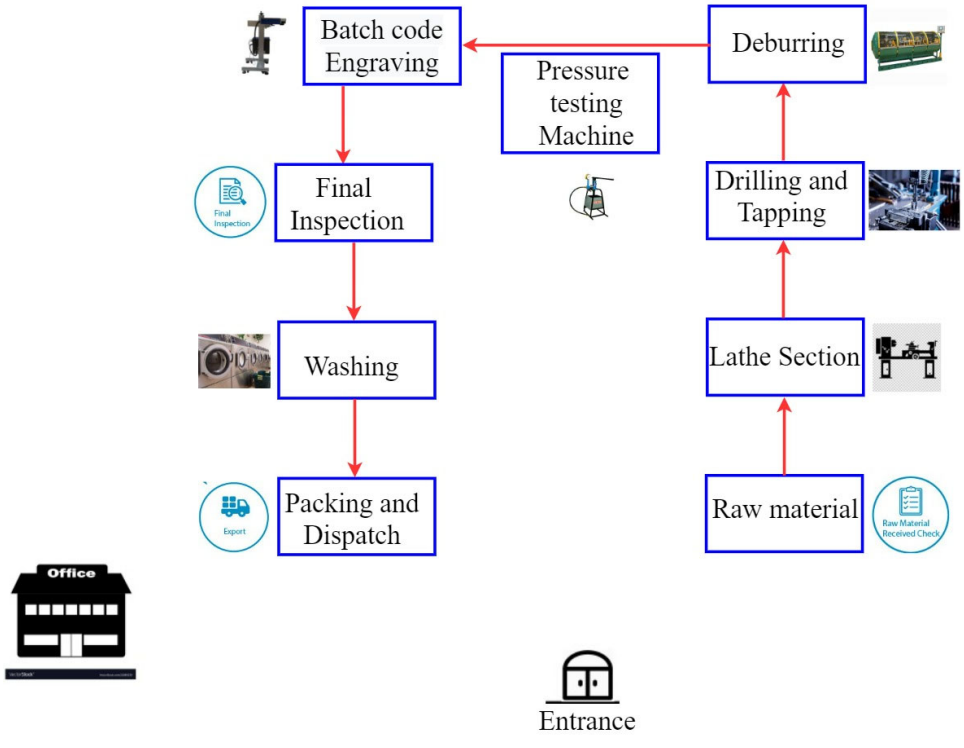
Moreover, to determine the main cause of critical factor that is inessential worker movements, a brainstorming session was conducted among selected experts. The result of the brainstorming session reveals that improper plant layout is the main cause of inessential worker movements within the plant. The current plant layout was outlined and analysed those methods were not accurately aligned and caused in the inessential movement of workers and materials. The faculty plant layout also assists in enhanced electricity consumption for jib crane operation and other related material handling

equipment. To improve the existing layout, primarily movements of workers were traced with the existing layout to find out materials, tools, etc. Thus, the movements of the semi-finished products, raw material, and material handling equipment are also tracked. Figure 17 illustrates the plant layout before analysis. It has been observed by the methodical study of the plant that in the existing plant needed floor space was not efficiently planned. The possible solutions for execution were investigated and further steps were instigated to improve the prevailing plant layout.

It has been recognised that in the existing layout there was no appropriate space for the storage of tools or accessories and as a part of the same workers have to move every time to find out the needed tools. That is why an appropriate toolset box was unified on each machine tool to save time to find out the tools. This has assisted in saving time for workers and increased their overall efficiency. Furthermore, the pressure testing machine that was firstly positioned near the office, moved nearby to the deburring section that was initially occupied with waste material. The resulting movement of the machine tool assists in the attainment of the U-shaped layout of the plant.

Furthermore, efficient floor space usage was attained by the removal of the waste material and repositioning of the machine tools in the plant. The existing developed layout assisted in the attainment of the smooth workflow of material and employees, and subsequently supports a minimisation in waiting and electricity consumption for material handling equipment. Figure 18 depicts the plant layout after analysis.

Figure 18 Plant layout after analysis (see online version for colours)



4.5 Sustain with an adopted solution and make it mistake-proof

After several enhancement activities in the previous step of the GLSS framework, different 'activities' and data were registered form 'next' six months to inspect whether enhancements activities sustain for a longer duration. Distinct measures relate to wastes, environmental, and defects were evaluated again to inspect for any deviation from enhancement step. The improvements attained from implementation of GLSS project are imparted to all the associates included in this project and flowchart is created for the role and responsibilities of each member to sustain enhancements. Table 8 illustrates the Out of Control Action Plan (OCAP) to decide roles and responsibilities to maintain improvements for a long duration. The performance metrics in terms of observation, collection of data, and registering are planned to trace the performance of the system after the execution plan.

Based on the exploration of the current state of VSM, enhancement activities were mapped out and executed to enhance the distinct process measures of the considered organisation. After effective implementation of the recommended activities, future state of VSM was created. It is imperative to dispense appropriate training and education to the workers included in the GLSS project to support improvements made and sustain assumed best practices. The tools like Poka Yoke, visual management, out-of-control action plan, and total productive maintenance have been employed in the present study to dispense pictorial assistance and to control major input-output variables relates to functional and ecological practices.

Table 8 Out of control action plan

Sr. no.	*Control element*	*Control process*	*Responsibility*	*Response plan*
1	Conveyor system	Visual audit	Machine operator	Certify mistake-proofing and inspect appropriate maintenance of crane bearings
2	Location of pressure gun	Visual audit	Machine operator	Instruct machinist for appropriate pressure gun location setting at the tool-workpiece interface
3	Location of drill in the drill and tapping section	Visual audit	Machine operator	Certify appropriate location of drill and assumption by standard operating procedures
4	Hydraulic motor	Metric	Maintenance section	The gap occurs in the sleeve part of the motor are protected in such a way that hydraulic obstruction does not exist
5	Coolant system	Visual audit	Machine operator	Instruct machinist for appropriate supply and outflow of the coolant

5 Results and discussion

On effective implementation of the GLSS approach by the proposed framework, the concerned industry was able to enhance its functional performance and ecological sustainability. Enhancements were perceived in the manufacturing process and ecological

specifications by implementation of adopted GLSS framework. The enhancements perceived stated to lean measures like cycle time and process lead time. The efficient execution of method 7S, Kanban, formation of proper plant layout, and Kaizen activities resulted in a minimisation of the cycle time from 570 minutes to 440 minutes (22.80%). Moreover, process lead time was also reduced from 16.7 days to 13.1 days (21.55%), which assists in a substantial saving in postponement of the final product. The applied enhancement activities fetched enhancement in the environmental measures of raw material consumption, water consumption, power consumption, and overall environmental impacts. Raw material consumption, power consumption, and water consumption were minimised by 19.35%, 18.66%, and 16.66% respectively. As there is a decrease in the principal resource consumption, a minimisation in overall environmental impacts was also detected. The environmental impacts were minimised from 44.70 Pt to 32.70 Pt con 26.84% enhancement.

Furthermore, the methodical application of several enhancement methods carried significant enhancements in prevailing capacity utilisation of plant by 19.80%. The sigma level of the considered industry was enhanced significantly by a minimisation in number of parts rejected. Sigma level was enhanced from 3.65 to 4.08 (for a sample size of 1,000 parts the number of parts found defective was 7 and it is correspondence to the DMPO 7.000 that was previously 18.000). Table 9 represents the process parameters before and after the execution of the GLSS project in the considered industry.

Table 9 Process parameters before and after the implementation of GLSS project

Process parameters	*Before implementation*	*After implementation*	*Percentage improvement (%)*
Cycle time	570 min	440 min	22.80
Lead time	16.7 days	13.1 days	21.55
Raw material consumption	15.50 kg	12.50 kg	19.35
Power consumption	7.5 kWh	6.1 kWh	18.66
Water consumption	72 litre	60 litre	16.66
Sigma level	3.65	4.08	11.78
Production waste	48.30 %	38.80 %	19.66
Environmental impact	44.70 Pt	32.70 Pt	26.84

Table 10 Financial gains from GLSS project implementation

Particulars	*Before GLSS implementation*	*After GLSS implementation*
Total number of products produced/month	13.000	15.060
Number of parts rework/months	185	35
Rework cost/ piece	$4	$4
Total rework cost	$17.760	$3.360
Total earnings obtained	$325.000	$373.000
Possible financial savings because of GLSS project implementation	$48.000	

Moreover, enhancement metrics resulted in the minimisation of rework parts from 185/month to 35/month. This assists in a saving of $ 1,210/month from the rework associated problems in the considered industry. The inclusive implementation of GLSS project caused in a monetary improvement for industry in terms of saving a net value of $ 48,000/year (3,672,967 Indian rupees). Table 10 depicts monetary gains from implemented GLSS project in selected industry.

The considered organisation attained substantial benefits in terms of functional parameters, environmental metrics by the effective implementation of the GLSS project. This proves the competence of the presented GLSS framework to alleviate the current challenges of the industrial sectors.

5.1 Managerial implications

The GLSS framework which is assumed in the present study will encourage the industrial sectors to execute the GLSS approach within the organisation in a pragmatic way. The suggested GLSS framework activities enumerated under each step have been outlined in such a way that it assists to the methodical step-by-step procedure to address both functional and ecological issues. During the execution of the GLSS framework, the organisations should be focused on the existing culture of the organisation towards environmental measures. The organisations may utilise the EVSM to draw the whole process in the quantified value sustainably. A training session about GLSS execution is also needed for employees and supervisors so that they can engage in GLSS execution with full eagerness and attention. The current study's unique contribution lies in supporting industrial sectors to compute several functional, environmental, and societal measures and dispense ways to enhance and sustain the same for improved organisation competitiveness.

6 Conclusions

Approaches to enhance environmental performance must be associated with the conventional industrial initiatives to enhance measures like process efficacy, satisfaction of customers, and receptiveness. GLSS, environmental aspects, and societal contemplations have been combined with an intent to reduce waste, resource consumption, cultivate worker health and well-being. The contribution of the current study lies in two-fold, first, the GLSS framework has been suggested to direct in conducting the activities of implementation of this program. The presented framework dispenses a prospect to the industrial sectors to enhance ecological wastes, improved capacity usage, handling of items, along with enhancement in social subtleties by the deployment of tools like LCA, EVSM, Kaizen, etc. Second, this work exhibits the empirical benefits of using the projected GLSS by its effective execution framework in an industrial environment by methodical insertion of green technology, Lean and Six Sigma tools.

Effective implementation of the suggested framework has assisted to a minimisation in defects, level of rework, and environmental wastes, together with enhancement in functional and financial gain. The efficient execution of method 7S, Kanban, formation of proper plant layout, and Kaizen activities resulted in a minimisation of the cycle time from 570 minutes to 440 minutes (22.80%). The environmental impacts were minimised

from 44.70 Pt to 32.70 Pt contributing 26.84% enhancement. Sigma level was enhanced from 3.65 to 4.08 (for a sample size of 1,000 parts the number of parts found defective was 7 and it is correspondence to the DMPO 7,000 that was previously 18,000). The GLSS project fetches a financial savings of $ 48,000 by the effective implementation of this framework. The current research work allows the organisation to understand its present level of environmental effects and aids it in detecting further means of minimising CO_2 emissions by the integration of more green technology measures. This framework also had a constructive impact on the societal significance as enhancements were perceived relating to the health of human (as an outcome of minimised ecological effects) and shopfloor safety (after the deportment of the 7S).

Limitations and future scope

Despite several contributions, the study has its limitations. This GLSS framework can be employed only in automotive manufacturing sectors, and definite industrial sectors employing with analogous industrial operations. In the present study, the suggested framework has been tested through only in a single automotive manufacturing organisation. In future research, proposed framework can be expanded to another industrial organisation wherever the necessity to implement the GLSS approach is insistent. Future research can also focus on improving the current steps and by incorporating additional tools and techniques into every phase concerning producing reliable outcomes by the application of the proposed framework in several enlightened environments.

In another future research direction, the framework can be improved to encompass its scope for allowing additional sustainability drivers during the GLSS execution and more unconventional tools and techniques can be appended to framework for furthermore improvement.

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Repurposing production operations during COVID-19 pandemic by integrating Industry 4.0 and reconfigurable manufacturing practices: an emerging economy perspective

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Abstract
The Covid-19 pandemic has had a significant impact on manufacturing industries and supply chains. Manufacturing industries are struggling to repurpose their production activities and ramp up the supply chain to bridge the demand–supply gap. A framework that can cover Industry 4.0 technologies and reconfigurable manufacturing system (RMS) practices is desperately needed. The current study focuses primarily on the framework that could assist managers in decision-making and the stepwise adoption of RMS during repurposing. The extensive literature review was conducted to identify the prominent Industry 4.0 technologies and RMS practices. To compute the weights of selected practices, the novel Pythagorean fuzzy analytical hierarchy process (AHP) was used; while the Pythagorean fuzzy combined compromise solution (CoCoSo) method was used to prioritize the selected performance metrics. To test the robustness of the developed framework, a sensitivity analysis was carried out. According to the findings, smart factory adoption (SFA) practices were the most significant among the major criteria, followed by reconfiguration practices (RCP), soft computing practices (SCP), sustainable & circular economy practices (SCE), and quality practices (QPS). SFA's advanced technologies and SCP's computer algorithms certainly assist in the repurposing of production activities (RPO). The results of the sensitivity analysis demonstrated the robustness of the developed framework. The developed framework will be useful during RPO, and the identified practices can make a significant contribution. Advanced technologies and sustainable practices can help to improve the organization's work culture. Managers will be able to evaluate the organization's performance with the help of identified performance metrics. The work presented here may be the first attempt to develop a framework for RPO in a pandemic situation.

Keywords Reconfigurable manufacturing system · Industry 4.0 · Repurposing of production operations · Pythagorean fuzzy AHP · CoCoSo method

1 Introduction

The pandemic caused by COVID 19 has had a negative impact on a variety of industries, including manufacturing, tourism, healthcare, and many others. The spending power of a large population has been significantly reduced as a result of the lockdown and quarantine period, which has resulted in a stagnant economy in the majority of regions (Shen et al. 2020). The coronavirus outbreak has also had a significant impact on several manufacturing industries in many countries, and some researchers have developed an accounting index to assess the impact of the virus (He et al. 2020). As a result, manufacturing industries are suffering from disrupted supply chains, a shortage of manpower due to the lockdown, a shortage of raw materials, highly dynamic market needs, disrupted transportation facilities, reduced customer purchasing power, etc. The global economy's growth rate is expected to fall up to –3% in 2020, potentially leading to a global recession. Furthermore, the manufacturing industries are expected to lose around 10.7% in 2020, while the service industries are expected to lose around 16% (Gu et al. 2020). As a result, there is a need to repurpose the manufacturing

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operations to maintain the organization's financial performance. Furthermore, the repurposing of essential drugs, healthcare equipment, food and safety-related products, and many other items is a top priority. The majority of the world's supply chain has been severely impacted and must be resumed for the necessary products to reach customers. As a result, according to López-Gómez et al. (2020), a strong roadmap for rapid repurposing of manufacturing and development activities that can reflect national priorities is required to improve global manufacturing capacity. Several researchers, practitioners, and manufacturing organizations are attempting to repurpose activities, but are falling short since new product introduction necessitates the compliance of several resources as well as extensive planning. This situation necessitates the use of advanced technologies capable of meeting pandemic requirements such as customized products and rapid response. The fourth industrial revolution, also known as Industry 4.0, is made up of several advanced technologies, including information technologies used in manufacturing, which can meet such demands (Javaid et al. 2020). According to Liu and Beltagui (2021), digital technologies such as 3D printing can help to increase required flexibility, whereas collaborations with other organizations, in conjunction with digital technologies, can help to reduce product development time and thus lead time. The researchers also stated that technologies such as Computer Numerically Controlled machines can be useful for repurposing. Furthermore, advanced manufacturing systems such as Reconfigurable Manufacturing System (RMS) can help to provide the necessary flexibility during the manufacturing of products required to deal with the pandemic situation as well as to maintain individual country's economic conditions (Pansare et al. 2022a). RMS, the next generation manufacturing system, with its higher reconfigurability, flexibility, and intelligence, can assist in the rapid transition to new products required to deal with the varying needs of a pandemic situation as well as post-pandemic challenges (Khan et al. 2022; Pansare et al. 2021a).

The most important attribute in incorporating changeability in any manufacturing system in the context of Industry 4.0 is reconfigurability (Pansare et al. 2022b). Furthermore, product complexities are constantly increasing, necessitating the use of modern manufacturing systems such as RMS to manufacture them in this scenario (Bortolini et al. 2021). RMS practices and technologies such as Holonic manufacturing, Agent-based design, Cyber-Physical System (CPS), Digital Twins (DT), Industrial Internet of Things (IIoT), and many more are strengthening manufacturing systems in the Industry 4.0 era (Morgan et al. 2021). RMS, when combined with these enabling technologies and practices, can meet the aforementioned requirements and assist manufacturing systems in repurposing their manufacturing operations during a pandemic. However, in the context of Industry 4.0, there is a need to bridge the design, theory, and practices of RMS (Liu et al. 2020).

Looking at the current situation, many manufacturing activities are hampered as a result of the pandemic, and organizations are struggling to ramp up the same using various techniques. Despite wartime efforts to address the issue, manufacturing industries are unable to meet the shortage of supply, dynamic market needs, and unexpected growth in demand for a specific type of product (López-Gómez et al. 2020). While doing so, manufacturing industries face several challenges, such as a lack of employees due to the lockdown, a lack of raw materials, etc. Furthermore, market demands are drastically changing, and products essential for Covid-19 virus protection, as well as products of basic needs, are in high demand. As a result of this shift in demand, many manufacturing industries have become desperate for survival, and they are now forced to manufacture products in response to market demands. Hence, many researchers have concentrated on developing methodologies and frameworks for repurposing manufacturing operations (López-Gómez et al. 2020). Simultaneously, Javaid et al. (2020) attempted to use several Industry 4.0 technologies to deal with a pandemic situation in which advanced manufacturing technologies are used to meet customized requirements. Similarly, many other researchers attempted to discover pathways for the recovery of various industries such as aviation (Dube et al. 2021), tourism (Škare et al. 2021), and others. However, there was a strong need to develop a framework that can use several hybrid technologies, such as RMS-Industry 4.0, to repurpose manufacturing activities while also being able to switch over products demanded by the pandemic situation. It was also necessary to identify several RMS-Industry 4.0 enabling technologies and practices that can assist practitioners during this transition as well as contribute to pandemic preparedness. Furthermore, a set of performance metrics that can reflect the overall impact of this framework and allow organizations to measure their current status must be developed. Given the current pandemic situation, the above-mentioned framework was especially important, as it may also indicate future opportunities for organizational development and market competition even during a down economic period. The following were the study's objectives:

1. To identify RMS-Industry 4.0 practices that assist in repurposing manufacturing organizations during a COVID-19 pandemic situation through a literature review.
2. Identifying and researching the challenges that manufacturing organizations face during and after a pandemic.
3. To present the role of RMS-Industry 4.0 practices in the RPO within an organization and to develop a framework for it.

4. Identifying and prioritizing performance metrics to assess an organization's ability to deal with a pandemic situation.

With the aforementioned objectives in mind, an extensive literature review was conducted to identify RMS-Industry 4.0 practices and performance metrics to assess the impact of these practices in any organization during and after a pandemic situation. This was followed by the development of a framework for these practices as well as performance metrics to assist practitioners in manufacturing organizations in dealing with the pandemic situation. To compute the weights of selected practices and then prioritize the identified performance metrics, the hybrid Pythagorean fuzzy analytical hierarchy process (PFAHP) – combined compromise solution (CoCoSo) method was used. Therefore, the current study explores the novel PFAHP and CoCoSo methods that have a ability to differentiate the alternatives. This contributes to multi-criteria decision-making (MCDM) and demonstrates how these methods can be used. The study also developed a framework for RPO during the COVID-19 pandemic situation; thus, it contributes to the field of manufacturing systems by providing a novel framework that can assist them in repurposing and bringing manufacturing operations back to normal.

The current study is divided into six sections, one of which is the current section. Section 2 presents a literature review related to RMS, Industry 4.0, and research gaps, followed by research methodology in Sect. 3. Section 4 explains the case analysis, including framework development and performance metric prioritization, while Sect. 5 discusses the study findings and their implications. Section 6 summarises the study's conclusions as well as its future scope.

2 Literature review

During the literature review, the Scopus database was used to retrieve the previous research articles that were related to RMS, Industry 4.0, COVID-19, and repurposing of manufacturing operations. Using the keyword 'Reconfigurable Manufacturing System', total 1140 research articles were retrieved that were further filtered and only 454 articles from peer-reviewed reputed journals in the English language were finally selected for further study from 1999 to 2021. Furthermore, the keyword 'Industry 4.0' was used to retrieve 281 articles published in English from 2010 to 2021 from only reputable peer-reviewed journals. Similarly, from 2019 to 2021, 151 research articles related to COVID-19, including the repurposing of several sectors, were chosen from peer-reviewed journals in English. These selected articles were later stored in a central location so that they can be retrieved as needed. Only peer-reviewed articles from reputable publishers such as Emerald insight, Springer link, Elsevier, Taylor & Francis, and Inderscience were chosen for this study, while conference proceedings and book chapters were excluded. The selected articles were investigated further, and the results are presented below.

2.1 Repurposing Production Operations (RPO) in manufacturing industries

As previously stated, the COVID-19 pandemic has had a significant impact on manufacturing operations. As a result, many researchers began to focus on the repurposing of these operations, developing several methodologies and frameworks in the process. In addition, practitioners and managers in manufacturing organizations were working hard to recover from the current situation and restore normalcy to production operations. However, the contributions of a few researchers to RPO are summarised in Table 1 and discussed further below.

During the COVID-19 global emergency, the healthcare sectors faced a challenge due to a lack of ventilators, masks, test kits, etc. As a result, López-Gómez et al. (2020) reviewed key challenges for repurposing their manufacturing activities and proposed probable methods to mitigate the challenges. Furthermore, Deshmukh and Haleem (2020) attempted to prepare a conceptual framework for enhancing manufacturing activities from an Indian perspective, involving a variety of stakeholders. Researchers also proposed using more automation and localized skills during manufacturing activities to meet the increased demand for products. Another researcher Liu and Beltagui (2021) wanted to speed up the innovation process by repurposing; they examined case studies and concluded that exaptation can help during the crisis recovery. Saberian et al. (2021) wanted to reduce the waste generated as a result of the pandemic situation, so they proposed recycling it in civil construction. Researchers also proposed incorporating 1% shredded face masks into recycled concrete aggregate to increase compressive strength. Furthermore, Hill et al. (2020) discovered that by repurposing existing drugs for COVID-19 treatment, the mortality rate and manufacturing costs could be reduced.

2.2 Integrating Industry 4.0- RMS practices

The COVID-19 pandemic has had a significant impact on several manufacturing organizations and their production operations. The pandemic has also had an impact on the market, as the demand for certain types of products, such as sanitizer, masks, and PPE kits, has increased significantly, while the demand for other types of products has decreased significantly. Furthermore, the World Health Organization (WHO) had published a list of critical products to tackle

Table 1 Contribution of researchers for RPO

Sr. No.	Authors	Objectives	Outcomes
1.	(López-Gómez et al. 2020)	To review the challenges for repurposing the manufacturing activities and ways to mitigate them	A roadmap is prepared for rapid repurposing
2.	(Deshmukh and Haleem 2020)	To give an Indian perspective for enhancing post-COVID manufacturing activities. He also involved stakeholders during this process	The conceptual framework is prepared to assess Indian industries
3.	(Liu and Beltagui 2021)	To accelerate the process of innovation through repurposing, its application for manufacturing and design	Suggested the ability of exapt for design and manufacturing
4.	(Saberian et al. 2021)	Repurposing of single-use face masks to reduce waste	The compressive strength is enhanced
5.	(Hill et al. 2020)	To minimize the cost of manufacturing new drugs for the treatment of COVID-19 through repurposing	Repurposed drugs can be manufactured at a low cost

the COVID-19 outbreak and had advised several countries to increase the production of these products (López-Gómez et al. 2020; Qi et al. 2021). Despite the many efforts made by manufacturing organizations, there was still a demand–supply gap, and as a result, manufacturing organizations were shifting to other alternatives. Many governments around the world were encouraging manufacturers to repurpose their production lines to narrow the gap between demand and supply (López-Gómez et al. 2020). As a result, many manufacturing industries were attempting to cope with the situation by employing advanced technologies, while researchers are also contributing to this through their research into advanced technologies and practices. According to Javaid et al. (2020), advanced Industry 4.0 technologies such as information technology may assist manufacturing industries in customizing their products such as gloves, masks, and many others. Javaid et al. (2020) went on to say that the facilities available at Industry 4.0 factories, such as wireless connectivity, sensors, artificial intelligence, etc., can help with RPO. The incorporation of video surveillance and sensors into healthcare products may reduce the workload of COVID-19 doctors. Industry 4.0 information technologies may also assist doctors and staff in maintaining the necessary information to avoid misinformation.

Furthermore, due to changes in product demand, many industries are forced to transition to new products during pandemics. However, insufficient flexibility in the manufacturing system is preventing capacity adjustment and product switchover (Qi et al. 2021). Manufacturing systems, technologies, and practices that assist in this transition are becoming increasingly important at this time. Information technologies and Industry 4.0 are largely assisting in the automation of the manufacturing of healthcare-related products, whereas RMS is assisting in the adjustment of production capacity and required flexibility (Qi et al. 2021). The RMS core characteristics (Modularity, Integrability, Customization, Convertibility, Diagnosability, and Scalability) provide the required flexibility to the manufacturing system and allow it to adjust production capacity in response to market demand (Pansare et al. 2021b). In addition, Psarommatis (2021) used several Industry 4.0 technologies for zero defect manufacturing (ZDM), including Cyber-Physical System (CPS), Artificial Intelligence (AI), Big Data, Cloud Manufacturing, etc. ZDM can be implemented in two stages using these technologies, triggering factors (detection, prediction) and actions (repair, prevention) that may result in improved quality and cost savings. Malik et al. (2020) further said that Industry 4.0 technologies like robots, IoT, etc. could help ramp up ventilator production during a pandemic. Researchesrs demonstrated a model for integrating robots and design guidelines. Morgan et al. (2021) conducted a review of RMS articles and investigated next-generation machines equipped with Industry 4.0 technologies and reconfigurable capabilities. Furthermore, many researchers in the Industry 4.0 and RMS domains attempted to investigate the impact of these technologies and practices in manufacturing in terms of cost, productivity, economy, forecasting, quality, etc. (Bortolini et al. 2018; Jaskó et al. 2020; Liu et al. 2020). Such RMS capabilities can assist in RPO and may help in dealing with pandemic situations; thus, it was necessary to identify major Industry 4.0-RMS practices. The effectiveness of these practices during RPO due to the COVID-19 pandemic must also be measured; thus, the performance metrics identified through the literature review are listed in Table 2.

The advanced technologies of Industry 4.0 and RMS practices can help on a large scale to handle the pandemic situation; meet customer needs, customize required products, and bridge the demand–supply gap. Table 3 shows how the nexus practices assist in overcoming the challenges posed by COVID-19, as well as a set of performance metrics used to assess the effectiveness of the practices.

Table 2 Industry 4.0-RMS practices

Industry 4.0 technologies	RMS practices	Reference
AI, Internet of things (IoT), Big data, Virtual reality, Holography, Cloud computing, Autonomous robots, 3D scanning, 3D printing, Biosensors	-	(Javaid et al. 2020)
CPS, IoT, Machine Learning, Big Data, Cloud Manufacturing, Smart Sensors Network	-	(Psarommatis 2021)
Human–Robot collaborative systems, IoT, Augmented Reality, Big data, additive manufacturing	Modularisation, Digital twins, Industrial Robots	(Malik et al. 2020)
Computational agents, Holonic systems, Service Oriented Architecture, IoT, CPS, Digital Twins	Reconfigurable Machine Tools (RMT), Machine control, Human–Machine interface, Horizontal & Vertical integration, Distributed & decentralized control	(Morgan et al. 2021)
-	AI, Big data, Digital Twins, Virtual models	(Qi et al. 2021)
Cybersecurity, IoT connectivity, Digital Twins, Horizontal & Vertical integration	-	(Jaskó et al. 2020)
CPS, Digital Twins	Configuration design, Optimization	(Liu et al. 2020)
Internet & Wireless Local Area Network, Robots	Reconfigurable ability, tool replacement	(Xu et al. 2021)
Advanced manufacturing solutions, Additive manufacturing, Augmented reality, Simulation, Horizontal & Vertical integration, Industrial internet, Cloud, Cyber-security, Big-data & Analytics	Configuration design, Optimization, Customized products, Quality, Testing	(Bortolini et al. 2018)
-	Prognostics & health management, Cyber-physical systems, Maintenance optimization & Scheduling	(Xia and Xi 2017)
-	CPS, 3D printing, Holonic control, Optimization, controller designs	(Kruger and Basson 2019)
-	Digital Twins, Rapid reconfiguration, Architecture design, CPS, IoT, Smart manufacturing	(Jiewu et al. 2020)
Sustainability, life standard, creativity, High quality, Customization	Reconfigurability, Optimization, waste reduction, Product & Process quality	(Massimi et al. 2020)
-	Total Quality Management (TQM), Mass customization, Concurrent Engineering, Real-time control, Human resource, Shorter lead time	(Bi et al. 2008)
-	Sustainability, Reusability, Environmental emissions,	(Kurniadi and Ryu 2020)

It is also necessary to assess the effectiveness of this nexus effect during RPO, and thus performance metrics are required (Chandak et al. 2022). The performance metrics that can evaluate the performance of the system during RPO have been identified through a literature review, as shown in Table 3. It should be noted that the important performance metrics in RMS are reconfiguration time, which represents the time required to switchover the product (Huang et al. 2019), manufacturing cost (Chen and Huang 2006), reconfiguration cost, and lead time (Puik et al. 2017), which represents the time from order placement to product delivery. Fatimah et al. (2020) considered several dimensions during his waste management study, including employee retention, manpower required, employee availability, etc., that can be used to determine its maturity level. Employee retention indicates how long an employee has been providing a service to the organization, whereas employee availability indicates the absenteeism due to illness or other reasons. These are also significant factors during RPO and must be taken into account. The authors also considered the availability of advanced technologies such as soft computing and advanced machines, as well as energy consumption, as evaluation dimensions. Yurdakul (2002) considered several factors related to product quality such as scrap rate, defectives ratio, customer complaints such as guarantee/warranty, etc. when measuring the performance of a manufacturing system. Here, the scrap rate represents manufacturing rejections, whereas the defectives ratio represents the total number of defectives that require rework or rejections. Furthermore, while evaluating RMS performance, Garbie (2014a, b) took into account machine utilization, throughput, cycle time, breakdowns, etc. The set of performance metrics identified through this literature review may enable an evaluation of the current state of RMS during RPO and the identification of development opportunities.

2.3 Literature gaps

An extensive literature review of articles on Industry 4.0, RMS, and COVID-19 is conducted, and the research gaps are identified as listed below.

Table 3 Nexus effect of Industry 4.0-RMS practices

Challenges incurred due to COVID-19	Industry 4.0-RMS practices	Nexus effect to overcome the challenges	Performance metrics
Rapid increase in demand for particular products like masks, sanitizer, etc	RMT, Scalability, CPS, Customization, Reconfigurability	RMS's scalability enables it to increase production, whereas reconfigurability enables it to switch from one product to another	• Reconfiguration time • Manufacturing cost • Lead time • Employee retention • Number of defectives per day • Reconfiguration cost • Throughput material • Number of warranty/ guarantee claims per year • Machine utilization • Total manpower requirement • Number of soft computing technologies available • Number of breakdowns per fortnight • Cycle time • Overall energy consumption • Number of advanced machines available • Number of training sessions conducted • Number of customized products • Ratings received for online customer feedback • Number of accidents per month • Financial performance (profit percentage) • Number of RMT available • Employee availability • Scrap rate
Unavailability of manpower due to lockdown	Autonomous robots, IoT, Cloud Manufacturing, Smart Sensors Network, CPS, Internet & Wireless Local Area Network	Automation of manufacturing activities in RMS and Industry 4.0 may assist in operating with fewer employees. In addition, IoT, cloud manufacturing, and wireless networks allow for remote work	
Disturbed supply chain management	IoT, Internet & Wireless Local Area Network	The online services that use IoT, the internet, and wireless networks allow for the timely delivery of products. It also allows you to order the raw materials you need	
Increased requirement of customized products	Customized products, customization, creativity,	The ability of RMS and Industry 4.0 permits to satisfy these requirements	
Need of required medical standards	Product & Process Quality, Quality, Testing	The ability to manufacture quality products and testing practices enables the production of products that meet the required standards	
Cost expectations and financial crisis	Optimization, waste reduction	The optimization and waste minimization practices of RMS may assist to meet this challenge	
Protect the employees/ workforce	Autonomous robots, IoT, Cloud Manufacturing, Smart Sensors Network, CPS, Internet & Wireless Local Area Network	Employees must be protected from COVID-19 infections in the workplace. IoT, CPS, cloud manufacturing, and other technologies assist organizations in maintaining a safe distance and avoiding infections	
Business continuity risk and its management	RMT, Scalability, CPS, Customization, Reconfigurability, creativity, Optimization	The nexus effect of Industry 4.0-RMS provides the ability to anticipate likely fluctuations in product demand and the plant's reconfigurability to respond to them. Because of this, business continuity can be ensured	
Maintaining global competitiveness	Optimization, waste reduction, Product & Process Quality, Quality, Testing, Customization	The international supply chain has been impacted by COVID-19, and manufacturing industries are struggling to supply products at the lowest possible cost to maintain competitiveness. It is assisted by the practices mentioned above	
Maintaining productivity along with social distancing	Autonomous robots, IoT, Cloud Manufacturing, Smart Sensors Network, CPS, Internet & Wireless Local Area Network	The advanced technologies and practices of Industry 4.0-RMS allow for social distance while maintaining manufacturing system productivity	

- Several RMS and Industry 4.0 researchers have contributed to this area to increase system adoption and performance. However, the overall representation of Industry 4.0 technologies was seen in very few articles, while the listing of RMS practices was quite lacking in the available literature.
- Although few researchers attempted to identify the challenges faced by manufacturing industries during the COVID-19 pandemic, the use of various technologies and practices to overcome these challenges went unnoticed in the literature.
- Almost no researchers had described the use of the nexus effect of Industry 4.0-RMS to overcome the COVID-19 pandemic and other challenges.
- The framework for overcoming COVID-19 pandemic challenges in the manufacturing sector was quite lacking in the available literature. The previous researchers also did not participate in the development of a set of performance metrics to assess the effectiveness of the prepared framework. Furthermore, the prepared framework must be tested using industrial case analysis.
- Case studies that describe the success stories of using Industry 4.0 and RMS to switchover production as well as adjust production capacity to another product to bridge the supply–demand gap were attended by almost no researchers.
- While maintaining reconfigurability and customization during production, researchers in this domain almost completely ignored the process of incorporating sustainability in the product as well as the manufacturing system.
- The use of Multi-Criteria Decision Making (MCDM) techniques to create a framework that can assist researchers and practitioners in determining the relative importance of practices and performance metrics was lacking in the existing literature. In addition, the inclusion of expert opinion in the preparation of such a framework was seen in only a few articles.
- Researchers in this domain had not yet addressed the methodology for improving and sustaining the supply chain of the manufacturing system in such a pandemic situation.

The gaps identified through the literature review demonstrated the need to prepare the framework for RPO due to the COVID-19 pandemic, which can assist researchers and practitioners in repurposing and ramping up their production activities. As discussed in Sect. 1, López-Gómez et al. (2020) highlighted the need to prepare a roadmap for repurposing manufacturing activities; thus, the identified research gaps were supported, and such a framework can assist in determining the nation's priorities. In addition, during a pandemic, this may help to bridge the demand–supply gap. As stated in the study objectives, the current study focuses on the development of a framework for the RPO and the prioritization of performance metrics that can be used to evaluate the performance of the manufacturing system. As a result, the study attempted to fill the above-mentioned research gap using expert opinion.

3 Research methodology

Initially, an extensive literature review of RMS and Industry 4.0 articles was conducted to identify the technologies and practices used during product manufacturing. For this purpose, the Scopus database was used, and the identified technologies and practices were presented to the expert panel. According to the expert panel's (please see Sect. 4.1 for more information) recommendations, they were further sorted and classified as advanced machines, scalability practices, quality practices, reconfiguration practices, and remote technologies. The expert panel was also asked to give opinion for the hybrid Pythagorean fuzzy AHP – CoCoSo approach. Based on this, the RPO framework was developed, as discussed in the following section. The Pythagorean fuzzy AHP was used to compute the weights of the major and sub-criteria, whereas the CoCoSo method was used to rank the performance metrics and compute the adoption index. Finally, the sensitivity analysis was performed, and the study's implications were listed. The sensitivity analysis was carried out to ensure that the developed framework is robust. Figure 1 depicts the research methodology used for the current study.

4 Case analysis

4.1 Industry identification and data collection

The primary goal of the presented study was to develop a framework that could assist practitioners during RPO via RMS and Industry 4.0 during the COVID-19 pandemic; thus, twenty different manufacturing industries were approached and the entire concept was explained to them. Three industries agreed to participate in the process; however, it was a difficult task for the authors to select these industries because they must be similar in terms of products manufactured, turnover, capacity, number of employees, etc. As a result, the three industries that were ultimately chosen are involved in the production of various types of plastic bottles, employing approximately 125 people, including technical and non-technical staff. All three industries have a monthly capacity of approximately 10,000 bottles and an annual turnover of 55 to 60 crore rupees. The manufactured bottles are used for a variety of applications including drinking water, sanitizer dispensing, healthcare applications, etc.

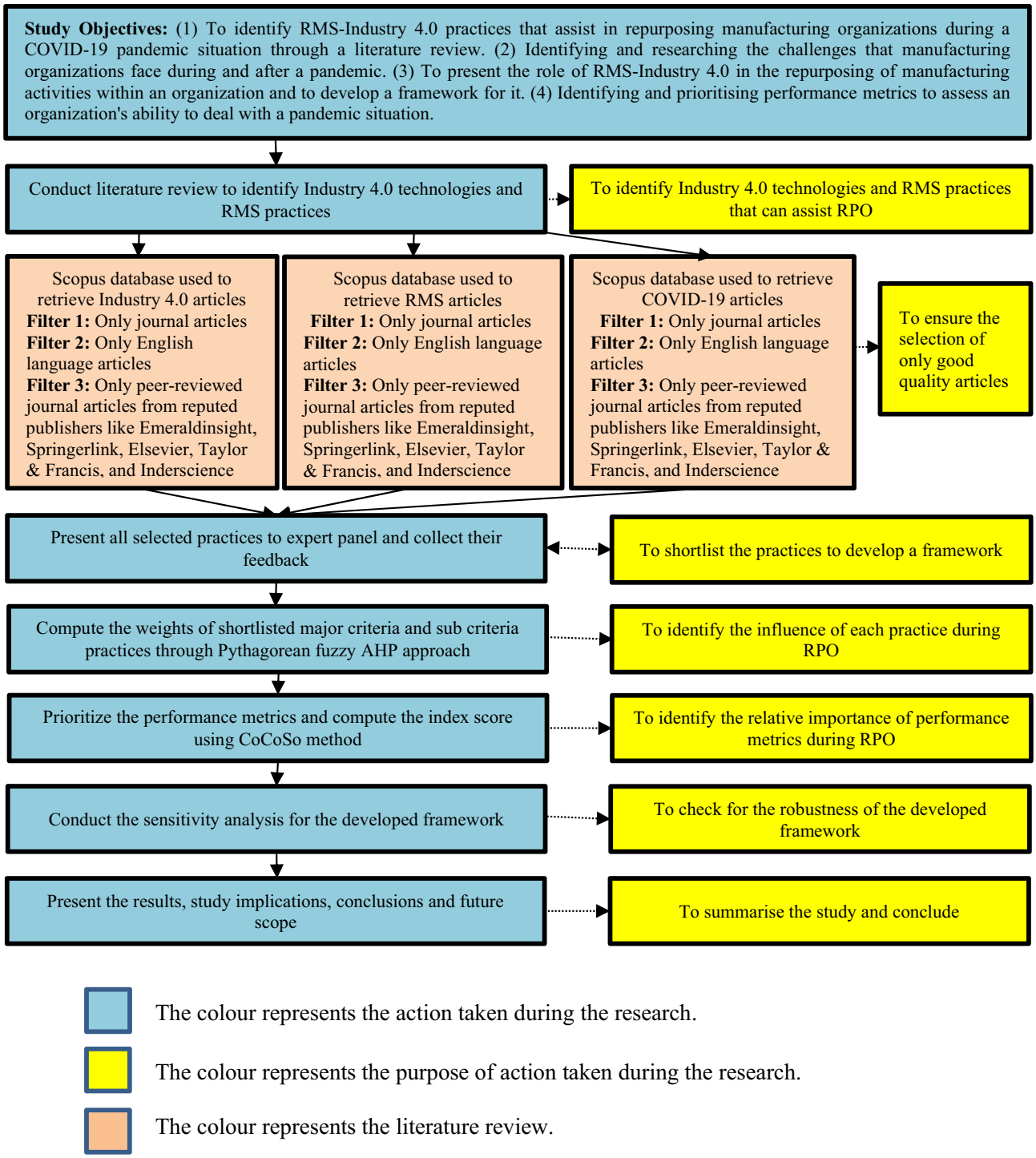

Fig. 1 Research methodology

The bottles produced are shipped to various parts of India as well as to countries outside of India. Following a lengthy discussion with industry officials, it was decided to form a panel of experts comprised of 15 members from various industries to ensure that the proposed framework development process is carried out effectively. As summarised in Table 4, all of the experts were highly qualified and had extensive experience in a variety of fields.

Following a series of meetings with the expert panel, the identified Industry 4.0-RMS practices were further filtered, and the ultimately selected practices were further classified, as discussed in Sect. 4.2. The expert panel was now tasked

with creating a pairwise comparison for major criteria and sub-criteria practices. For the initial pairwise comparison required by the CoCoSo approach, expert opinion was also gathered, standard weight computation and prioritization process was executed, the results were presented and discussed with the expert panel, and minor changes were made in accordance with the panel's recommendations.

4.2 Framework development

The chosen practices were then presented to an expert panel for their input, and minor changes were made based on their suggestions. The expert panel also proposed categorizing the practices into five major criteria, as depicted in Fig. 2.

The developed framework have five levels, as shown in Fig. 2. Level 1 includes the developed framework's objective as well as indications of where the framework can be applied. Level 2 displays the major criteria practices to highlight the categorization of the selected practices based on the expert panel's recommendations. The major criteria practice indicates the area of application of selected practices, which can assist practitioners to implement them. Level 3 displays the sub criteria practices according to the major criteria practices to which they belong. This is the most important level for the framework because it contains several sub-criteria practices to be used for RPO. Level 4 of the developed framework lists the selected performance metrics. This can help practitioners evaluate the effectiveness of the adopted practices in the manufacturing system, as well as identify areas for further improvement. Finally, level 3 displays the five organizations where the expert panel formation and framework case analysis was carried out. The framework depicted in Fig. 2 demonstrates how it can be implemented in the organization in stages and evaluated using a set of performance metrics. This can help practitioners understand the chronology in which the framework must be implemented.

4.3 Framework analysis

The hybrid Pythagorean fuzzy AHP-CoCoSo method was used to compute the weights of selected Industry 4.0-RMS practices during RPO and performance metric ranking. The execution of the entire process is discussed further below.

4.3.1 Application of Pythagorean fuzzy AHP method

Many researchers have criticized the AHP process for the inaccuracy of the ranking and the need for interdependence among the criteria and alternatives, which can lead to inconsistencies (Bag et al. 2021). The intuitionistic fuzzy sets, hesitant fuzzy sets, and Pythagorean fuzzy sets all have the ability to deal with vagueness and uncertainty; however, the intuitionistic fuzzy sets are more capable of dealing with imprecision, whereas the hesitant fuzzy sets are made up of discrete values in the interval [0, 1] rather than a single number. Also, Pythagorean fuzzy sets give decision makers more flexibility when assigning values where the sum of membership and non-membership grades is greater than unity but the sum of squares is in the interval [0, 1]. To address this, Interval-valued Pythagorean fuzzy AHP was used, with the linguistic terms used listed in Table 5 (Bakioglu and Atahan 2021).

The following steps are to be executed for Pythagorean fuzzy AHP,

Table 4 Members of an expert panel

Expert code	Age group (Years)	Educational qualification	Role in industry	Department of work	Work experience (Years)
E1	41–50	Post graduate	Founder/Director	Administration	23
E2	31–40	Graduate	Manager	Design	18
E3	51–60	Ph. D	Vice president	Manufacturing	28
E4	41–50	Post graduate	Senior Manager	Manufacturing	23
E5	41–50	Post graduate	Sales Manager	Marketing	19
E6	41–50	Graduate	Logistics Manager	Administration	24
E7	60+	Ph. D	Consultant	Design	40
E8	21–30	Graduate	Production Engineer	Manufacturing	06
E9	51–60	Ph. D	Senior Manager	Manufacturing	31
E10	41–50	Post graduate	Senior Manager	Design	23
E11	51–60	Post graduate	Director	Administration	32
E12	41–50	Graduate	Production Manager	Manufacturing	22
E13	51–60	Post graduate	General Manager	Manufacturing	33
E14	51–60	Post graduate	Senior Manager	R & D	32
E15	51–60	Ph. D	Senior Manager	Design	25

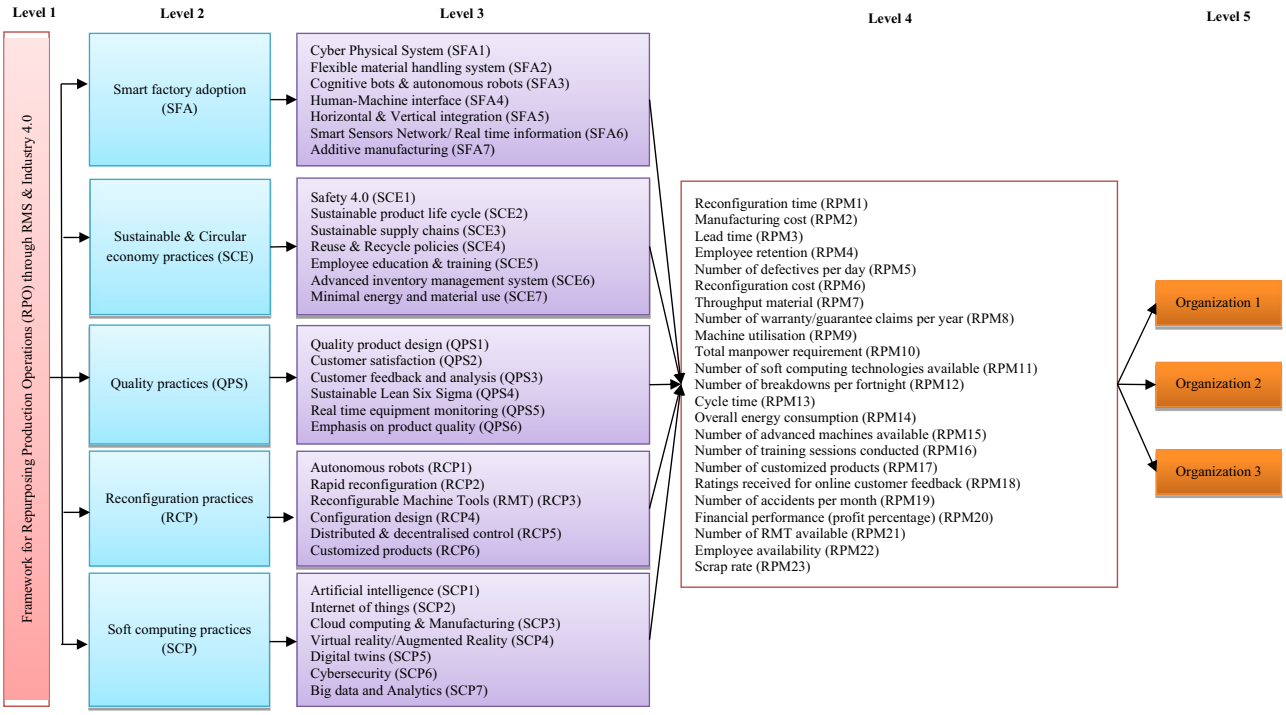

Fig. 2 A developed framework for prioritizing RPO performance metrics

Step 1: Identify the alternatives (i = 1, 2,…, m)
Step 2: Construct the pairwise comparison matrix $A = (a_{ik})_{m\times m}$
Step 3: Compute the difference matrices $D = (d_{ik})_{m\times m}$
Step 4: Compute the interval multiplicative matrix $S = (s_{ik})_{m\times m}$
Step 5: Calculate the determinacy value $\tau = (\tau_{ik})_{m\times m}$
Step 6: Compute the matrix of weights $T = (\tau_{ik})_{m\times m}$
Step 7: Compute the normalized weights w_i using the following equation,

$$w_i = \frac{\sum_{k=1}^{m} t_{ik}}{\sum_{i=1}^{m}\sum_{k=1}^{m} t_{ik}}$$

Table 5 Linguistic terms used in Pythagorean fuzzy AHP

Linguistic variables	Pythagorean fuzzy numbers			
	μ_L	μ_U	V_L	V_U
Certainly low importance (CLI)	0.00	0.00	0.90	1.00
Very low importance (VLI)	0.10	0.20	0.80	0.90
Low importance (LI)	0.20	0.35	0.65	0.80
Below average importance (BAI)	0.35	0.45	0.55	0.65
Average importance (AI)	0.45	0.55	0.45	0.55
Above average importance (AAI)	0.55	0.65	0.35	0.45
High importance (HI)	0.65	0.80	0.20	0.35
Very high importance (VHI)	0.80	0.90	0.10	0.20
Certainly high importance (CHI)	0.90	1.00	0.00	0.00
Exactly equal (EE)	0.1965	0.1965	0.1965	0.1965

The sample pairwise comparison by one of the experts is shown in Table 6.

As previously stated, the experts' opinions were gathered for pairwise comparisons of major criteria as well as sub-criteria Practices, and the weights were computed using Pythagorean fuzzy AHP. As shown in Table 7, this is followed by the computation of global weights for sub-criteria Practices.

4.3.2 Application of Pythagorean fuzzy CoCoSo approach

Yazdani et al. (2019) proposed a novel CoCoSo method, where the obtained solution is consistent with weight variation, providing stability to the decision-making process when compared to other techniques. Also, when compared to other techniques, the CoCoSo method combines the simple additive method with the exponentially weighted product method to obtain the compromise solution (Yadav et al. 2021). Reasearchers also included a Pythagorean fuzzy set in this method, which can effectively deal with uncertain issues in decision-making. Another reason for using this method was the total absence of counterintuitive phenomena, as well as the higher resolution when distinguishing between alternatives. Due to the Pythagorean fuzzy set, the approach can effectively deal with uncertainty issues and can differentiate the best alternative. The steps in the Pythagorean fuzzy CoCoSo method are as follows (Lahane and Kant 2021).

Table 6 Pairwise comparison for smart factory adoption practices

Criteria	SFA1	SFA2	SFA3	SFA4	SFA5	SFA6	SFA7
SFA1	EE	BAI	HI	BAI	AAI	AAI	LI
SFA2	AAI	EE	BAI	AAI	LI	LI	AI
SFA3	AAI	AAI	EE	HI	HI	HI	HI
SFA4	BAI	AI	AI	EE	LI	BAI	LI
SFA5	HI	AAI	AAI	AI	EE	HI	AAI
SFA6	AAI	BAI	AI	EE	AAI	EE	BAI
SFA7	HI	HI	AI	LI	EE	AAI	EE

Step 1: Initially, the decision matrix $D = (d_{ij})_{m\times n}$ where, (i = 1, 2,…m; j = 1, 2,…n) is to be constructed using the linguistic scale as shown in Table 8 and expert opinion.

Step 2: The linguistic decision matrix is then converted into Pythagorean fuzzy decision matrix as per the equation $P = (P_{ij})_{m\times n}$ where, (i = 1, 2,…m; j = 1, 2,…n)

Table 7 Global weights of major and sub-criteria practices

Major Criteria	Major criteria weights	Sub-criteria	Sub-criteria weights	Global weights
Smart factory adoption (SFA)	0.2214	Cyber Physical System (SFA1)	0.1661	0.0368
		Flexible material handling system (SFA2)	0.1307	0.0289
		Cognitive bots & autonomous robots (SFA3)	0.1457	0.0322
		Human–Machine interface (SFA4)	0.1352	0.0299
		Horizontal & Vertical integration (SFA5)	0.1399	0.0310
		Smart Sensors Network/ Real time information (SFA6)	0.1251	0.0277
		Additive manufacturing (SFA7)	0.1574	0.0348
Sustainable & Circular economy practices (SCE)	0.1905	Safety 4.0 (SCE1)	0.1624	0.0309
		Sustainable product life cycle (SCE2)	0.1327	0.0253
		Sustainable supply chains (SCE3)	0.1482	0.0282
		Reuse & Recycle policies (SCE4)	0.1331	0.0253
		Employee education & training (SCE5)	0.1407	0.0268
		Advanced inventory management system (SCE6)	0.1283	0.0244
		Minimal energy and material use (SCE7)	0.1546	0.0294
Quality practices (QPS)	0.1860	Quality product design (QPS1)	0.1739	0.0323
		Customer satisfaction (QPS2)	0.1679	0.0312
		Customer feedback and analysis (QPS3)	0.1577	0.0293
		Sustainable Lean six sigma (QPS4)	0.1652	0.0307
		Real time equipment monitoring (QPS5)	0.1535	0.0286
		Emphasis on product quality (QPS6)	0.1818	0.0338
Reconfiguration practices (RCP)	0.2068	Autonomous robots (RCP1)	0.1598	0.0330
		Rapid reconfiguration (RCP2)	0.1798	0.0372
		Reconfigurable Machine Tools (RMT) (RCP3)	0.1760	0.0364
		Configuration design (RCP4)	0.1671	0.0346
		Distributed & decentralised control (RCP5)	0.1519	0.0314
		Customized products (RCP6)	0.1654	0.0342
Soft computing practices (SCP)	0.1953	Artificial intelligence (SCP1)	0.1538	0.0300
		Internet of things (SCP2)	0.1453	0.0284
		Cloud computing & Manufacturing (SCP3)	0.1504	0.0294
		Virtual reality/Augmented Reality (SCP4)	0.1402	0.0274
		Digital twins (SCP5)	0.1338	0.0261
		Cybersecurity (SCP6)	0.1399	0.0273
		Big data and Analytics (SCP7)	0.1366	0.0267

Step 3: The score function is to be computed using $R = (r_{ij})_{m\times n}$ using the equation,

$$r_{ij} = \mu_{ij}^2 - \nu_{ij}^2 - \ln(1+\pi_{ij}^2)$$

Step 4: The score function matrix is then to be converted into an orthogonal Pythagorean fuzzy matrix $R' = (r'_{ij})_{m\times n}$ by using the following equation,

$$r'_{ij} = \begin{cases} \frac{r_{ij}-r_j^-}{r_j^+-r_j^-}, & if\ j \in B, \\ \frac{r_j^+-r_{ij}}{r_j^+-r_j^-}, & if\ j \in C \end{cases}$$

where, $r_j^- = \min r_{ij}$ and $r_j^+ = \max r_{ij}$

Step 5: Using the following equation, compute the weighted comparability sequence.

$$S_i = \sum_{j=1}^{n} w_j * r'_{ij}$$

Step 6: The power weight of comparability sequences is to be computed now for each alternative.

$$P_i = \sum_{j=1}^{n} (r'_{ij})^{w_j}$$

Step 7: For each alternative, the relative weight is determined using an equation,

$$K_{ia} = \frac{P_i + S_i}{\sum_{i=1}^{m}(P_i + S_i)}$$

$$K_{ib} = \frac{S_i}{\min\limits_i S_i} + \frac{P_i}{\min\limits_i P_i}$$

Table 8 Linguistic scale for Pythagorean fuzzy CoCoSo method

Linguistic term	Pythagorean fuzzy number	
	μ	ν
Extremely low (EL)	0	1
Very low (VL)	0.1	0.9
Low (L)	0.2	0.8
Middle low (ML)	0.3	0.7
Below middle (BM)	0.4	0.6
Middle (M)	0.5	0.5
Above middle (AM)	0.6	0.4
Middle high (MH)	0.7	0.3
High (H)	0.8	0.2
Very high (VH)	0.9	0.1
Extremely high (EH)	1	0

$$K_{ic} = \frac{\lambda S_i + (1-\lambda)P_i}{\lambda \overset{max}{_i} S_i + (1-\lambda)\overset{max}{_i} P_i} 0 \le \lambda \le 1$$

Step 8: Compute the assessment value (K_i) by using an equation,

$$K_i = \sqrt[3]{K_{ia}K_{ib}K_{ic}} + \frac{K_{ia}+K_{ib}+K_{ic}}{3}$$

Step 9: The selected alternatives are ranked based on descending order of K_i

The linguistic decision matrix prepared with expert opinion for the selected performance metrics is shown in Table 9, and the ranking obtained for performance metrics after following the procedure for the Pythagorean fuzzy CoCoSo method is shown in Table 10.

4.4 Sensitivity analysis

It is critical to perform sensitivity analysis tests to ensure the suitability of the developed framework as well as its behavior under varying conditions (Yadav et al. 2020). The weights were varied by 5% and 10%, resulting in a total of 23 experiments, the details of which are shown in Table 11 and the results of which are shown in Fig. 3. Figure 3 shows that there are fewer variations in RPM 10, whereas significant variations are seen in other performance metrics. However, no significant change in ranking was observed, indicating that the developed framework is robust under varying conditions.

5 Discussion on results

The results obtained through the Pythagorean fuzzy AHP-CoCoSo method and its implications are discussed in the current section.

5.1 Study findings

During this study, an extensive literature review was conducted, and 33 Industry 4.0 technologies and RMS practices, as well as 23 performance metrics, were identified. To compute the weights of the selected practices, the Pythagorean fuzzy AHP method was used, while the Pythagorean fuzzy CoCoSo method was used to prioritize the selected performance metrics. The current section discusses the obtained results.

Among the major criteria practices, smart factory adoption received the most weight, indicating that SFA practices are extremely beneficial to RPO. Morgan et al. (2021) conducted a review of RMS and Industry 4.0 technologies

Table 9 Linguistic decision matrix for Pythagorean fuzzy CoCoSo method

Short code	Smart factory adoption							Sustainable & Circular economy practices							Quality practices					
	SFA1	SFA2	SFA3	SFA4	SFA5	SFA6	SFA7	SCE1	SCE2	SCE3	SCE4	SCE5	SCE6	SCE7	QPS1	QPS2	QPS3	QPS4	QPS5	QPS6
RPM1	VH	VH	MH	H	AM	AM	AM	H	AM	AM	AM	AM	AM	AM	H	H	AM	AM	H	H
RPM2	H	H	AM	MH	H	MH	H	MH	AM	AM	MH	MH	MH	ML	H	H	AM	AM	AM	AM
RPM3	VH	VH	VH	MH	VH	H	H	ML	ML	H	ML	ML	H	ML	VH	H	H	H	H	AM
RPM4	M	M	L	H	H	M	L	H	M	M	M	H	AM	AM	L	M	L	L	L	L
RPM5	MH	MH	MH	MH	MH	MH	MH	M	BM	BM	M	H	M	M	MH	MH	MH	MH	MH	MH
RPM6	H	H	MH	MH	H	H	H	ML	ML	ML	ML	AM	H	ML	H	ML	AM	AM	AM	AM
RPM7	VL	M	L	L	M	L	L	M	L	L	L	AM	AM	L	L	L	L	L	M	L
RPM8	MH	MH	MH	MH	MH	MH	MH	ML	ML	ML	M	VH	AM	AM	VH	VH	VH	AM	H	VH
RPM9	H	MH	MH	H	MH	H	MH	ML	M	H	MH	H	H	M	MH	MH	MH	MH	H	M
RPM10	AM	AM	M	AM	AM	AM	AM	M	ML	M	M	MH	M	M	AM	AM	M	AM	AM	AM
RPM11	MH	MH	MH	AM	AM	MH	MH	M	M	M	AM	M	AM	MH	AM	M	AM	MH	MH	M
RPM12	AM	AM	M	M	M	M	M	H	M	M	M	AM	M	M	ML	ML	ML	M	MH	M
RPM13	VH	VH	H	H	MH	MH	MH	L	M	H	L	H	MH	ML	AM	MH	MH	MH	H	M
RPM14	AM	AM	M	AM	AM	ML	AM	ML	AM	AM	AM	MH	ML	VH	M	M	ML	M	M	M
RPM15	VH	H	VH	VH	VH	H	VH	M	H	M	M	MH	M	M	H	AM	ML	M	AM	H
RPM16	M	M	M	M	M	M	M	VH	H	H	VH	VH	H	H	H	M	M	H	M	H
RPM17	MH	MH	MH	MH	MH	MH	MH	ML	ML	ML	M	MH	AM	AM	MH	MH	MH	AM	M	MH
RPM18	AM	AM	AM	AM	AM	AM	AM	ML	MH	M	ML	MH	M	M	H	H	H	M	M	M
RPM19	MH	MH	MH	H	MH	H	H	VH	AM	M	AM	VH	M	AM	M	M	M	M	H	AM
RPM20	H	H	H	H	MH	H	MH	L	M	AM	ML	H	ML	M	M	AM	AM	AM	AM	MH
RPM21	H	H	H	H	H	H	H	ML	ML	ML	ML	M	M	M	MH	AM	AM	MH	MH	MH
RPM22	M	M	M	M	M	L	L	H	M	M	M	H	L	M	M	L	L	M	M	L
RPM23	AM	AM	AM	AM	AM	M	AM	L	AM	M	AM	AM	AM	L	AM	L	VL	M	M	M

Short code	Reconfiguration practices						Soft computing practices						
	RCP1	RCP2	RCP3	RCP4	RCP5	RCP6	SCP1	SCP2	SCP3	SCP4	SCP5	SCP6	SCP7
RPM1	VH	VH	VH	VH	VH	H	VH	VH	H	H	H	H	H
RPM2	VH	VH	VH	H	H	H	H	H	MH	AM	H	AM	AM
RPM3	VH	H	H	H	H	AM	MH	MH	MH	AM	AM	AM	MH
RPM4	M	M	L	M	M	L	M	L	M	L	M	L	L
RPM5	AM	AM	AM	AM	M	M	AM	AM	AM	M	AM	AM	AM
RPM6	VH	VH	VH	H	VH	H	H	VH	H	VH	VH	VH	VH
RPM7	L	M	L	L	M	L	L	M	L	L	L	L	M
RPM8	H	H	H	H	H	H	MH	MH	MH	MH	MH	MH	MH
RPM9	MH	MH	MH	MH	MH	MH	MH	MH	MH	MH	M	MH	M

Table 9 (continued)

Short code	Reconfiguration practices						Soft computing practices						
	RCP1	RCP2	RCP3	RCP4	RCP5	RCP6	SCP1	SCP2	SCP3	SCP4	SCP5	SCP6	SCP7
RPM10	MH	AM	MH	M	AM	AM	AM	AM	AM	ML	M	M	AM
RPM11	MH	MH	H	MH	MH	AM	H	H	H	H	H	H	H
RPM12	M	M	M	M	M	M	AM	AM	M	M	M	M	M
RPM13	H	H	H	MH	MH	MH	MH	MH	M	M	M	M	M
RPM14	AM	M	AM	M	AM	ML	AM	M	M	M	AM	M	M
RPM15	H	H	H	AM	M	H	H	H	H	MH	MH	MH	MH
RPM16	AM	AM	AM	AM	AM	AM	AM	AM	AM	AM	M	M	AM
RPM17	AM	AM	AM	M	AM	MH	AM	AM	AM	MH	AM	M	AM
RPM18	M	M	M	M	M	M	AM	AM	AM	M	AM	M	M
RPM19	AM	AM	AM	M	AM	M	M	AM	AM	M	AM	AM	M
RPM20	MH	MH	AM	MH	AM	MH	H	H	AM	AM	AM	AM	AM
RPM21	H	H	H	H	H	MH	H	H	H	MH	H	MH	MH
RPM22	M	M	AM	L	AM	M	AM	M	AM	AM	M	M	M
RPM23	L	L	M	L	M	M	VL	VL	VL	L	L	L	L

that were useful during COVID-19 and presented a vision of next-generation manufacturing machines that supported the current findings. Morgan et al. (2021) examined several smart technologies and smart machines that can be useful during a pandemic. Such technologies give the manufacturing system flexibility while also reducing lead time and manufacturing costs. The reconfiguration practices came in second, emphasizing the importance of reconfigurability and the technologies required for it. A similar discussion was observed in the article Prasad and Jayswal (2018), where the researchers stated that RMS is capable of adjusting its capacity and functionality as it can be upgraded to current technology. This can help manufacturing systems quickly transition to a new product in response to market demands. Also. Soft computing practices such as AI, IOT, cloud computing, BDA, etc. are extremely useful in such situations; thus, SCP was ranked third. During his literature review, Morgan et al. (2021) discussed the same and summarized the importance of such technologies in RMS and pandemic situations. The SCE and QPS ranked fourth and fifth, indicating that these practices are equally important for remaining competitive in the market.

According to global weights, rapid reconfiguration has obtained the maximum weight, implying that RMS reconfigurability is critical during pandemic to meet changing customer needs. Several researchers, including Morgan et al. (2021), had emphasized RMS's capability. According to Prasad and Jayswal (2018), the reconfigurability of the manufacturing system is assessed in terms of cost, time, and effort for product changeover, all of which are significant factors during a pandemic. The CPS and RMT have occupied the second and third positions in terms of global weight, highlighting the importance of technologies for RPO. According to Morgan et al. (2021), several technologies such as CPS and RMT that enable RMS to be capable of smart manufacturing are extremely useful during pandemic situations because they can help to increase reconfigurability and flexibility. Practices such as additive manufacturing also assist in product development; thus, during pandemic situations where demand is constantly changing, the practice is extremely beneficial for RPO. As Dantas et al. (2021) discussed, technologies such as CPS and additive manufacturing can help during product optimization and thus reduce product cost to help RPO. RMS practises such as configuration design and the ability to provide customized products were ranked fifth and sixth, respectively. These practices can help meet volatile customer demands in a pandemic situation while keeping manufacturing costs to a minimum. Among the QPS, the RMS feature, i.e. the emphasis on product quality, was the most important and ranks seventh. Because the RMS focuses on product flexibility and quality (Bortolini et al. 2018), the expert panel may gave it the most weight.

Table 10 Ranking obtained using Pythagorean fuzzy CoCoSo method

Code	Performance Metrics	K_{ia}	K_{ib}	K_{ic}	K_i	Rank obtained
RPM1	Reconfiguration time (RPM1)	0.0449	6.1364	1.0000	3.0447	1
RPM2	Manufacturing cost (RPM2)	0.0446	5.6199	0.9929	2.8483	3
RPM3	Lead time (RPM3)	0.0445	5.5857	0.9892	2.8327	4
RPM4	Employee retention (RPM4)	0.0422	3.1040	0.9381	1.8584	21
RPM5	Number of defectives per day (RPM5)	0.0439	4.5503	0.9779	2.4378	14
RPM6	Reconfiguration cost (RPM6)	0.0445	5.6710	0.9892	2.8643	2
RPM7	Throughput material (RPM7)	0.0397	2.0738	0.8835	1.4165	23
RPM8	Number of warranty/guarantee claims per year (RPM8)	0.0445	5.5470	0.9904	2.8193	6
RPM9	Machine utilisation (RPM9)	0.0444	5.2418	0.9878	2.7039	8
RPM10	Total manpower requirement (RPM10)	0.0436	4.0553	0.9696	2.2449	17
RPM11	Number of soft computing technologies available (RPM11)	0.0443	5.1062	0.9863	2.6522	9
RPM12	Number of breakdowns per fortnight (RPM12)	0.0432	3.6334	0.9615	2.0785	19
RPM13	Cycle time (RPM13)	0.0441	5.0391	0.9814	2.6235	10
RPM14	Overall energy consumption (RPM14)	0.0433	3.8016	0.9634	2.1440	18
RPM15	Number of advanced machines available (RPM15)	0.0445	5.5776	0.9913	2.8313	5
RPM16	Number of training sessions conducted (RPM16)	0.0441	4.8238	0.9810	2.5427	11
RPM17	Number of customized products (RPM17)	0.0439	4.4843	0.9758	2.4115	15
RPM18	Ratings received for online customer feedback (RPM18)	0.0436	4.0843	0.9694	2.2557	16
RPM19	Number of accidents per month (RPM19)	0.0440	4.6731	0.9793	2.4850	13
RPM20	Financial performance (profit percentage) (RPM20)	0.0440	4.8021	0.9793	2.5333	12
RPM21	Number of RMT available (RPM21)	0.0443	5.3003	0.9863	2.7245	7
RPM22	Employee availability (RPM22)	0.0427	3.3704	0.9501	1.9696	20
RPM23	Scrap rate (RPM23)	0.0372	2.7420	0.8272	1.6406	22

The selected performance metrics were then ranked using the Pythagorean fuzzy CoCoSo method, with the descending order being RPM1 > RPM6 > RPM2 > RPM3 > RPM15 > RPM8 > RPM21 > RPM9 > RPM11 > RPM13 > RPM16 > RPM20 > RPM19 > RPM5 > RPM17 > RPM18 > RPM10 > RPM14 > RPM12 > RPM22 > RPM4 > RPM23 > RPM7. The reconfiguration time was on the first position, indicating the time required to switch to another product during RPO. According to Puik et al. (2017), reconfiguration time is an important factor in determining product lead time, whereas Garbie (2014a, b) stated that when evaluating RMS, reconfiguration is an extremely important issue. During RPO, it is critical that the required products reach the customers in a timely manner, which supports the obtained results. Because lockdown has significantly reduced consumer purchasing power, manufacturing costs and thus reconfiguration costs must be kept to a minimum. Similar discussions were observed in Xia et al. (2017), where the researchers attempted to reduce manufacturing costs by reducing reconfiguration cost; thus, reconfiguration cost was ranked second and manufacturing cost was ranked third. During the Covid-19 pandemic, lockdown had a significant impact on people's financial situation. As a result, manufacturers are struggling to produce products at the lowest possible cost and with the shortest possible lead time (López-Gómez et al. 2020). The lead time was ranked fourth, while the availability of advanced machines was ranked fifth. According to Morgan et al. (2021), advanced machines, particularly those with control capabilities, are extremely beneficial to reconfiguration tasks, which support the obtained results. Furthermore, as discussed by Morgan et al. (2021), RMS focuses on product quality; thus, warranty claims have occupied the sixth position in the ranking. During their study, the researchers also emphasised the importance of RMT, which supports the seventh position for the number of RMT available. The set of performance metrics and their ranking can help practitioners evaluate manufacturing systems and make decisions.

5.2 Theoretical implications

The work presented here contributes to the theory of Industry 4.0 and RMS in three parts. First, it broadens the application of the novel Pythagorean fuzzy AHP-CoCoSo method and may assist future researchers in using it in their research. During this process, a critical review of articles on Industry 4.0, RMS, and repurposing was conducted in order to identify the prominent practices that can assist RPO. This contributes to the theoretical enrichment of the manufacturing

Table 11 Details of experiments to conduct sensitivity analysis

Code	K_i	Exp.1	Exp.2	Exp.3	Exp.4	Exp.5	Exp.6	Exp.7	Exp.8	Exp.9	Exp.10	Exp.11	Exp.12	Exp.13	Exp.14	Exp.15	Exp.16	Exp.17	Exp.18	Exp.19	Exp.20	Exp.21	Exp.22	Exp.23
RPM1	5.5215	6.184	5.628	5.402	4.916	6.051	5.506	5.286	4.810	5.920	5.387	5.172	4.706	5.793	5.271	6.488	5.904	5.668	5.157	6.348	5.776	5.545	5.046	6.211
RPM2	5.1497	5.768	5.249	5.039	4.585	5.643	5.135	4.930	4.486	5.522	5.025	4.824	4.389	5.402	4.916	6.051	5.506	5.286	4.810	5.920	5.387	5.172	4.706	5.793
RPM3	5.1120	5.725	5.210	5.002	4.552	5.602	5.098	4.894	4.453	5.481	4.988	4.788	4.357	5.363	4.880	6.006	5.466	5.247	4.775	5.877	5.348	5.134	4.672	5.750
RPM4	2.3448	2.626	2.390	2.294	2.088	2.570	2.338	2.245	2.043	2.514	2.288	2.196	1.999	2.460	2.239	2.755	2.507	2.407	2.190	2.696	2.453	2.355	2.143	2.638
RPM5	4.2012	4.705	4.282	4.111	3.741	4.604	4.190	4.022	3.660	4.505	4.099	3.935	3.581	4.407	4.011	4.936	4.492	4.312	3.924	4.830	4.395	4.219	3.840	4.726
RPM6	5.1689	5.789	5.268	5.057	4.602	5.664	5.155	4.948	4.503	5.542	5.043	4.842	4.406	5.423	4.935	6.073	5.527	5.306	4.828	5.942	5.408	5.191	4.724	5.814
RPM7	0.9682	1.084	0.987	0.947	0.862	1.061	0.966	0.927	0.843	1.038	0.945	0.907	0.825	1.016	0.924	1.138	1.035	0.994	0.904	1.113	1.013	0.972	0.885	1.089
RPM8	5.0577	5.665	5.155	4.949	4.503	5.542	5.044	4.842	4.406	5.423	4.935	4.737	4.311	5.306	4.828	5.943	5.408	5.192	4.724	5.815	5.291	5.080	4.622	5.689
RPM9	4.8265	5.406	4.919	4.722	4.297	5.289	4.813	4.621	4.205	5.175	4.709	4.521	4.114	5.063	4.608	5.671	5.161	4.954	4.508	5.549	5.049	4.847	4.411	5.429
RPM10	3.8881	4.355	3.963	3.804	3.462	4.261	3.877	3.722	3.387	4.169	3.794	3.642	3.314	4.079	3.712	4.568	4.157	3.991	3.632	4.470	4.068	3.905	3.553	4.373
RPM11	4.6724	5.233	4.762	4.572	4.160	5.120	4.659	4.473	4.070	5.010	4.559	4.377	3.983	4.902	4.461	5.490	4.996	4.796	4.364	5.372	4.888	4.693	4.270	5.256
RPM12	3.4027	3.811	3.468	3.329	3.030	3.729	3.393	3.257	2.964	3.648	3.320	3.187	2.900	3.570	3.248	3.998	3.638	3.493	3.178	3.912	3.560	3.417	3.110	3.827
RPM13	4.6108	5.164	4.699	4.511	4.105	5.053	4.598	4.414	4.017	4.944	4.499	4.319	3.930	4.837	4.402	5.418	4.930	4.733	4.307	5.301	4.824	4.631	4.214	5.186
RPM14	3.6434	4.081	3.713	3.565	3.244	3.993	3.633	3.488	3.174	3.906	3.555	3.413	3.106	3.822	3.478	4.281	3.896	3.740	3.403	4.189	3.812	3.659	3.330	4.098
RPM15	5.0389	5.644	5.136	4.930	4.486	5.522	5.025	4.824	4.390	5.403	4.916	4.720	4.295	5.286	4.810	5.921	5.388	5.172	4.707	5.793	5.271	5.061	4.605	5.668
RPM16	4.3089	4.826	4.392	4.216	3.837	4.722	4.297	4.125	3.754	4.620	4.204	4.036	3.673	4.520	4.114	5.063	4.607	4.423	4.025	4.954	4.508	4.328	3.938	4.847
RPM17	4.2165	4.722	4.297	4.126	3.754	4.621	4.205	4.037	3.673	4.521	4.114	3.950	3.594	4.423	4.025	4.954	4.508	4.328	3.939	4.847	4.411	4.235	3.854	4.743
RPM18	3.8071	4.264	3.880	3.725	3.390	4.172	3.797	3.645	3.317	4.082	3.715	3.566	3.245	3.994	3.635	4.473	4.071	3.908	3.556	4.377	3.983	3.824	3.479	4.282
RPM19	4.3593	4.882	4.443	4.265	3.881	4.777	4.347	4.173	3.798	4.674	4.253	4.083	3.716	4.573	4.162	5.122	4.661	4.475	4.072	5.012	4.561	4.378	3.984	4.903
RPM20	4.4275	4.959	4.513	4.332	3.942	4.852	4.415	4.239	3.857	4.747	4.320	4.147	3.774	4.645	4.227	5.202	4.734	4.545	4.136	5.090	4.632	4.447	4.046	4.980
RPM21	4.9033	5.492	4.997	4.798	4.366	5.373	4.890	4.694	4.272	5.257	4.784	4.593	4.180	5.144	4.681	5.761	5.243	5.033	4.580	5.637	5.130	4.925	4.481	5.515
RPM22	2.8347	3.175	2.889	2.774	2.524	3.106	2.827	2.714	2.470	3.039	2.766	2.655	2.416	2.974	2.706	3.331	3.031	2.910	2.648	3.259	2.966	2.847	2.591	3.189
RPM23	2.0996	2.352	2.140	2.054	1.869	2.301	2.094	2.010	1.829	2.251	2.049	1.967	1.790	2.203	2.004	2.467	2.245	2.155	1.961	2.414	2.197	2.109	1.919	2.362

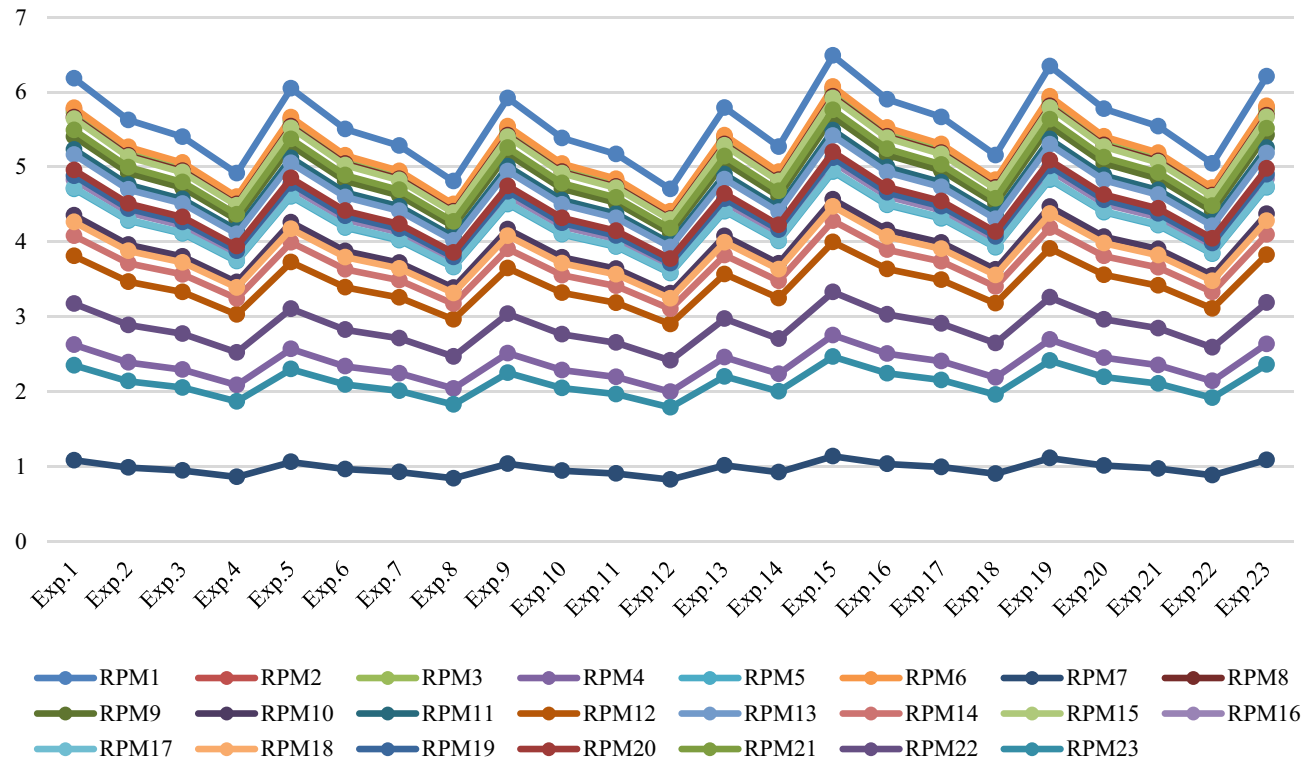

Fig. 3 Sensitivity analysis of K_i values

domain by demonstrating the useful framework development process by identifying practices and applied methods. The presented work's findings, as well as the relative importance of the practices and performance metrics, highlight the need for additional research in this domain to increase the adoption of selected practices. Researchers can use this as their future agenda and develop a detailed plan for implementing these practices in industries.

Second, as seen in a few articles, the presented research establishes a link between Industry 4.0 and RMS to assist RPO (Morgan et al. 2021). This demonstrates RMS's ability to adopt advanced Industry 4.0 technologies and provide manufacturing flexibility with the help of these technologies. As product complexity increases and customer demands become more customized, the developed framework and this connection can assist in satisfying such demands. This creates a strategy for dealing with the dynamic market demand situation as well as RPO due to a pandemic situation. This approach can be used to deal with future challenges, such as the ones we are currently facing due to COVID-19.

The importance of advanced technologies in manufacturing, as highlighted by the major criteria weights, was the third contribution. The study contributes to the proposition that important performance metrics such as lead time, flexibility, capacity, etc. are determinants of advanced technologies used in the manufacturing system. Furthermore, the set of identified performance metrics and their prioritization provides a roadmap for evaluating the manufacturing system and assessing the efficacy of the identified practices.

5.3 Managerial implications

The presented work have managerial implications too that can improve the adoption of RMS in industries and also assist during RPO. The proposed framework can assist managers in decision-making during the pandemic situation and for RPO that can benefit society during critical situations of a pandemic. The managers may refer to the framework, selected practices, and ranking so that decisions for step-by-step RPO can be taken effectively and efficiently. The proposed framework may also assist managers to evaluate the performance of the organization which can become the basis for future improvements. This can lead to social and economic benefits for an organization. The framework can assist managers to take care of several aspects simultaneously as listed in major criteria practices. The proposed framework may motivate managers to improve the infrastructure, technologies, and work culture in an organization. This may lead to the overall growth of the organization, improved customer satisfaction, and social contributions for fighting the pandemic situations by reducing the gap between demand and supply. The framework guides and motivates the managers

to switch over the products that are in large demand in a pandemic situation and also the products that require dealing with pandemic situations.

5.4 Implications for researchers and practitioners

The presented research has a significant contribution for researchers and practitioners of the RMS and Industry 4.0 domain. During the presented work, the key Industry 4.0-RMS practices were identified that can assist during RPO during the Covid-19 pandemic. This can also help to increase the adoption of RMS in the industries. The framework developed for RPO was rarely observed in the past literature; hence, it can assist the practitioners during decision making, implementing the selected practices, evaluating the performance of the organization, etc. The prioritized performance metrics may assist practitioners to decide a suitable action plan at the initial stage of RPO that can reduce the risk of failure. This may also assist during the successful adoption of RMS in the industry. It is slightly challenging to incorporate all the practices in any manufacturing system; however, the weights computed in the presented work may assist to decide the priority of their implementation during RPO. In practice, this means that among the SFA practices first preference must be given to the cyber-physical system and additive manufacturing as compared to real-time information systems. This may result in the efficient adoption of RMS during RPO. The RMS adoption is at the initial stage in developing countries like India. Also, most of the manufacturing countries around the globe are struggling for RPO during a pandemic situation. The researchers and practitioners may use the developed framework as a ready reference to increase their organizational performance. The identified and ranked performance metrics can also assist them during the evaluation of performance. The proposed framework can also assist to reduce the difficulties during the adoption of RMS in the Covid-19 pandemic as the framework provides a structured approach of the same. This may also assist in step-by-step improvement in the performance of the organization by incorporating the practices in ranked order. The developed framework may also lead to social, economic, and sustainability including environmental benefits as several aspects related to it have been taken care of while selecting the practices. It may also assist to frame the long-term strategy of the organization during a pandemic situation and may lead to high returns for the society. The proposed framework can assist in maintaining the supply chain during a pandemic situation as the organizations in several geographical locations think of RPO and bridge the gap between demand and supply of that area. This may also assist to boost the missions of countries like 'Make in India', 'clean India', etc.

6 Conclusion and future scope

The research presented here has provided a novel framework for RPO in which advanced Industry 4.0 technologies and RMS practices can greatly assist in dealing with pandemic challenges. To find answers to the proposed research questions, 33 Industry 4.0-RMS practices and 23 performance metrics were identified. Following that, the weights of selected practices were computed using the Pythagorean fuzzy AHP method, and performance metrics were prioritized using the CoCoSo technique. It was also ensured that the selected practices would be beneficial to RPO, and the performance metrics would reflect the effectiveness of the practices selected. When selecting practices and performance metrics, manufacturing companies' challenges are taken into account.

The efforts had resulted in the development of a framework that can assist in RPO in the post pandemic situation. The obtained results show that in the manufacturing industries, the adoption of advanced technologies such as SFA, which includes CPS, the use of robots, additive manufacturing, etc., is required for RPO. This suggests that advanced technologies and computer algorithms can greatly assist RPO during pandemic situations and that practitioners and decision-makers should focus on them for effective repurposing. Furthermore, practices such as RMT adoption and rapid reconfiguration are extremely beneficial for RPO and can help to reduce manufacturing costs. During the prioritization of performance metrics, reconfiguration time was ranked first, indicating the importance of the time required to switch to another product to meet dynamic customer needs in a pandemic situation. The cost of doing so is also important; thus, reconfiguration cost has taken the second place in the ranking. The top rankings of performance metrics show that manufacturing lead time and manufacturing costs are the top priorities for any company in a pandemic situation.

However, the presented research work may have some limitations and can be attempted by future researchers. The framework was prepared based on MCDM techniques and expert opinion, but, the expert opinions are always subjective, and biasing may impact the results. Hence, the computations using the hybrid approach have to be attempted with due care. Also, the framework development process and the case organization were restricted to the three organizations in the Indian manufacturing environment. The future research work may be extended to organizations from different geographical locations with required modifications and the results can be compared. More advanced MCDM techniques may also be employed for the same and the results may be compared.

Declarations

Conflict of interest The authors declare no potential conflict of interest. The authors have no competing interests to declare that are relevant to the content of this article.

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Development of Ultra High Performance Concrete using Microfine and GGBS

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Abstract: - Ultra high performance concrete is advanced level of concrete which possesses compressive strength in excess of 60 MPa. UHPC having good mechanical strength and durability. This provides long service life to the constructed structure with higher level of performance in terms of durability, performance, maintenance etc. In the present study the development of ultra high performance concrete by using Microfine and ground granulated blast furnace slag are used as a replacement of binding agent cement. The main aim is to develop Ultra high performance concrete which can give higher durability with greater performance and less maintenance of concrete during the service life of the structure. Ultra High Performance Concrete can also fulfill the requirement of architecture because it can be used for elevation design to make elevation more attractive and aesthetic along with that it also covers resistance against buckling behavior so that it will not buckle in case of Slender column.

Keywords:- *Mechanical Properties; Compressive Strength; Split Tensile Strength; Ground Granulated Blast Furnace Slag; Microfine etc.*

I. INTRODUCTION

The Ultra high performance concrete is the cementitious mixture which provides high mechanical strength with great performance. The world's population is getting increases very fast and there is requirements of efficient material in the construction are on the peak therefore the UHPC having potential to give best results in terms of both strength and performance. Research and development on new UHPC have been running from last 15 years and many researchers have given the solution for the proportion from which we can have high performance concrete related to strength and serviceability of concrete. This concrete can be used for Heavy Construction like Bridge, Dams, Flyover, Multi Storey Structure, Road pavement etc. Due to its performance it can create revolution in construction industry.

The construction material used to enhance the durability and workability of concrete are different types of fibers, micro fine, Ground granulated blast furnace slag etc. Concrete is the most popular and most consumed material in the construction industry and it has been used widely since the invention of the concrete and that also will be demanded in future.

At the time of invention of concrete nearby around 1960's the starting progress was very slow because the maximum compressive strength could achieve 15 MPa to 20 MPa only but now it has become very high like 80 Mpa to 100 MPa and even more. There is a increase in the strength along with the performance of the concrete and it's safe to use and have highly attracted the construction industry for concrete uses.

Because of the high costing the use of ultra high performance concrete is limited and the design codes which provide information regarding designing of ultra high performance concrete are also limited. To reduce the initial cost of ultra high performance concrete Microfine and Ground Granulated Blast Furnace Slag have been incorporated. Basically GGBS and Microfine are the waste by product of Steel Manufacture industry. These are capable enough to enhance the strength and durability of concrete.

For achieving higher ductility, small fraction of Steel fiber can be used. These waste materials having homogeneous structure and can provide homogeneity to the concrete.

II. MATERIALS

A. Materials

a. Ground Granulated Blast Furnace Slag (GGBS) and Microfine:

The nano material used in this project is Ground Granulated Blast Furnace Slag due to their rich mechanical strength and bonding strength along with Microfine for improving intermolecular bond between ingredients of concrete. GGBS and Microfine added as a replacement of Cement with certain percentage depending upon mix design.

- Physical Composition of GGBS:
  Color: White
  Specific Gravity: 2.92
  Bulk Density: 1060-1160 kg/m^3 (Loose) and 1260-1360 kg/m^3
  Fineness: > 350 m^2/kg

- Physical Composition of Microfine:
  Fineness: > 550 m^2/kg
  Compressive Strength: >15 (in N/mm^2 at 28 Days)
  Initial Setting Time: 150 minutes
  Final Setting Time: 180 minutes
  Grain Density: 2.92 kg/m^3

b. Cement:

The strength of concrete mainly depend upon the binding material cement. The Ultra high performance concrete must needed use of ordinary Portland cement of

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high quality. The quality of cement directly affects the strength of concrete and its durability. The physical and chemical property of the cement having predominant role in the performance of the concrete. Following are the key factors which are needed in the cement for achieving Ultra high performance concrete.

Cement Grade: Ordinary Portland Cement 53 – ACC
Conforming IS: 269
Minimum Compressive Strength (7 Days): 29.7 N/mm^2
Air Content in mortar: between 5 to 15%

The Portland cement of grade 53 was used in this study. All the experiments were performed as per IS 12269:2013. Various test performed on the cement like normal consistency, fineness, initial setting time and final setting time as per Indian standard.

c. Fine and Coarse Aggregate:

The distribution of aggregate normally creates uniformity in the concrete mix. The workability of concrete depends on the fine aggregate and coarse aggregate dispersion in the concrete. If the sand having sticky property then it will give the minimum compressive strength and workability to the concrete. The suitable range of fineness modulus for sand is 2.5 to 3.2 for Ultra high performance concrete. By crushing stones the coarse aggregate are obtained generally and having key role in the workability and compressive strength in the concrete. Many tests have been performed on coarse and fine aggregate to make it suitable for Ultra high performance concrete.

Aggregates having predominant role in strength and durability of concrete. The bifurcation of the aggregate are carried out by using Indian standard suggestions like if the particle size of the aggregate is less than 4.75 mm then it is categorized as fine aggregate and if the particle size are more than 4.75 mm then aggregates are categorized as coarse aggregate.

d. Admixture:

In this study, the strength enhancer and water amout reducer admixture is used. Perma Plast PC-405 admixture is used with the mixture. As per the suggestion or recommendation the minimum dose of admixture must be in the range of 0.2 to 1.5 % by weight of cement content. The dose of admixture should not be less or more than the range otherwise it would have diverse results in final observation.

III. METHODS AND EXPERIMENTAL DATA

A. Concrete Mix Design:

Mix design was done as per Indian Standard 10262:2009 with incorporation of GGBS and Microfine in certain % as a trial mixture.

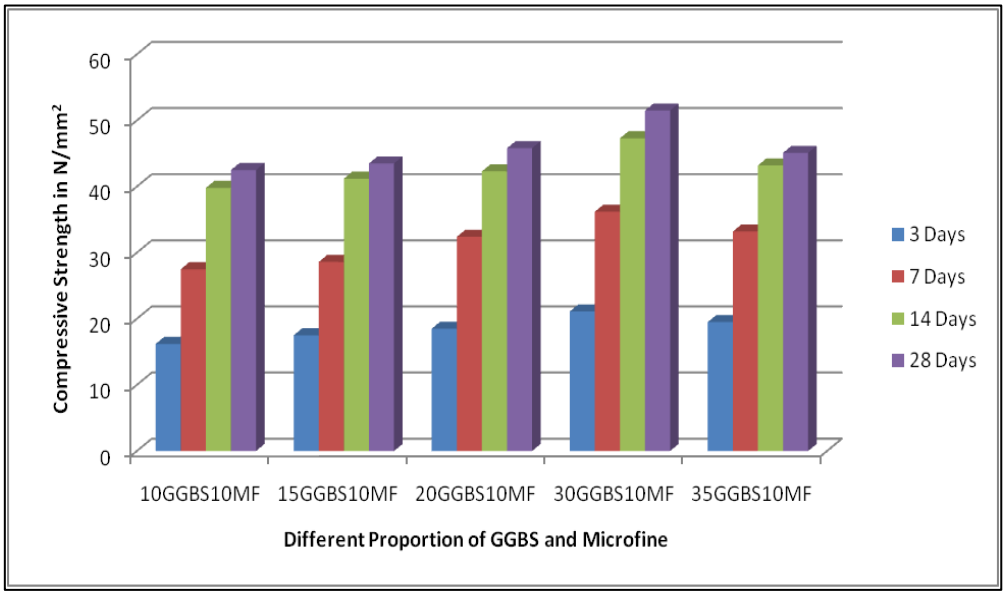
Testing:

a. Compressive Strength Test:

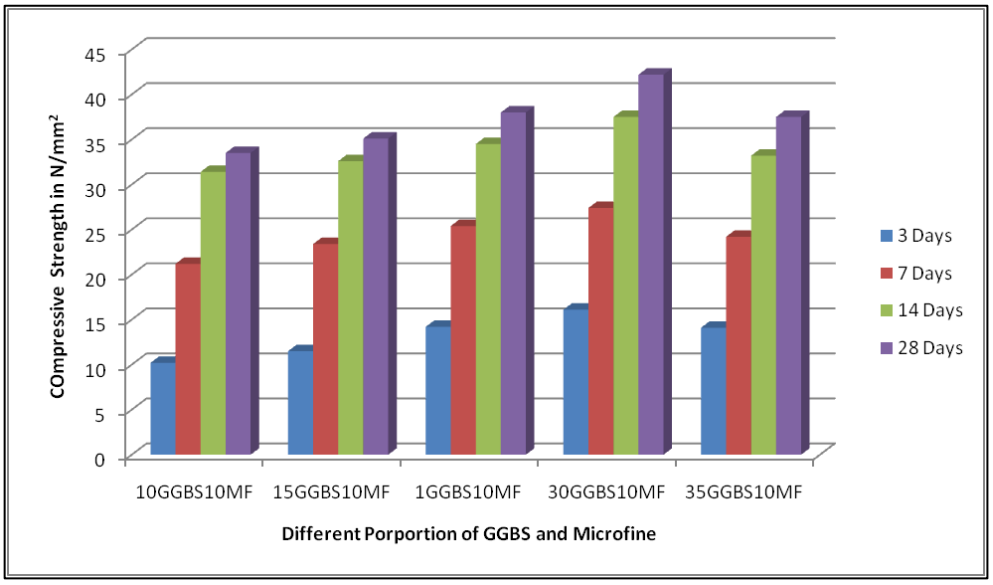
The Following data were observed as per mix design and proportion calculated.

Mix Design	W/C Ratio	GGBS (%)	Micro fine (%)	Compressive Strength in N/mm^2			
				3 days	7 days	14 days	28 days
M50	0.35	10	10	16.2	27.5	39.8	42.5
		15	10	17.5	28.6	41.2	43.5
		20	10	18.5	32.4	42.3	45.8
		30	10	21.1	36.2	47.3	51.5
		40	10	19.5	33.2	43.2	45.1
M40	0.35	10	10	10.2	21.2	31.4	33.5
		15	10	11.5	23.4	32.6	35.1
		20	10	14.2	25.4	34.5	38.0
		30	10	16.1	27.4	37.5	42.2
		40	10	14.1	24.2	33.2	37.5

Table 1: Compressive Strength Test Values of M50 and M40



Graph-1 Compressive Strength data comparison for Mix-50



Graph-2 Compressive Strength data comparison for Mix-40

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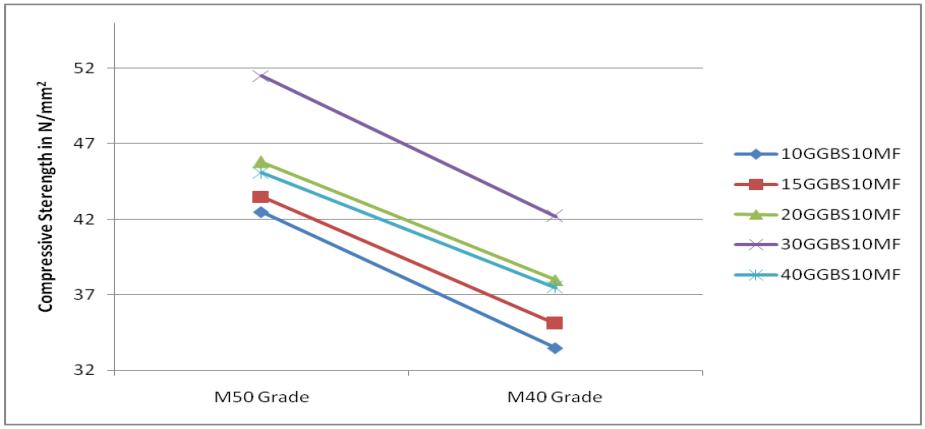

Graph-3 Comparative Graph for CS of Mix-40 and Mix-50

b. Split Tensile Strength Test:

This Test is performed to determine the split tensile strength of concrete. A Cylindrical mould is prepared having size 150 mm diameter and 300 mm length as per Indian Standard Specifications. After Preparing Specimen is prepared, the loads are applied on it across the vertical diameter. For this test various equipments and tools are used like grinding machine, compressive strength machine, capping fixture, PI tape, Ruler etc.

The Loads are applied as triaxial compression and it is applied until the tensile load failure point reaches.

Mix Proportion	Split Tensile Strength Value in (N/mm2)		
	7 Days	14 Days	28 Days
Mix 50 (W/C = 0.35) + GGBS (30%) and Microfine (10%)	5.40	7.00	7.75
Mix 40 (W/C = 0.35) + GGBS (30%) and Microfine (10%)	4.12	5.63	6.45

Table 2: Split Tensile Strength on different trials

c. Flexural Strength Test:

Flexural strength test is used to find out tensile property of the concrete. The core concept behind this test is to determine how much load the beam can resist under bending. For performing this test, specimen is prepared having size 150 mm x 150 mm and length 700 mm. This mould is poured with concrete mix and further this specimen is placed to perform three point load experiment. The loading conditions are applied at one third and two third by the total length of the specimen. Tests are always performed after the minimum curing required as per the Indian Standard.

Mix Proportion	Flexural Tensile Strength Value in (N/mm^2)		
	7 Days	14 Days	28 Days
Mix-50 (W/C = 0.35) + GGBS (30%) and Microfine (10%)	5.92	7.75	9.40
Mix-40 (W/C = 0.35) + GGBS (30%) and Microfine (10%)	4.55	6.24	6.92

Table 3: Flexural Tensile Strength on different trial

d. Rebound Hammer test:

Rebound hammer test comes under non-destructive test in which compressive strength of the concrete is identified without any dismantle of concrete.

This test is used to assess the durability workability and consistency of concrete. it is the one of the convenient method used to determine the compressive strength of concrete without any physical destruction. In this experiment instrument is used in which a plunger is fitted and it is connected to a spring that used to control the mass. After that marking is done on the surface and the minimum horizontal distance between two marks must be 25 mm. From the end of the surface it must be 50 mm. we need to impose total 10 numbers of marking on the surface of concrete to identify the compressive strength by using by performing rebound hammer test.

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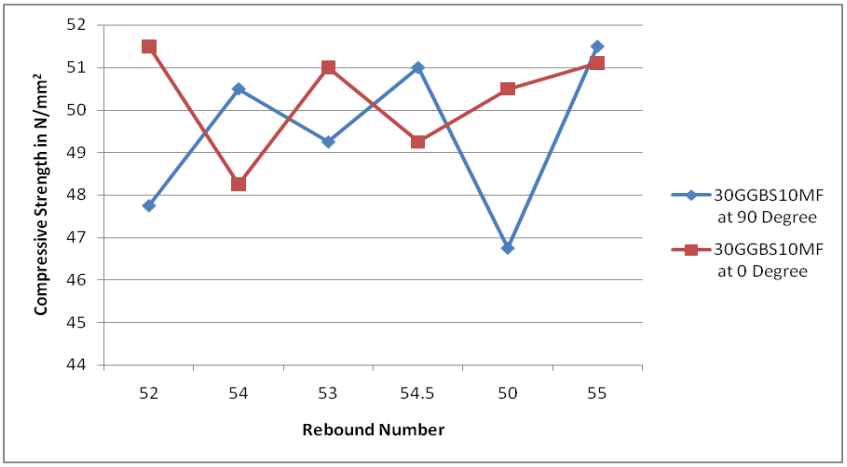

Graph-4 Comparison of CS at 0 and 90 degree.

e. Ultrasonic Pulse Velocity Test*:*

The ultrasonic pulse velocity test is also comes under non destructive test. This test is used to determine the quality of concrete in terms of uniformity and consistency of mix. In this experiment, Ultrasonic waves passes through the concrete specimen and the time taken by the Ultrasonic waves to pass that specimen is noted. If the time consumed by the ultrasonic wave is more that means there is something which is uniform and well organize structure. If the time taken by the wave is less that means there is something which is not well organized or disturbed arrangement of mixture ingredient. Further, there is no need to disintegrate the structure to determine these values.

Spot No.	Pulse Velocity (Km/Sec)		Concrete Quality (Grading)
	Direct Method	Semi Direct Method	
1	4.05	4.00	Good
2	4.25	3.95	
3	3.80	3.91	
4	4.17	4.20	
5	4.3	3.99	

Table 4: Pulse Velocity test Observations

IV. CONCLUSIONS

By adding GGBS and Microfine to achieve UHPC, the following conclusions were made as per expectations and observation received.

- GGBS and Microfine both are capable to enhance the Physical property of concrete like compressive strength, Ductility and performance of concrete under service period.
- The Compressive Strength found 43.5 N/mm ^{2} and 52.75 N/mm ^{2} after 28 days for Mix-40 and Mix-50.
- By considering economic point of view, the UHPC is 15.5% Cost effective than conventional concrete due to using Industrial waste by product.
- The Best results found when we add 30% GGBS and 10% Microfine as a replacement of cement.
- The Split and Flexural tensile strength were maximum when 30% GGBS and 10% Microfine is added.
- The Water Cement ratio is 0.25 for getting best result under this proportion.
- Ultrasonic Pulse Velocity and Rebound hammer test results were also up to the mark as per expectation and categorized as good.
- UHPC is also capable to protect itself from corrosion and acid Attack..

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Investigation of Structural Plate with Cracks and Hole under Combined Loading

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Abstract. *Here, XFEM is used to model structural discontinuities like cracks and holes in order to forecast the strength and dependability of the structure under service conditions. By contrasting the numerical outcomes of several issues with the analytical and experimental findings, the method's resilience has been shown. Additionally, XFEM is coupled with a stochastic method to predict the sensitivity of a structure with discontinuities (cracks and holes) under tensile loading conditions in terms of output COVs and fracture strength in terms of mean values of stress intensity factors (SIFs) using input individual and combined randomness in various system parameters. The second order perturbation technique has been utilized in stochastic / perturbation theory to forecast how constructions would fracture. The perturbation technique is also utilized as Taylor series expansion method and yields accurate results if the input randomness is less than twenty percentage.*

Keywords. XFEM, COV, MMSIF, Stochastic, Perturbation

1. Introduction

We are aware that randomness always exists in reality and affects every aspect of a construction, including its geometry, strength, lifespan, susceptibility to damage, and fracture parameters. Even with the finest quality control procedures, randomness in system attributes has a major impact on how the mechanical

component responds to fracture. Therefore, randomness, external loads, material qualities, crack parameters, and geometry must all be taken into account when performing a fracture analysis on a structure. The stochastic fracture analysis increases the safety of structures by offering a reliable prediction of the fracture behaviour of the structure. The reliability evaluation methodologies can aid in the creation of preliminary recommendations for reliable designs. Many scholars have successfully analysed the stochastic fracture behaviour of the structure. Through the use of several numerical examples and the scaled boundary finite element method (SBFEM), Chowdhury et al. [1] completed the shape sensitivity analysis (Rahman and Chen [2]; Reddy and Rao [3]) of stress intensity variables to the crack size and direction. They performed the reliability assessment by Monte Carlo simulations (Chakraborty and Rahman [4, 5]; Choi et al. [6]; Evangelatos and Spanos [7]; Haldar and Mahadevan [8]; Khasin [9]; Lal and Palekar [10]). Some academics have talked about their work using the perturbation technique to forecast the material's stochastic reaction. In this regard, Rahman and Rao [11] introduced a stochastic meshless technique for resolving random material property boundary-value issues in linear elasticity. For the purpose of forecasting stochastic structure response, they created a meshless formulation. Classical perturbation expansions were produced in conjunction with the meshless equations to forecast the response's second-moment characteristics.

The XFEM has been further improved or enhanced by many researchers through coupling the XFEM with another technique to overcome the difficulties faced by the general XFEM. In the direction, a new set of enrichment functions was proposed for solving the Poisson equation in 1D and 2D spaces and was reduced the analysis error by Paweł [12]. The XFEM was coupled with a constitutive law with embedded discontinuity (CLED) approach for modelling of mixed mode cracking in concrete structure for simplifying the numerical implementation (Pietruszczak and Haghighat, [13]). Improved XFEM was developed for 3D and demonstrated better accuracy, convergence and efficiency. It overcomes the linear dependency problem by utilizing an extra degree of freedom free partition of unity approximation which is based on local least-squares fitting with a one-point interpolation constraint (Tian et al., [14]).

Using XFEM and various independent, combined uncorrelated and correlated input random Gaussian variables using SOPT and MCS, Lal and Markad [15] presented mixed mode SIFs and crack propagation analysis of the symmetric angle-ply laminated composite plate with through-thickness arbitrary curve cracks subjected to tensile and shear stress. The stochastic finite element technique is an extension of the MCS with uncertainty in the system parameters, such as materials, geometry, etc. given by Arregui-Mena et al. [16]. The spectral stochastic finite element approach and the perturbation technique (SSFEM). Lal and Markad [10] utilised a C^0 FEM based on higher order shear deformation plate theory was used to evaluate the second order statistics of MMSIFs of single edge V-notched angle-ply laminated composite plates under in-plane tensile load with uncertainty in material parameters, crack opening, and fracture length (HSDT). With the help of FOPT, SOPT, and MCS, the probabilistic evaluation was carried out.

The few researchers predicted how an infinite plate with a separate circular hole and a crack would fracture under tensile force. To the author's knowledge, XFEM with SOPT has not been used to investigate the stochastic fracture behaviour in terms of normalised MMSIFs and corresponding COVs of the infinite plate with various positions of a separate circular hole and a crack with various crack angles under tensile loading with input random parameters such as crack length, normalised radius of the hole, crack angle, and the central distance between separate hole and crack.

By incorporating the individual and combined randomness in the normalised crack length, crack angle, and normalised radius of the hole in an isotropic plate with a hole emanating cracks using SOPT, the stochastic fracture response through the normalised MMSIFs is calculated. Some results are validated with MCS. Present work is also focuesed on effect of combined loading over stochastic fracture response of the structural plate in terms of normalized MMSIFs.

2. Mathematical formulation

The XFEM is useful for modelling discontinuities like fractures, holes or voids, inclusions, interfaces, etc. while including discontinuous functions in the FE mesh. The level set method (LSM) has been successfully

used in conjunction with the XFEM to address these problems by providing further enrichment functions like crack faces and crack tips. Here, the XFEM software is built upon the 2D MATLAB code by Pais [18].

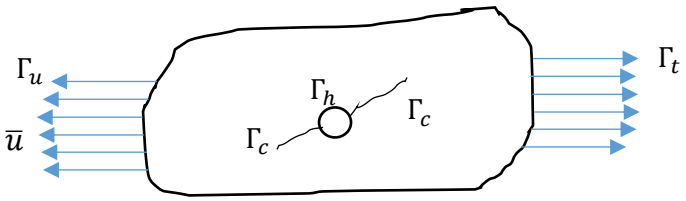


Fig. 1 Area under consideration with cracks, holes, and boundary condition

2.1 Equilibrium equation

The surfaces of cracks Γ_c and holes Γ_h are assumed traction free as are mentioned by Daux et al. [20], and shown in figure 1. The equilibrium equation in the domain Ω is:

$$\tilde{\nabla} \cdot \boldsymbol{\sigma}_t + \mathbf{f}_b = 0 \tag{1}$$

Small strains and displacements are taken into consideration in the current work. Thus, the relationship between strain and displacement illustrates the kinematics equations:

$$\boldsymbol{\varepsilon} = \boldsymbol{\varepsilon}(\mathbf{u}) = \tilde{\nabla}_s \cdot \mathbf{u} \tag{2}$$

Here, $\tilde{\nabla}_s$ is the symmetric part of the gradient operator and $\mathbf{u}$ is a displacement field vector. The boundary conditions for the displacements on the boundary Γ_u are:

$$\mathbf{u} = \bar{\mathbf{u}} . \tag{3}$$

The constitutive relation for elastic material can be shown by Hooke's law as:

$$\boldsymbol{\sigma}_t = \boldsymbol{D} \cdot \boldsymbol{\varepsilon}(\mathbf{u}) \tag{4}$$

where $\boldsymbol{D}$ is Hooke tensor or constitutive matrix for isotropic materials for plane stress and strain conditions in 2D.

The equilibrium equations' weak form is provided by:

$$\int_{\Omega} \boldsymbol{\varepsilon}(\mathbf{u}) : \boldsymbol{D} : \boldsymbol{\varepsilon}(\mathbf{v}) d\Omega = \int_{\Omega} \bar{\mathbf{b}} \cdot \mathbf{v} d\Omega + \int_{\Gamma_t} \bar{\mathbf{t}} \cdot \mathbf{v} d\Gamma \quad \forall \mathbf{v} \in \gamma_0 \tag{5}$$

The linear, FF and bilinear, SS forms of the equation (5) are:

$$FF(\mathbf{v}) = \int_{\Gamma} \bar{\mathbf{b}} \cdot \mathbf{v} d\Omega + \int_{\Gamma_t} \bar{\mathbf{t}} \cdot \mathbf{v} d\Omega \tag{6}$$

$$SS(\mathbf{u}, \mathbf{v}) = \int_{\Omega} \boldsymbol{\varepsilon}(\mathbf{u}) : \boldsymbol{D} : \boldsymbol{\varepsilon}(\mathbf{v}) d\Omega \tag{7}$$

Potential energy (Π) of an elastic body is $\Pi = \frac{1}{2} SS(\mathbf{u}, \mathbf{u}) - FF(\mathbf{u})$ (8)

By applying a variant of the previous equation and substituting $\frac{\partial \Pi}{\partial \mathbf{u}} = 0$, the minimization of the elastic body's potential energy may be solved, and the following set of discrete equations is produced as a result.

$$[\mathbf{K}]\{\mathbf{d}\} = \{\mathbf{f}\} \tag{9}$$

where, $[\mathbf{K}]$ is the global stiffness matrix, $\{\mathbf{d}\}$ are the global degrees of freedom and $\{\mathbf{f}\}$ are the applied loading or force.

$$\mathbf{K}_{ij}^{e} = \begin{bmatrix} \mathbf{K}_{ij}^{uu} & \mathbf{K}_{ij}^{ua} & \mathbf{K}_{ij}^{ub} & \mathbf{K}_{ij}^{ug} \\ \mathbf{K}_{ij}^{au} & \mathbf{K}_{ij}^{aa} & \mathbf{K}_{ij}^{ab} & \mathbf{K}_{ij}^{ag} \\ \mathbf{K}_{ij}^{bu} & \mathbf{K}_{ij}^{ba} & \mathbf{K}_{ij}^{bb} & \mathbf{K}_{ij}^{bg} \\ \mathbf{K}_{ij}^{gu} & \mathbf{K}_{ij}^{ga} & \mathbf{K}_{ij}^{gb} & \mathbf{K}_{ij}^{gg} \end{bmatrix} \tag{10}$$

$$\mathbf{f}_i^e = \left\{ \mathbf{f}_i^u \;\; \mathbf{f}_i^a \;\; \mathbf{f}_i^{b_1} \;\; \mathbf{f}_i^{b_2} \;\; \mathbf{f}_i^{b_3} \;\; \mathbf{f}_i^{b_4} \;\; \mathbf{f}_i^g \right\}^{\mathbf{T}} \tag{11}$$

$$\mathbf{d} = \left\{ \mathbf{u} \;\; \mathbf{a} \;\; \mathbf{b}_1 \;\; \mathbf{b}_1 \;\; \mathbf{b}_1 \;\; \mathbf{b}_1 \;\; \mathbf{g} \right\}^{\mathbf{T}} \tag{12}$$

2.2 XFEM Approximation

XFEM Approximation for Cracks and voids are defined as,

$$\mathbf{u}^{fi}(\mathbf{x}) = \mathbf{u}^{\mathbf{FEM}} + \mathbf{u}^{\mathbf{ENR}} = \sum_{i=1}^{n} \mathcal{N}_i(\mathbf{x}) \left\{ \bar{\mathbf{u}}_i + \sum_{j=1}^{m} \mathbf{F}^j(\mathbf{x}) \mathbf{a}_i^j \right\} \tag{13}$$

Heaviside function for a discontinuous function for the crack and voids defined as,

$$\mathcal{H}_1(\mathbf{x}) = \begin{cases} 1 \text{ for } \boldsymbol{\varphi}(\mathbf{x}) > 0 \\ 0 \text{ for } \boldsymbol{\varphi}(\mathbf{x}) = 0 \\ -1 \text{ for } \boldsymbol{\varphi}(\mathbf{x}) < 0 \end{cases} \quad \text{and} \quad \mathcal{H}_2(\mathbf{x}) = \begin{cases} 1 \text{ for } \chi(\mathbf{x}) > 0 \\ 0 \text{ for } \chi(\mathbf{x}) \le 0 \end{cases} \tag{14}$$

2.3 Level Set Method

For crack, level set method implemented by eq. (15), and for voids by eq. (16). The sign distance function $\phi(\mathbf{x}, \mathrm{t})$ to the curve Γ_c

$$\phi(\mathbf{x}) = \begin{cases} \min\limits_{\mathbf{x}_c \in \Gamma} \left\| \mathbf{x} - \mathbf{x}_c \right\| = d\left(\mathbf{x}, \mathbf{x}_i\right) & \forall \left(\mathbf{x} - \mathbf{x}_c\right) \cdot e_2 \ge 0 \\ \min\limits_{\mathbf{x}_c \in \Gamma} \left\| \mathbf{x} - \mathbf{x}_c \right\| = -d\left(\mathbf{x}, \mathbf{x}_i\right) & \text{otherwise} \end{cases} \tag{15}$$

$$\chi(\mathbf{x},0) = \min_{\mathbf{x}_c^i \in \Omega_c^i} \left\{ \left\| \mathbf{x} - \mathbf{x}_c^i \right\| - \mathrm{r}_c^i \right\} \qquad \text{where, } i = 1, 2, ..., n_c \tag{16}$$

where, d is the absolute distance, $\mathbf{x}_i$ is the point on crack closest to a point x with any point $\mathbf{x}_c$ on the crack surface Γ_c. r_c^i is the radius of the *i*th hole.

2.4 Evaluation of Stress Intensity Factors (SIFs)

For general mixed-mode problems in two dimensions, SIFs and J-integral can be stated as,

$$J = \frac{K_I^2}{E^*} + \frac{K_{II}^2}{E^*} \tag{17}$$

where, $E^* = \begin{cases} E & \text{for plane stress} \\ \dfrac{E}{1-\nu^2} & \text{for plane strain} \end{cases}$ (18)

The J -integral also follows the path-independence and it is explained

$$J = \int_{\Gamma} \left(W n_j - \mathbf{t}_i \cdot \frac{\partial \mathbf{u}_i}{\partial x} \right) d\Gamma \tag{19}$$

where, W is the strain energy density. For the plate of the elastic material, it can explain that $W = (1/2)\boldsymbol{\sigma}_{ij}\boldsymbol{\varepsilon}_{ij}$.

Now, two equilibrium, independent states of a cracked body are considered. Consider the state1, $\left(\boldsymbol{\sigma}_{ij}^{(1)},\boldsymbol{\varepsilon}_{ij}^{(1)},\mathbf{u}_{j}^{(1)}\right)$, corresponds to the present or actual state and state 2, $\left(\boldsymbol{\sigma}_{ij}^{(2)},\boldsymbol{\varepsilon}_{ij}^{(2)},\mathbf{u}_{j}^{(2)}\right)$, is an auxiliary state. Further, $\boldsymbol{\sigma}_{ij}^{(2)}$, $\boldsymbol{\varepsilon}_{ij}^{(2)}$ and $\mathbf{u}_{j}^{(2)}$ are the auxiliary stress field, auxiliary strain filed and auxiliary displacement field, respectively. Thus, superposition of these two states brings another equilibrium state, say, $\left(\boldsymbol{\sigma}_{ij},\boldsymbol{\varepsilon}_{ij},\mathbf{u}_{j}\right)$. Now, we have:

$$\boldsymbol{\sigma}_{ij}=\boldsymbol{\sigma}_{ij}^{(1)}+\boldsymbol{\sigma}_{ij}^{(2)}\quad \boldsymbol{\varepsilon}_{ij}=\boldsymbol{\varepsilon}_{ij}^{(1)}+\boldsymbol{\varepsilon}_{ij}^{(2)}\qquad \mathbf{u}_{j}=\mathbf{u}_{j}^{(1)}+\mathbf{u}_{j}^{(2)} \tag{20}$$

The strain energy densities are:

$$W=W^{(1)}+W^{(2)}\quad W^{(1)}=\frac{1}{2}\boldsymbol{\sigma}_{ij}^{(1)}\boldsymbol{\varepsilon}_{ij}^{(1)}\qquad W^{(2)}=\frac{1}{2}\boldsymbol{\sigma}_{ij}^{(2)}\boldsymbol{\varepsilon}_{ij}^{(2)} \tag{21}$$

$$W=\frac{1}{2}\boldsymbol{\sigma}_{ij}\boldsymbol{\varepsilon}_{ij}=\frac{1}{2}\left(\boldsymbol{\sigma}_{ij}^{(1)}+\boldsymbol{\sigma}_{ij}^{(2)}\right)\left(\boldsymbol{\varepsilon}_{ij}^{(1)}+\boldsymbol{\varepsilon}_{ij}^{(2)}\right)=\frac{1}{2}\left(W^{(1)}+W^{(2)}\right)-\boldsymbol{\sigma}_{ij}^{(1)}\boldsymbol{\varepsilon}_{ij}^{(2)} \tag{22}$$

2.5 Stress intensity factor (SIF)

The Mode-I and Mode-II SIFs are formulated as,

$$K_{I}=K_{I}^{(1)}+K_{I}^{(2)}\quad K_{II}=K_{II}^{(1)}+K_{II}^{(2)} \tag{23}$$

The Mode-I and Mode-II SIFs for the actual state can be obtained by choosing the auxiliary state (state 2), e.g., if auxiliary state 2 is chosen to be state for Mode-I, then the auxiliary state is Mode-I near tip displacement and stress field, then by putting $K_{I}^{(2)}=1$ and $K_{II}^{(2)}=0$ in the equation (23), we have:

$$K_{I}^{(1)}=\frac{M^{(1,\text{Mode I})}E^{*}}{2} \tag{24}$$

Similarly, if auxiliary state 2 is chosen to be state for Mode-II, then the auxiliary state is Mode-II near tip displacement and stress field, then by putting $K_{I}^{(2)}=0$ and $K_{II}^{(2)}=1$ in equation (23), we have:

$$K_{II}^{(1)}=\frac{M^{(1,\text{Mode II})}E^{*}}{2} \tag{25}$$

where, $M^{(1,\text{Mode I})}$ and $M^{(1,\text{Mode II})}$ are interaction integrals.

3. Results and discussion

By incorporating the individual and combined randomness in the normalised crack length $\left(e_1 = a/W\right)$, crack angle $\left(e_2 = \alpha\right)$, and normalised radius of the hole $\left(e_3 = R/W\right)$ in an isotropic plate with a hole emanating cracks using SOPT, the stochastic fracture response through the normalised MMSIFs is calculated. Some results are validated with MCS. The input random variables are indicated by the parameter { e_i (*i*=1, 2 and 3). Furthermore, it is assumed that the input COV for individual and combined randomness in all the parameters is 15% or 0.15 variation of characteristics from their mean values in order to forecast the stochastic MMSIFs of the plate under tensile, shear, and combination (tensile and shear) loadings. The percentage of the input random parameters has been randomly adopted because in perturbation technique, for input COVs < 0.2 or 20 %, the solution can be obtained up to the acceptable accuracy (Stefanou [20]). The normalized MMSIFs in terms of K_I and K_{II} are expressed as:

For Tensile loading

$$K_I = K_{I,\text{mean}} / \left(\sigma\sqrt{\pi a}\right) \text{ and } K_{II} = K_{II,\text{mean}} / \left(\sigma\sqrt{\pi a}\right) \tag{26}$$

For Shear loading

$$K_I = K_{I,\text{mean}} / \left(\tau\sqrt{\pi a}\right) \text{ and } K_{II} = K_{II,\text{mean}} / \left(\tau\sqrt{\pi a}\right) \tag{27}$$

where K_I , K_{II} , $K_{I,\text{mean}}$, $K_{II,\text{mean}}$, σ , τ and λ are normalized Mode-I and Mode-II SIFs, numerical Mode-I and Mode-II SIFs, tensile, shear and combined stresses, respectively and where, $\lambda = \sigma = \tau$.

3.1 Convergence and validation study

The results of Grasa et al. [21] using a first-order perturbation technique (FOPT) on the basis of analytical and XFEM solution for an isotropic edge cracked plate subjected to tensile loading are available and are compared with the mean value of Mode-I SIF using the current perturbation-based SOPT combined with XFEM, and they are in good agreement as shown in Table 1.

Table 1 Validation of SIFs of an isotropic edge cracked plate subjected to tensile loading

Analytical Solution [21]	XFEM with FOPT [21]	% Error	XFEM with SOPT	% Error	XFEM with MCS	% Error
99.8182	98.951	0.87	100.4834	0.67	100.1276	0.31

Rarely are the SOPT findings for the stochastic fracture analysis of the investigated model under various stress situations available in the literature. To validate the current stochastic fracture analysis for a/W= 0.4 with $\alpha = 30^0$, as indicated in Table 2, the current mean and corresponding COV $\{e_i(i=1, 2 \text{ and } 3) = 0.15\}$ of MMSIFs K_I and K_{II} acquired by SOPT are compared with those obtained by MCS.

Table 2 Behaviour of the analyzed model under different loading conditions for normalized crack length (a/W= 0.4) with crack angles ($\alpha = 30^\circ$) through individual randomness in a/W by MCS with different numbers of samples

Total no. of samples	Tensile loading				Shear loading			
	K_I		K_{II}		K_I		K_{II}	
	Mean	COV	Mean	COV	Mean	COV	Mean	COV
9000	0.809	0.121	0.354	0.223	2.527	0.059	1.296	0.125
9500	0.822	0.084	0.342	0.197	2.536	0.051	1.193	0.097
10000	0.828	0.056	0.334	0.167	2.540	0.047	1.128	0.081
10500	0.828	0.056	0.334	0.167	2.540	0.047	1.128	0.081
11000	0.828	0.056	0.334	0.167	2.540	0.047	1.128	0.081

The results obtained by both SOPT and MCS are in very good agreement. In the direct MCS method, the different sets of random samples of random system properties are generated first by direct use of the computer by using Gaussian random number generation. These sets of random samples are substituted in the response equation of MMSIFs and again generated the random samples of MMSIFs. The mean of these random samples gives the mean value of MMSIFs, while the variance of random samples gives the variance of MMSIFs. The optimum numbers of samples are decided on the basis of convergence of mean results. In the present analysis, 10,000 samples are used for satisfactory convergence of the results. Therefore, the 10,000 random samples are used for further computation of results using MCS. In the present study, MCS is used only for validation purpose due to higher consumption of computational time, particularly for fracture problem with very high mesh density.

Fig. 2(a) and 2(b) show the line diagram of an isotropic rectangular plate with the analyzed model with dimensions of length $(2L)$, width $(2W)$, crack length $(2a)$, and hole radius (R) and a central cracked plate without hole with required above-mentioned dimensions, under shear (τ) stress.

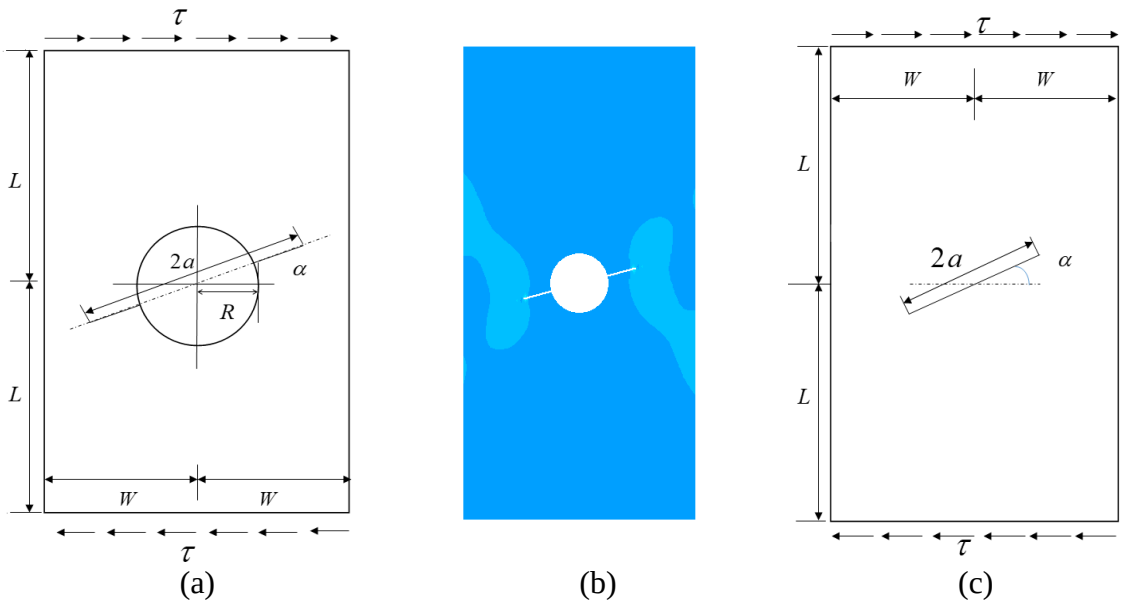
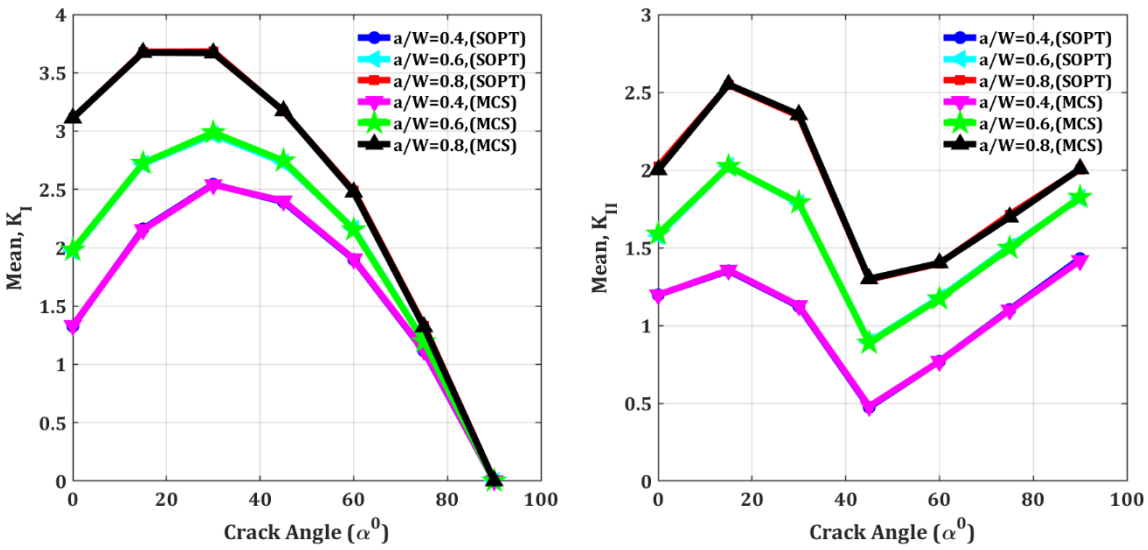


Fig. 2 (a) A line diagram and (b) the stress contour (general) of a plate with radial cracks on a hole and (c) a line diagram of central crack under shear loading

The behaviour of mean values of normalized MMSIFs of the analyzed model under uniform shear loading w.r.t. different crack angles is presented in Fig. 3(a) and 3(b). It is again clear that the SOPT results are in good agreement with those of MCS.

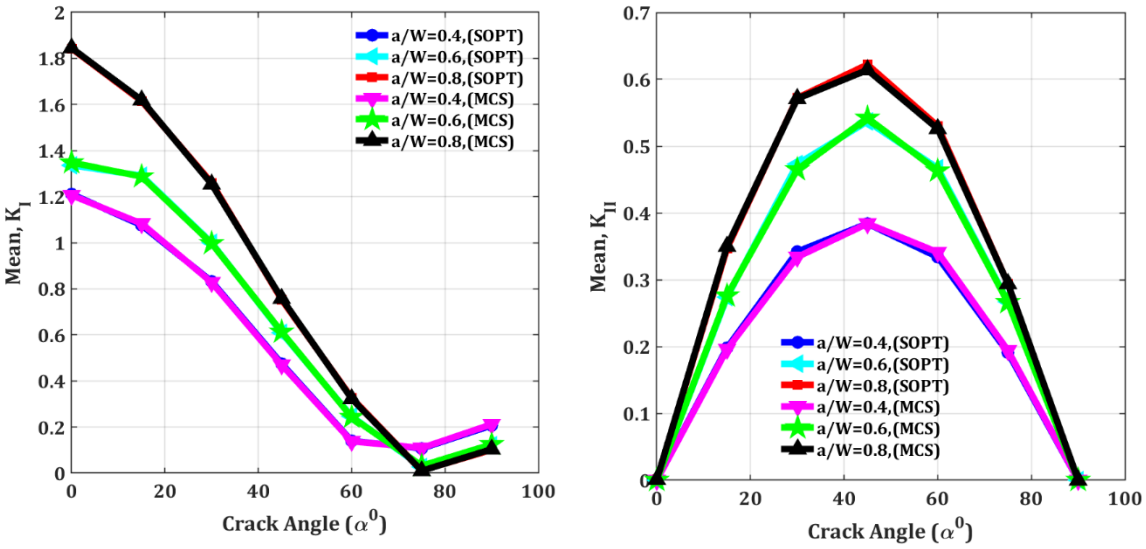


(a) (b)

Fig. 3 The mean values of normalized MMSIFs (a) K_I and (b) K_{II} of a plate under shear loading with individual randomness in e_1, e_2 and e_3

It can be seen that the mean values of K_I are largest at a crack angle α = 30°, and due to the increment in *a/W*, the mean values of K_I starts to dominate at α= 15°. As the crack angle (α) increases from 0° to 30°, the mean values of K_I are increased. Then, these values are continuously decreased to zero at 90° crack angle. Now, the mean values of normalized Mode-II SIFs K_{II} of the analyzed model are maximum at 15° crack angle and are minimum at 45° crack angle. At α = 0° and 90°, the mean values of K_{II} are nearly equal as the normalized crack length increases (*a/W*= 0.8). From crack angle 45° to 90°, the mean values of K_I and K_{II} continuously decrease and increase, respectively.

Fig. 4(a) and 4(b) show the behaviour of the mean values of normalized MMSIFs K_I and K_{II} of the analyzed model under uniform tensile loading with individual randomness { e_i (*i*=1, 2 and 3)} with respect to different crack angles using SOPT and MCS.



(a) (b)

Fig. 4 The mean values of normalized MMSIFs (a) K_I and (b) K_{II} of plate under tensile loading with individual or combined randomness in e_1, e_2 and e_3

It is clear that the SOPT results are in good agreement with those obtained using MCS. It can be seen that the mean values of normalized Mode-I SIFs K_I of the analyzed model are the largest at a crack angle α = 0°, and the SIFs K_I are decreased with increment in the crack angle till 75°. At 90° crack angle, the SIFs K_I for the shorter crack lengths *a/W* are further increased and it is so because the compressive stresses dominant and so the tips of longer crack will get less influence of the buckling, as compared to the shorter ones and the results is the higher SIFs in shorter cracks and the lower SIFs for longer cracks. The mean values of normalized Mode-II SIFs K_{II} of the analyzed model are largest at a crack angle α = 45° and are minimum (zero) at α = 0° and 90°. For the crack angles α and (90◦ -α), the mean values of K_{II} are almost equal if the normalized crack length (a/W = 0.4 and 0.6) is shorter. For the longer cracks (a/W = 0.8), the mean values of K_{II} are not the same.

Fig. 5(a) and 5(b) show the line diagram of the analyzed model with dimensions of length $(2L)$, width $(2W)$, crack length $(2a)$, and hole radius (R) and a central cracked plate without hole with required above-mentioned dimensions, under combined tensile (σ) and shear (τ) stresses.

The behaviour of the mean values of normalized MMSIFs K_I and K_{II} of the analyzed model w.r.t. different crack angles using SOPT is predicted and compared with the deterministic values of normalized MMSIFs K_I and K_{II} of the plate with a central crack without any hole with the same geometrical properties subjected to combined loading, as shown in Fig. 6(a) and 6(b).

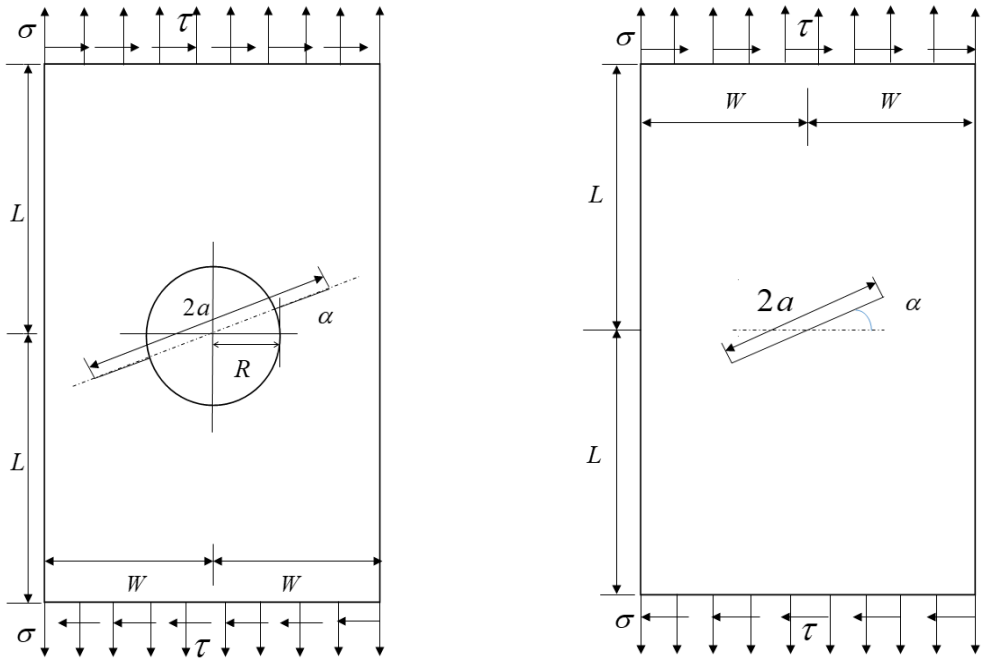


Fig. 5 Line diagrams of the plates with (a) hole emanating radial cracks and (b) a central crack subjected to combined loadings

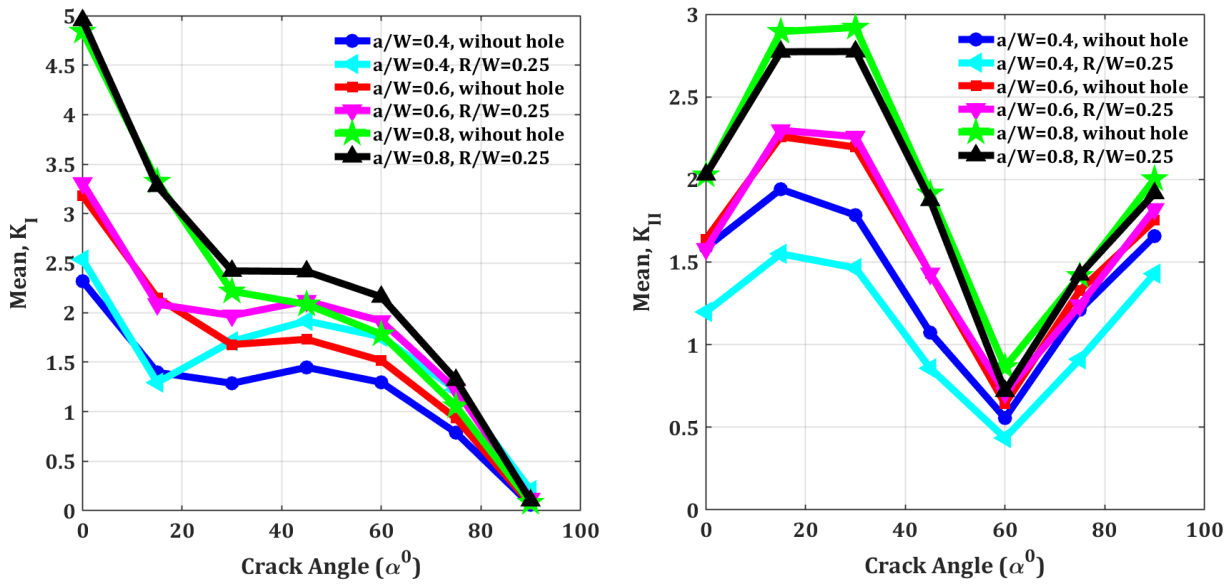
It can be seen that the mean values of normalized Mode-I SIFs K_I are highest at crack angle α = 0°. Also, as the crack angle (α) is increased, the mean values of K_I are decreased from 0° to 90° crack angle. At 90° crack angle, the mean values of K_I are zero. For the crack angle 15°, the mean values of K_I are increased for shorter crack length (a/W = 0.4) because due to combined loading the stress concentration on the periphery of the hole, from where the cracks are emanating, will be maximum and the stress concentration zone will be upper and lower parts of the sides of the hole and crack. As the crack makes an angle of 30°, the tip of the crack will be much nearer to the stress concentration zone and more stresses will be on a crack tip, therefore, the mean values of K_I are continuously increased till angle 45° and remain

critical. After 45° angle, the crack tips gradually leave the stress concentration zone till angle 90°. But, for longer crack, the crack tip remains somewhat away from the periphery of the hole. That is why the stress concentration zone becomes unable to produce much effect on the crack tip. If the length of the emanating cracks is very large, then the hole becomes the part of crack only.

The mean values of normalized Mode-II SIFs K_{II} are highest at a crack angle α = 15° but as a/W increases, the values of K_{II} start to dominate at α = 30°. From crack angles 30° to 60° and 60° to 90°, the mean values of K_{II} decreased and increased, respectively. Now, the mean values of normalized Mode-II SIFs K_{II} of an isotropic plate with a hole emanating radial cracks are the largest at 15° crack angle and are minimum at 60° crack angle.

At 90° crack angle, the mean value of K_I is zero because here, the effect of K_I is completely ineffective under the shear and combined loading. The mean values of normalized MMSIFs K_I and K_{II} of an isotropic plate with a hole emanating radial cracks subjected to combined and shear loadings are much higher as compared to those are under tensile loading. So, it can be concluded that the combined loading is much critical as compared to tensile and shear loading for the present problem.

Under all types of loading conditions, the gaps between the graphs, for the mean values of normalized MMSIFs K_I and K_{II} and the deterministic values of MMSIFs $K_{I,\text{det}}$ and $K_{II,\text{det}}$, are decreased as (a/W) is increased. It is so because the smaller crack with the hole has the influence on stress concentration as well as it works as a small edge crack on the periphery of the hole, whereas for the larger crack, the hole works as a part of the crack only or the role of the hole is just like a crack. Also, the mean values of normalized MMSIFs K_I and K_{II} are increased with increment in a/W.



(a) (b)

Fig. 6 Comparison of the behavior of the mean and deterministic values of normalized MMSIFs (a) K_I and (b) K_{II} of the plate with a hole and without hole with central cracks of different lengths subjected to combined loading

At the crack angles α = 0° and 90°, the mean values of K_{II} for a plate emanating radial cracks are nearly equal to the deterministic values of $K_{II,\det}$ for the cracked plate without hole with the increment in normalized crack length (a/W = 0.8). At 60° crack angle, the mean values of K_{II} are nearly equal to the deterministic values of normalized Mode-II SIFs $K_{II,\det}$ of an isotropic cracked plate without a hole.

4. Conclusions

The fracture behaviour of the plate with discontinuities subjected to shear and combined loading conditions are much more critical as compared to tensile loading. Hence, proper control of these types of loading will increase the reliability of structures. The input random variables such as normalized crack length, crack angle, and normalized radius of the hole show much influence on the stochastic fracture behavior of the plate with discontinuities. So, the reliability and safety in a structure can be enhanced by controlling the input random variables properly.

Under tensile loadings, the plate is the least critical and sensitive when the geometry (hole emanating cracks) at the centre position and is the most critical and sensitive when the geometry is either side of the central part of the plate. Under shear and combined loadings, the plate is the least critical and sensitive when the geometry is below the central part of the plate and is the most critical and sensitive when the geometry is above the central part of the plate.

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Generalization of Vedic Mathematics Method for Nth Degree Polynomial Factorization: Using Sutras Paravartya Yojayet, Vilokanam and Ganita Samuccaya: Samuccaya Gunita

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Abstract: In this paper, we have presented a new approach to factorization of apolynomial,with the help of Vedic mathematics and modern mathematics concepts. This method is based on the Vedic mathematics sutras Vilokanam, Gunita Sumaccaya: Samuccaya Gunita, and Paravartya Yojayet given by Swami Bharti Krishna Maharaj. It is an easier and more useful method for studentsto easily factorize this type of polynomial with mental calculation.

Keywords: Modern Mathematics, Fundamental Theorem of Algebra, Vedic Mathematics, Vilokanam, Gunita Samuccaya: Samuccaya Gunita, Paravartya Yojayet, polynomial.

Introduction:
Vedic mathematics is an ancient Indian system of mathematical calculations or operation techniques that was developed in 1957. It consists of 16 sutras (formulae) and 13 sub-sutras (Sub Formulae) that can be utilized to solve problems in arithmetic, algebra, geometry, calculus, and conics. [1]. Various methods have been developed for the factorization of polynomials. In the Vedic method by Jagadguru Shankaracharya Shri Bharati Krishna Thirtha Swamiji, He introduced the method of factoring cubic polynomials [1]. In this study, we use the same concept for factorization of the nth type of polynomial equation with the help of modern mathematics.

The introduction of a method for factorizing nth-degree polynomials, which can be expressed as $x^n + a_1x^{n-1} + a_2x^{n-2} + \cdots + a_k$, (where x is variable of polynomial, n is degree of polynomial and$a_1, a_2, \ldots, a_k$ are constant terms of polynomial)

Type (1): When thepolynomial doesnot have a factor $(x-1)$**and**$(x+1)$**.**

Step (1)
If the Sum of the coefficients of this polynomials$s_c = 0$.Then one factor of the polynomial is $(x-1)$ and if the sum of the coefficient of odd power of the polynomialss_0 = sum of the coefficient of even power of the polynomial s_e. Then one factor is $(x+1)$. If both conditions are not satisfied. Then the given polynomial does not have $(x+1)$ and $(x-1)$ factors.

Step (2)
The polynomial equation is of the nth degree. So, By the Fundamental Theorem of Algebra, every polynomial equation of n degree has n roots. Here, the polynomial is nth degree, so it has nth roots called, them $a_1 a_2 a_3, \dots, and\ a_n$.

Hence
$A = a_1 + a_2 + a_3 + \cdots + a_n$ = Sum of roots = coefficient of x^n …Condition (1)
$B = a_1 a_2 a_3, \dots, a_n$ = Product of four roots = last term .... Condition (2)

Step (3)
Write down all possible factors of the last term of the given polynomial without 1. As in Step (1) we said that$(x+1)$ and$(x-1)$ are not factors of the given polynomial.
(Note that here we take the last term as only a positive number and write all the positive factors of the last term)

Step (4)
Apply Vilokanam Sutras (mere observation) for condition $B = a_1 a_2 a_3, \dots, a_n$. (Assume B as a positive number)
Observe Step 3 and make possible groups of the nth term that satisfy the condition. And write down all the possible groups.

Step (5)
1) If only one group satisfies Step (4), then that group factor is the factor of the given polynomial.
2) If more than one group of factors satisfies Step (4), Then use (+ or – sing) with factor check condition number (1).
3) From those groups, if one group satisfies the condition (1), Then that group factor with their sign is a factor of the given polynomial.
4) If more than one group also satisfies the condition (1) with their sign. Then check those groups with their (+ or -) sign condition (2). When checking the condition, if only one group satisfies the condition. Then this group, with their sign all factors are factors of the given polynomial.

If more than one group satisfies condition (2) then try Step (6).

Step (6)
Here by Gunita Samucaaya: Samucaaya gunita, we can verify that the factors are right or wrong and check by these Steps which factors groups are factors of the given polynomial.
By checking the Sum of the coefficients in the product of the polynomial =Product of the sum of the coefficients of factors.

Example: Factories$x^3 - 8x^2 - 5x + 84$

Step (1)
The sum of the coefficient $s_c = 1 - 8 - 5 + 84 = 72$, $s_c \neq 0$.

So $(x-1)$ is not a factor of the given polynomial.
Also, the sum of the coefficient of odd power $s_0 = 1 - 5 = -4$.
The sum of thecoefficient of even power $s_0 = -8 + 84 = 76$.
The sum of the coefficient of odd power $s_0 \neq$sum of the coefficient of even power s_e.
Therefore $(x+1)$ is not a factor of the given polynomial.

Step (2)
The polynomial is three degrees. So, it has three roots called $k_1, k_2 \; and \; k_3$.

Hence
$A = k_1 + k_2 + k_3$ =Sum of roots = coefficient of $x^2 = -8$… (1)
$B = k_1 k_2 k_3$ = Product of four roots = 84.... (2)

Step (3)
For the given polynomial, the last term is 84 (we take the last term as positive). So, factories 84 without 1.

$$2\,,3\,,4\,,6\,,7\,,12\,,14 \; and \; 21.$$

Step (4)
From these factors, there are possible groups that satisfy the condition $B = k_1 k_2 k_3$.
Group 1: $(2 \times 2 \times 21) = 84$
Group 2: $(2 \times 3 \times 14) = 84$
Group 3: $(3 \times 4 \times 7) = 84$
Group 4: $(2 \times 6 \times 7) = 84$
So here four groups satisfy this step.

Step (5)
Check condition (1)
Here only satisfies cases $(3, -4, -7)$Satisfies Step 2 conditions (1)

$$A = k_1 + k_2 + k_3 = 3 - 4 - 7 = -8$$

Check this case for Step 2 condition (2)

$$B = (3)(-4)(-7) = 84$$

Here in this case$(3, -4, -7)$Both conditions satisfy so the factors of the given polynomial are $(x+3, x-4, x-7)$

Step (6)
Here, The sum of the coefficient product of the polynomial= 72
Product of the sum of the coefficients of factor$(1+3)(1-4)(1-7) = 72$.
Here the sum of the coefficient of product= product of the sum of the coefficient of factors.
Hence result verified by Gunita Samuccaya: Samuccaya Gunita.
$\therefore x^3 - 8x^2 - 5x + 84 = (x+3), (x-4), (x-7)$.

Example: Factories$x^4 + 6x^3 - 25x^2 - 222x - 360$

Step (1)
Here, $s_c = -600 \neq 0$ and$s_0 = -216$, $s_e = -384$, and $s_0 \neq s_e$.
Therefore, $(x-1)$ and $(x+1)$ are no factors in the given polynomial.

Step (2)
This polynomial is of the fourth degree. So, it has four roots called them $p_1 p_2 p_3 \; and \; p_4$

Hence
$A = p_1 + p_2 + p_3 + p_4$ =Sum of roots = coefficient of $x^3 = 6$... (1)
$B = p_1p_2p_3p_4$ = Product of four roots = -360... (2)

Step (3)
For the given polynomial, the last term is 360 (we take the last term as positive). So, factories 360 without 1
I.e. (2, 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 20, 24, 30, 36, 40, 45, 60, 72, 90, 120,180, 360).

Step (4)
From these factors, possible groups that satisfy the condition $B = p_1p_2p_3p_4$

$(45 \times 2 \times 2 \times 2) = 360$, $(30 \times 3 \times 2 \times 4) = 360$, $(20 \times 3 \times 3 \times 2) = 360$

$(18 \times 5 \times 2 \times 2) = 360$, $(15 \times 6 \times 2 \times 2) = 360$,$(15 \times 4 \times 3 \times 2) = 360$

$(12 \times 5 \times 3 \times 2) = 360$, $(10 \times 9 \times 2 \times 2) = 360$,$(10 \times 6 \times 3 \times 2) = 360$

$(9 \times 5 \times 4 \times 2) = 360$, $(8 \times 5 \times 3 \times 3) = 360$,$(6 \times 6 \times 5 \times 2) = 360$

$(6 \times 5 \times 4 \times 3) = 360$.

Step (5)
Check condition (1)
Case (1)

$$A = p_1 + p_2 + p_3 + p_4 = 6$$
$$= 15 - 4 - 3 - 2 = 6$$

Therefore, case 1 four-factor group is $(15, -4, -3, -2)$

Case (2)

$$A = p_1 + p_2 + p_3 + p_4 = 6$$
$$= 12 - 5 - 3 + 2 = 6$$

Therefore, case 2 four-factor group is $(12, -5, -3, 2)$

Case (3)

$$A = p_1 + p_2 + p_3 + p_4 = 6$$
$$= 9 - 5 + 4 - 2 = 6$$

So, case 3 the factor group is $(9, -5, 4, -2)$

Case (4)

$$A = p_1 + p_2 + p_3 + p_4 = 6$$
$$= -6 + 5 + 4 + 3 = 6$$

Therefore, case 4 the factor group is $(-6, 5, 4, 3)$

In these four cases, all four factors satisfy these conditions
Therefore, we check all four groups from which case satisfies condition (2)

Here cases (1) and case (4) satisfy condition (2)
Case (1)

$$B = (15 \times -4 \times -3 \times -2) = -360$$

Case (4)

$$B = (-6 \times +5 + 4 \times +3) = -360$$

Therefore, four factors of a given polynomial are $(x + 15), (x - 4), (x - 3), (x - 2)$

otherwise, four factors of the given polynomialare$(x-6),(x+5),(x+4),(x+3)$.

Step (6)
So here, by using sutra Gunita Samuccaya:Samuccaya Gunita.
We can check the Sum of the coefficients in the product of polynomials =Product of the sum of the coefficients of factors.

The sum of the coefficient product of the given polynomial is $=-600$

Here first we Check the condition for factors$(x+15),(x-4),(x-3),(x-2)$
Product of the sum of the coefficients of factors.

$$=(1+15)(1-4)(1-3)(1-2)=(16)(-3)(-2)(-1)=-96$$

So here factor groups $(x+15),(x-4),(x-3),(x-2)$is is not a factor of the given polynomial

For factors, $(x-6),(x+5),(x+4),(x+3)$
The Product of the sum of the coefficients of factors

$$=(1-6)(1+5)(1+4)(1+3)=(-5)(6)(5)(4)=-600$$

Here, this all-factor group satisfies Step 6 conditions.
The sum of the coefficients of the product = product of the sum of the coefficients of the factors.

$$\therefore x^4+6x^3-25x^2-222x-360=(x-6)(x+5)(x+4)(x+3)$$

Type (2): When the polynomial has $(x-1)$either$(x+1)$factors,otherwise if both $(x-1)$and $(x+1)$are factors of the given polynomial.

1) If the polynomial satisfies the Step 1 condition in the Type (1) Method.Then the polynomial is divided by$(x-1)$If $s_c=0$, otherwise if $s_0=s_e$Then divided by$(x+1)$.Otherwise if both Step 1 conditions are satisfied then the polynomial is divided by both $(x-1)$ *and* $(x+1)$Using paravartyayojayet. After dividing among factors by polynomial then the remaining Quotient is the new polynomial.

2) By using the new polynomial, we can find the Remaining factor of the polynomial by using the above Type-1 method.

Example: Factories $x^5+3\cdot x^4-113x^3-447\cdot x^2-104\cdot x+660$

Step (1)
Here $s_c=0$ and$s_0\neq s_e$.
Therefore, $(x-1)$ is one factor of the given polynomial.

By using Paravartya sutras, divide the polynomial by $(x-1)$

$x-1$	1	$+3$	-113	-447	-104	$:+660$
$MD\ 1$				1 4 -109 -556 $:-556$		
	1	$+4$	-109	-556	-660	$:\ 0$

New Polynomial (Quotient)= $x^4+4x^3-109x^2-556x-660$

(Note: here we will use Type (1) method on the new polynomial to get the remaining factors of the given polynomial)

Step (1)
Here $s_c \neq 0$ and$s_0 \neq s_e$.
Therefore $(x-1)$ and $(x+1)$ are not factored into the given new polynomial.

Step (2)
The new polynomial is of the fourth degree. So, it has four roots called them $n_1, n_2, n_3 and\ n_4$

Hence
$A = n_1+n_2+n_3+n_4 = 4 \ldots (2)$
$B = n_1n_2n_3n_4 = -660 \ldots (3)$

Step (3)
Here are factors of 660 (without 1)

$2, 3, 4, 5, 6, 10, 11, 12, 15, 20, 22, 30, 33, 44, 55, 60, 66, 110, 132, 165, 220, 330\ and\ 660.$

Step (4)
From these factors, there are possible groups that satisfy the condition. $B = n_1n_2n_3n_4$

$(55\times3\times2\times2)=660,\ (33\times5\times2\times2)=660, (22\times5\times3\times2)=660$
$(15\times11\times2\times2)=660, (11\times10\times3\times2)=660, (11\times5\times6\times2)=660$
$(11\times5\times4\times3)=660$,
So here, seven groups satisfy this condition.

Step (5)
Check condition (1)

Case (1)

$$A = 15-11+2-2=4$$

Therefore, case 1 four-factor group is $(15, -11, 2, -2)$

Case (2)

$$A = -11 + +10 + 3 + 2 = 4$$

Therefore, case 2 four-factor group is $(-11, 10, 3, 2)$

In these two cases, all four factors satisfy these conditions.

Therefore, we check all four groups to see which case satisfies condition (2).

Here only case (2) satisfies condition (2)

Case (2)

$$B = (-11 \times 10 \times 3 \times 2) = 660$$

Therefore, factors of the given new polynomial are $(x - 11,\ x + 10,\ x + 3,\ x + 2)$

So, all factors of the given main polynomial

$x^5 + 3 \cdot x^4 - 113x^3 - 447 \cdot x^2 - 104 \cdot x + 660$is $(x - 11, x + 10, x + 3,\ x + 2, x - 1)$

Step (6)

Here, byGunita Samuccaya:Samuccaya Gunita verify.

The sum of the coefficient product of the main polynomial = 0

Product of the sum of the coefficients of factors

$$(x - 11)(x + 10)(x + 3)(x + 2)(x - 1) = 0.$$

The sum of the coefficients of the product of the sum of the coefficient of factors.

Hence, result verified by Gunita Samuccaya: Samuccaya Gunita.

Conclusion:

On the basis of the above discussion, we may conclude that the Vedic mathematics method of factorization of polynomials is a mental calculation technique that requires few algebraic procedures, making it faster than the standard method. In this study, we apply the method to cubic, four-degree, and five-degree polynomials. Using these methods, we can also find the nth degree polynomial equation. This method can factorize only a particular polynomial,which can be expressed as $x^n + a_1x^{n-1} + a_2x^{n-2} + \cdots + a_k$.

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Review paper

Recent progress on gold nanoparticle biosensors monitored water quality: Insights on diversified contaminants and functionalization paradigms

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ABSTRACT

Over the past few years, water quality monitoring has swiftly emerged as a thrust area for most of the developing nations. Despite its renewable essence, incessant industrialization and urbanization have depleted the natural water resources, culminating in adverse impact on potable water quality. As a consequence, reliable technologies with utmost sensitivity and accurate predictions *vis-à-vis* authentic qualitative standards are urgently needed. Herein, interest in using gold nanoparticles (Au NPs) biosensors to gauge the qualitative profile of water resources has been quite significant. Major fascinations for Au NPs biosensing driven water quality monitoring are steadfast preparation methodologies, well-understood mechanisms for size-shape modulation and inert sensitivity manifested remarkable functionalization abilities. The size-shape modulated functionalization advances for Au NPs are the dynamic outcomes of their quantum effects, anchored *via* single or multidimensional quantum confinements (QCs). Morphologies as vibrant as rod, spherical, cylindrical, shells and combinatorial regime have been the backbone aspects of Au NPs based biosensors. With such insights, the present article focuses on last decade noted advances aimed at Au NPs biosensors assessed water quality. The studies discussed herewith were retrieved from Pubmed using the keywords, "Gold Nanoparticle Biosensors for Water Quality Monitoring". The knowledge shared herein could consolidate the fabrication of future Au nanomaterials based sensing technologies *vis-à-vis* functionalization mechanisms, cost considerations, precision aspects, integrated possibilities and long-term cautions.

1. Introduction

Deteriorating potable water quality has been an emerging global concern, manifested *via* unchecked human, industrial and agricultural exploitations. Pollutants from diversified sources (industrial and agricultural) contaminate the water bodies, rendering them unsafe for human consumption. Layman understanding of a contaminant *vis-à-vis* qualitative screening of any water resource implies any material prevailing at a more than optimum extent. Broadly, water contaminants can be chemical and biological, the former comprising insecticides, pesticides, aromatic compounds, heavy metals (HMs) *etc.*, the usual discards of industrial, agricultural and human activities. The mounting risk of all these contaminants relates to their persisting tendency with a non-biodegradable essence. Notable of these entities in the biological domain include humans, animals and microbial (fungal, bacterial and algal) excreta [1–3]. Emerging concern for declining water quality is well-inferred from the World Health Organization (WHO) recognition of "Safely Managed Drinking Water Services" as a global aim. Statistics report staggering 76 million annual cases of waterborne illness from United States [4]. Similarly, in Bangladesh, one of every five food poisoning deaths attributes to poor water quality [5]. Thereby, accurate, precise and reproducible detection of pollutants is the major step towards reclaiming freshwater resources for minimizing environmental and health damage [6,7]. Declining water quality on the global front is

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aptly inferred by a mere 2.5% contribution of freshwater despite 70% of earth's surface being covered with water. More timid concerns include ~70% industrial wastes being dumped into water each year with 80% water pollution caused by domestic sewage. Estimates predict a staggering 6 billion pounds of garbage (majorly plastic) in oceans each year, with >4 lakh diarrhoea deaths due to polluted drinking water consumption. Shockingly, 368 million people use unsafe water globally with 80% land contributed wastes. The International Organization for Standardization (ISO) demarcates qualitative profile of water samples into I to III types, with type I being recognized as ultrapure (>18 MΩ-cm resistivity, $\sigma < 0.056$ μS•cm^{-1}, < 50 ppb total organic carbons).Corresponding nomenclature for drinking water are ISO24510 and ISO24511 while for wastewater is ISO24512. In India, decline in polluted rivers extent from 70% in 2015 (275 out of 390) to 46% in 2022 (279 out of 603) reflects awareness for conservation of water resources. However, increasing population, casualty for industrial effluent disposal has rendered 38.2% freshwater resources as polluted. As per 2018 Composite Water Management Index report, India ranks 120th amongst 122 countries on water quality index, with ~80.6% water being contaminated. Consensus for human consumption suited water deems (1–2) ppm as biological oxygen demand (BOD), (6.5–8) as optimum pH, (150–250) as total dissolved solids (TDS) as ideal. The physicochemical properties (PCPs) are more reliable than external energy driven UV spectroscopy, High Performance Liquid Chromatography (HPLC), Gas Chromatography (GC) [8,9]. A reliable aspect of PCPs is their temperature sensitivity as authentic qualitative indicators. For instance, recognition of *E. coli* strains (spreading fatal diseases) *via* incubation elapses 18–72 h to fetch reproducible results which could be done in (1–2) h using temperature specific density, ρ surface tension, γ and viscosity, η measurements [10].

Recent thrust into gold nanoparticles (Au NPs) with their high native stability and shape-size modulated quantum confinements (QCs) promises a well controlled, accurate and reproducible contaminants sensing *via* functionalized assays. A native inertness of Au (atomic number: 79, electronic configuration: [Xe] $4f^{14}$ $5d^{10}$ $6s^{1}$) entrusts Au NPs sensing advances *vis-a-vis* minimal cross-reaction risk with the corresponding analytes. Such attributes of Au NPs are the reasons for their portable, sensitive, automated and online feasible sensing configurations [11]. The efficacy of a biosensor is adjudged by probe-analyte specificity and sensitivity of transduction system intercepted analyte-probe biophysical interactions. Classification of biosensors could be made *via* screened analyte or workable detection mechanism. The detection mechanism based classifies configurations as electrochemical, calorimetric, optical and acoustic, characterized *via* differences in measurable prospects of probe-analyte combinations. A fair degree of similarity prevails in some types, such as electrochemical biosensors include both amperometric and potentiometric similar to optical fibre and surface plasmon resonance (SPR) regimen under optical regime. Incorporation of nanomaterials (NMs) simplifies the classification criteria, *via* specific NM based naming such as those using rod shaped NMs and quantum dots (QDs) being recognized as nanowire or QD based biosensors [12,13]. The rationale of amalgamating NMs in biosensors relates with their constricted energy levels driven prompt response, QC manifested alterations in optical, electronic and chemical properties. A prompt sensing of external stimulus in NMs is attributed to their high surface area (SA) manifested low E_a, whereby quick response to native energy levels is accomplished. The miniaturized dimensions of NMs make the sensing assembly robust and easy to relocate. A prominent distinction of NMs comprising sensors accounts for multifunctional probe sensitivity including temperature, pressure, optical, physical modulations due to missing quantum effects in bulk state. Analogy of this comparison could be understood *via* shrinking size of our electronic integrated circuits, whereby functionality is enhanced. Explicit benefit (s) for Au NPs relates to their distantly located 6 s sub-shell valence electron, which they can easily lose to form Au^{+} and readily couple with anionic surface sensitivity. Besides, the diversity of morphologies (rod, spherical, stars, shells and others) makes Au NPs suitable for a wide range of physical phenomenon and interacting receptiveness [13–16].

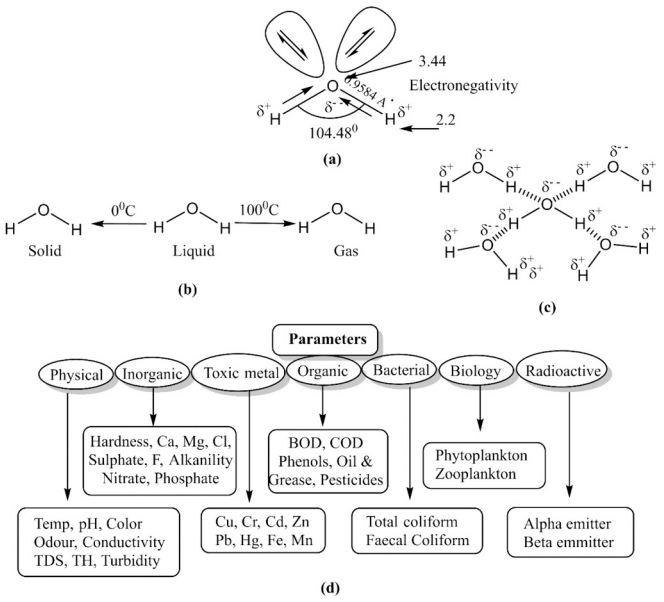

Fig. 1. Defining prospects of water, comprising its (a) Molecular structure with characteristic bond length and bond angle, (b) Temperature dependent prevalence of water in solid, liquid and gaseous states, (c) Possible inter and intra molecular hydrogen bonding attributing to a cage like networking of water molecules, (d) Native physical, chemical and biological attributes of water. With a polar nature and manifold usage, water has a unique ability of dissolving every substance to some extent, accounting for diversified contamination risks.

This article focuses on recent advances on Au NPs-biosensors monitored water quality. A high ground state stability conferred robust functionalization of Au NPs is the basis of not merely the sensing applications but also the targeted drug delivery where binding with specific cell surface receptors is needed. Readers are suggested to acquaint themselves with such distinctive abilities of Au NPs from the specific literature sources [17–19]. The unique optical traits of Au NPs, inspired by integrated oscillations of surface electrons are responsible for surface plasmon resonance (SPR). Surface plasmons (SPs) refer to the coherent electronic oscillations generated *via* electromagnetic radiations (EMR) at the metal-dielectric interface. Prominent optical sensitivities of Au NPs are explicit functions of dielectric environment and the EMR incident frequency. Herein, the SPR implication is manifested by resonance of oscillating SPs with incident EMRs, generating a characteristic stimulus at metal-dielectric interface [20,21]. The exclusive SPR frequency is decided by physical dimensions, morphology and chemical composition of NPs. For spherical regime, the resonant frequency falls within visible region of electromagnetic spectrum [22]. The high aspect ratio of Au NPs is sensitively affected by the dielectric nature of interacting vicinity (interfacial refractive index, RI) [23]. These features comprise physicochemical intricacies for analytes *via* interacting regimes substantiated surface absorption/desorption, aggregation and optical sensitivity. Analyte-detection corresponds to a binding extent proportionate SPR change of Au NPs, perceived *via* colorimetric changes [24,25]. Sensing platforms using Au NPs are optimized *via* enhanced localized electromagnetic field driven SPR changes. Such enhancements (Surface-Enhanced Raman Scattering) considerably improve the sensing sensitivity, distinctly identifying each target [26]. The robust functionalization techniques *vis-à-vis* NPs assembly on surface engineered platforms such as graphene and its derivatives encompass significant precision in electrochemical responses [27,28]. The shape-size controlled PCPs of Au NPs enable a precise detection of micro/nano-scale pollutants at parts per billion resolutions. Keeping above aspects in mind, hereby the major focus is on prospective attributes of Au NPs monitored water quality.

Table 1
Pure water standardized parameters as per WHO standards [34].

Parameter	Optimized range
pH	6.5–8.5
Turbidity (NTU)	1
Total Dissolved Solids (mg•L^{-1})	(150–250) but accepted till 500
Total hardness (as $CaCO_3$, mg•L^{-1})	200
Total alkalinity (as $CaCO_3$, mg•L^{-1})	200
Electrical conductance (μS•cm^{-1})	400

NTU: Nephelometric Turbidity Units.

Table 2
Native concentrations (mg•L^{-1}) of various ions fixed for water quality as per WHO standards [35,36]. The relative extents could ascertain the contamination extent.

Metal Ion	Ideal extents for potable water (μg•L^{-1})
Na^+	200
Ca^{2+}	100
Mg^{2+}	50
K^+	20
HCO_3^-	125–350
Cl^-	250
SO_4^{2-}	250
NO_3^-	50
Fe^{2+}	0.3
Mn^{2+}	0.1–0.5
Zn^{2+}	0.01–3
Al^{3+}	0.2
Pb^{2+}	0.01
Cu^{2+}	2
Cd^{2+}	0.003
Hg^{2+}	6 (For inorganic Hg)
Cr^{2+}	< 2
As	10
Se	40
U	30
F^-	1500

Emphasis has been paid to limit of detection (LOD) precision, selectivity, structural extensions and shape-size modulated PCPs.

2. Defining aspects of pure water and diversifications of contaminants

In its unadulterated form, water prevails as odourless, tasteless and colourless liquid with a bond angle of 104.48°, 0.9584 Å O—H bond length and an electronegativity of 3.44. Physical state of water varies with temperature, enabling a molecular distinction *via* varied intermolecular forces (Fig. 1). The intrinsic blueness of water is due to red light absorption [29]. With an ability to dissolve almost every material to a certain extent, water exhibits a highest density (1000 kg•m^{-3}) at 4 °C, prevailing in liquid state even at higher temperatures. In solid state (ice), the assembly of water molecules has one molecule as bonded to four others *via* intermolecular hydrogen bonding (HB), conferring strong cohesiveness, room temperature (RT) γ of 71.97 dynes•cm^{-1} and η as 0.8903 cP (Fig. 1b) [30–33]. Qualitative considerations on a global front distinguish the water resources as potable, palatable, contaminated and infected with surface water, oxygen depletion, nutrient, microbiological, groundwater and chemical mediated pollutions being distinguished. Screening of water quality is accomplished through physical, chemical and biological assessments Table 1 comprises the WHO recommendations for human usage compatible water traits, with acceptable TDS extents till 500. Human feasibility of water body could be adjudged by its high oxidation reduction potential (ORP), whereby plentiful oxygen implying a native cleansing ability *via* breakdown of waste products (contaminants, dead plants and animals) [34]. Table 2 comprises the regulatory guidelines recommended titre of ions in potable water, providing the basis for screening contamination [35,36]. Qualitative analysis could be accomplished *via* physical, chemical and biological assessments amongst which the physical standards (electrical conductivity, salinity, TDS, turbidity, melting and boiling points, odour, colour and taste) exhibit a highest consensus (Fig. 1d) [37,38].

Impurities in water are broadly distinguished on the basis of their biological or chemical origin, wherein the former includes the invasive and non-indigenous microbial species dwelling in a water sample. The biological and chemical contaminants affecting water quality are distinguished *via* microbial pathogens, excessive pesticides use, unmanaged industrial effluents, heavy metal prevalence (Fig. 2) [39–50]. Inceptive conceptualization of 'biological pollutants" was proposed by Elliott in 1972, considering them for invasion biology, *vis-à-vis* bacterial, algal and related toxins [51]. Though microbial contamination *via* improper wastewater management remains a biological concern, it can be tackled *via* pre-treating the toxic waste streams. Readers are advised to consult specific literature to have a better knowledge on microbial contaminant's health issues and environmental impacts [52–58]. Of late, microbial enzymes facilitated metallic NPs are being increasingly employed as remediation agents as several xenobiotics are easily degraded into simpler forms by microbes [59,60]. So, using recombinant DNA technology, the gene expressions controlling these enzymatic activities could be enhanced. Similarly, adversities of fertilizers and pesticides could be mitigated *via* nanocarrier mediated delivery [61–63]. Nanocarriers encompass a structural protection of delivered fertilizers and moderate the loading extents to counter undesired soil stress. Co-delivery of fertilizers with ecofriendly antioxidants safeguards them from oxidative damage, synergizing their antimicrobial activities with moderated administered quantities. Nonionic surfactants and plant extract capped NPs could be compatible stabilizers for such formulations, reducing the non-specific interactions [64].

3. Preparation methods for gold nanoparticles

With an atomic number of 79, Au exhibits [Xe] $4f^{14}$ $5d^{10}$ $6s^1$ electronic configuration. Owing to completely occupied energy shells, Au has a high ground state stability, minimizing the interfering possibility in sensing applications [65,66]. Preparation method for Au NPs (perhaps any singular metal NPs) comprises the reduction of chosen precursor salt, wherein zerovalent Au state (or the desired metal) is attained. The reduction of precursor salts could be accomplished *via* external energy (physical method), using microbial enzymes or plant metabolites (mostly natural polyphenols) or synthetic reducing agents (chemical method). The physical methods employ external energy, usually generate a lot of wastes and are environmentally threatening are the typical Top-down methodologies whereby no control in particle size dimensions could be exercised. Multiple methods using external energy as a source to reduce the metal salt precursors are known, such as laser beam ablation, ionic bombardment and others. Although the concerns of high energy dependence and enormous waste generation are resolved in chemical and biological methods for NPs preparation, the biological methods (nature friendly approaches using microbial enzymes or extracts of varied plant resources) suffer from scale up compatibility as the plant growth varies from one to other region [67–75]. Chemical methods of preparing metal NPs utilize the synthetic reducing agents and function without drastic energy inputs, enabling remarkable control in optimizing the particle dimensions *via* their "Bottom-Up" working principles (Fig. 3) [76–88]. Chemical methods of NPs preparation use moderate energy sources such as microwave treatment, emulsification, sustained ultrasonication (at low frequency), or a combination of these. The primed approach for Au NPs preparation was proposed by Turkevich, *via* varying precursor (mostly chloroauric acid, $HAuCl_4$)-reducing agent (trisodium citrate, $Na_3C_6H_5O_7$, sodium borohydride, $NaBH_4$ etc) interacting stoichiometries.

The nanoscale attributes of prepared NPs are explicit functions of their size-shape modulations, wherein a smaller size corresponds to stronger QC mediated changes in optical, physical, chemical and

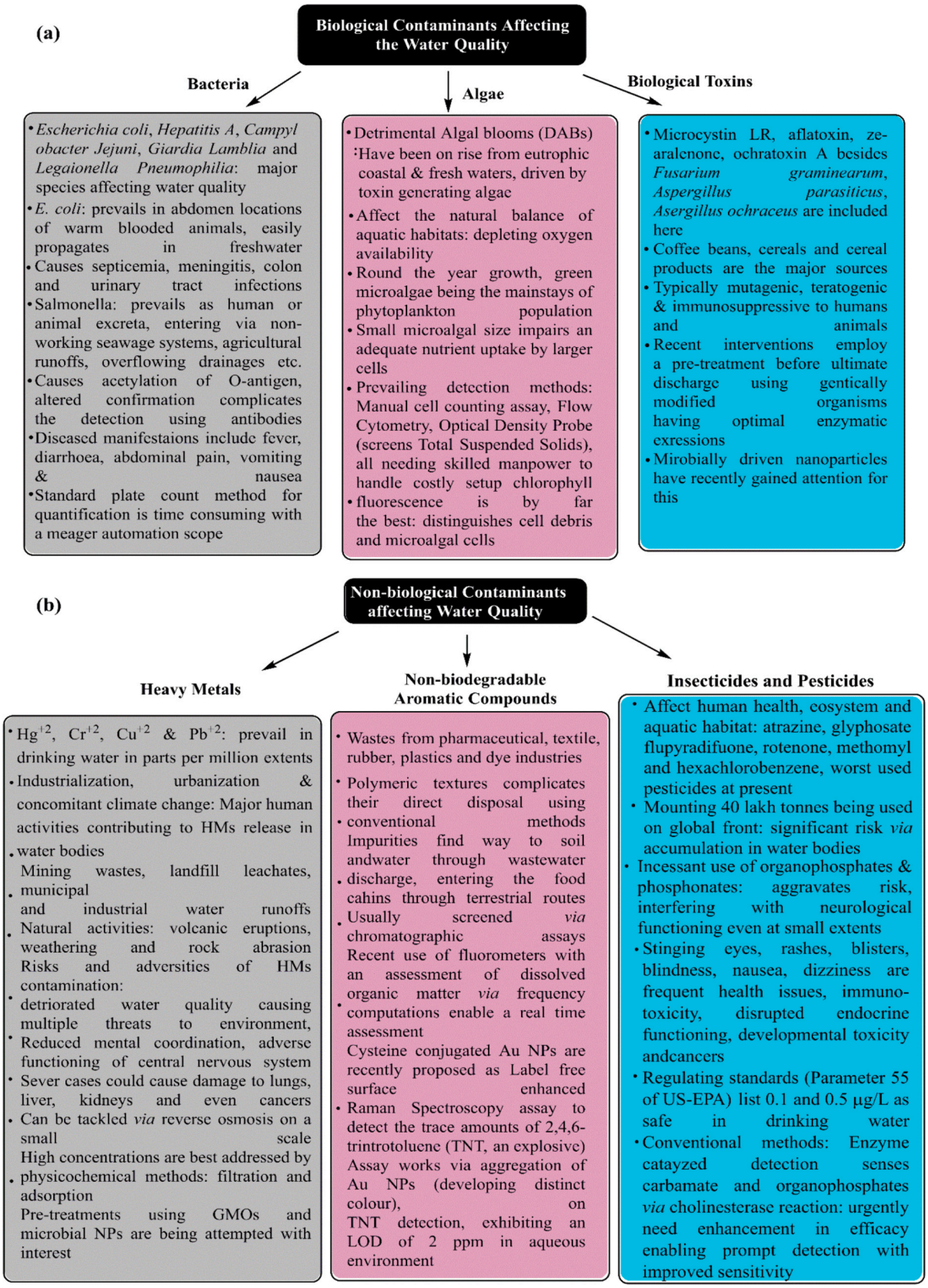

Fig. 2. (a) Major biological contaminants affecting the water quality, distinguished as bacteria, algae, and biological toxins, (b) Prominent non-biological contaminants affecting water quality, distinguished as heavy metals, insecticides and pesticides, and non-biodegradable aromatic compounds.

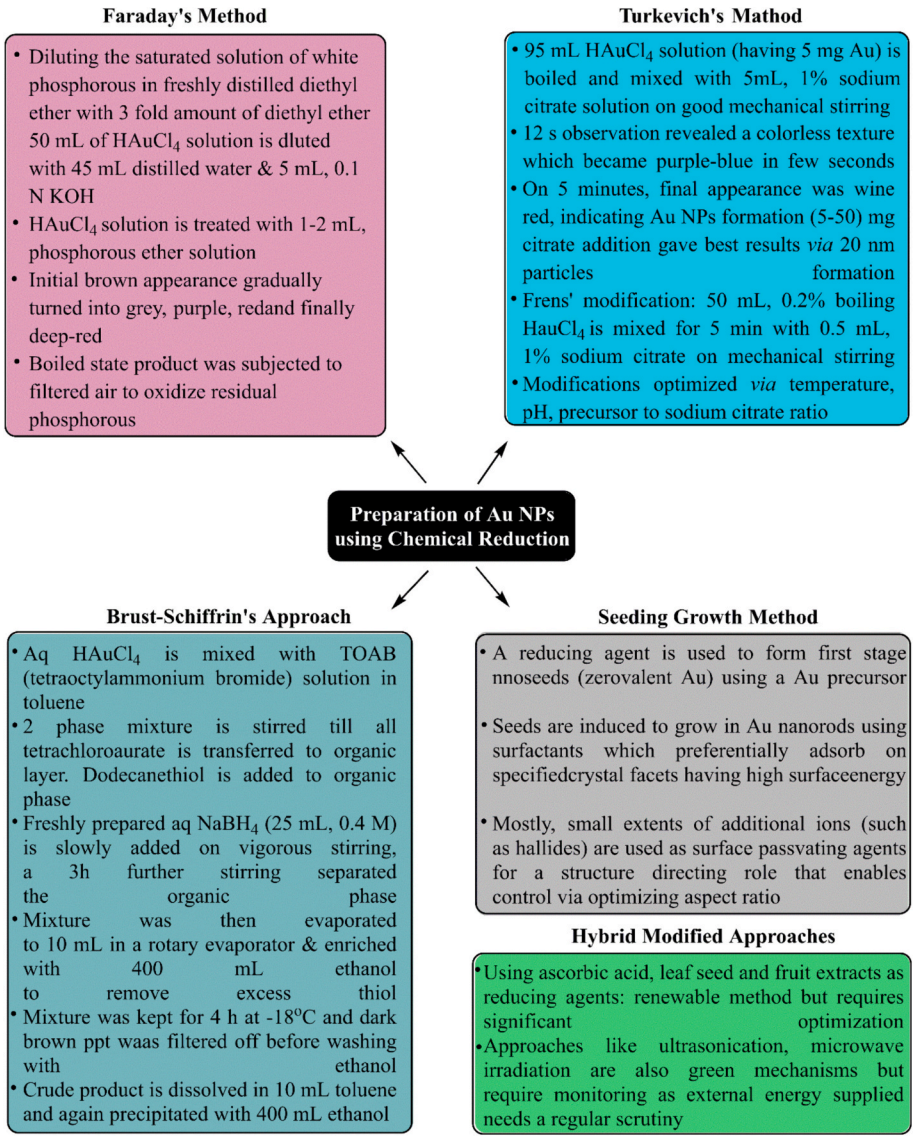

Fig. 3. Salient aspects of prominent chemical reduction methods for preparing Au nanoparticles, varying precursor to reducing agent stoichiometry is the basis of altered morphology and diversified applications.

electronic properties. Smaller dimensions attribute to a low energy band gap, owing to which, electrons from valence band are easily transitioned to conduction bands, generating the exciton promptly. The working mechanism for controlling the size and shape of NPs, is the optimized precursor to reducing agent stoichiometry, wherein rod or spherical morphology could be obtained. Other than precursor to reducing agent ratio, working pH, temperature and the precursor type are the prominent factors affecting the pace of NPs formation. From the precursor viewpoint, oxides are most easily reduced while nitrates are relatively tough to treat. With reference to pH and temperature, the optimum responses are generally retrieved for physiological pH and temperature albeit there may be variations for chemical methods. A number of iterations for size and morphology control of Au NPs *via* varied precursor and reducing agent ratios, have been comprehensively discussed in the publications on Turkevich's method and its optimizations [77–79].

Keeping such performance regulating attributes of Au NPs in mind, the next section discusses about the last ten year studies on Au NPs biosensors monitored quality of water resources.

4. Recent studies on gold nanoparticles monitored water quality

As discussed in earlier sections, preferential use of Au NPs and corresponding assemblies in biosensing (environmental and health concerns, majorly) is due to their high native stability, enabling multiple functionalization abilities. Our cautious literature search consolidated Au NPs as sensing probes, *via* (i) aggregation based singular or combined use, (ii) engineered electrodes as sensing platforms, (iii) functionalization with peptides, amino-acids, antibodies or manifold enzyme-conjugated biomolecules (DNA or RNAzymes), (iv) anchoring over graphene and reduced graphene assemblies, and (v) a miscellaneous approach (comprising integration of two or more of first four principles. The separate listing of graphene or graphene oxide conjugated Au NPs as functionalization assays is due to chemically distinct nature of graphene from the biological entities (proteins, antibodies and others). The surface versatility and tuneable energy levels of graphene makes it unique for engineered optoelectronic responses *via* numerous functionalization routes encompassed enhanced interactions for industrial, biological and energy harvesting [89,90].

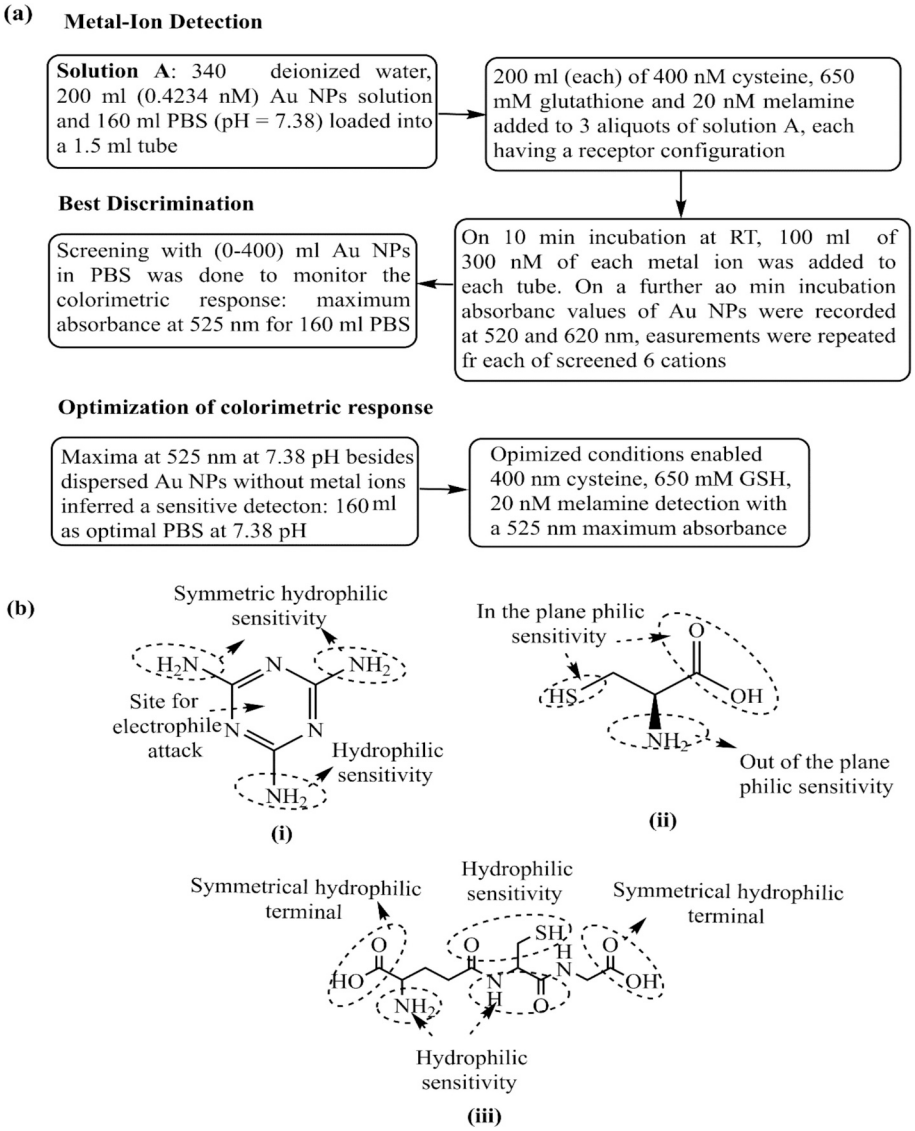

Fig. 4. (a) Metal ion detection and colorimetric response optimization steps for the 2019 study by *Li and colleagues* [95], (b) Molecular structures of (i) melamine, (ii) cysteine, and (iii) glutathione, with plentiful –OH, -SH and $–NH_2$ functional groups conferring a hydrophilic sensitivity. This implies that detection of these moieties mandates the probe interaction *via* hydrogen bonding, philic-philic or philicphobic interaction forces.

4.1. Aggregation facilitated singular or combinatorial assays

This section comprises the studies monitoring water quality *via* singular and combined (with other metal/metal oxide NPs) use of Au NPs. Working principle herein, uses distinct optical properties of monodispersed and aggregated states, the latter resulting in diminished energy due to increased sizes and reduced QC. So, the screened stimulus is detected *via* changes in native SPR of Au NPs through modulated dispersion regimes. The observed SPR of Au NPs varies as per the capping agent interaction with underlying NPs. Irrespective of formation mechanism, the SPR is observed corresponding to 520 nm, a variation arises due to distinct dispersion interception in course of UV–Vis spectroscopy [91]. The morphologies and architectures of NPs are the riders of their sensing abilities due to varied QC extents. For instance, a number of studies employ combinative use of NPs whereby the participation of capping layer is reduced to bare minimal. Regarding the morphology specific distinctions, the rod regime is better suited for sensing applications due to its capability of screening multiple functional responses on the same surface simultaneously. For instance, carbon nanotubes functionalized with Au NPs-anchored enzymes have been significantly explored as corresponding substrate detection(s) assemblies. Such distinctions are not feasible with spherical NPs which are better suited for adsorption, drug loading and charge transfer driven transport and surface engineering needs. The core-shell architecture is a characteristic configuration of NPs whereby enhanced protection, encapsulation extent and controlled release could be achieved *via* surrounding the functional NPs with a compatible shell. The functional aspects of shell material include a high dispersibility, biofunctionalization ability and control of optical properties. The uniqueness of these NPs pertains to their core-shell organic and inorganic sensitivity, with sizes in the order of few μm. These heterogeneous arrangements are highly stable in ambient conditions (at <200 °C) with minimal oxidation in (200–400)^{o}C. Unlike the conventional NPs, the specific characterizations for core-shell NPs are aberration corrected scanning tunnelling electron microscopy (equipped with high angle annular dark field detector), energy-dispersive X-ray spectrometry, electron energy loss spectroscopy. The shell protection in makes these NPs as highly useful for biomedical applications (bioimaging, drug delivery, sensing and gene delivery) [92–93].

Exploiting such remarkable attributes of core-shell morphology, a

2017 study by *Dong and colleagues* [94] developed Ag (core) and Au (shell) containing NPs which were conjugated with iridium (III) complex to screen cyanide presence in the water samples. The mechanism involved luminescence monitoring, getting quenched on (Ir(7-chloro-2-phenylquinoline)$_2$(4,7-dimethoxy-1,10-phenanthroline) (complex I) adsorption over Au surface of Ag@Au NPs. Electrostatic interactions between cationic, (Ir(7-chloro-2-phenylquinoline)$_2$(4,7-dimethoxy-1,10-phenanthroline) and Au shell, stabilized the assembly. The source of quenching was energy transfer from Ag@Au NPs to complex I *via* (300–800) nm absorption over Ag NPs. Such binding force dynamics engineered resonance of core-shell NPs and complex I- luminescence. Cyanide screening was facilitated by restoration on loss of Au shell, with Ag core being unable to do so. Inspection revealed a high sensitivity with 0.036 μM LOD with null detection of 10 fold contents of erstwhile anions. The approach could be extended to CN^- similar impurities *via* interacting with complex I. The optimized functioning of designed Au—Ag comprising core-shell NPs draws considerable interest wherein Au NPs as shell attributed to a flexible geometry and topology with low reactivity of Ag NPs containing core. Such an integrated assembly enabled thermal and oxidative stability of core NMs, making them suitable for biomedical, electrical and semiconducting applications. Thus, Au NPs as shell, conferred protection to Ag core and engineered a precise stimulus detection.

Subsequent 2019 effort used a colorimetric assay comprising cysteine, L-glutathione and melamine as recognition entities for screening toxic metal ions. Binding affinities of toxic cations with these recognition receptors were screened *via* Au NPs aggregation and consequent colorimetric response. The optimized configuration achieved significant Ti^{4+}, Cr^{3+}, Mn^{2+}, Fe^{3+}, Pb^{2+} and Sn^{4+} discrimination, in deionized water (DW) and real samples. Fig. 4a illustrates the detection procedure optimization for this study wherein, selective response was monitored *via* screening the absorption with and without Ti^{4+}, Cr^{3+}, Mn^{2+}, Fe^{3+}, Pb^{2+}, Sn^{4+} bound state of Au NPs at (300–1000,5000,10,000) nM. Six parallel measurements were made for each cation, generating a matrix of 6 ions, 3 receptors and 6 replicates. Thereafter, LDA (Linear Discriminant Analysis) converted this matrix into canonical factors, generating 3D-plots, with 95% confidence. The LDA scores for each cation revealed distinct clustering and discrimination. Analysis for intuitive distribution revealed a possible prominence in 300–10,000 nM range, exhibiting Ti^{4+}, Cr^{3+}, Sn^{4+}, Mn^{2+}, Pb^{2+} as preferentially captured by cysteine and melamine. Lower Au NPs absorbance differences with and without cations inferred a moderate receptor binding, with strongest affinity for cysteine. The discrimination accuracy (DA) were 75% (cysteine), 72.2% (glutathione), 72.2% (melamine), 94.4% (cysteine-glutathione), 91.7% (melamine-glutathione) and 91.7% (melamine-cysteine) and 100% (cysteine-glutathione-melamine), signifying a synergistic response.

Fig. 4b depicts melamine, cysteine and glutathione structural distinctions, wherein plentiful –OH, =O and –NH_2 functionalities exhibit a hydrophilic sensitivity. While glutathione is a physiological antioxidant, melamine is a toxic molecule with an excessive use being prohibited by FDA. The quantitative performance of developed probe was monitored using (100−1000) nM cationic extents, at 100 nM intervals. Maximum response was ascertained for 800 nM Ti^{4+}, 800 nm Cr^{3+}, 200 nM (each for) Mn^{2+}, Pb^{2+}, Sn^{4+} and 400 nM Fe^{3+}. The sensor array demonstrated nM sensitivity for Ti^{4+}, Cr^{3+}, Mn^{2+}, Fe^{3+}, Pb^{2+}, Sn^{4+}, with (100–900) nM linear responses for Ti^{4+}, Cr^{3+}, Mn^{2}, Pb^{2+}, (100–800) nM for Fe^{3+} and (100–1000) nM for Sn^{4+}. A linear variance of dose-response curve inferred stable cation-recognition receptor interactions with discrimination analysis revealing (Ti^{4+}-Mn^{2+}), (Ti^{4+}-Mn^{2+}-Sn^{4+}) and (Ti^{4+}-Cr^{3+}-Mn^{2+}-Sn^{4+}) for 1:9, (2:8, 3:7, 4:6, 1:1, 6:4, 7:3,8:2, 9:1), (2:2:6, 2:6:2, 6:2:2, 4:4:2, 4:2:4, 2:4:4) and (2:2:2:3, 2:3:3:2, 2:2:2:3, 3:2:2:3, 3:3:2:2, 3:2:3:3) stoichiometries, facilitating a 300 nM detection. Analysis of real water samples from *Yuyuantan Park* in Beijing, revealed no ion detection by ICP-MS but on being spiked at 300 nM to the sensor array, the screened ions were distinguished. Identification for screened

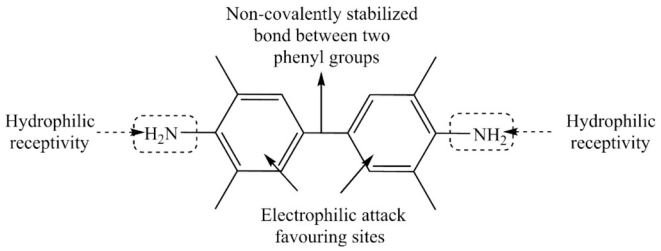

Fig. 5. Molecular structure of 3,3′,5,5'tetramethylbenzidine (TMB), the –NH_2 substituted phenyl rings confer a moderate interaction with Au NPs functionalized MOF framework. No steric hindrance in the –NH_2 groups vicinity argues well for their probing involvement. The (50–200) nM linear detection range with 8.1 ng•mL^{-1} LOD and (106–110)% recovery rate in 2019 study by *Li and colleagues*, creating interest for possible structural similarities with screened ampicillin, tetracycline and oxytetracycline [96].

cations was also made on serum samples, revealing a unique response alongwith LDA assisted six samples being clustered as distinct groups [95]. The working principle could be used to estimate the chemically similar impurities (similar group elements from periodic table), illustrating usefulness *via* characteristic Au NPs aggregation encompassed distinctive optical responses.

The next 2019 effort was the study by *Li and colleagues* [96] who screened antibiotics contaminated water samples using metal organic framework (MOF) conjugated aptamer functionalized with 3,3′,5,5'tetramethylbenzidine (TMB)-H_2O_2. The assay monitored TMB catalytic oxidation (included as label) from colourless to blue, using aptamer as antibiotic recognizer, *via* ascertaining the variations in MOFs catalytic activity. Out of Fe-MIL-53, Fe-MIL-88 A and Fe-MIL-100 ligands, Fe-MIL-53 was chosen due to its superior topological flexibility and small electron transfer impedance. Working configuration comprised quenched MOF catalysis through antibiotic-Au NPs-aptamer conjugate coating on MOF outer surface, increasing the impedance *via* reduced electron transfer. Selectivity and sensitivity of the assay revealed a (50–200) nM linear detection with 8.1 ng•mL^{-1} LOD and (106–110)% recovery, exhibiting suitability for chloramphenicol detection besides viable potential for ampicillin, tetracycline and oxytetracycline screening. Fig. 5 depicts TMB structure wherein –NH_2 substituted phenyl rings manifest a hydrophilic likability with an electrophilic proximity of π-conjugation rich phenyl rings. Development of such probes argued variability for a feasibility to screen hydrophilic contaminants. One concern shared by the authors though, points to 8.1 ng•mL^{-1} LOD, unable to screen fewer extents. A feasible extension of the work could be the SPR variations of Au NPs alone and their compatibility with Ag, Cu, Co, Mn for consolidated probe configuration to screen water-borne pathogens.

Next in line is a 2021 study wherein Au NPs functioned as segmented bridge for growing Ag shell and gather together the Au-Fe_3O_4 NPs with a dumb-bell morphology exhibiting a magnetic sensitivity. The assembly was optimized to screen aflatoxin *via* modulating the transverse relaxation time of examined water molecules. The Ag@Au-Fe_3O_4 nanoscale assembly was controlled *via* H_2O_2 which on horseradish peroxidase degradation, reduced Ag^+ to Ag^0, accompanied with transformation of dispersed Au-Fe_3O_4 NPs to Ag@Au-Fe_3O_4 aggregated entities. Detection sensitivity of assay was 3.81 pg•mL^{-1}, on par with competitive immunoreactions, improving the ELISA and HPLC screening by 21 and 9 folds [97].

A nearly similar but recent study used Au@MnO_2 core-shell morphology to screen *E. coli* contamination *via* accessing β-galactosidase action on single particle enumeration *via* colour code distinction. Presence of *E. coli* in tested water stream hydrolyzed *p*-aminophenyl β-D-galactopyranoside to p-aminophenol (AP) *via* endogenous β-galactosidase. Detection was confirmed *via* MnO_2 shell-AP reaction, resulting in blue shift of localized SPR (bright yellow to green colour change) with

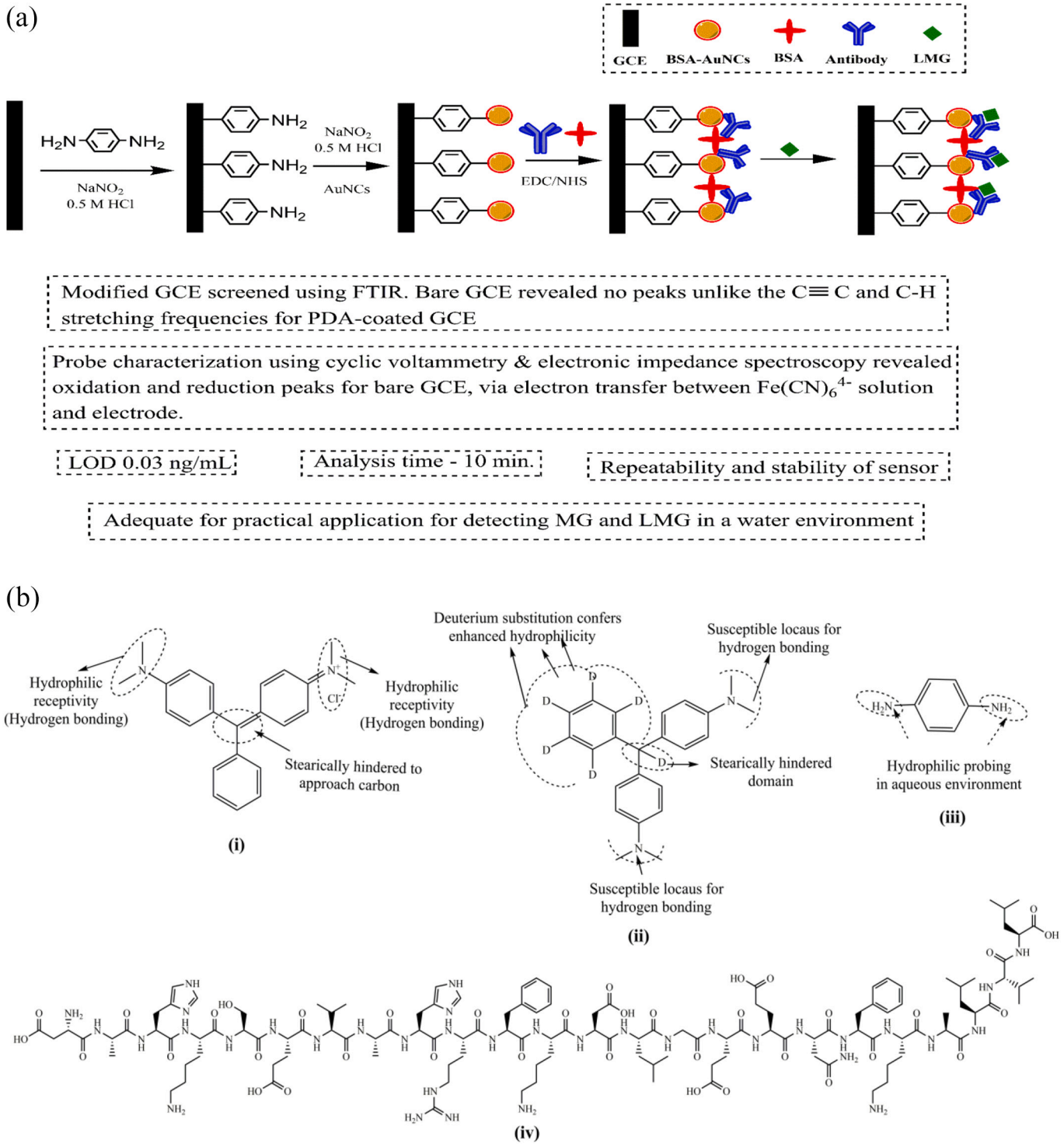

Fig. 6. (a) Optimization of probe assembly *via* N,N′-(3-dimethylaminopropyl ethylcarbodiimide hydrochloride) EDC-NHS (N-hydroxysuccinimide) assisted chemical reaction and the subsequent validation *via* cyclic voltammetry and electrical impedance spectroscopy for the 2016 study by *Zhu and colleagues* [101], (b) Characteristic hydrophilic and hydrophobic functionalities of (i) Malachite green (MG), (ii) Leucomalachite green (LMG), (iii) 1,4-phenylenediamine (PDA) and (iv) Bovine serum albumin (BSA), pertaining to the discussion of 2016 study by *Zhu and associates*. The matching of distributive hydrophilicities amongst PDA, BSA and MG, LMG offer enhanced understanding of probe design for distinctive MG and LMG recognition.

concomitant Mn^{+2} formation. The assay exhibited an LOD of 15 CFU•mL^{-1} over a (100–2900) CFU•mL^{-1} dynamic range, enabling an ultrasensitive and economic *E. coli* screening in river water. The robust configuration with dynamic working feasibility of the probe demonstrated the assembly as ultrasensitive, low cost measure to screen other than *E. coli* bacterial contaminations in river water and food samples [98]. Comparative analysis of last two studies [97,98] conceptualizes a wide anticipation of Au NPs comprising biosensors, *via* compatibility with Fe_3O_4 as well as MnO_2 and providing ultrasensitive detection of distinct contaminants. Such prospects illustrate the multifunctional analytical perceptivity of Au NPs with immense scope of modulated energy levels.

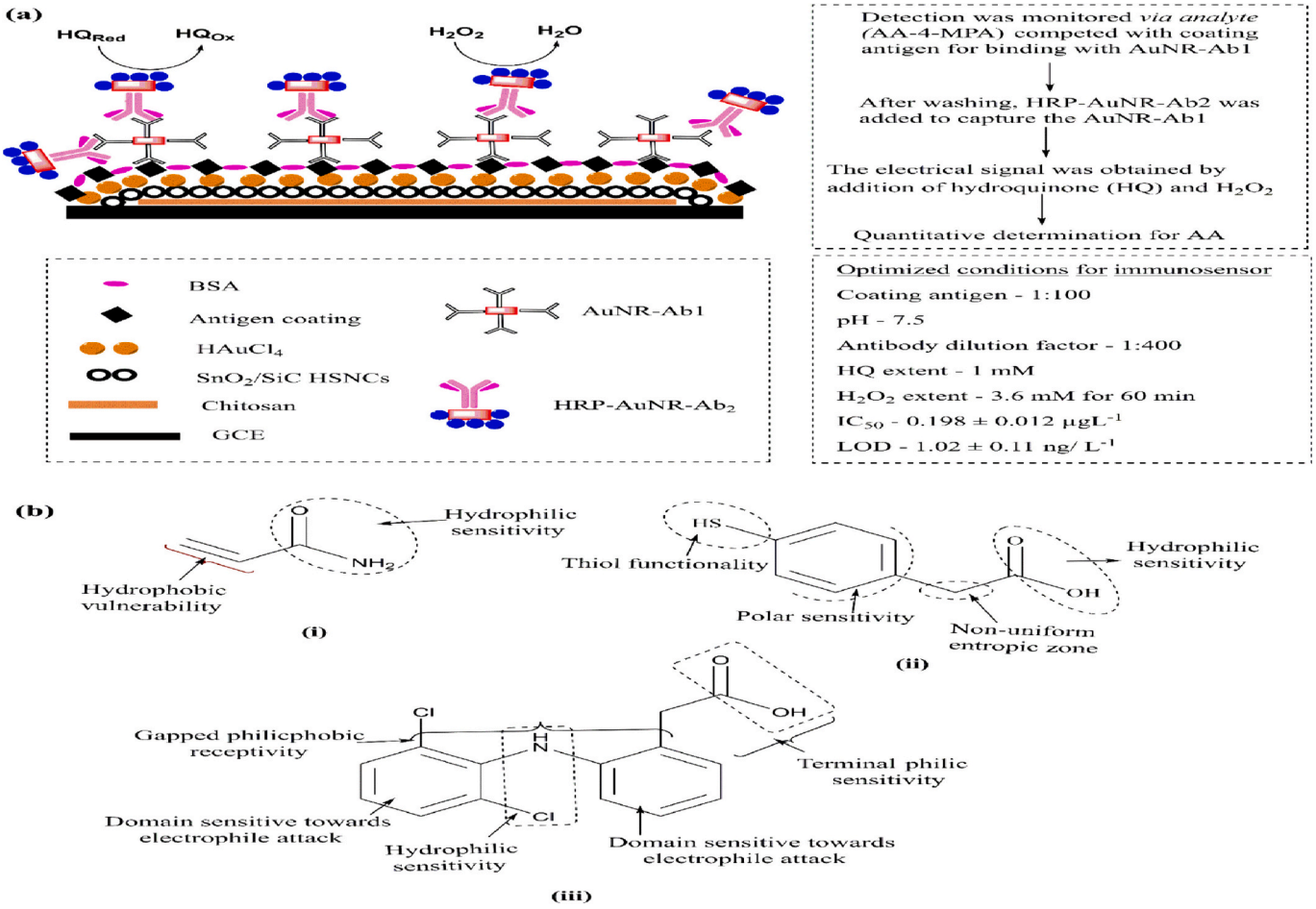

Fig. 7. (a) Schematic representation ofpH, dilution factor and H_2O_2extent driven detection methodology using Au nanorods conjugated with hollow SnO2-*SiC* spherical nanochains on chitosan pre-coated glassy carbon electrode, (b) Molecular structures of (i) acryalamide and (ii) 4-mercaptophenylacetic acid, and (iii) diclofeanc, with –NH, Cl, and –COOH and pi-conjugation conferring phenyl rings confer a distributed philicphobic receptivity. The structures pertain to the screened impurities in food and water samples in the 2018 study by *Wu and colleagues* [102].

Another worthwhile effort from 2021 optimized a surface-enhanced Raman Scattering (SERS) coupled wavenumber selection chemical signal monitored approach for screening Hg^{+2} in aqueous environment. Optimized probe configuration involved Au@Ag core-shell NPs which were used as SERS substrates while rhodamine 6G (R6G) was included as Hg^{+2} signaling probe. The Au NPs were prepared *via* 30 min uninterrupted stirring of 50 mL, 0.25 mM $HAuCl_4$ and 750 μL, 1% $C_6H_5Na_3O_7•2H_2O$ mixture at boiling conditions. Henceforth, 2 mL, 1% $C_6H_5Na_3O_7•2H_2O$ was added again to the reaction mixture. Finally, to develop Ag NPs shell, 9 mL, 1 mM $AgNO_3$ was injected at the rate of two drops per minute, followed by another 30 min stirring to obtain Au@Ag NPs. Physical indication of NPs formation was red wine to orange-yellow conversion. Characterization of as formed NPs corroborated their nanoscale traits, with 28.51 nm as average hydrodynamic diameters (using DLS), a spherical morphology (*via* TEM) and an SPR peak within (388–498) nm alongside a face-centred cubic, crystalline texture. The Hg^{+2} screening by optimized probe was accomplished *via* quenching of R6G strong SERS signal due to its interaction with Au@Ag NPs, resulting in progressive replacement of Ag^{+} by the bound Hg^{+2}. Enhanced extents of bound Hg^{+2} within $(10^{3}–10^{-2})$ μg•g^{-1} resulted in disorganized Ag shell morphology in the TEM micrographs of the probe, revealing an aggregated state. Correspondingly, a blue shift in UV–Vis SPR peak of Ag shell of Au@Ag NPs was noticed, reducing Hg^{+2} to Hg^{0} on the Ag shell surface of Au@Ag NPs, following Hg^{+2}-citrate ion of Au@Ag NPs complex formation. The SERS coupled sensing revealed a good efficacy over the SPR methodology, developing 0.9745 and 0.9773 as correlation coefficients within $(10^{2}–10^{-3})$ μg•g^{-1}. Specificity analysis of probe for 1 μg•g^{-1} Hg^{+2} with and without 100 μg•g^{-1} Ba^{+2}, Ca^{+2}, Cd^{+2}, Co^{+2}, Cu^{+2}, Fe^{+2}, Fe^{+3}, Mg^{+2}, Mn^{+2}, Ni^{+2}, Pb^{+2} and Zn^{+2} revealed Hg^{+2} acceptable SERS signal, inferring a good sensitivity. The recovery (88.45–94.73)% and (3.28–5.76)% coefficient of variations revealed a suitability of optimized SERS modulation for Hg^{2+} screening in aqueous conditions [99].

Summarizing the findings of singular or combined state Au NPs prevalence mediated SPR varied sensing responses, reveals a high sensitivity, reproducibility and specificity of various contaminants in examined water samples. There seems a possibility of still higher accuracies being accomplished *via* optimum combinatorial approaches whereby detection precision and reproducibility could be improvised. The accuracy of responses is sharply affected by the respective preparation methods of NPs with a higher reliability of chemical approaches.

4.2. *Use of Au nanoparticles modified electrodes as sensing platforms*

This section comprises the studies where Au nanothin layers functionalized electrodes (electrochemical detection) have been used as sensing platforms. A high electrical conductivity of Au augments its electrochemical abilities, paving way for accurate and precise stimulus detection [100]. Added incentive herewith is the robust size-shape modulation of Au NPs whereby detection platform geometry could be modulated. Herein, many studies have demonstrated thin film monodispersed textures of Au NPs in combination with other elements (such

as zirconium, vanadium *etc.*) for improved responses. A serious challenge in such probe configuration is the rigorous characterization *vis-à-vis* stimulus nature and intensity. The working principle screens the probe electrical and optoelectronic response in varying environments. Ahead is the discussion of post 2015 studies in this regard.

The 2016 attempt by *Zhu and associates* [101] reported a sensitive electrochemical impedance spectroscopy (EIS) assay for malachite green (MG) and leucomalachite green (LMG) detection using bovine serum albumin-functionalized Au nanocluster (BSA-Au NC) Ab composite film conjugated immunosensor. The investigators modified GCE with 1,4-phenylenediamine (PDA, for $–NH_2$ group), to obtain a stable surface suited for covalent binding. Fig. 6a summarizes the optimized probe configuration *via* EDC (N,N′-(3-dimethylaminopropyl ethylcarbodiimide hydrochloride))-NHS (N-hydroxysuccinimide) conjugation and its validation *via* cyclic voltammetry (C*V*) and EIS scrutiny. Analysis revealed an agreement for circuit model over the scanned frequencies with negligible resistance R_s (95 Ω) and impedance variations Z_w (1.45 m Mho) for each impedance scan, inferring no electrode surface modification. Owing to this, R_{et} was chosen for interfacial properties, increment in which deciphered electrically insulated LMG and Ab interactions. The analysis efficacy varied with incubation time and solution pH, examined *via* Ab-modified electrode immersion in LMG solution (10 ng•mL^{-1}) at (6–8.5) pH for (10–60) min. For calibration curve and interaction specificity, the EIS response to LMG concentrations was investigated at 5 mV, (0.1 Hz-100 KHz) and 0.29 V. The R_{et} increased with increasing LMG extents, supported by relative resistance and calibration curve linearity within (0.1–10.0) ng•mL^{-1}. With a 0.03 ng•mL^{-1} LOD, the R_{et} change was steady at >10 ng•mL^{-1} LMG. The EIS repeatability for 10 ng•mL^{-1} LMG with five assessments deciphered a 5.6% relative standard deviation (RSD) at 4 °C. Till 2 weeks, no significant reduction was noticed and impedance remained 90% of initial extent. Commercial feasibility was determined *via* EIS and ELISA inspections of (1–5) ng•mL^{-1} LMG spiked farm water samples. Analysis revealed good recoveries and EIS precision on comparative assessments with ELISA and Mass spectroscopy estimations, demonstrating suitability for aqueous MG and LMG screening. Fig. 6b depicts MG (i), LMG (ii), 1,4-PDA (iii) and BSA (iv) structural distinctions, wherein hydrophilic proximity favours 1,4-PDA coated BSA-Au NC constituted electrodes. The hydrophilicity of BSA argues well for its functionalization with Au-BSA NCs. Distinct binding accuracies with detection thresholds for MG and LMG were due to higher LMG hydrophilicity as it is substituted with five deuterium atoms. The structural distinctions of LMG and MG also provide a clue for the LOD dissimilarities as exposed hydrophilicity of LMG seems readily accessible by Au-BSA NC hydrophilic sensitivity. These attributes could be conceptualized for probe configurations *via* structure-activity-relationships modulations.

Subsequent attempt on Au NPs monitored water quality used high SA, hollow SnO_2-*SiC* spherical nanochains and Au nanorods (NRs), anchored on a chitosan pre-coated GCE for acrylamide (AA) screening in water and food samples. The 50 nm long, 20 nm wide Au NRs were prepared *via* seed mediated mechanism, using $HAuCl_4$ as precursor, $NaBH_4$ as reducing agent and CTAB as capping agent. The coating antigen, AA-4-mercaptophenylacetic acid-ovalbumin conjugate (AA-4-MPA-O*V*A) was immobilized on electrode while AA-4-MPA specific polyclonal Ab was conjugated to Au NR as primary antibody (AuNR-Ab_1). The Horseradish peroxidase labelled anti-rabbit Ab goat was conjugated to Au NRs as secondary antibody (HRP-AuNR-Ab_2). Sensing configuration involved dropping 5 μL, 0.2% chitosan solution over the electrode and RT drying. Subsequently, 0.5 mg SnO_2-*SiC* HSNC was monodispersed in 1 mL DW followed by its 5 μL-deposition on chitosan coated electrode, and a second RT drying. Thereafter, electrochemical deposition was done in 4 mL, 0.5 mM $HAuCl_4$ *via* (−0.3 to 0.3) V ranged CV for 5 cycles at 50 mV•s^{-1}. Fig. 7(a) summarizes the detection methodology optimization for validated pH, dilution factor and H_2O_2 extents. Real analysis on drinking water, coffee and potato chips revealed (45.9 ± 2.7) ng•kg^{-1} as LOD for (187 ± 12.3) ng•kg^{-1} to (104 ± 8.2) μg•kg^{-1} linear range. The AA content was ascertained as 1000 fold higher for coffee and potato chip, ruling out LOD quantification. Distinguishing aspects comprised stability monitoring *via* 4 °C periodic current response time assessments, revealing 97.3, 93.6, 90.7% initial current retaining on one, three and six weeks. Likewise, electrode regeneration monitoring revealed (15–50)% reduced output with no reuse feasibility, due to varied pH triggered electrode surface tampering. The AA recoveries ranged (86–115)% with (6.4–8.6)% variation coefficients, and (86.5–112), (4.3–9)% extents for coffee and potato chips. Selectivity analysis for AA-4-MPA revealed no cross-reactivity to 4-MPA, 4-aminothiophenol, AA, methacrylamide, methyl acrylate and acrylic acid [102]. The $–CO-NH_2$, –COOH, -HS functionalities of AA and 4-MPA exhibit compatibility whereby 4-MPA as electrode coating agent attributed well for immobilized Au NRs, vide interfacing thiol linkage (Fig. 7(b)). A pertinent concern herewith is the inadvertent AA use in childcare products (talc, soaps *etc.*), accounting for its recent suspension by US-FDA.

A recent investigation by *Iqbal and colleagues* [103] used DNA aptamer conjugated magnetic beads to quantify the *C. parvum* oocysts, frequent contaminants in potable water. A sensitive 3′-biotinylated R4–6 aptamer was used as secondary ligand for immobilizing streptavidin coated magnetic beads. The ligand bound magnetic bead assembly was then included within Au NPs modified screen printed carbon electrode (SPCE). The detection efficacy for *C. parvum* oocysts inferred specificity using square wave voltammetry with no *Giardia duodenalis* cysts binding, another ubiquitous water-borne pathogen. The sensing LOD was ascertained as 50 units with steadfast *C. parvum* oocyst detection in raw lake and river water. The study also screened a combination of Au NPs coated carbon electrode and aptasensor functionalized magnetic beads for deleterious aqueous contaminants, revealing significance *via* manifold Au NPs morphologies. The subsequent attempt was a 2019 study by *Costa-Rama and colleagues* [104], wherein a paper-based platform was used to screen diclofenac (DCF, an anti-inflammatory drug) in contaminated water samples. Carbon-ink paper was used as working electrode and two metallic wires, linked *via* Au connectors functioned as reference and counter electrodes. Porous paper membrane aided the sample preconcentration apart from its de-coupling and detection, accomplishing a 60 folds enhanced sensitivity and 8000 fold lower LOD over the DCF pre-concentration on the working electrodes. The detectable adsorption attributed to (0.10–5) μM and (5–100) μM linear detection. Feasibility for DCF contamination in spiked tap water samples revealed a 70 nM LOD with 5% RSD accuracy. Structural versatility of probe aided in integrated assembly of eight electrochemical cells, with -NH, Cl, and -COOH functionalities inferring an aqueous persistence besides π-conjugation supported electrophilic receptivity (Fig. 7biii). The cationic probes efficiently immobilized and detached the drug. It is essential hereby to understand the mitigating philicphobic sensitivities in such assays, necessitating a modulation of philicphobic force gradients is needed, could be accomplished *via* computational techniques ascertained most stabilized combination with least binding energy.

A latest attempt herein used Au NPs-PPy (polypyrrole)-$Ti_3C_2T_x$ (titanium carbide) nanocomposite, prepared *via* robust layer by layer self-assembly. Probe analysis using XPS and XRD revealed $Ti_3C_2T_x$ (a natural 2D material consisting of layered nitrides) significance in the formation and alignment of PPy (an organic polymer derived from pyrrole oxidative polymerization) besides Au NPs growth. Screening of composite texture revealed enhanced stability with improved electrochemical performance wherein Au NPs conferred the ability to form covalent bonds with biomaterials *via* Au—S linkage. Sensing response of optimized assembly for Pb^{+2} detection revealed a $5•10^{-14}$- $1•10^{-8}$ M linear working range with $1•10^{-14}$ M LOD. Besides the probe exhibited good selectivity and sensitivity for Pb^{+2} screening in environmental fluids (Nong Fu spring and tap water) [105]. Another significant effort from 2023 itself demonstrated an integrated nanoscale configuration of an electrochemical biosensor wherein functional probe design comprised a

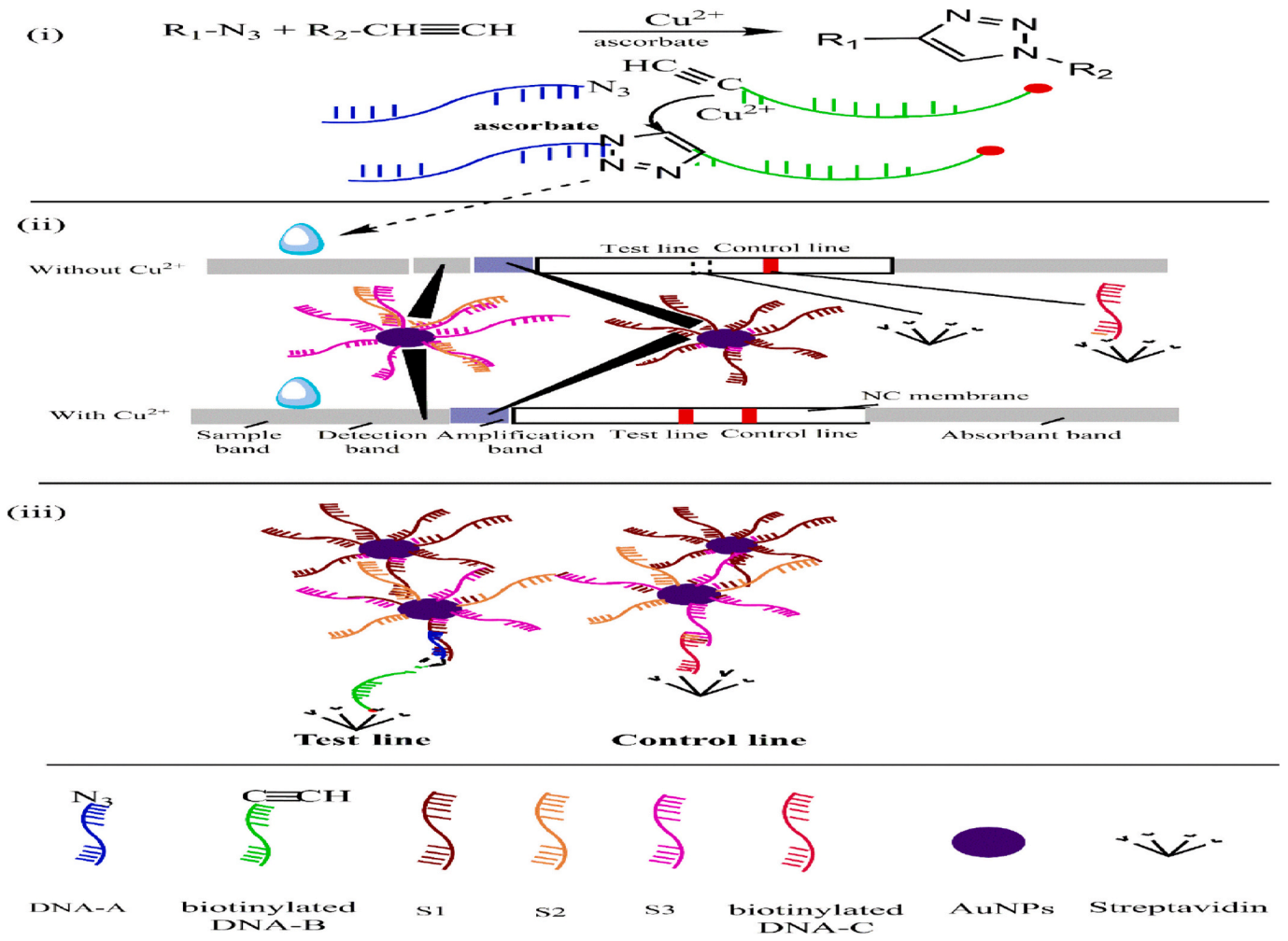

Fig. 8. Representative aspects of (a) Lateral flow test strip (SA-LFTS), (*Wang and colleagues* 2017), (i) Cu^{+2} detection based on Cu^{+}-catalyzed click chemistry, (ii) Visual detection of generated click-ligated ssDNA product, SA-LFTS includes an additional amplification pad (compared with traditional LFTS) that confers higher sensitivity [108]. The streptavidin-biotin interaction at the test line allows an easier implementation of the test, and (iii) The test and control lines of SA-LFTS assay after flow with Cu^{+2} addition. Au NPs are captured *via* streptavidin-biotin interaction and ssDNA hybridization.

carbon nanotubes-Au NPs and *E. coli*-polyclonal Ab and BSA engineered glassy carbon electrode (GCE), immersed in 0.1 M phosphate buffered saline (pH = 7). The sensor worked *via* acetaminophen (a non-opoid analgesic and antipyretic drug used to treat pain and fever) conjugation, detecting *E. coli* aqueous contamination *via* conductivity and current variations. Precision of the working assay was screened using square-wave, differential pulse and cyclic voltammetry, deciphering an LOD of 3.02 CFU•mL^{-1} *E. coli* detection in 3 min with reasonable accuracy, specificity, repeatability and reproducibility. Since *E. coli* is a frequent invader of food and drinking water, the demonstrated sensor configuration provides vital clues to integrate nanostructures for their synergistic bio-electronic response [106]. Thus, a generalized assessment of the studies in this section infers that Au NPs coating over the GCE surface either as nanothin films or *via* nanocomposite texture, efficiently screens aqueous contaminants with low response times. Indeed, probe functioning do requires a rigorous optimization as is the electrode stability for repeatable accuracies.

4.3. Biomolecules functionalized Au nanoparticles as water quality monitoring probes

This section comprises biomolecules (such as antibodies, enzymes, peptides, aptamers, engineered oligonucleotides *etc.*) functionalized Au NPs as water quality sensing probes. Select ligands or surface pre-treatments used *via* Au NPs functionalization herein comprise alkane thiol conjugation, Ab linking *via* avidin-biotin mutual interception, biocompatible peptide-dye conjugation and combinatorial regimen with other conducting/semi-conducting materials. Functionalization method needs a rigorous monitoring to ensure minimal interactions failing which, the probe's working efficacy could be tampered with.

The first major post 2015 effort herein used oligonucleotide functionalized Au NPs for rapid and specific *Staphylococcus aureus* (*S. aureus*) detection using a colorimetric mechanism. The probe configuration involved functionalization of a chemically modified 11-mer sequence onto the Au NPs *via* chemical conjugation. Analysis revealed Au NPs aggregation in response to *S. aureus* detection (as supernatants). The designed Au NPs-oligonucleotide assembly exhibited a biological suitability in creek and ocean water besides being storable as lyophilized powder, suggesting transportation and packaging robustness. Another advantage comprised the bacterial enzyme detection proximity (besides *S. aureus*) through modifications in oligonucletide array and coated NPs morphology. It is pertinent to mention here that *S. aureus* is a Gram-positive bacterium with a spherical morphology familiarly prevailing in the upper respiratory tract and on skin. The bacterium is positive for catalase and NO_3^- reduction, ruling out a mandatory need of oxygen for growth. Opportune pathogenic expressions are widely manifested as common cause of skin infections (abscesses), respiratory infections (sinusitis) and food poisoning. Major cause of such pathogenic

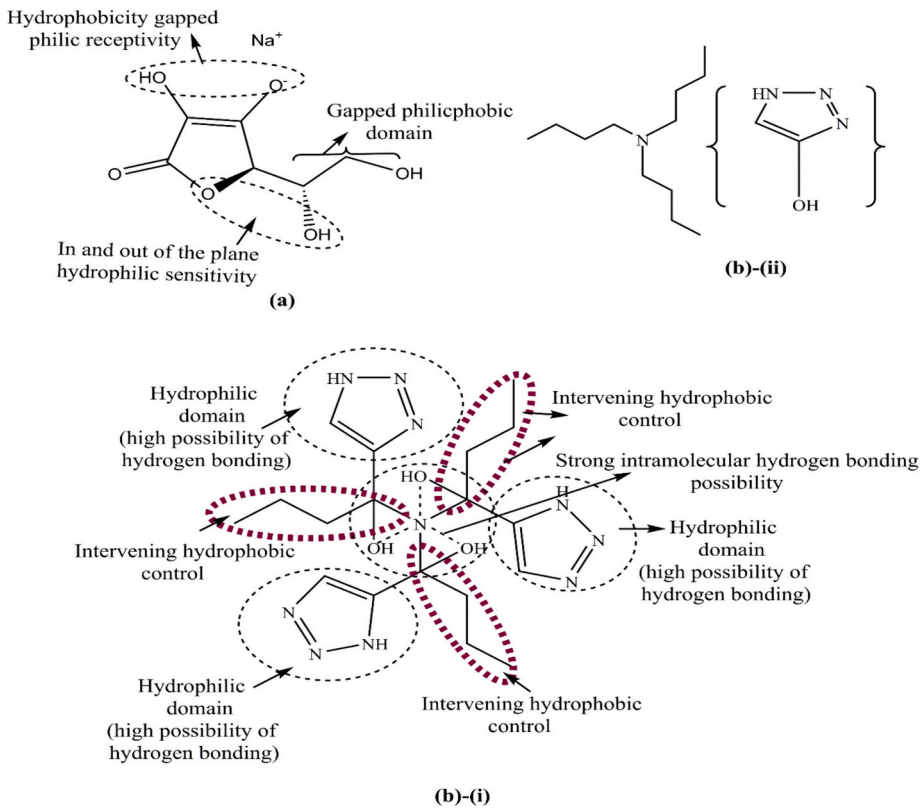

Fig. 9. Structural proximities of a) sodium ascorbate (SA), and (b)-(i) tris-(hydroxypropyltriazolylmethyl) amine (THPTA) and (ii) overlapping hydrophobic and hydrophilic domains in THPTA structure. While SA facilitated the reduction in the Cu^{+} catalyzedazide-alkyne cycloaddition and chemical ligation of alkyne and azide modified ssDNA, the intent of adding THPTA was to stabilize water-soluble copper(I) ligand exclusively used in copper(I)-catalyzed alkyne-azide cycloaddition.

expressions is the virulence factor generation, including protein toxins and cell-surface proteins binding for inactivating the antibodies [107].

Progressing to 2017, the first notable attempt by *Wang and colleagues* [108] demonstrated a signal-amplified lateral flow test strip (SA-LFTS) for Cu^{+2} aqueous screening using click chemistry based Cu^{+} hybridization of ssDNA. The alkyne and azide modified ssDNA perceived Cu^{+2} *via* Cu^{+} aided cycloaddition *vis-à-vis* alkyne and azide groups modified ssDNA, chemical ligation. The ssDNA-Au NPs hybridization resulted in high sensitivity with naked eye visualization of test strip ligated ssDNA. Primitive SA-LFTS features comprised DNA-A (azide group) and biotinylated DNA-B (alkyl group) as Cu^{+2} recognition reagents. Assay worked through azide cycloaddition and alkyne functionalized ssDNA to generate a click ligated, ssDNA chain (like, DNA-A-DNA-B). This ssDNA was biotinylated and applied to the test strip (Fig. 8(i & ii)). The reaction commenced with ssDNA-DNA-Au NPs probe I hybridization on strip detection pad (partially complementary to DNA-A). Upon test line migration of this complex, it was captured by strepdivin-biotin complex *via* Au NPs binding. The Au NPs binding with DNA-C was deciphered as red band on control line, confirming a proper functioning of test strip. Thereafter, DNA-Au NPs probe II was hybridized with DNA-Au NPs probe I on the amplification pad, resulting in Au NPs test line accumulation. Monitoring the test line colour change validated Cu^{+2} existence, based on which the quantitative screening was optimized using portable strip reader recorded relative intensity. Fig. 8(iii) illustrates the

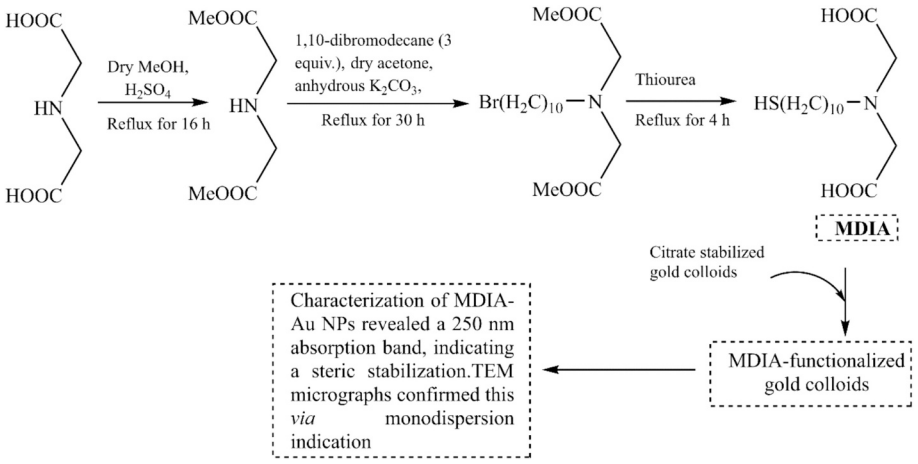

Fig. 10. Optimized procedure for 10-mercaptodecyl-1-iminodiacetic acid (MDIA) synthesis and its functionalization with Au nanoparticles, for the 2017 study by *Chai and colleagues* [110].

optimized probe configurations, wherein sodium ascrorbate moderated Cu^{+} catalyzed azide-alkyne cycloaddition and subsequent ligation of alkyne-azide modified ssDNA. The optical response for sodium ascorbate variations revealed 800 μM as adequate extent which was similarly ascertained as 1 mM for tris-(hydroxypropyltriazolylmethyl) amine (THPTA, for enhanced Cu^{+} binding) with a pH of 7 (highest relative intensity). Functional assay retrieved an LOD of 4.2 nM, ~four orders lower than US Environmental Protection Agency (EPA) prescribed 20 μM. Specificity for Cu^{+2} was monitored *via* test line colour intensity and Mg^{+2}, Hg^{+2}, Pb^{+2}, Ca^{+2}, Cd^{+2}, Zn^{+2}, Fe^{+3}, Na^{+}) responses. Except 100 nm Cu^{+2}, no ion developed a bright red band. Practical feasibility was studied using (20, 200 nM, 2 μM) Cu^{+2} spiked municipal and river water, retrieving (92.30–106.52)% recoveries, confirmed by inductively coupled Mass Spectroscopy (ICP-MS).

Fig. 9a depicts sodium ascorbate and THPTA distinctions, wherein oxygen, OH and Na^{+} functionalities of the former confer a hydrophilic sensitivity while the in and out O, –OH placements in the 5-membered ring and extended aliphatic chain manifested hydrophilicity. Similarly, the terminal –OH in aliphatic chain conferred philicphobic sensitivity. For THPTA, alternative hydrophilic and hydrophobic domains manifest a homogenization (Fig. 9b-i). The overlapping hydrophilic domains (-OH substituted pyrimidine ring) and N centred 3 alkyl chains (ACs) are demarcated in Fig. 9b-(ii). The THPTA inclusion in the probe assembly stabilized water-soluble Cu (I) ligand, widely used in Cu(I)-catalyzed alkyne-azide cycloaddition [109]. These logics could be extended to detection assays *vis-à-vis* moderate analyte-probe interactions. Stronger DNA-Au NPs hybridization with sodium citrate affirmed a best sensing, leaving aside PBS and Tris-HCl.

Another significant 2017 study from *Chai and colleagues* [110] used 10-mercaptodecyl-1-iminodiacetic acid (MDIA) to modify Au NPs for RT Cu^{+2} sensing from solution. Fig. 10 illustrates MDIA synthesis, its post synthesis characterization and Au NPs (made using Turkevich's method)-functionalization Subsequent to Cu^{+2} binding, the MDIA@Au NPs absorbance decreased with a distinct 560 nm band besides a red to purple change. These observations were complemented by TEM micrographs, exhibiting Cu^{+2}-carboxylate ligand complex formation on Au NPs surface with. The estimated LOD for Cu^{+2} was $1\bullet10^{-4}$ mol•L^{-1}, ascertained *via* colour change intensity. The 520 nm absorbance changes *via* calibration plot, revealed a linear trend for ($5\bullet10^{-6}$ to $5\bullet10^{-4}$) mol•l^{-1} Cu^{+2}. The 3.9% RSD for five assessments inferred reproducibility of the assay. The EDTA effect on MDIA@Au NPs *vis-a-vis* enhanced Cu^{+2} extents revealed sudden intensity increments *via* RT (610 to 520) nm blue shift, with red to purple colour change, indicating strong EDTA-Cu^{+2} interactions. The assay reusability screening revealed an aggregation (red to purple) on Cu^{+2} and EDTA addition. Continued EDTA addition generated red colour again, suggesting a reversible aggregation *via* metal ion chelation. The Cu^{+2} holding MDIA@Au NPs were thus, centrifuged to separate Cu^{+2} complex and the MDIA@Au NPs were dispersed in distilled water, promptly developing a red colour. Similar observations on equal Cu^{+2} addition to MDIA@Au NPs inferred the assay reusability. Analysis for Cu^{+2} detection from acidic waste having (30, 40, 50, 60 and 70) μM Cu^{+2}, was done *via* mixing 1 mL concentrated MDIA@Au NPs with 9 mL acid etching solution. On 30 min stirring, the mixture was centrifuged to retrieve the supernatant which on Atomic Absorption Spectrophotometer (AAS) screening, revealed 3051 mL•g^{-1} as absorption coefficient. Thus, this study used MDIA functionalized Au NPs to screen Cu^{+2} with a feasibility to screen erstwhile chelating agents other than EDTA.

Next in line is a 2018 study, using monoclonal antibodies (MAbs) and 6-carboxyfluoroscein labelled single stranded-thiol oligonucleotides (6-FAM-SH-ssDNAs) functionalized Au NPs. The study screened triazophos (a pesticide) *via* ovalabumin conjugated haptens competitive assay for antibodies anchored Au NPs. Functionalization with 6-FAM quenched the Au NPs fluorescence *via* inverse variance with analyte extent. Sensing parameters included an hour of salting whereby (166 ± 9) ss DNAs were loaded on Au NPs. Feasibility studies were done on water,

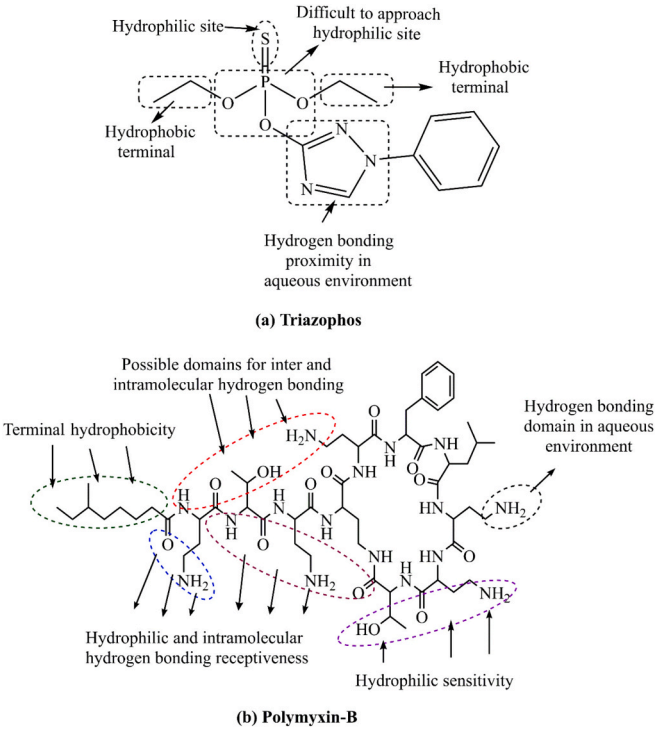

Fig. 11. (a) Distribution of hydrophilic and hydrophobic force factors in the insecticide triazophos, and (b) the drug polymyxin-B. Manifold hydrophilic sensitivities in both compounds confer the possibility of significant hydrogen bonding, with the latter exhibiting significant intra and inter molecular controls.

rice, cucumber, cabbage and apples, revealing (0.01–20) μg•L^{-1} linear range, 6 ng•L^{-1} LOD, (85–110.3)% recovery and (9.4–17.4)% RSD. The assay revealed 0.9794, 0.9758, 0.9783, 0.9841, 0.9709 correlations with liquid chromatography-tandem mass spectrometry (LC-MS) [111]. Specificity studies deciphered >2000 μg•l^{-1} IC_{50} for chlorpyrifos, chlorpyrifos methyl, parathion, malathion, diazonin and fenitrothion. The P and S double bond besides multiple N substituted 5-membered ring in traiazophos endow a tough biodegradation (Fig. 11a). Assay efficacy could be improved *via* S and P double bond interception, with 3 O linked to P and hydrophobic sensitivity at the terminal locations. The S atom in P—S linkage restricts the approachability to P *via* its lone pair electrons and reduces the hydrophilic activities of the pesticide. The π-conjugation at the terminal location of middle O atom linked to P manifests a electrophilic sensitivity and could be re-engineered *via* substitution to augment the detection *vis-à-vis* moderate cationic probe sensitivity.

The first noted attempt from 2019 used polymyxin-B conjugated Au NPs (PMB-Au NPs) for lipopolysaccharide (LPS) (a bacterial endotoxin) detection. Sensing probe comprised a U-bent fibre optic probe (UFOP), entrapping LPS from aqueous solutions using biomimetic self-assembled octadecyltrichlorosilanes (OTS) layer functionalization. Fig. 12 summarizes the UFOP fabrication and its characterization for sensing response. The OTS coating of fibre surface was engineered *via* incubation with fixed fluoro-LPS on getting rid of excess LPS. Real time probe efficacy was ascertained from an improved RI sensitivity whereby a glass flow cell having OTS functionalized UFOPs was dipped in samples with varied LPS amounts. Inspection revealed an LPS RI of ~1.5 contrary to 1.45 for bulk OTS solution, due to an additional LPS layer *via* displacing water (RI = 1.33). The LOD with OTS free UFOP was 0.1 μg•mol^{-1}, assuming 10 kDa as LPS molecular weight.

Screening of PMB bound Au NPs at 525 nm revealed an enhanced absorbance, varying exponentially with LPS amount with 1 ng•mL^{-1} as least screened LPS extent; two orders higher than direct assay

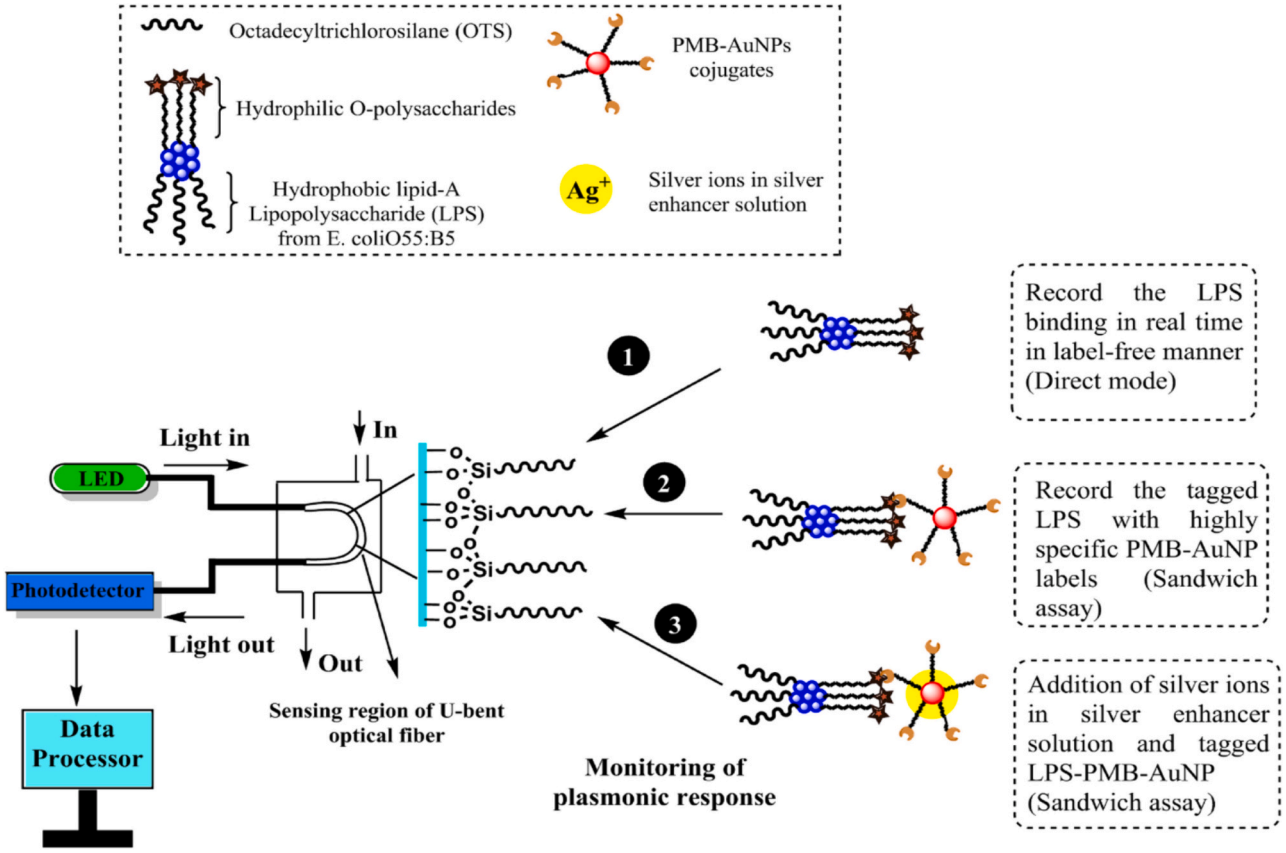

Fig. 12. Fabrication steps forU shaped bent fibre optic probedevelopment and its characterization for sensing response, for the 2018 study of *Zhang and colleagues* [111].

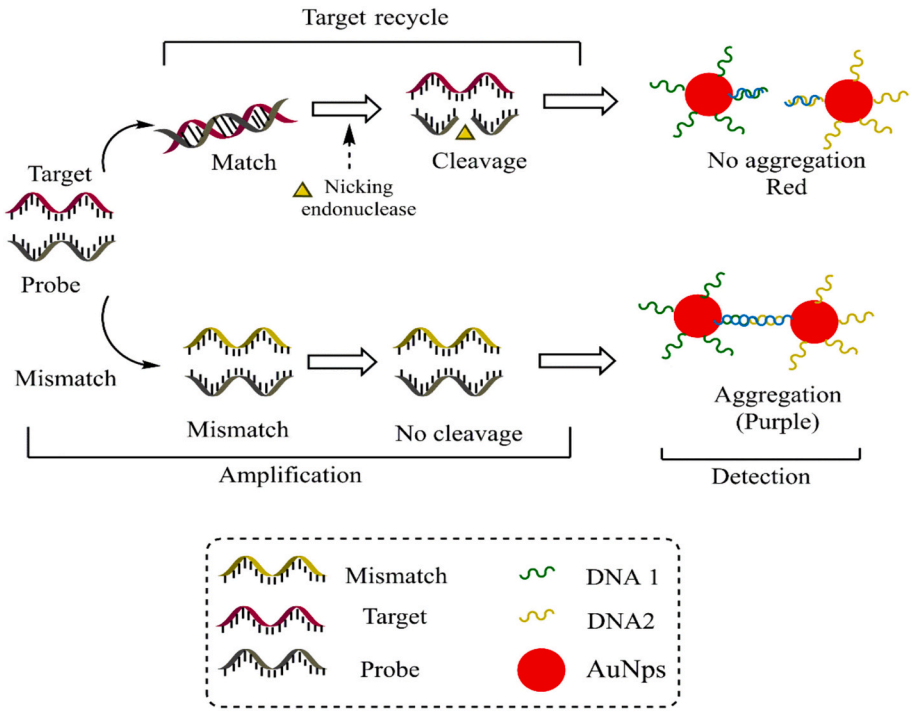

Fig. 13. Optimization of probe design, in terms of amplification and detection procedures for DNA nanoparticles mediated zebra mussel DNA identification in contaminated water samples [116].

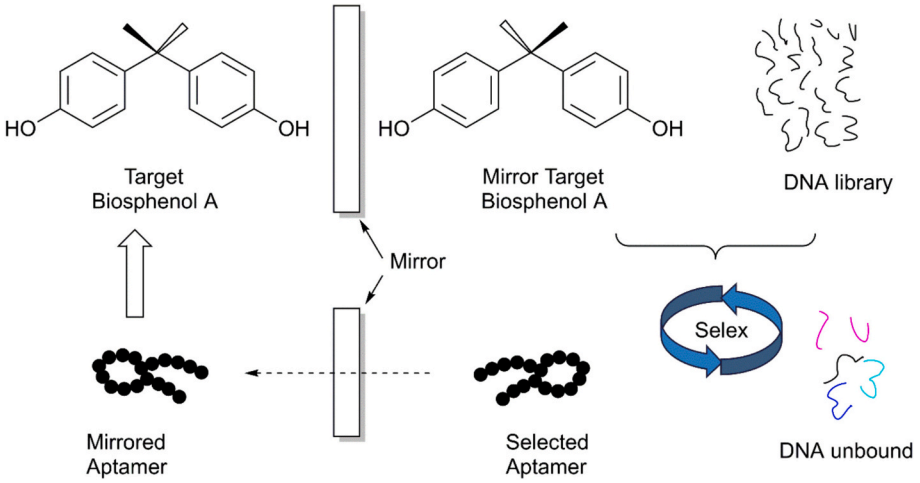

Fig. 14. Optimization of probe design for D-oligonucleotide enantiomers mediated Bisphenol A detection in contaminated water samples [119].

[112,113]. Linear detection within (0.1–100) ng•mL^{-1} with 0.97 correlation coefficient, supported the SEM observations. Specificity inspection for threonine, tyrosine, lactic acid, human immunoglobulin (IgG), normal saline and dextrose normal saline revealed (10−100) folds higher LPS extents. The response was monitored *via* incubation in 100 ng•mL^{-1} LPS-interferers and PMB-Au NPs, revealing least LPS contamination for human IgG with none signal being >15% without interferers. Sensitivity enhancement *via* catalytically assisted Ag deposition on Au NPs, facilitated prompt Ag^{+} reduction and subsequent nucleation [114]. Upon 3 min Ag enriching, unfolded probes exhibited a dose dependent signal with 36 fold higher sensitivity, 0.998 correlation coefficient and a (0.1–100) ng•mL^{-1} linear response. The LOD was 0.4 ng•mL^{-1}, better than sandwich assay regime. The Ag enhancement revealed a large red shift on Ag NPs deposition over the fibre surface

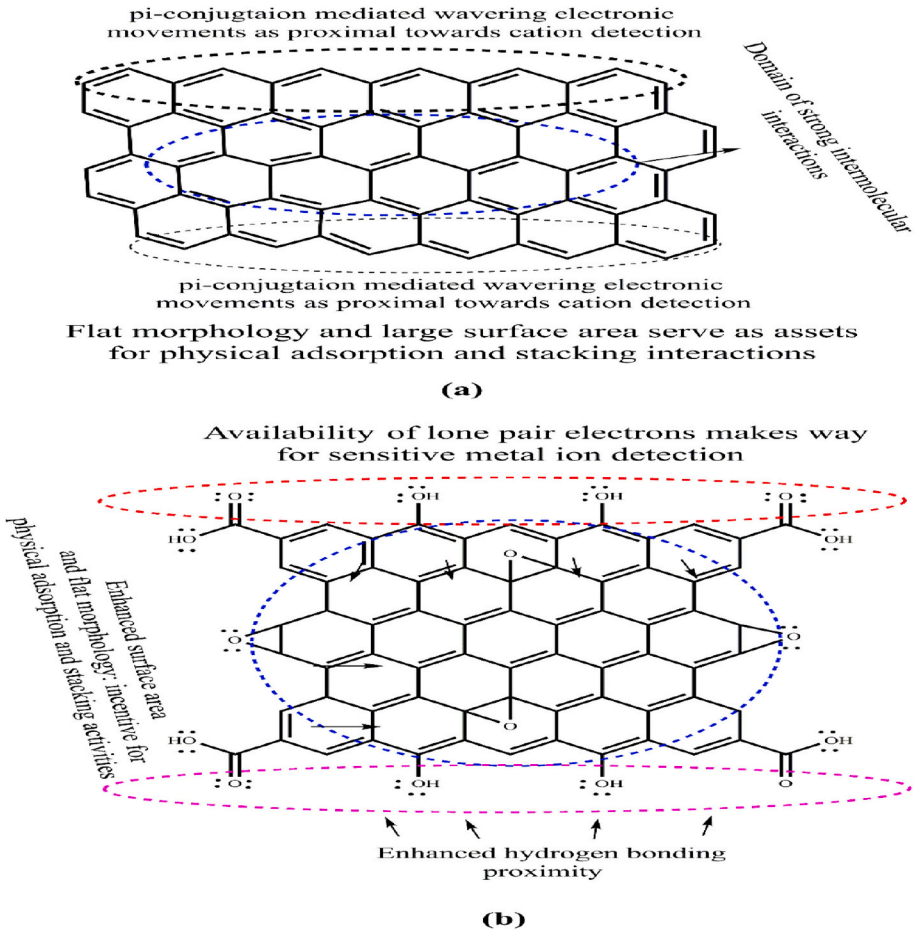

Fig. 15. Schematic representation of (a) sp^2 hybridized pure carbon hexagonal lattice, and (b) representative chemical structure of graphene oxide. While hexagonal lattice depicts the large surface area of graphene the formation of graphene oxide is attributed towards enhanced interactive functionalities *via* conjugated O and –OH functionalities. Varying oxygen contents in graphene oxide formed from graphene are the basis of multiple applications.

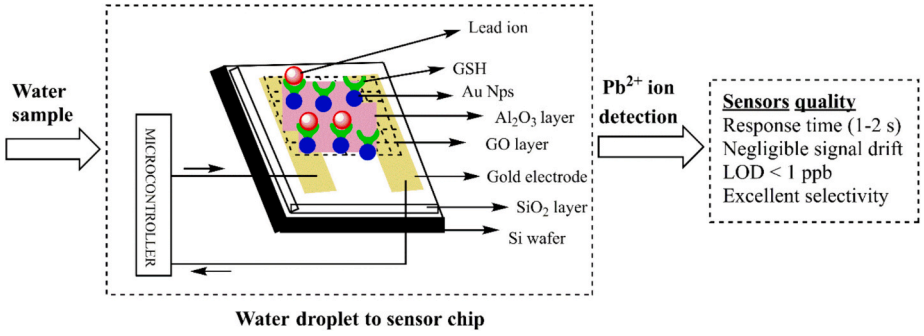

Fig. 16. Pictorial depiction ofsensor chip describing the functional biosensing mode for the 2017 study by *Maity and colleagues* [127].

[115]. Fig. 11b depicts the PMB structure, wherein O, -OH and $–NH_2$ groups manifest a hydrophilic sensitivity. Closer O and $–NH_2$ placements besides –NH, =O, -OH,$–NH_2$ functionalities infer a sensitivity for intra and inter molecular HB. A weaker hydrophobicity with only one AC attributed the probe-analyte interactions a stronger hydrophilic sensitivity.

Next in line is a 2021 effort, wherein target DNA amplification mediated signal enhancement was validated *via* dual mode colorimetric naked eye and smartphone screening, for screening zebra mussel DNA. Of note, zebra mussel is an invasive, fingernail sized mollusk native to Eurasian freshwaters, named so due to zig-zagged shell stripes. Analyte DNA amplification was accomplished *via* nicking endonuclease cleavage of probe-complimentary target hybridization subsequent to which, modified probe interacts with DNA functionalized Au NPs. Fig. 13 depicts a target DNA amplification and detection, improving the naked eye sensitivity by 12 folds for ~8 nM LOD in controlled conditions and 22.5 nM in complex environment. The assay discriminated zebra mussel DNA sequences besides 130 fold improved sensitivity *via* smart-phone monitored environmental samples. The 0.17 nM LOD was highly relevant to gauge aggregation with reduced naked eye subjectivity [116]. Subsequent study using biomolecules functionalized Au NPs for water quality screening used D-oligonucleotide enantiomers for ascertaining bisphenol A (BPA) contamination. Of note, BPA is a prominent plastic monomer widely reported for its endocrine disruptive actions [117,118]. The study exploited aptamer binding ability of D-oligonucleotides enantiomers *via* Biolayer interferometry alongside screening biological stability on nucleases exposure. Fig. 14 depicts the optimized probe configuration as label free Au NPs colorimetric assay for BPA detection with 0.057 ng•mL^{-1} LOD over (100 pg•mL^{-1}-10 mg•mL^{-1}) range [119]. Another 2022 effort from *Ye and colleagues* [120] demonstrated multiplex sensors with specific locus centred aptamer functionalized Au NRs facilitated Pb^{+2} and Hg^{+2} detection. The detection of heavy metals (Pb and Hg) was optimized *via* distinct responses of individual Au NRs with characteristic spectra shifts in the scattering spectrum. Inspection of bound Pb and Hg using a spectral imaging dark field microscope ascertained the response of manifold single plasmonic nanosensors with high time resolution and precision. The LOD for the assay was determined *via* monitoring concentration specific response of position specific nanosensors for Hg^{+2} and Pb^{+2} containing mixtures. Inspection revealed 5 nM (Pb^{+2}) and 1 nM (Hg^{+2}) sensitivities, exhibiting the feasibility to screen other heavy metal ions (alike periodic table groups).

4.4. Gold nanoparticles anchored graphene and reduced graphene assemblies

Large SA and functionalization diversity of graphene and its derivatives are the reasons for their remarkable applications in catalysis, energy storage and conversion. Structural distinctions of graphene include a single, thin layer of tightly packed pure carbon atoms as hexagonal honeycomb lattice with sp^2 hybridization and a 0.142 nm C—C bond length (Fig. 15a). With a thickness of ~one atom and (100−300) times higher strength than steel, graphene oxide (GO) is the most used graphene derivative, prepared *via* graphite oxidation (Fig. 15b). Multiple applications of GO include use in electrodes, solar cells, polymer filler for improved tensile strength, elasticity, conductivity *etc.* [121,122]. The studies using graphene/GO-Au NPs as probes for screening water quality are as discussed ahead.

First major post 2015 study herein, examined NO_3^- *via* absorption spectrum, involving Au NPs interaction with $-NH_2$ modified GO ($-NH_2$@GO), avoiding aggregation due to low NO_3^- amount remaining untraced *via* conventional assay. The optimized probe configuration exhibited a reduced aggregation on NO_3^- and modified GO interaction, screening NO_3^- *via* absorption spectrum, superseding the Au NPs due to anionic impurities. Optimization involved no pretreatment, screening 5 nM NO_3^- in DW, much lower than 161 μM (absorption spectroscopy) [123]. The Au NPs used herein were prepared *via* citrate reduction and optimized *via* 10 min, 8000 rpm centrifugation of their 4 mL quantity on aqueous washing and subsequent dispersion in 0.2 mL H_2O. Real screening was done *via* deliberate NO_3^- contamination on 10 min centrifugation of river water (pH = 7) at 10,000 rpm. Finally, 20 μL, 1 mg•mL^{-1} $-NH_2$@GO was mixed with sample (1:1) and incubated for 1 h at RT, before examining its UV–visible absorption. A decisive step in probe optimization involved ethylenediamine (EDA) modification of GO sheets, prior to $–NH_2$ functionalization. The $-NH_2$@GO mixing with Au NPs induced their aggregation *via* electrostatic interactions, nullified *via* NO_3^- π-aromatic cloud interception of $-NH_2$@GO [124]. Detection sensitivity (ΔR) was monitored *via* subtracting $R_{nitrate}$ to R_{blank} ratios, where $R_{nitrate}$ was 620 to 520 nm absorbance ratio of NO_3^- contaminated samples in UV–visible spectra while R_{blank} was similar extent for blank samples. A high ΔR inferred a NO_3^- contamination with a higher sensitivity, where (1.51–4.53) μg•mL^{-1} increment enhanced ΔR. Since 6.03 μg•mL^{-1} GO decreased the ΔR, 4.53 μg•mL^{-1} was chosen as optimum GO. The investigators noted inadequate signal distinctions for blank and NO_3^- contaminated samples due to excessive aggregation. The optimum incubation for detection sensitivity was ascertained as 1 h. Polarity changes inferred $-NH_2$@GO-NO_3^- interactions, with −29.4 mV ζ-potential for GO being enhanced to −18.9 mV for EDA modified GO and yet again decreasing to −26.6 mV on NO_3^- incubation. These surface polarity changes for NO_3^- neutralizations were supported by SEM and TEM inferred Au NPs aggregation for null and 50 mM NO_3^-. Selectivity was ascertained *via* Cl^-, Br^-, I^-, SO_4^{2-} recognition, where only NO_3^- decreased absorption ratios at 620 and 520 nm (Au NPs SPR) [125]. Commercial feasibility was monitored *via* screening NO_3^- contaminated river water, wherein 5 nM was retrieved as LOD, in river and DW [126]. The sensing precision could be further improved using GO derivatives and highly diverse morphologies for Au NPs shapes and sizes (obtained on altered precursor to reducing agent ratios).

Next in line is a 2017 effort, wherein an ultrasensitive pulse-driven capacitance based Pb^{+2} recognition was accomplished *via* self-assembly driven GO monolayer to monitor the contamination of water samples. Intact field effect transistor (FET) comprised thermally reduced

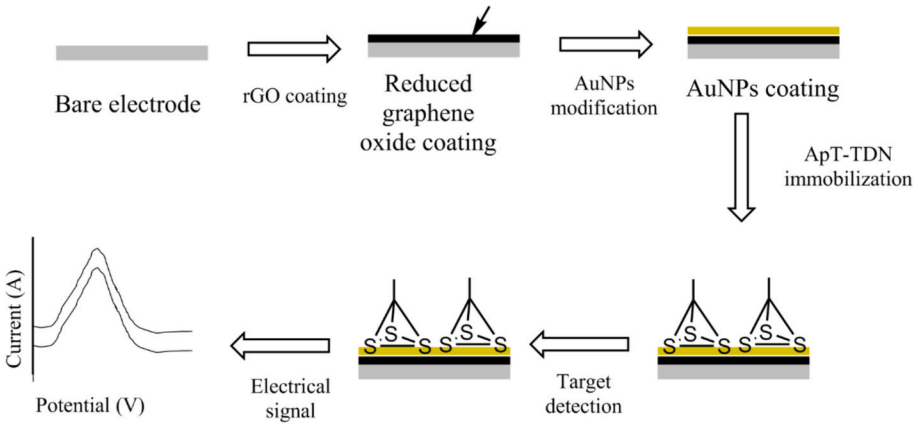

Fig. 17. Optimized probe configuration, comprising Au NPs functionalization on the electrochemically reduced graphene oxide surface and concomitant enrichment by tetrahedral DNA nanostructures for ampicillin detection in aqueous environment [128].

GO channel with a defunct thin Al_2O_3 layer as a top gate combined with sputtered Au NPs conjugated glutathione (GSH) as probe. Fig. 16 summarizes the sensor chip configuration, working module and electronic properties for the probe. For real application, a miniaturized Arduino-based microcontroller was programmed to generate pulses, capacitance signal reading and continuous data recording. The Pb^{+2} probe-specificity was ascertained *via* its insignificant responses for Zn^{+2}, Mg^{+2}, Hg^{+2}, Cd^{+2}, Fe^{+3}, Na^{+} and Ag^{+}. Sensitivity was monitored *via* monitoring real time capacitance transient for Hg^{+2} (5–100 ppb) with Pb^{+2}, revealing an insignificant relative capacitance change for Hg^{+2} solution. Commercial feasibility was adjudged *via* water samples from the city of Flint, fresh tap water from Milwaukee, Lake Michigan and river Mailwaukee, revealing agreements with ICP analysis for Flint water, having 2.38 ppb Pb^{+2} than <0.8 ppb for others. The 180 and 30% capacitance transient responses for Flint water and Milwaukee tap water enabled a (0.4–2.38) ppb Pb^{+2} screening in Flint water. The assay time for background stabilization subsequent to Pb^{+2} monitoring was ascertained as 10 s, was much lower than FET resistance (in min) and inductive/optical plasma methods (in hours). Approximate linear range (5–20) ppb estimation for ~15 ppb extent projects probe suitability for drinking water [127]. Intriguingly, functionalization with doped graphene could improvise the accuracy *via* reduced interception time. The optimized configuration (rGO passivated by thin Al_2O_3 as top gate with GSH functionalized sputtered Au NPs) could be engineered for other impurities too. Besides, portable configuration could be employed in remote locations and moderate economies.

Latest attempt in rGO-Au NPs screened water quality is a 2022 study whereby, aptamer mediated electrochemical sensing was optimized *via* surface engineering and DNA nanotechnology to monitor ampicillin contamination in animal products. The working electrode was modified in SPCE *via* electrochemically rGO and Au NPs enhanced electrochemical conductivity (Fig. 17). Subsequent surface engineering *via* self-assembled tetrahedral DNA nanostructures (TDN) improved the detection sensitivity, *via* aptamer nano-spacing immobilized over electrode surface. These aptamers were put in solution for target binding, and accessed *via* differential pulse voltammetry for bound ampicillin extents. Analysis revealed a (10 pM-1 mM) detection in <30 min with 1 pM LOD, ~100 folds higher than without TDN functionality. Feasibility monitoring revealed a reusable tendency on DW rinsing besides 15 day storage stability and reproducibility [128].

4.5. Miscellaneous platform configurations of Au nanoparticles as water sensors

An integrated approach using microfluidics and porosity modulated papers as sensing platforms (microfluidic paper based provisions, μPADs) *vis-à-vis* laser printing (LP) devices feasibility for pesticide screening in aqueous conditions. Optimized probe configuration was accomplished *via* studies with varied paper platform porosities, textures and channel thickness. The Au NPs for the probe were prepared using citrate reduction, ensured *via* terminal colour change to blue. The as prepared NPs were thoroughly screened for their nanoscale traits, using DLS, UV–Vis spectroscopy and SEM. Optimized LP-μPAD configuration was prepared using Adobe illustrator software (V2019), wherein a laser printer was employed to print a hydrophobic barrier over the filter paper having a highest printing ability (600 DPI). Printed filter papers were uniformly heated in an incubator at 170 °C till 30 min (forming requisite hydrophobic barrier) to ensure optimum paper impregnation with toner ink. The 2023 effort from Turkey involved a thorough probe characterization to screen the titre of atrazine (a chlorinated triazine systemic herbicide used to selectively control the annual grasses and broadleaf weeds prior to their emergence) in water *via* colorimetric assessments using a smart-phone assisted imaging. Analysis revealed an LOD of 10.9 μM with high repeatability and reproducibility. Thereby, the probe configuration in this study conceptualized a successful integration of laser assisted viewing across the microfluidic, capillary flow assisted paper channels for specific detection of pesticides. Interference studies revealed the pesticide screening as unaffected by added NaCl quantities and varied pH levels. On the whole, the study presented LP assisted capillary flow monitoring as effective and low-cost remedy for accessible water quality monitoring [129].

5. Summary and future directions

We have presented a comprehensive account of Au NPs sensing distinctions (shape-size modulated structure-function diversity) alongwith the discussion of prominent research attempts using their diversified regimens for screening the contamination of water resources. The reason for unceremonious interest in Au NPs as sensing moieties for validating the upright quality of water resources is the remarkable stability of Au which assists in their robust functionalization. Besides the steadfastness of manifold reproducible and nature friendly preparation methods (largely bottom-up) with a well-understood mechanism and physical indications are the additional impetus. The first mechanism of Au NPs use in biosensing relies on their monodispersed or aggregated state variations in SPR. Second workable strategy involves the coating of electrodes with Au nanothin films (due to electrically conductive nature of Au). Third strategy towards Au NPs use as water quality assessment agents involves their functionalization with biomolecules such as antibodies, engineered DNA or RNA fragments, proteins, carbohydrate derivatives and others. This configuration of Au NPs could be used for *in vivo* screening owing to a compatible functioning of the probe. Fourth

Table 3
Summary of post 2000 studies with a brief description of probe configurations and major findings, complete discussion of these attempts features in the text.

Sensed stimulus	Sensing configuration of Au NPs	Response characteristics (linear range, LOD and sensitivity)	Reference
Singular or combinatorial existence driven SPR changes			
Aflatoxin B1-MRS	Dumbbell similar Au-Fe_3O_4 NPs as magnetic nanoprobes	• Au NPs as core facilitated the growth of Ag shell and gather Au-Fe_3O_4 NPs, modulating transverse relaxation time of neighbouring water molecules • Ag(shell)-Au-Fe_3O_4 core-shell NPs as probe were generated by H_2O_2 • On horseradish peroxidase degradation, H_2O_2 reduces Ag^{+} to Ag^{0}, accumulating dispersed Au-Fe_3O_4 as Ag@Au-Fe_3O_4 NPs • With 3.81 pg•mL^{-1} sensitivity, the Ag@Au-Fe_3O_4 NPs as nanoprobes • 21 and 9 folds better efficacy than ELISA and HPLC • Consistency with HPLC for real samples inferred accuracy for optimized configuration.	[97]
Escherichia coli contamination	Au@MnO_2 NPs in core-shell morphology having MnO_2 as shell	• LOD: 15 CFU•mL^{-1} • Dynamic range: (100–2900) CFU•mL^{-1} • Ultrasensitive and low cost *E. coli* screening in river water	[98]
Hg^{+2}	Au@Ag core-shell NPs as SERS substrates while rhodamine 6G (R6G) as a Hg^{+2} signaling probe	• Hg^{+2} screening accomplished *via* quenching of R6G strong SERS signal on interaction with Au@Ag NPs, slowly replacing Ag^{+} by bound Hg^{+2} • Blue shift in UV–Vis SPR peak of Ag shell of Au@Ag NPs, reducing Hg^{+2} to Hg^{0} on Ag shell surface of Au@Ag NPs, on Hg^{+2}-citrate ion of Au@Ag NPs complex formation • 0.9745 and 0.9773 as correlation coefficients within (10^{2}–10^{-3}) µg•g^{-1} • (88.45–94.73)% recovery and (3.28–5.76)% as coefficient of variations	[99]
Electrochemical Configurations			
Pb^{+2}	Au NPs-Ppy-$Ti_3C_2T_x$ nanocomposite prepared *via* layered self assembly PPy is an organic polymer retrieved *via* oxidative polymerization of pyrrole	• XPS and XRD inspections revealed $Ti_3C_2T_x$ significance in PPy formation, alignment and Au NPs growth • Au NPs facilitated covalent linkage, *via* Au—S functionality • Response analysis inferred a 5•10^{-14}-1•10^{-8} M linear working range with 1•10^{-14} M LOD • Good selectivity and sensitivity for Pb^{+2} in Nong Fu spring and tap water • *E. coli* identification was accomplished *via* square-wave, differential pulse and cyclic voltammetry	[105]
Escherichia coli screening in pharmaceuticals or certain real samples	• Multi-walled CNTs-Au NPs-*E. coli* polyclonal Ab-BSA optimized at pH = 7 using PBS buffer • Acetaminophen was added for *E. coli* detection *via* conductivity and current variations	• Square-wave voltammetry revealed 3.02 CFU•mL^{-1} as LOD 3 min with adequate sensitivity, repeatability and reproducibility • Could be explored for drug safety, quality control, clinical diagnostics and environmental assessment	[106]
Au NPs functionalized with compatible biomolecules			
Zebra mussel DNA (an invasive, fingernail sized mollusk)	Nicking endonuclease assisted Au NPs signal amplification	• 12 fold higher naked eye sensitivity • LOD: ~8 nM in controlled and 22.5 nM in complex environment • Smartphone improved sensitivity by 130 folds with 0.17 nM LOD, • Probing aggregation tracking with increased accuracy and reduced naked eye subjectivity	[116]
Bisphenol A (widely reported for its endocrine disruptive activities)	First ever use of nuclease resistant spiegelmer in a label-free Au NP based colorimetric assay	• Aptamer-target interactions supported by chemically made spiegelmers were screened using biolayer interferometry	[119]

(*continued on next page*)

Table 3 (*continued*)

Sensed stimulus	Sensing configuration of Au NPs	Response characteristics (linear range, LOD and sensitivity)	Reference
Pb^{2+} and Hg^{2+}	Multiplexed nanosensors having locus fixation aptamer functionalized Au NRs	• Stabilities in multiple biofluids was examined *via* exposure to nucleases • 0.057 ng•mL^{-1} LOD over (100 pg•mL^{-1} to 10 mg•mL^{-1}) range. • Highly sensitive and selective efficacy, non-biodegradable platform for sensitive bisphenol A detection • Home-built spectral imaging dark-field microscope screened thousands of single plasmonic nanosensors • Explicit Au NRs responded to Pb^{+2}, Hg^{+2} *via* discrete SPR alterations • LOD: 5 nM for Pb^{2+} and 1 nM for Hg^{2+}, exhibiting suitability for other heavy metal ions too	[120]
Au NPs functionalized Graphene oxide or its functionalized derivatives			
Antibiotic ampicillin	Electrochemically reduced graphene oxide-Au NPs surface coated by self-assembled tetrahedral DNA nanostructures	• (10 pM-1 mM) detection in <30 min with 1 pM LOD • ~100 fold better than without TDN. • Reusable platform on rinsing with deionized water besides 15 day storage stability and reproducibility	[128]
Integrated Configurations (Not matching any of the above)			
Atrazine (a pesticide)	Dual chromatic laser-printed microfluidic paper-based analytical device (μPAD)	• LP assisted capillary flow as effective and low-cost remedy for accessible water quality monitoring • Optimized LP-μPAD was prepared using Adobe illustrator, wherein a LP aided imprint of a hydrophobic barrier over the 600 DPI ability filter paper • Atrazine titre was screened using 170 °C dried filter papers *via* colorimetric assessments and a smart-phone assisted imaging • LOD of 10.9 μM with high repeatability and reproducibility	[129]

Abbreviations: SPR: surface plasmon resonance, MRS: magnetic relaxation switching, MOF: metal organic framework, IgG: immunoglobulin G, NPs: nanoparticles, NRs: nanorods, LOD: Limit of Detection, MDIA: 10-mercaptodecyl-1-iminodiacetic acid, LPS: lipopolysaccharide, NPs: nanoparticles, PPy: polypyrrole, FAM: carboxyfluoroscein, GO: Graphene oxide, GSH: glutathione, ppb: parts per billion, LP: laser printer, rGO: reduced graphene oxide.

configuration of Au NPs monitored water quality involves their functionalization over the surface-active graphene oxide and its related configurations. Functionalization holds the backbone aspects of Au NPs use in water quality monitoring and could be done in covalent/non-covalent mode to engineer the interaction potentials. Table 3 summarizes the post 2020 attempts for the discussed Au NPs configurations where the LOD differences convey the precision sensitivity of miniaturized dimensions. Distinct responses are the typical outcomes of characteristic size-shape modulations wherein quantum effects are exhibited at ease with larger SA. Future insights for similar applications of Au NPs could be consolidated *via* ascertaining a reproducible performance of their composite configurations alongwith improving their specific response. Docking simulations for integrated prevalence and optimized combinations with Au NPs could help predict their stability and a transition driven energetic excitations and de-excitations. Enhanced precision of characterization techniques is a crucial aspect of reliance for such diversified applications of Au NPs. Collaborative participation of chemists with material scientists and electronics expert could strengthen the Au NPs accuracy further with the integration of micro and nano electromechanical systems (NEMS and MEMS) could still fasten the read out mechanisms of analyte-probe interactions. Micromachining and surface engineering of NMs alongwith predictive *in situ* tools consolidate the constitutional energy levels for infinitesimal responses.

6. Conclusions

The native state high stability of Au NPs encompassing their manifold functionalization, consolidates their dynamic shape-size modulated PCPs. Although singular or combined use of Au NPs remains the most understood mechanism working *via* reversible aggregation, functionalization has recently turned the attention to biomolecules coupled Au NPs assay. Despite sophisticated characterization *via* CV and EIS, better probe performance could be accomplished subject to computational assessment of combinatorial stoichiometry stability. As lifestyle changes and industrialization loom high, there is a need for high precision assisted sensing tools wherein Au NPs as the emerging frontrunners. Contaminations like antibiotics, pesticides and microbial colonies are prominent interferers in edible texture of water resources at large. Perhaps the scenario urgently needs co-operation between engineers and bio-scientists for diligent detection efficacy and time-lapse of interactions. Cautions must be exercised for a characterization specific size and functionalization abilities. These cautions must warn with results of earlier findings so that sustainability aspect is not tampered with. Likewise a rigorous tract of known response time (size-shape artefacts, reducing and capping agents for making Au NPs) must be adequately referred and update so that necessary cautions and resource conservation could be strengthened in future attempts.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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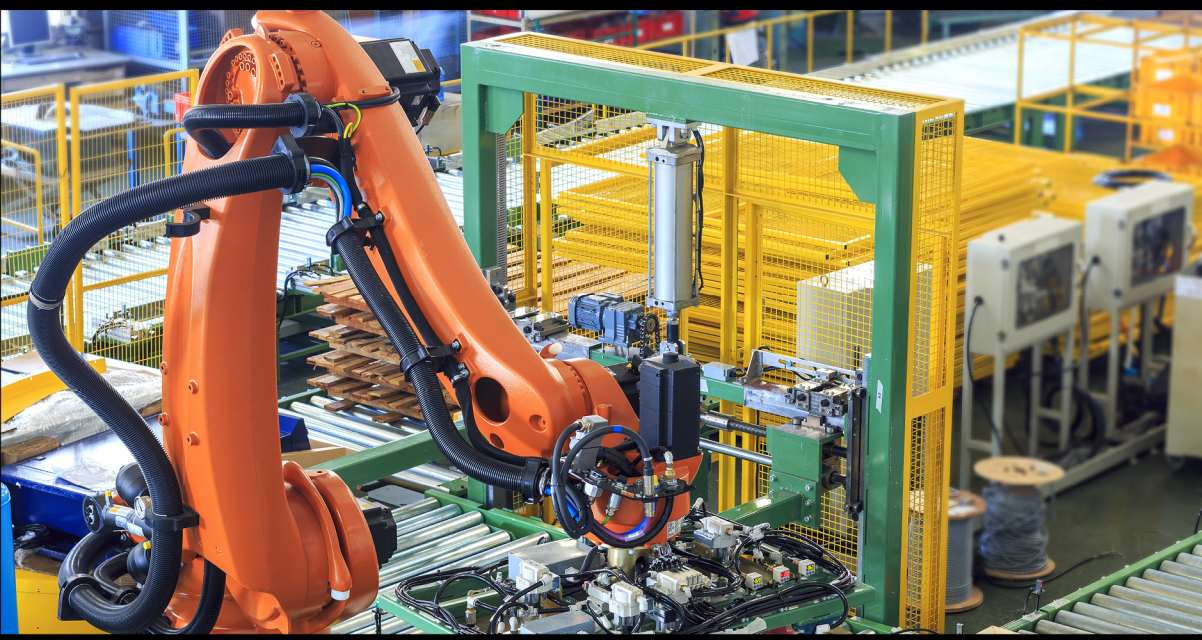
Handbook of Smart Manufacturing

Forecasting the Future of Industry 4.0

EDITED BY
Ajay, Hari Singh, Parveen,
and Bandar AlMangour



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Handbook of Smart Manufacturing

This handbook covers smart manufacturing development, processing, modifications, and applications. It provides a complete understanding of the recent advancements in smart manufacturing through its various enabling manufacturing technologies, and how industries and organizations can find the needed information on how to implement smart manufacturing towards sustainability of manufacturing practices.

Handbook of Smart Manufacturing: Forecasting the Future of Industry 4.0 covers all related advances in manufacturing such as the integration of reverse engineering with smart manufacturing, industrial internet of things (IIoT), and artificial intelligence approaches, including artificial neural network, Markov decision process, and heuristics methodology. It offers smart manufacturing methods like 4D printing, micro-manufacturing, and processing of smart materials to assist the biomedical industries in the fabrication of human prostheses and implants. The handbook goes on to discuss how to accurately predict the requirements, identify errors, and make innovations for the manufacturing process more manageable by implementing various advanced technologies and solutions into the traditional manufacturing process. Strategies and algorithms used to incorporate smart manufacturing into different sectors are also highlighted within the handbook.

This handbook is an invaluable resource for stakeholders, industries, professionals, technocrats, academics, research scholars, senior graduate students, and human healthcare professionals.

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Edited by
Ajay, Hari Singh, Parveen,
and Bandar AlMangour

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Preface

Smart manufacturing is a broad category of manufacturing that employs computer-integrated manufacturing, high levels of adaptability and rapid design changes, digital information technology, and more flexible technical workforce training. Other goals sometimes include fast changes in production levels based on demand, optimization of the production system, efficient production, and recyclability. This book is expected to provide the compiled smart manufacturing knowledge to the involved stakeholders from users in the industry to the academics and researchers. The detailed description of various smart manufacturing techniques like 3D printing, 4D printing, and approaches that makes manufacturing digital such as Industry 4.0 techniques are included in this book along with various smart materials like polymers, metals, ceramics, composites, biomaterials, biodegradable materials, responsive materials, functionally graded materials, and various applications of smart industries. In addition to above various case studies of smart manufacturing specially related to production, mechanical, industrial, computer science, electronics engineering, and biomedical are covered to help undergraduates, postgraduates, and research scholars. This compilation will bring to its readers the latest developments/advancements in smart manufacturing, which is currently not available at one place. This book will bridge the gap between R&D in smart manufacturing and professionals.

This book is an outcome of the extensive research accomplished by various researchers, academicians, scientists, and industrialists in smart manufacturing. The area is under-explored and the outcomes are worth the research effort. Experimentation, modeling, characterization, and simulation techniques are the powerful tools for developing new concepts, approaches, and solutions to devise valuable information on the process which led to need of compiling this work. Since, the information related to smart manufacturing is scattered into patents and research publications and not at one place in a systematic form, editors recognize their ethical responsibility to compile, share, and spread the knowledge accumulated and technology developed, with the students, researchers, and industry people, to draw the benefits of this work in the form of a book and gain technical competence in the frontal area.

The book consists of 18 chapters that describe perspectives of smart manufacturing with Industry 4.0 aspects. “Smart Manufacturing and Industry 4.0: State-of-the-Art Review” determines the dimensions that help in implementing smart manufacturing in the I4.0 environment in SMEs. “Study and Analysis of IOT (Industry 4.0): A Review” provides an overview of analysis of IOT adaptation effect in past and present industries. “Recent advances in Cybersecurity in Smart Manufacturing Systems in the Industry” discusses advances in the security of smart manufacturing systems, strengths and weaknesses of the manufacturing systems, existing threats, and preparedness for future cyber-attacks. “Integration of Circular Supply Chain and Industry 4.0 to Enhance Smart Manufacturing Adoption” focuses to develop a framework based on

the Fuzzy Analytical Hierarchy Process (FAHP), one of the multi-criteria decision-making methods (MCDM), which computes and assigns weights to each identified circular supply chain practice within an industry. "Artificial Intelligence with Additive Manufacturing" summarizes the role of artificial intelligence in additive manufacturing in a manner to show how innovative additive manufacturing plays a role in today's industry. "Robotic Additive Manufacturing Vision towards Smart Manufacturing and Envisage the Trend with Patent Landscape" foresees robotic additive manufacturing in various aspects covering basic system step to futuristic vision. "Smart Materials for Smart Manufacturing" demonstrates the various kinds of smart nanomaterials and their advantageous properties in both historical and future applications. "Smart Biomaterials in Industry and Healthcare" explores smart materials for bringing advancement in biomedical engineering and other industrial applications. "Ferroelectric Polymer Composites and Evaluation of Their Properties" presents the results of a study of ferroelectric polymer composites with a high permittivity. "4D Print Today and Envisaging the Trend with Patent Landscape for Versatile Applications" analyzes the future trend with the aid of patent landscape analysis. "Investigating the Work Generation Potential of SMA Wire Actuator" aims to develop an elementary mathematical model of an SMA wire actuator in biasing conditions on the SIMULINK platform while including the traveled path history of SMA material and thereby, carries out a parametric study that determines the most influencing parameter that affects the work generation capability of wire actuator. "Troubleshooting on the Sample Preparation during Fused Deposition Modeling" deals in-depth with the challenges and issue during the printing and suitable solution for better print quality. "Hybrid Additive Manufacturing Technologies" focuses to produce and compare research studies on the different hybrid additive manufacturing processes. "Smart Manufacturing Using 4D Printing" deals with the concepts and regulations governing 4D printing, along with the materials utilized, applications, and obstacles that still need to be removed. "Developments in 4D Printing and Associated Smart Materials" provides a brief overview of 4D printing processes using various composites and intelligent materials including smart materials, and shape memory alloys. "Role of Smart Manufacturing Systems in Improving Electric Vehicle Production" explores the current market need for manufacturing that closely relates to an electric vehicle and develops a structural framework that utilizes the interpretative structural modeling approach and MICMAC approach to achieve the objective. "Safety Management with Application of Internet of Things, Artificial Intelligence, and Machine Learning for Industry 4.0 Environment" evaluates the major issues regarding health and safety integration with the Industry 4.0 revolution. "CPM/PERT-Based Smart Project Management: A Case Study" optimize the design and installation time of the 8-megawatt power plant to be built for a cement factory in Barbados.

This book is intended for both the academia and the industry. The postgraduate students, PhD students, and researchers in universities and institutions, who are involved in the areas of smart manufacturing with Industry 4.0 perspectives, will find this compilation useful.

The editors acknowledge the professional support received from CRC Press and express their gratitude for this opportunity.

Reader's observations, suggestions, and queries are welcome,

Dr. Ajay
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Mr. Parveen
Dr. Bandar AlMangour

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Acknowledgments

The editors are grateful to the CRC Press for showing their interest to publish this book in the area of smart manufacturing and Industry 4.0. The editors express their personal adulation and gratitude to Ms. Cindy Renee Carelli (Executive Editor) CRC Press, for giving consent to publish our work. She undoubtedly imparted the great and adept experience in terms of systematic and methodical staff who have helped the editors to compile and finalize the manuscript. The editors also extend their gratitude to Ms. Christina Graben, CRC Press, for support during her tenure.

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Finally, the editors obligate this work to the divine creator and express their indebtedness to the "ALMIGHTY" for gifting them power to yield their ideas and concepts into substantial manifestation. The editors believe that this book would enlighten the readers about each feature and characteristics of smart manufacturing and Industry 4.0.

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Editor's Biography

Dr. Ajay is currently serving as an associate professor in the Mechanical Engineering Department, School of Engineering and Technology, JECRC University, Jaipur, Rajasthan, India. He received his PhD in the field of advanced manufacturing from Guru Jambheshwar University of Science & Technology, Hisar, India after B.Tech. (Hons.) in mechanical engineering and M.Tech. (Distinction) in manufacturing and automation. His areas of research include artificial intelligence, materials, incremental sheet forming, additive manufacturing, advanced manufacturing, Industry 4.0, waste management, and optimization techniques. He has over 60 publications in international journals of repute including SCOPUS, Web of Science, and SCI indexed database and refereed international conferences. He has also co-authored and co-edited many books and proceedings including: *Incremental Sheet Forming Technologies: Principles, Merits, Limitations, and Applications*, CRC Press, ISBN: 9780367276744; *Advancements in Additive Manufacturing: Artificial Intelligence, Nature Inspired and Bio-manufacturing*, ISBN: 9780323918343, ELSEVIER; *Handbook of Sustainable Materials: Modelling, Characterization, and Optimization*, CRC Press, ISBN: 9781032286327; and *Waste Recovery and Management: An Approach Towards Sustainable Development Goals*, CRC Press, ISBN: 9781032281933.

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- Handbook of Sustainable Materials: Introduction, Modelling, Characterization and Optimization, CRC Press, Taylor and Francis, ISBN: 9781032295874

He has organized a series of faculty development Programs, workshops, and seminars for researchers, UG-level students. He is associated with many research, academic, and professional societies in various capacities.

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behavior of materials, ranging from metals, to (nano-) composites, for advanced structural applications. His research focuses on advanced materials processing (additive manufacturing, friction joining, laser processing, powder metallurgy, bulk nanostructured alloys and composites), mechanical behavior at multiple length scales, and surface engineering. AlMangour has authored more than 40 peer-reviewed papers in internationally recognized journals, and his research works have been presented at well over two dozen international conferences, including invited talks in UAE, Turkey, and Greece.

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1 Smart Manufacturing and Industry 4.0
State-of-the-Art Review

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1.1 INTRODUCTION

The term "smart manufacturing," or SM, was used to describe a new approach to production that is in step with the trends of "industry 4.0". The potential of I4.0 in data networking and information technology have considerable effect on manufacturing operations [1]. With big data processing, artificial intelligence, and intelligent robots, "smart manufacturing" improves factory output while cutting costs in energy and labour. This allows for the machines and tools that are used in smart manufacturing to be interconnected with one another [2]. Smart manufacturing is a subset of I4.0 that seeks to improve production by applying AI techniques including machine learning, big data analytics, and computer simulations. [3]. It also refers to the adoption of cutting-edge cyber technologies by corporate executives, including enhanced sensing, control, modelling, and platform technologies in I4.0 environment [4].

The manufacturing plans of most influential countries in the global market are focused on the industries of the future. This is a major development in the implementation of intelligent production methods. Germany was the first country to launch the I4.0 initiative for smart manufacturing, which is now recognized across the globe as the generational leap in technology that will revolutionize the manufacturing industry [2]. I4.0 was recognised for the first time in German industries, where it has led to increased productivity with the adoption of SM practices and more effective utilisation of the resources that are available [5,6]. It encouraged the businesses to adopt smart manufacturing practices, IIoT, cloud analytics and big data etc. Notably, it has resulted in high performance and, in comparison to the past, significantly greater positive effects. Role of work, management, and social ecosystem elements in SM need to be considered. [7]. The job profiles are undergoing transformations as a direct result of the opportunities made available by I4.0. Leaders in the corporate and public sectors, as well as academics and practitioners,

need to collaborate to learn more about smart manufacturing's potential and its necessary infrastructure. [8,9].

At present, investigations into smart manufacturing are underway, but lacks Industry 4.0 adoption. Also, the present literature is devoid of assessment of the different facets of Industry 4.0 [10]. Several supplementary investigations have delved into the current literature and identified hindrances to the adoption of intelligent manufacturing [10–13]. Zhou et al. [14] examine the main topics of smart factories and SM within the context of Industry 4.0, while also presenting obstacles, prospects, strategic planning, and crucial technologies.

The adoption of I4.0 concept among practitioners is popular as a means of putting smart manufacturing practises into effect. Industry 4.0 is not yet ready to be implemented because there is a lack of technical know-how and terminology [15]. Currently, there is limited knowledge about the possible advantages and disadvantages associated with the introduction of intelligent manufacturing [16,15]. Companies are unable to implement I4.0 because they are unable to comprehend the particulars of the implementation that are relevant to their own organisation [17]. Organizations have not conducted any specific research in their business operations, as such research has not been found [17,15]. As a direct consequence of this, the vast majority of businesses are unable to devise an appropriate strategy for implementing industry 4.0 [18].

For in-depth understanding of the dimensions that influence the success of I4.0 implementation, a Petersen et al. [19] guidelines-based SLR was carried out. The participants in this study will be provided with a tool that will assist them in determining which aspects of their organization are the most important and in formulating a strategy to improve those aspects using the findings of this study.

The entire research paper is broken up into six sections. After the introduction has been finished for section 1, the related work, which is contained in section 2, is presented. The discussion of the methodology can be found in Section 3. Section 4 contains a presentation of the results. In section 5, the validity threats are detailed, and in section 6, the conclusions are discussed.

1.2 RELATED WORK

Numerous research has been performed to identify and evaluate dimensions. All the studies are distinct from one another in terms of the approaches and procedures that were utilized to give the facets of putting the I4.0 concept into practice in manufacturing firms. The contributions that were made by the related work can be found in this section.

In order to give the reader a full picture of what SMSs are and how they work, Qu et al. [20] summarises the background, definition, goals, functional requirements, business needs, and technological requirements of SM. At the same time, it describes where things stand in terms of progress. Based on this, we present a model of autonomous smart manufacturing that is driven by fluctuating demand and key performance measures. The technological differences between traditional production and smart manufacturing were explored by Phuyal et al. [2]. In this study, as well as its current implementation status. Recent developments and their consequences were reviewed for this field.

To ascertain the dimensions, Elibal and Ozceylan [21] conducted a relevant literature study. The authors employed various database search to examine 90 distinct studies. There is a discussion on the categorization of the studies, which includes things like meta-models, combinations of models, comparison models, and so on. To conduct this research, qualitative analysis is performed. In the study, the descriptive evaluation model for the review study was presented, and the limitations of the existing model were discussed. The study has some problems with its validity. Ghobakhloo et al. [7] in their work determined drivers of I4.0 concept. They also described a descriptive evaluation of the 745 studies that were eligible for consideration. The study found that organisational factors, technology factors, and environmental factors are the primary determinants of I4.0. The author discussed both the study's theoretical underpinnings and its potential real-world applications. However, the study does not address whether the model being used is accurate. Hizam-Hanafiah et al. [22] and Kamble et al. [23] analysed various studies and proposed numerous dimensions. The authors identified technology as the most crucial dimension, with 44 percent of the 158 dimensions pertaining to technology. Consequently, technology is deemed the most significant factor. They refer to three critical dimensions, including technology, based on aspects, and process integration. The author put forth strategic guidelines in their proposal. The study does not include the validation component. In their presentation on I4.0 dimensions, Liao et al. [24] used SLR. The author went over the repercussions of putting industry 4.0 into practice as well as the research agenda for the foreseeable future. However, many of the studies suffer from the same types of shortcomings.

Despite the significance and potential opportunities in SM fields with I4.0 adoption, there has been limited research conducted on identifying the dimensions of SM. In this study, the dimensions are identified from selected studies and ranked according to their importance [25]. However, previous studies lack validation aspects as they mostly rely on qualitative analysis without strong evidence to support the SLR. Therefore, the dimensions are identified quantitatively from the selected studies to provide stronger evidence.

1.3 METHODOLOGY

This section presents details about the research techniques that are employed. Following Petersen et al. [19] guidelines for conducting SLR and Aria and Cuccurullo [26] for conducting bibliometric mapping, methodology based on five phases is adopted. In the first phase, the authors define the parameters of the work and formulated research questions. Three research questions are formulated. RQ1 and RQ2 were answered using SLR and RQ3 was answered following the bibliometric analysis. Search methodology is the focus of the next phase. In this step, the author searched for relevant articles in a scientific database by entering a string of search terms that makes use of "AND" and "OR" Operators. In accordance with the approach proposed by Kitchenham and Charters [27], a search string was constructed by combining relevant keywords

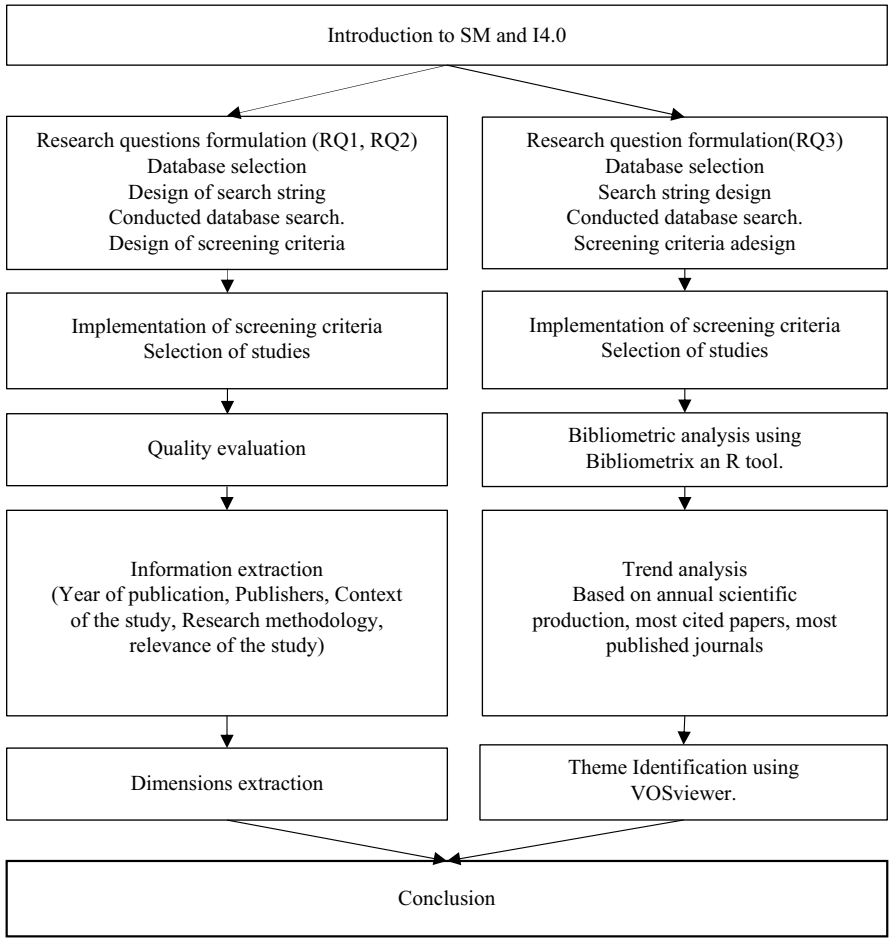

FIGURE 1.1 Methodology flowchart.

using PICO approach. The third phase presents screening of the studies. In the fourth phase, the work is reviewed on the basis of their titles and keywords. The final phase of the study involved mapping research questions. To minimize bias in the study, a quality evaluation was conducted. The results were analyzed and presented in Figure 1.1, which illustrates the research process.

1.3.1 Research Questions

The following research questions are framed to meet the research objectives:

RQ1: What are I4.0 dimensions which help in smart manufacturing?
RQ2: What are those dimensions which are critical for SM systems?
RQ3: What are the future research directions for SM systems?

1.3.2 Search strategy

The work utilized the PICO (Population, intervention, comparison, and outcome) approach recommended by Kitchenham and Charters [27] to guide the search process.

1.3.2.1 Population

It refers to the targeted group. In this study, the population was Smart Manufacturing or Industry 4.0 elements.

1.3.2.2 Intervention

Various maturity models and industry reports served as interventions.

1.3.2.3 Comparison

Empirical studies were conducted to compare the different smart manufacturing techniques and methods.

1.3.2.4 Outcomes

The study's outcomes involved the extensive literature review and empirical analysis of dimensions.

To conduct the study, the author searched for studies in popular databases utilizing search strings tailored to each database. The author utilized the "AND" operator to form the search string. Search string for the databases is as follows:

("smart manufacturing" AND "industry 4.0")

1.3.3 Selection of studies

Our study used screening criteria to select relevant articles. The inclusion year (2007–2022) for articles in English language. We identified seven criteria for selecting articles, labelled as C1 to C7, which are listed in Table 1.1, we provide the criteria that will be used to determine what will and will not be considered for screening.

1.3.4 Data extraction

The study has gathered information regarding smart manufacturing. Additionally, a data attributes sheet has been generated that outlines the research questions (See Table 1.2).

1.3.5 Quality evaluation

According to the standards in Table 1.3, a quality evaluation has been performed. The purpose of this step was to ensure that only relevant studies were considered and to strengthen the validity of our findings. For a comprehensive breakdown of the quality evaluation scores, please refer to Table A1 in appendix section.

TABLE 1.1
Criteria for Screening

Criteria Id	Criteria Type	Explanation
C1	Inclusion	Publication year: 2007–2022
C2	Inclusion	English language articles
C3	Exclusion	Books, book chapters, dissertations, and theses
C4	Exclusion	Articles containing less than six pages
C5	Inclusion	Articles including the terms "SM," "I4.0," and "digital transformation".
C6	Inclusion	Articles that address SM and I4.0.

TABLE 1.2
The Data Attributes in the Present Study

Class	Elements	Address Research Question
Intuitive information	Publication year, publisher, author, title and abstract	1
Methodology	Study design, case study, survey, evaluation study	2
Setting	Work motivation, validity threats, subjective research	2
Results and conclusion	Work limitations, address challenges, future work discussion	1, 2

TABLE 1.3
Quality Evaluation Parameters (QEP)

QEP ID	Description
QEP1	Does the article state its research aims clearly?
QEP2	Does the study explore dimensions related to its research aims?
QEP3	Does the article provide a literature review and outline the main contributions?
QEP4	Does the work describe the design of research methodology?
QEP5	Does the study present research findings?
QEP6	Are the research objectives and conclusions of the work explained in a clear manner?
QEP7	Does the article discuss future research or areas for further investigation?

1.4 RESULTS AND DISCUSSION

1.4.1 Discussion on RQ1 and RQ2

In accordance with Petersen et al. [19], the results of SLR are discussed. A pilot study was conducted using PICO criteria [28] to develop the search string. Applying the search criteria to the databases identified 3001 studies, which were screened based on selection criteria and publication date from 2007 to 2022. This resulted in 115 studies, with 40 duplicates removed, leaving 75 studies for quality assessment. Based on quality scores less than 3, approximately 13.37% of studies were removed, and 65 final articles were selected for the study. The search results are shown in Table 1.4. The number of academic studies showed a constant trend from 2007 to 2015, with only 1 or 2 studies, but the trend increased continuously from 2016–2022. The distribution of primary research according to year is presented in Figure 1.2.

The author aimed to respond to RQ1 by identifying dimensions. Additionally, the author calculated the frequency/percentage of each dimension. The authors identified 8 dimensions. To address RQ2, the author selected five dimensions that had a percentage equal to or greater than 25%. Table 1.5 provides the order and variables of the identified dimensions.

1.4.1.1 Technology (E_8)

The study found that technology is the most significant dimension in SMEs' digital readiness, with 92.31% of the selected studies focusing on various technological areas. Cyber-physical systems, as noted by Rahamaddula et al. [29] and Swarnima et al. [30], are particularly critical for integrating digital and physical entities. Saad et al. [31] outlines the importance of technology in smart manufacturing in industry 4.0 environment has further highlighted the growing significance of AI, ML, and cloud computing [32–34].

1.4.1.2 Organizational strategy (E_1)

The study identifies the second most significant dimension as strategy with a frequency of 30. 46.15% studies considered organization strategy as a dimension for smart manufacturing. Strategy involves planning for products and services that align with smart manufacturing requirements. Additionally, the strategy includes the funding strategy, which refers to the financial investment made for implementing smart manufacturing practices.

1.4.1.3 People/culture/employees (E_3)

The current research reveals that people/culture is identified as crucial dimensions. It is ranked at 5 with frequency 17 and 26.15%. This dimension relates to the employee attitude towards use of digital means for work [35,36,29]. As a final recommendation, it is essential to foster a learning culture to achieve smart manufacturing culture [37]. People/culture/employees are crucial to the success of SM. A skilled workforce and a culture of collaboration and continuous improvement are essential for implementing and optimizing advanced technologies.

TABLE 1.4
Search Results

Name of Database Library	Search Count	Articles Left after Applying Screening Criteria						Articles Left after Removing Duplicates	Articles Remaining after Quality Evaluation
		C1	C2	C3	C4	C5	C6		
ScienceDirect	2430	2428	2421	1315	785	286	50	75	65
ACM	115	108	133	109	93	50	22		
Wiley	209	209	200	143	123	56	25		
JSTOR	22	22	20	16	10	8	3		
DOAJ	225	225	172	150	96	76	15		
Total	3001	2992	2946	1733	1107	351	115	75	65

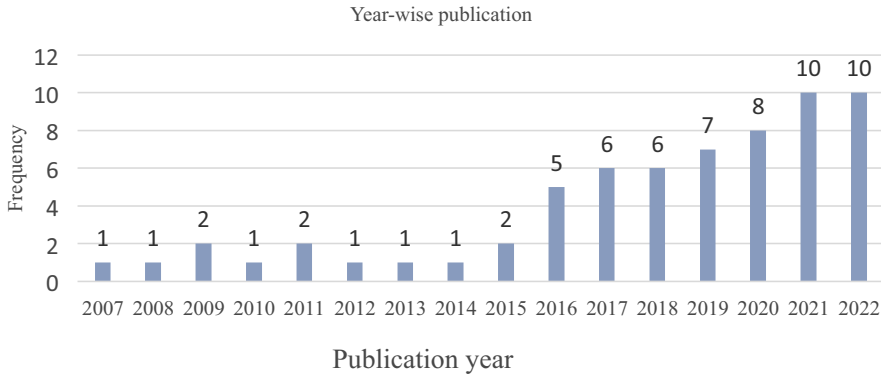

FIGURE 1.2 Year-wise studies.

1.4.1.4 Processes (E4)

smart manufacturing processes are crucial to the success of modern manufacturing operations. By optimizing processes, manufacturers can increase efficiency, reduce waste, improve product quality, and be more responsive to customer needs, ultimately leading to greater competitiveness in the marketplace. Findings reveals that, processes with frequency 27 and 41.54 % were ranked third. This dimension encompasses various types of processes such as business, communication, and management processes.

1.4.1.5 Products (E_6)

Product as a dimension (Frequency 21, percentage 32.31) ranked at four. One of the main goal of SM is to produce high-quality products that meet or exceed customer expectations while minimizing waste and reducing costs. It requires in-depth knowledge of the product and its manufacturing process [34]. Digital features in products enhance customer interest and promote association with the industry 4.0 ecosystem [38–41].

1.4.1.6 Customers (E_5)

According to the study, the sixth-ranked dimension is customers (Frequency 12 and percentage 18.46). Customers are important in smart manufacturing because they have high expectations for the products they purchase. They want products that are high-quality, reliable, and meet their specific needs. By understanding customer preferences and behaviours, manufacturers can tailor their products to meet those needs more effectively. This can lead to increased customer satisfaction and loyalty, which is essential for the long-term success of any business [5,29].

1.4.1.7 Innovation (E_2)

According to the information provided in Table 1.5, innovation (Frequency 10, percentage 16.67) is ranked seventh among the critical dimensions for industry 4.0.

TABLE 1.5
Identified Variables

S. no.	Dimensions	Definition	References	Frequency	Percentage	Ranking
E_1	Organisational Strategy	Organisational Strategy refers to the approach and plan of action adopted by an organization to align its resources, goals, and capabilities with the opportunities and challenges posed by the new technologies and digitalization. It involves the development of a clear roadmap for Industry 4.0 adoption, infrastructure, organizational structure, workforce planning, and continuous improvement strategies. Organisational strategy is critical for SMEs in their implementation of smart manufacturing practices ensuring its long-term sustainability and competitiveness.	[3,17,42–51,30,52–61,35–41]	30	46.15	2
E_2	Innovation	Innovation in this context includes the exploration and implementation of new business models, supply chain strategies, and value creation opportunities to stay competitive in the rapidly evolving digital landscape.	[33,39,40,43,44,47,51,59,62, 63]	10	16.67	7
E_3	People/culture/ Employees	People/culture/employees refer to the human aspect of the organization, including its employees' skills, knowledge, behaviour, and attitudes towards digital transformation. It involves the organization's culture, values, leadership, and change management strategies necessary for successful adoption of smart manufacturing practices. It also includes the development of a skilled workforce capable of operating and maintaining advanced digital technologies.	[17,29,58,60,62,64–67,33, 36–39,44–46]	17	26.15	5

(*Continued*)

TABLE 1.5 (Continued)
Identified Variables

S. no.	Dimensions	Definition	References	Frequency	Percentage	Ranking
E_4	Processes	Processes refer to the methods and procedures used in making products. It includes adoption of technology with process automation, industrial robots. Processes in I4.0 involve the integration of various systems across the entire value chain, including design, production, supply chain, logistics, and customer service. Smart processes are designed to be flexible, adaptable, and responsive to changes in customer demand, market trends, and technological advancements.	[3,29,50,55,60–63,65, 66,68,69,33,70–75,35–38,43, 38,43,45,46]	27	41.54	3
E_5	Customers	This dimension includes understanding and meeting customer expectations, providing customer-tailored products, and using data analytics to improve customer experience. Customer retention is a key focus, and companies strive to create a customer-centric environment to improve their competitiveness in the market.	[29,36,64,76,38,39,42,44, 55,57,60,62]	12	18.46	6
E_6	Products	Products refers to the physical goods or digital services produced by a company or organization using advanced technologies and processes. These products may be customized or personalized for individual customers and may incorporate digital features and connectivity to enhance their functionality and value.	[3,35,62,64,65,69–73,75,77, 36,78,38,42,43,46,57,59,60]	21	32.31	4

E_7	Services	Services refers to the digital features and capabilities that are integrated with the products offered by an organization. This includes data-driven services, remote monitoring, product configuration, product simulation, and condition monitoring, among others. By leveraging digital technologies and integrating them with their products, organizations can improve their competitiveness and customer satisfaction.	[35,36,44,50,59,60,64,71,79]	9	13.85	8
E_8	Technology	It involves the integration of physical and cyber systems, resulting in smart and efficient manufacturing processes. Technology is a critical dimension in Industry 4.0 as it enables companies to improve their operations, increase productivity, reduce costs, and develop new products and services.	[3,7,38–40,42–46,50,51,17, 52–55,57–60,62,63,29, 64–73,30,74–83,31,84–90, 33,35–37,91,92]	60	92.31	1

Innovation allows manufacturers to improve their processes and operations, resulting in reduced costs and improved quality. For example, the implementation of predictive maintenance systems can reduce downtime and prevent costly equipment failures. Similarly, the use of robotics and automation can increase production efficiency and reduce labour costs.

Innovation can also enable manufacturers to create new products and services, opening new markets and revenue streams. For example, smart products equipped with sensors can provide valuable data used to improve customer satisfaction.

1.4.1.8 Services (E_7)

According to the findings presented in Table 1.5, the dimension of services ranks at the eighth position (frequency 9, percentage 13.85. In I4.0, services refer to the digital features offered by an organization that attract end-users to adapt to the industry 4.0 environment. Such services may include product configuration, development, and simulation, as well as remote and condition monitoring, and other data-driven services that are integrated with digital technologies.

Sections 4.1.1 through 4.1.8 presents discussion on variables. Based on the analysis, it is apparent that Technology (E8), Organizational strategy (E1), Processes (E4), Products (E6), and People/culture/employees (E3) are the most crucial dimensions for SMEs. Dimensions reporting a frequency of more than 25% considered critical. The selection of these critical dimensions is subjective, and further input from experts in the field may be necessary to support the findings.

1.4.2 Discussion on RQ3

For the identification of future research theme, the authors have conducted bibliometric analysis. The work is done on Bibliometrix and Vosviewer. The authors selected the WoS database. Authors designed the search string such that it covers the objective of the chapter. The search string is as follows: ("smart manufacturing" AND "industry 4.0"). the authors conducted the search from the web of science database using the string followed by screening of the articles (Table 1.6).

186 articles are selected for further analysis. The authors have gone through the most relevant sources. The analysis shows that the IJPR journal receives a total of 598 citations on the topic followed by Journal of manufacturing systems with 386 citations. Figure 1.3 shows the most cited sources form the smart manufacturing and industry 4.0.

The authors now conducted the keyword cooccurrence analysis using VOSviewer. Which result in making the five clusters. Figure 1.4 shows the keyword cooccurrence analysis and clusters. These clusters are identified by the colors. Each cluster contain several elements. The details of the clusters are given in Table 1.7.

TABLE 1.6
Screening Results

Description	Type	Article Count
Search using keywords ("smart manufacturing" AND "industry 4.0")	Inclusion	609
Review article	Exclusion	504
Editorial material	Exclusion	495
Proceeding paper	Exclusion	492
Web of science categories such as engineering industrial, operation management, Engineering manufacturing, computer science and AI, automation control systems, engineering mechanical	Inclusion	233
Citation topics meso such as design and manufacturing, supply chain and logistics, management, AI and ML, manufacturing, human computer interaction, knowledge engineering and representation	Inclusion	186
Analysis of title, abstract, keywords	Inclusion	184

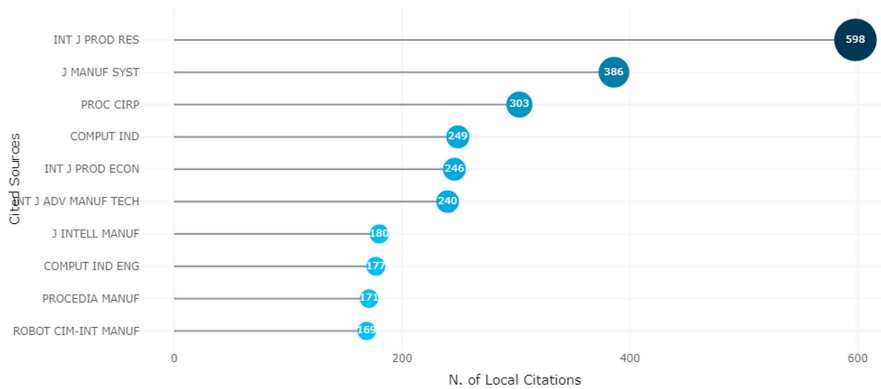

FIGURE 1.3 Most cited sources.

1.4.2.1 Theme based on blue cluster.

> ***"Enhancing Smart Manufacturing through CPS and Industrial Internet: Investigating Decision-Making in Smart Factories."***

The theme directs researchers and academicians to exploring the challenges and barriers to the implementation of SM systems in I4.0 environment and developing strategies to overcome them. The research will investigate how CPS

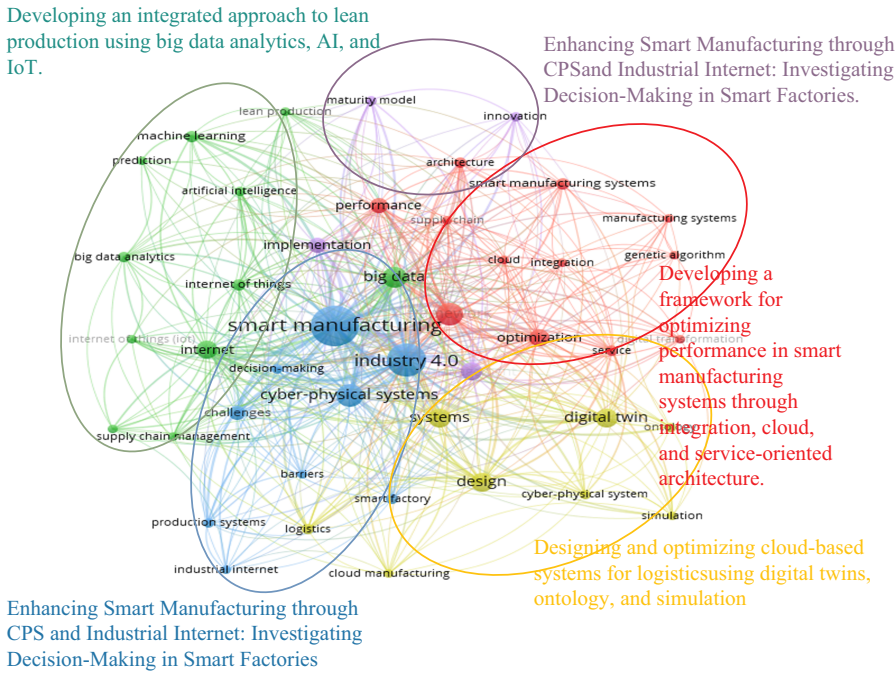

FIGURE 1.4 keyword cooccurrence network analysis with research themes.

and IIoT can be integrated to create a smart factory environment. The decision-making processes involved in the implementation of such systems will also be studied to ensure effective implementation. Finally, the proposed strategies will be evaluated in terms of their effectiveness in addressing the identified challenges and barriers and their ability to facilitate the implementation of SM systems in I4.0 environment.

1.4.2.2 Theme based on yellow cluster.

> ***"Designing and optimizing cloud-based systems for logistics using digital twins, ontology, and simulation."***

This covers areas on utilizing cloud manufacturing, digital twins, and simulation technologies to design and optimize manufacturing and logistics systems. The design aspect of this theme emphasizes the importance of considering both product and process design in the development of such systems. Ontology can be used to standardize data and communication protocols, while logistics can help ensure efficient material flow and inventory management. Finally, the use of digital twins allows for virtual testing and optimization of the proposed systems before implementation, reducing risks and costs.

TABLE 1.7
Cluster Items with Proposed Themes

Cluster colour	Items (Occurrence)	Sub-Items (Occurrence)	Proposed Theme	References
Blue	Smart manufacturing (116) Industry 4.0 (78)	Barriers (5), challenges (15), cyber-physical systems (36), decision-making (7), industrial internet (5), industry 4.0 (78), production systems (7), smart factory (8), smart manufacturing (116)	Enhancing Smart Manufacturing through CPS and Industrial Internet: Investigating Decision-Making in Smart Factories.	[93–99]
Yellow	Systems (26) Digital twin (25) Design (25)	cloud manufacturing (5), cloud manufacturing (7), design (25), digital twin (25), logistics (8), ontology (7), simulation (5), systems (26)	Designing and optimizing cloud-based systems for logistics using digital twins, ontology, and simulation	[93,94]
Red	Framework (37), Optimization (20)	Architecture (8), cloud (5), digital transformation (5), framework (37), genetic algorithm (5), integration (5), manufacturing systems (6), optimization (20), performance (17), service (8), smart manufacturing systems (9), supply chain (6)	Developing a framework for optimizing performance in smart manufacturing systems through integration, cloud, and service-oriented architecture.	[95,98,99,100]
Green	Big data analytics (40) Internet (22)	AI (7), big data analytics (40), cloud computing (5), internet (22), IoT (14), lean production (5), machine learning (10), prediction (5), supply chain management (6)	Developing an integrated approach to lean production using big data analytics, AI, and IoT.	[93,97,98,101]
Purple	Management (23) Implementation (17)	Implementation (17), innovation (7), management (23), maturity model (7)	Developing a maturity model for effective innovation management implementation	[93,95,96]

1.4.2.3 Theme based on red cluster.

Developing a framework for optimizing performance in smart manufacturing systems through integration, cloud, and service-oriented architecture.

This theme focuses on developing framework that incorporates elements of cloud computing, service-oriented architecture, and integration to optimize performance in smart manufacturing systems. The framework will be developed through digital transformation of existing manufacturing systems and supply chain networks. Optimization techniques such as genetic algorithms will be used to fine-tune the system performance. The use of SM systems can help ensure effective data collection, decision-making. Finally, the framework will be evaluated to improve the performance of SM systems in real-world settings.

1.4.2.4 Theme based on green cluster.

"Developing an integrated approach to lean production using big data analytics, AI, and IoT."

The theme focuses on utilizing big data analytics to improve SCM by developing a framework that incorporates IoT, ML, and AI. The framework will be deployed on cloud computing platforms and will leverage lean production principles to reduce waste and improve efficiency. The internet will play a key role in facilitating data exchange and communication between different supply chain partners. The use of ML will enable prediction of supply chain events and help in making data-driven decisions.

1.4.2.5 Theme based on purple cluster.

"Developing a maturity model for effective innovation management implementation".

It focuses on developing a maturity model for effective innovation management implementation. The research points towards identification of factors that help in innovation management implementation. The maturity model can help organizations assess their current innovation management capabilities and identify areas for improvement. The research can use case studies to evaluate the effectiveness of model in different organizational contexts. The findings of the research can help organizations improve their innovation management capabilities and drive growth and competitiveness.

1.4.2.6 Co-citation network analysis

The authors have conducted the co-citation network analysis for deeper understanding of the emerging themes. Analysis was done using the tool VOSviewer. The result of co-citation network reveals that there are four clusters with minimum cluster size 17 and minimum link strength 2. Figure 1.5 shows the co-citation

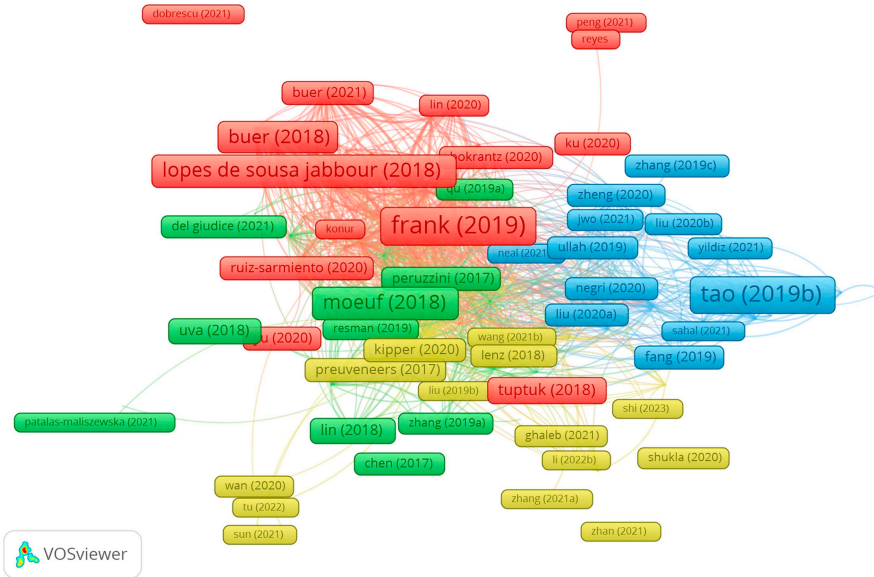

FIGURE 1.5 Co-citation network analysis of articles (VOS viewer).

network analysis of the selected articles. Table 1.8 presents the co-citation network details with top terms and themes.

The themes discussed can be used for research in smart manufacturing by providing a framework for investigating and improving various aspects of manufacturing operations, including maintenance, supply chain management, logistics, quality control, and performance optimization. For example, researchers can explore how data-driven approaches, such as condition-based monitoring and predictive maintenance, can be leveraged to improve equipment reliability and reduce downtime. Collaborative networks and cyber-physical systems can be studied to enable effective communication and coordination between different parts of the manufacturing process, from suppliers to customers. Augmented reality and machine vision can be investigated to enhance human-centered manufacturing, while blockchain and security monitoring can be explored to ensure data integrity and cyber resilience. Optimization techniques, such as simulation modelling and parameter identification, can be applied to improve manufacturing efficiency and quality.

Overall, the discussed themes provide a comprehensive framework for investigating various research questions related to smart manufacturing and offer opportunities for improving manufacturing processes through the integration of advanced technologies and data-driven approaches.

1.5 VALIDITY THREATS

Despite the use of SLR guidelines there are still potential validity issues with the findings. To further minimize bias, we followed the selection criteria guidelines and invited a guest researcher to validate the study selections, resulting in a 70% agreement

TABLE 1.8

Co-Citation Network Details with Themes

Cluster (Colour)	Name of Themes	Items Count	Year (Mean)	Top Terms
1 (Red)	Optimizing Industrial Maintenance and Supply Chain through Collaborative Networks and Big Data Ecosystems	42	2021	Collaborative network, success factors, industrial maintenance, operational performance, bigdata ecosystems, predictive maintenance, smart manufacturing, supply chain, inventory management, security, collaborative robots, toe framework, cps, lean supply chain, big data analytics, cyber-security challenges, sustainable I4.0, manufacturing scm, hybrid manufacturing
2 (Green)	Enabling Agile and Customizable Manufacturing through Data-Driven Approaches and Augmented Reality	31	2019	Data-driven scheduling, changeability, reconfigurability, augmented reality, cloud manufacturing, product-service system, feasibility evaluation, optimization, self-tuning model, operationalization framework, strategic response, cyber-physical production network, industrial management, management approach, human-cantered additive manufacturing, enterprise information systems, SM systems requirements, augmented reality-based SM, machine vision, mass personalization.
3 (Blue)	Enhancing Manufacturing Performance and Security through Digital Twins and Autonomous Collaboration	29	2021	Optimization, onto-based modelling, digital twin, CPS, autonomous collaboration, reinforcement learning, human-in-the-loop SM, web-based digital twin, security monitoring, quality, mes integration, cognitive twin, blockchain, data formats, human decision models, simulation modelling, product management, iot enabled, simulation-based approach, edge computing.
4 (Yellow)	Maximizing Efficiency and Quality in Industry 4.0 Ecosystems through Condition-Based Monitoring and Data-Driven Approaches	21	2020	Condition-based monitoring, synchroperation, bottleneck detection model, data-driven models, data analytics, SM systems, cyber-physical factories, logistics management, quality improvement, I4.0 ecosystem, parameter identification, machine learning, training, anomaly detection model, dynamic environment.

on the selections. However, there is still the possibility of publication bias, where researchers may only present positive results from their research. To address this, we utilized multiple search libraries. Finally, there is a possibility of data extraction bias, but we minimized it by using a data extraction template to record unbiased data.

Also, there may be the possibility of biasness while conducting bibliometric analysis such as biasness in database selection, incompleteness of data, citation practices, self-citations, inaccurate citation data, changing publication practices etc. However, to avoid such threats, the authors have conducted the word co-occurrence network analysis and co-citation network analysis for exploring future research directions.

1.6 CONCLUSION

Smart manufacturing has emerged as a transformative approach to manufacturing that integrates cutting-edge technologies and innovative processes to enable more efficient, flexible, and sustainable production. The success of smart manufacturing depends on several dimensions that are critical for achieving operational excellence and competitive advantage. To this end, the author conducted review of studies published from 2007 to 2022, eight dimensions that aid manufacturing firms in opting smart manufacturing practices. RQ1 was addressed by extracting data from 65 studies to identify 8 key dimensions, namely technology, organizational strategy, people/culture/employees, processes, products, customers, innovation, and services. To address RQ2, dimensions (Count percentage > 25%), which included technology, organizational strategy, products, processes, and people/culture/employees. The RQ3 was addressed by conducting a bibliometric analysis resulting in five potential research directions (keyword co-occurrence network analysis) and another four themes (using co-citation network analysis). This finding underscores the high demand for research on smart manufacturing. These findings can inform future smart manufacturing research. Further work on these themes can add value to research domain and ultimately lead to achieve socio-economic goals.

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APPENDIX

TABLE A1
Quality Evaluation Score (QES) of Some Studies

Author/Year	QEP1	QEP2	QEP3	QEP4	QEP5	QEP6	QEP7	QES Score
Lee et al., 2007	0	1	0	0	1	1	1	4
Lucke et al., 2008	1	1	0	1	1	0	1	5
Zühlke, 2009	1	1	0	1	0	0	0	3
James, 2012	1	1	1	0	0	1	1	5
Gruber, 2013	0	1	1	1	1	1	0	5
Lasi et al., 2014	0	1	1	1	0	1	1	5
Faller and Feldmüller, 2015	0	1	1	1	0	1	0	4
Weyer et al., 2015	0	1	1	1	1	1	0	5
Li, 2016	0	1	1	1	1	1	1	6
Lu and Ju, 2017	0	1	1	1	1	1	0	5
Iyer, 2018	1	1	0	1	1	1	0	5
Bibby and Dehe, 2018	1	1	0	1	1	1	1	6
Hamidi et al., 2018	1	1	1	1	1	1	1	7
Horvat et al., 2018	1	1	1	1	1	0	0	5
Chou, 2018	1	1	1	1	1	1	0	6
Simetinger and Zhang, 2020	1	1	1	1	1	0	0	5
Bachinger and Kronberger, 2021	1	1	0	1	1	0	1	5
Paasche and Groppe, 2022	1	1	1	1	1	1	0	6
Liu et al., 2022	0	1	1	1	1	0	1	5

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ORIGINAL RESEARCH PAPER

Orthopaedics

A RESEARCH ON PREVALENCE OF LOW BACK PAIN DISABILITY IN MARBLE FACTORY WORKERS

KEY WORDS: Work related musculoskeletal disorders, Low back pain, WMSDs, Disability

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ABSTRACT

INTRODUCTION: WMSD's among marble factory workers are common. They are a major concern of workers, union, employers and government. Work-related musculoskeletal disorders (MSDs) are disorders of body structures such as tendons, joints, muscles, ligaments, bones, nerves or a local blood circulation system caused or aggravated primarily by the nature of performance of work. The aim of this study was to determine the prevalence of low back pain in marble factory of Aburoad, to know the relation between low back pain and physical activity.

Most work related MSDs are resulting from repeated exposures to low - or high intensity workloads over a prolong period of time. This indicates a strong relationship between factors within the working environment and the development of MSDs, and that these conditions result in significant reduction in productivity

OBJECTIVE: The objective of the study was to study and identify issues and problems of MSDs, specifically LBP. It was believed that results of this study would provide a base for planning interventional programs at work place and improving workers health.

MATERIALS AND METHODS: A questionnaire was formulated with few variables which were specifically focused.

A general set of subjective variables such as name, age, sex, occupation, hand dominance, hypertension, weight, BMI were included. Few specific variables were-Nature of job, experience in years, working hours & overtime, drug addiction (alcohol, tobacco intake),routine of work (sitting/standing/walking/bending/lifting heavy loads), rest time-up to 3 categories(30 minutes/45 minutes and above)

MATERIALS: It included demographic identification form, modified oswestry disability index of LBP, NPRS scale, consent form, tapes, Mats etc.

SETTING OF THE STUDY: Data were collected at 5 marble factories.

PATIENTS: 180 subjects with LBP were involved in the study after screening of approximately 328 workers.

SAMPLING TECHNIQUE: Simple convenient sampling

SAMPLE SIZE: Total 180 subjects of 5 factories with low back pain participated in study.

SELECTION CRITERIA: The study populations were selected according to inclusion/exclusion criteria.

RESULTS: There was a higher prevalence of LBP in factory workers doing more of bending and sitting activities when compared to the standing positions. Even we found that the workers lifting more of heavy weight more than 20 kg reported of having LBP, which is in concordance to the support etal's study that the workers who had to lift the object up to 25 kg or more. There were significantly associated with LBP.

CONCLUSION: Work related musculoskeletal disorders in marble factory workers were common as a higher prevalence of LBP. This perception of intensified workloads, repetitive and monotonous work with limited job control and clarity might be one of the factors associated with MSDs. Further research is needed to investigate the effect of risk factors as general health status on prevalence musculoskeletal disorders.

INTRODUCTION-

The impairments of ligaments, muscles, joints, tendons, nerves, bones, etc. caused by the performance of work are called as work-related musculoskeletal disorders (WSDs). Work-related musculoskeletal disorders are a major public health problem in the industry and also more common in developing countries [1,2,3,4,8].WMSD's among marble factory workers are common. They are a major concern of workers, unions, employers, and government. Work-related musculoskeletal disorders (MSDs) are disorders of body structures such as tendons, joints, muscles, ligaments, bones, nerves or a local blood circulatory system.

Work-related physical handling of materials, especially heavy load lifting, frequent bending, twisting, working in awkward postures and vibration of whole-body, are well-established risk factors for LBP.[6,7]

Improper body movements such as manual handling, working in sitting, bending, lifting heavy loads etc. is directly related to prevalence of LBP.[6]

Evidence showed that in the period 2004-2005, 11 million days of work were lost because of musculoskeletal disorders in the U.K.[4]

These disorders are cumulative once resulting from exposure to high and low-intensity loads over a long period of time. The major factor contributing to musculoskeletal disorders is poor working posture resulting in a minor to a severe back problem.

There are various risk factors known to be included in workplace activities such as heavy load lifting, repetitive task, and awkward working postures as well as the nature of job cutting shearing drilling, etc. caused or aggravated primarily by the nature of the performance of work.[8]

Low back pain is not life threatening disorder but it has a long term impact on expenditures for affected workers.[9]

The aim of this study was to determine the prevalence of low back pain in the marble factory of Aburoad city and to know the relation between low back pain and physical activity.

Most work-related MSDs are resulting from repeated exposures to low - or high-intensity workloads over a prolong period of time. This indicates a strong relationship between factors within the working environment and the development of MSDs, and that these conditions result in a significant reduction in productivity.[10]

Approximately 100 million occupational disorders are occurring throughout the world annually.[11,12]

Marble is commonly used in the sculpturing of the statue, the construction of buildings and monument.[13]

The workers in the marble factory are involved in awkward posture and long hours of standing work.

Epidemiological data concerning WMSD are usually available in industrially developed countries. So we preferred study setting, which is also an industrial area and where ample amount of marble factories are available and Aburoad has opted for such a study setting.

Many studies have been conducted in various developed countries, in a large European survey showed that 45% of 130 million population workers were exposed to manual material handling and awkward postures.

Another study conducts in Iranian Communication Company showed a significant association between job tenure and MSD in the lower back region as well.

The aim of this study justifies on the prevalence of musculoskeletal disorders in marble factory workers, which can contribute to more effective strategic planning in the country.

Many active workers have musculoskeletal disorders as discomfort or pain may become incompatible which may lead to sick leave.

This study in active suspected workers who have minor problems –may help prevent the progression of the disease.

OBJECTIVE:

The objective of the study was to study and identify issues and problems of MSDs; specifically LBP. To assess occupational risk factors related to the prevalence of LBP It was believed that the results of this study would provide a base for planning interventional programs at the workplace and improving workers health.

INCLUSION CRITERIA:

Age: - 20-60
Gender: - Both male and female
Completing a minimum of 3 months period of occupation
Workers involved in sitting and standing activities
Nature of job involving bending and lifting activities
Good communication activities
Working hours more than 7

EXCLUSION CRITERIA:-

Acute health condition
Cancer
RA
Any health conditions that could alter the perception of pain
TB
Workers who involve in washing, cleaning activities

OUTCOME MEASURE:-

MODI
NPRS

MATERIALS AND METHODS:-

A questionnaire was formulated with few variables which were specifically focused.

A general set of subjective variables such as name, age, sex, occupation, hand dominance, hypertension, weight, BMI were included. Few specific variables were-Nature of job, experience in years, working hours & overtime, drug addiction (alcohol, tobacco intake), a routine of work (sitting/standing/walking/bending/lifting heavy loads), rest time-up to 3 categories (30 minutes/45 minutes and above).

Data were collected at 5 marble factories in Aburoad between February to March 2018.

The objective of the study is to "Study and identify the issues and problems of MSD" that to specifically LBP. It is believed that the results of this study would provide a base for planning interventional programs at the workplace and improving workers health.

MATERIALS: -

It included demographic identification form, modified Oswestry disability index of LBP, NPRS scale, consent form, tapes, Mats, etc.

SETTING OF THE STUDY:-

Data were collected at 5 marble factories.

PATIENTS:-

180 subjects with LBP were involved in the study after a screening of approximately 328 workers.

SAMPLING TECHNIQUE:-

Simple convenient sampling

SAMPLE SIZE:-

A total of 180 subjects of 5 factories with low back pain participated in the study.

SELECTION CRITERIA:-

The study populations were selected according to inclusion/exclusion criteria.

RESULTS:-

The prevalence of LBP was found to be 54.87 %. There was a higher prevalence of LBP in factory workers doing more of bending and sitting activities when compared to the standing positions. Even we found that the workers lifting more of heavyweight more than 20kg reported having LBP, which are in concordance to the Supreet et al's study that the workers who had to lift the object up to 25 kg or more. There were significantly associated with LBP and that to 1.27 times more frequently

Table 1: Give F and F% of AGE

AGE	F	F%
20-29	9	5
30-39	51	28.33333
40-49	15	8.333333
50-59	104	57.77778
60-69	1	0.555556
TOTAL	180	100

Table 2: Association with nature of work shows , those who are involved in cutting shows less MOLBPQ(41 People)

		Nature of work			
		CUTTING	DRILL	GRIND	SHEAR
MOL BPQ	> Median	19	19	37	12
	<= Median	41	22	21	9
NPRS	> Median	9	11	16	6
	<= Median	51	30	42	15

Table 3: Association with nature of work shows,there is significant association between MOLBPQ and nature of work because P=0.005 which is less than 0.05.

	MOLBPQ	NPRS
N	180	180
Median	34.0000	4.0000
Chi-Square	12.943b	3.518[c]
P-VALUE	.005SIG	.318NS

Table 4:No significant association between MOLBPQ, NPRS with experience

	MOLBPQ	NPRS
Median	36.0000	4.0000
Chi-Square	.312[b]	2.076[c]
P-VALUE..	.856NS	.354NS

Table 5:There is significant association with routine of work and MOLBPQ. ,above table shows. Those who involved in bending are having high MOLBPQ and NPRS.

	MOLBPQ	NPRS
Median	34.0000	4.0000
Chi-Square	53.780[b]	35.929[c]
P-VALUE..	.000SIG	.000SIG

ASSOCIATION MOLBPQ ,NPRS WITH REST TIME

Table 6: No significant association between MOLBPQ, NPRS with REST TIME.

	MOLBPQ	NPRS
Median	34.0000	4.0000
Chi-Square	2.906[b]	5.897[c]
P-VALUE.	.234NS	.052NS

DISCUSSION:-

This study describes the prevalence and risk factors for LBP among marble industry workers. More than 80% of the population experience LBP at some time during their lives. The prevalence of MSWDS among industry workers who usually are in full working activity is high. There are very few studies identified the prevalence of musculoskeletal pain among marble factory workers in India. Similarly, one study was conducted among dentists using questionnaires sent by mail with a prevalence rate of 58%. Similarly, another study conducted by Ardiana Murtezani et.al. mentioned a low back pain prevalence of 61.6% among industrial workers which is consistent with most of the epidemiological studies investigating over the year LBP prevalence in workers. The possible cause of this rising prevalence is due to the time spent by workers in a seated position or frequently turning and twisting torso and exposure to awkward postures, vibration, and load lifting.

Literature shows that manual handling, frequent bending, twisting, heavy load lifting, repetitive tasks, and heavy physical work are the risk factors for WMSD especially LBP.[14,18] Another study conducted by Supreet et.al. in India mentioned that the increasing age doubles the risk of having LBP and they found a higher prevalence in the age group of 30-40 and 50-60 years.

According to them the jobs involved in lifting or moving weights of 25 kgs or more have been found to have strong occupational associations with LBP. Work activities such as lifting, pulling, pushing, sitting and bending were highly associated with LBP (Anannont sak et al 1996).

This perception of intensified workloads, repetitive and monotonous work with limited job control and clarity might be one of the factors associated with MSD.

Almost similar results were found in our study as well, there was a higher prevalence of LBP in factory workers doing more of bending and sitting activities when compared to the standing position. Even we found that the workers lifting more of heavyweight i.e. more than 20 kg reported of having LBP, which are in concordance to the Supreet et al's study that the workers who had to lift the object up to 25 kg. or more there were significantly associated with LBP and that too 1.27times more frequently.

Most of the marble factory workers affected by LBP were age group between 30-39 & 50-59 years,Mostly sufferer ware doing sitting job.

CONCLUSION:

Work-related musculoskeletal disorders in marble factory workers were common as a higher prevalence of LBP. This perception of intensified workloads, repetitive and monotonous work with limited job control and clarity might be one of the factors associated with MSDs. Further research is needed to investigate the effect of risk factors as general health status on prevalence musculoskeletal disorders.

CONFLICT OF INTEREST:-None
SOURCE OF FUNDING:-Self
ETHICAL CLEARANCE:-Has taken from Ethical committee

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INDIAN JOURNAL OF PHYSICAL THERAPY AND REHABILITATION

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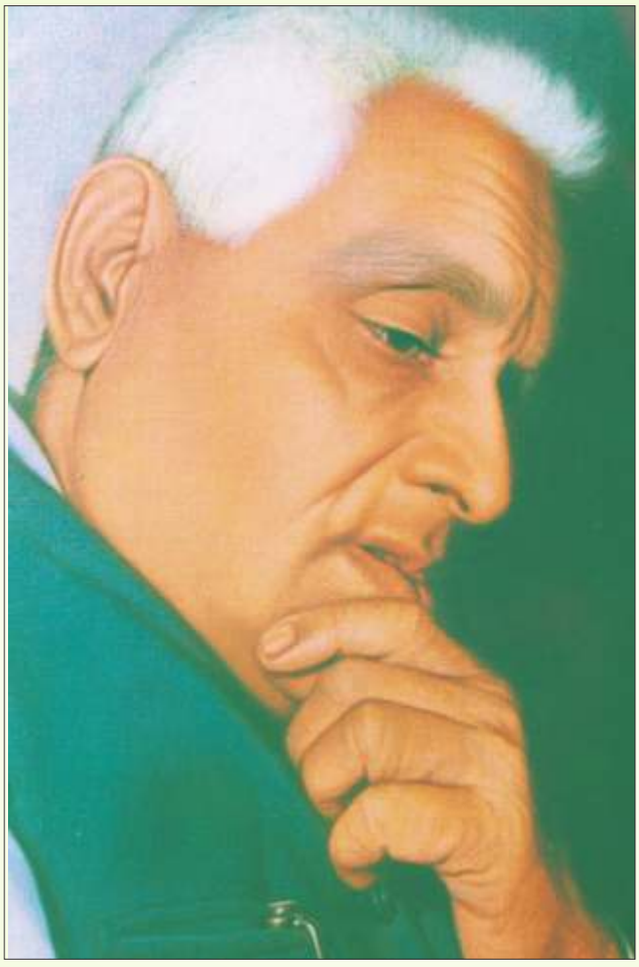
30 Minutes of brisk walking benefit health

Janardan Rai Nagar
Rajasthan Vidyapeeth
(Deemed) University, Udaipur

Our Beloved Founder



Late Manishi Pt. Janardan Rai Nagar

16th June 1911 - 15th August,1997

Popularly known as 'jannu bhai', the Late manishi's vision, farsightedness and sacrifice have enabled us reach the stature we enjoy today. He lit the lamp of knowledge by giving birth to an institution , named 'Hindi Vidyapeeth' on August 21, 1937 to spread education among those who were economically handicapped, and thereby enable them to learn the meaning of freedom Since then, the institution has been catering to the growing educational needs of an economically poor society having a rich socio-cultural heritage. Although the Manishi is not amongst us today, his ideals inspire us to fulfil the mission of imparting qualitative education to the society through preservation of our long cherished sociocultural values. We cherish his deeds and ideals, and strive to walk on the path shown by him.

Vice Chancellor's Message

It gives me immense pleasure to learn that the 8th Volume of Indian Journal of Physical Therapy and Rehabilitation is being published by department of physiotherapy. Sincere effort and keen interest taken by the members of department in the development of academic and research activities deserve all the admiration. I wish to express with a deep sense of joy and satisfaction on the release of this volume and the same moment to continue even in greater magnitude in the coming years so that the department accomplishes commendable place in the luminous field of physiotherapy at the international level.

Wishing all a scintillating success.

Prof. S.S. Sarangdevot
Vice Chancellor

Principal's Message

I have immense pleasure to gather that the Department of Physiotherapy, Janardan Rai Nagar Rajasthan Vidyapeeth (Deemed) University, Udaipur, is going to publish its 8th Volume of Indian journal of Physical Therapy and Rehabilitation this year.

We must engage in research and voice our opinions by publishing them in this, our local journal. To ensure wide leadership, the journal will carry a variety of articles of general interest, as well as scientific articles, based on topics relevant to our region. Articles in the following categories are welcome: Editorials, Letter to Editor, Major and Minor Reviews, Original Research, Notable Clinical cases, To conference report, New technique I clinical update. With so many categories, I am sure that all of you will be able to make regular contributions to this journal.

This is a major milestone for the physiotherapy field and I encourage all my staff and colleagues in the health care Sec-tor, both public an private, to embrace and support this Journal. The continuing success of this journal should give us a sense of pride and achieve meant. Please contribute articles to this journal in a timely manner to ensure it becomes an important forum for the exchange of ideas and knowledge which will ultimately transfate to better health care.

My Congratulations to the entire team of my Department of Physiotherapy working for this remarkable Endeavour and I wish editor in chief all the best for the successful publication of the journal.

DR. SHAILENDRA MEHTA
Principal
Department of Physiotherapy

The Editor's Desk

It gives me immense pleasure to write editorial for this 8th volume of IJPTR. The Department of Physiotherapy J.R. Nagar Rajasthan Vidyapeeth University Journal with a vision to promote physiotherapy science including all the specialities of Physiotherapy and uptake knowledge through new innovative research papers, case reports and Review articles in various field of physiotherapy specialities. This Journal with consistent precious publications ultimately aims to reach out to the International standards.

Our world is changing we face mounting challenges of Health Care to name a few. Their solution will require new ideas, discoveries, talents and innovations the fruits of research. To achieve them we must start by changing the way we do research there has to be free movement of people & ideas.

At this Juncture i wish to express my profuse thanks to all those who made an appreciable contribution for this journal and further i anticipate that their majestic effort shall continue, so to bring greater glory to our endeavors.

The arena of physiotherapy which as a matter of fact, works as a back bone of medical rehabilitation field should further be developed, for greater benefit to our suffering humanities

I implore & solicit all our members to spare no stone unturned in this noble and glorious mission.

I whole heartedly wish to express my deepest sense of gratitude to Honb'e chancellor & Honb'e Vice chancellor for their untiring help, relentless support and tremendous encouragement without which the present work would not have achieved its glorious completion.

On the behalf of editorial board I request to all the physiotherapist academicians, clinicians, research scholars and students to contribute articles for this Journal.

I pray to Almighty to grant all of us still greater success in times to come.

(Dr. S.B. Nagar)
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INDIAN JOURNAL OF PHYSICAL THERAPY & REHABILITATION

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EFFECT OF EUHYDRATION AND HYPOHYDRATION ON HEART RATE RECOVERY IN YOUNG UNIVERSITY ATHLETE

Dr. Ronald B*
Dr Anand Misra Dr Arun Mohzi*** MPT (Sports), Dr Shid Dhar******

Abstract: Aims and Objectives: To compare the effect of euhydration and hypo hydration on young University athletes Study Design: Experimental Study. Participants: Total of 60 subjects was included based on the inclusion and exclusion criteria through convenient sampling and . Before exercise all the subjects were measured for urine specific gravity subjects falling under euhydrated level were taken basal heart rate and then asked to follow the protocol same was done for hypohydrated state Outcome measure: Heart Rate. Results: The results of the study show that there is a significant faster heart rate recovery (p=0.000) between the groups for Hypohydration Group . Conclusion:We conclude that during hypohydration the heart rate is much more stable than in euhydrated state .which promotes better cardio vacular endurance.

INTRODUCTION

Water is the largest single component of the human body, accounting for about 50–60% of total body mass. For a healthy lean young male with a body mass of 70 kg, total body water will be about 42 lit. The turnover rate of water exceeds that of most other body components. For the sedentary individual living in a temperate climate, daily water turnover is about 2–3 lit. In other words, about 5–10% of the total body water content is renewed every day.

Water is lost from the body in varying amounts via a number of different routes the main avenues of water loss are urine (about 1400 ml), feces (200 ml), insensible losses from the lungs (400 ml) and loss via the skin (500 ml). The total daily water loss is therefore about 2500 ml, but this varies greatly between individuals and depends on the environmental conditions.

Water is the medium of circulatory function, biochemical reactions, metabolism, and substrate transport across cellular membranes, temperature regulation, and numerous other physiological processes. Fluid-electrolyte turnover and whole-body water balance change constantly because water is lost from the lungs, skin, and kidneys, and because water is gained in food and fluids. Therefore, accurate and precise laboratory and field techniques are needed to evaluate human hydration status.

water to reach the intracellular compartment. The cells imbibe, drinking is inhibited and the kidneys excrete more water.

Methodology

Design

This is an experimental study. All the subjects were recruited from the various colleges and sports center from of Dehradun.

Sampling :

Total of 60 subjects were chosen as per the inclusion and exclusion criteria, and informed consent was obtained from all the subjects after the procedure was explained to them

Procedure :

Euhydrated and Hypohydrated states.1st day the subject were studied for Euhydrated state. And for this he/she was asked to consume normal required water the specific gravity was checked by myself. If it came under the specified limit that is 0.010 they were made to follow the protocol or else follow the above procedure. Temperature was set at25O C. A pre exercise data was recorded of their basal heart rate. Then the Euhydrated subjects had to follow

MPT Scholar, Garden City University, Bangalore* Principal Indore Institute of medical Sciences**
Associate Professor, Garden City University, Bangalore ***

their prescribed exercise protocol which is as follows:

- 5 min warm up at speed of 2m/sec inclination 0 degree
- 20 min running at 7 m/sec speed on treadmill at inclination 1degree
- Then the time taken for recovery heart rate was measured

Throughout this the heart rate was recorded in the last 10 sec of a min.

The same subjects were then studied for hypohydrated state on next day.

Results:

TABLE : INTER GROUP COMPARISON OF HEART RATE RECOVERY TIME BETWEEN GROUP A AND B

VARIABLES	MEAN		SD		T	P
HEART RATE RECOVERY TIME	GROUP A	GROUP B	GROUP A	GROUP B	6.167	.000
	11	8.75	2.16286	1.81915		

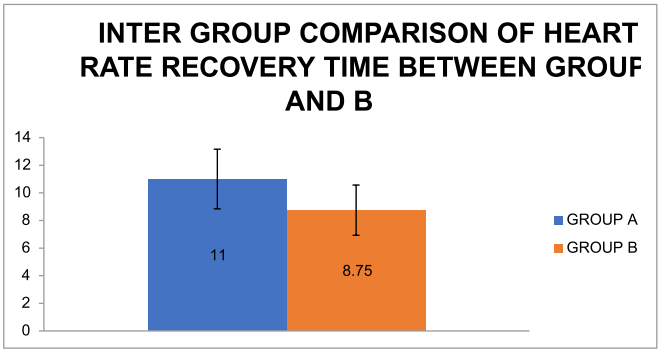

FIG 10: Shows significant difference in heart rate recovery time in group A and B

DISCUSSION

Hypohydration group showed significant early recovery after the exercise protocol. This could be explained by the reason that hypohydration causes decrease in blood volume. As result the arterial blood pressure falls leading to and there is decrease in blood volume level in the body which lead to increase incidence of orthostatic hypotension and syncope. As defense mechanism the body produces sympathoexcitation and increase in volume regulatory hormones like Angiotensin II. This increases blood volume in the body. So when there is increase in blood volume the heart rate does not increase this causes decrease in heart rate. This could be the possible mechanism of faster heart rate recovery in hypohydrated group.28

Adrenaline is a stimulator of heart rate, it increases the heart rate through sympathetic activity and thus increases heart rate but a physiological mechanism also says that when there is too much irritation by adrenaline it may causes decrease in the heart rate known as ADRENALINE BRADYCARDIA.25

In favor of present study it has been proved that during the period of dehydration there is an increase in concentration of epinephrine, norepinephrine and cortisol also cytokine along with adrenaline are precursor of sympathetic activity and shows that IL-6 component of cytokine is released 30 min after the exercise. So it suggest that for the first 30 min there is increased concentration of adrenaline which may cause adrenaline bradycardia, thus decreasing the heart rate3

In previous studies it was seen that when an athlete is made to exercise in a heat stress in a dehydrated state the heart rate recovery was faster in euhydrated subjects than dehydrated group but as per study done by me the heart rate of hypohydration group increased less which shows a contradictory results36, 37 and a need for future research.

Conclusion :

As per previous studies, euhydration and hypohydration both help in heart rate recovery but as per this study, hypohydration group showed an early recovery in a short period of time at 25ºC. This means that if we make an athlete enter a short term sport with moderate intensity in hypohydrated state, it can be beneficial for him/her as there will be early heart rate recovery which shows a better cardiovascular endurance in them.Thus.it will be beneficial for improving their performance at sport.

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EFFECT OF VIRTUAL REALITY VERSUS CONVENTIONAL THERAPY ON STATIC AND DYNAMIC IMBALANCE IN STROKE PATIENTS –A COMPARATIVE STUDY

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ABSTRACT

Background: Stroke, or a cerebral vascular accident, is the sudden death of brain cells due to inadequate blood flow. The WHO clinically defines stroke as the rapid development of clinical signs and symptoms of a focal neurological disturbance lasting more than 24 hours or leading to death with no apparent cause other than vascular origin'. (WHO 2005) . Stroke is a global health problem. These include impaired neuromuscular control, altered sensation, neglect (i.e. failure to respond to stimuli on the affected side) and visual deficits. Thus increasing the risk for falls, leading to subsequent injuries.

Methodology: 30 patients were randomly selected male and female both of the age group 40 to 65 of age with difficulty in walking. They were divided into 2 equal groups. Group A was experimental group and was given virtual reality training along with few exercises and group was given conventional therapy alone for 30 minutes, 5 days a week for 4 weeks. Both the groups were assessed pre intervention and post intervention on berg balance scale and TUG test.

Results: After administration of virtual reality exercises among stroke patients of group A group between baseline and post intervention (22.13 points) were large and thus strongly significant ($p<0.001$). Less improvement noted among stroke patients of group B than group A at post intervention stage.

Conclusion: Ultimately, the present research showed that the physiotherapeutic regime such as virtual reality exercises on static imbalances are more effective intervention protocol in improving the balance and better functional status in patients with stroke.

Key-words: Stroke, Virtual Reality, Balance improvement, Head Gear.

INTRODUCTION

Stroke is a global health problem. It is the second commonest cause of death and fourth leading cause of disability worldwide1.

It is defined as the sudden onset of focal neurological deficits, as a result of the interruption of blood flow to a specific part of the brain.2 It is one of the most common causes of death and is the single most common cause of severe disability (30% - 40% of survivors).3This condition is usually characterized by loss of functions of the motor, sensory and higher brain cognitive faculties to various degrees4 typically on side of the body opposite to side of the lesion.3Such motor deficits will lead to dramatic alteration in lifestyle, compromising the functional independence, decreasing mobility and ability to perform activities of daily living.3

Although 60% of the stroke survivors regain walking independence after 3 months, several have continuing problem with mobility due to impaired balance, motor weakness and decreased walking velocities. The ability to walk in stroke subjects can be affected by various neurological deficits, which are typically unilateral. These include impaired neuromuscular control, altered sensation, neglect (i.e. failure to respond to stimuli on the affected side) and visual deficits.7 Thus increasing the risk for falls leading to subsequent injuries. Research reveals that diverse factors, such as timing and force scaling problems, sensory loss, abnormal muscle tone, loss

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of sensory and anticipatory postural control, contribute to the difficulties of dynamic balancing in post-stroke population.8

Deficits due to impaired balance include an increase in a postural sway, a decreased areas of stability in stance, and an uneven weight distribution on stance with less weight placed on the weaker leg.2 Moreover, during ambulation stroke patients have a higher risk of falls.9 Many people returning home after stroke rehabilitation walk at average speed that is insufficient to cross the street safely or even to walk safely in the community.10

Cheng and Marigold showed significant improvement in dynamic balance function measurements following balance training.2 . Two major goals of rehabilitation are the enhancement of functional ability and the realization of greater participation in community life. These goals are achieved by intensive intervention aimed at improving sensory, motor, cognitive and higher level-cognitive functions on the one hand, and practice in everyday activities and occupations to increase participation on the other hand .17 Virtual reality-based therapy, one of the most innovative and promising recent developments in rehabilitation technology, appears to provide an answer to this challenge. Virtual reality typically refers to the use of interactive simulations created with computer hardware and software to present users with opportunities to engage in environments that appear to be and feel similar to real world objects and events 22,23,24. Users interact with displayed images, move and manipulate virtual objects, and perform other actions in a way that attempts to "immerse" them within the simulated environment thereby engendering a feeling of presence in the virtual world . 25,26

Virtual reality has a number of well-known sets, which make it highly suitable as a rehabilitation intervention tool .27 These assets include the opportunity for experiential, active learning and the ability to objectively measure behavior in challenging but safe and ecologically-valid environments while maintaining strict experimental control over stimulus delivery and measurement. VR also provides the capacity to individualize treatment needs, while gradually increasing the complexity of tasks and decreasing the support provided by the clinician .21,28

Given the variety of VR platforms and the diverse clinical populations that may benefit from VR-based intervention, it is helpful to view the VR experience as a multidimensional model that appears to be influenced by many parameters. A conceptual model was developed within the context of terminology established by the International Classification of Functioning, Disability and Health (ICF) 18 and the rehabilitation process 39,40. This model helps to identify the clinical rationale underlying the use of virtual reality as an intervention tool in rehabilitation as well as to design research to investigate its efficacy for achieving improved performance in the real world. The process of using VR in rehabilitation is modeled via three nested circles, the inner "Interaction Space", the intermediate "Transfer Phase" and the outer "Real World".

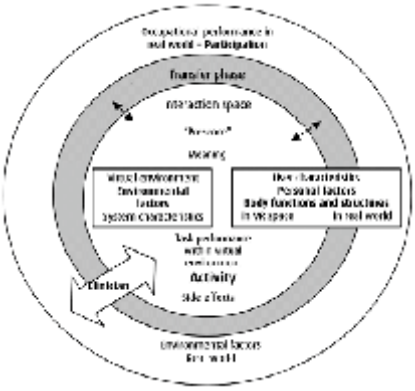

Figure: Model of VR-based rehabilitation within the context of terminology from the ICF(indicated in bold). (Weiss et al., 2006)

The "Interaction Space" denotes the interaction that occurs when the client performs within the virtual environment, experiencing functional or game-like tasks of varying levels of difficulty, i.e., the activity component according to the ICF terminology. This

interaction is influenced by user characteristics, which include personal factors (e.g. age, gender, and cultural background), body functions (e.g. cognitive, sensory, motor abilities) and structures (e.g., the parts of the body activated during the task). It is also influenced by the characteristics of VR platform and its underlying technology (e.g. point of view, encumbrance) that presents the virtual environment and the nature and demands of the task to be performed within the virtual environment.

It is during the interaction process that sensations and perceptions related to the virtual experience take place; here the user's sense of presence is established, and the process of assigning meaning to the virtual experience as well as the actual performance of virtual tasks or activities occurs. The sense of presence enables the client to focus on the virtual task, separating himself temporarily from the real world environment. This is an important requirement when motor and, especially, cognitive abilities and skills are trained or restored. The concept of meaning is also thought to be an essential factor that enhances task performance and skills in rehabilitation in general 16,18 and thus also in the VR-based rehabilitation 40. Environmental factors within the virtual environment may contribute information about issues that facilitate or hinder the client's performance, and may serve as facilitators of performance in the virtual environment leading to improved performance in the real world.

Two outer circles, the "Transfer Phase" and the "Real World" denote the goal of transferring skills and abilities acquired within the "Interaction Space" and eliminating environmental barriers in order to increase participation in the real world (i.e., participation in the natural environment according to the ICF terminology). The "Transfer Phase" may be very rapid and accomplished entirely by the client or may take time and need considerable guidance and mediation from the clinician. The entire process is facilitated by the clinician whose expertise helps to actualize the potential of VR as a rehabilitation tool.

VR-delivered therapy program, increased enjoyment while doing the exercises, improved confidence while walking and fewer incidents of falling.

Analysis of conventional and video capture VR treatment for SCI by specialists in rehabilitation highlighted several key differences between the two methods of intervention 45. First, control over delivery of the stimuli via the VR platform enabled the therapist to intervene more effectively, especially in terms of physical guidance and support. In addition, the VR platform allowed precise control over delivery of the number of stimuli simultaneously presented to the patient as well as their speed and direction. These features appeared to increase the number of times a desired balance-recovery movement was performed by patients. Finally, the ease with which this platform elicited dynamic equilibrium recovery responses, an essential component in balance training and encouraged weight transfer movements was remarkable. In contrast, the static presentation of stimuli during conventional therapy restricts intervention to focus almost exclusively on weight transfer.

Virtual reality (VR), which will be helpful in promotion of visual, auditory, tactile input and motivation and motor learning has been applied to improvement of motor skill after stroke .54 The number of studies and experimental applications exploiting VR in the rehabilitation environment has shown a rapid increase over the last few years. VR technology uses the principles of motor learning and neural plasticity in order to optimize recovery after brain damage .55 Application of VR is also varied, including gait and balance retraining and upper and lower limb rehabilitation. VR is the most recent intervention in stroke rehabilitation .56 VR is a powerful tool in a rehabilitation environment, providing the patients with repetitive practice, feedback information, and motivation for endurance practice .57

NEED FOR THE STUDY

In stroke balance dysfunction is common due to abnormal posture, reduced core stability, functional limitation. Thus the need of this study to find out the effectiveness of virtual reality for improving balance, improve core stability and posture control ,and activity of daily living. Thus improving their multitasking activity of stroke patients.

METHODOLOGY:-

The sampling technique was a purposive sampling technique. A sample size of 30 patients divided into 2 equal groups. The study was a quasi experimental study. Study time was 6months and the treatment was given for 4 weeks and 5days a week. Both the groups received treatment for 30 minutes. Inclusion criteria were no visual impairment, no Hearing disorder, patient must have ability to walk independently without use of walking aids for more than 10 meters, patient is able to understand and follow simple verbal instructions, having motor aphasia. Both males and females have been selected between 40 to 65 years. Patients with orthopedic or neurological diseases uncontrolled BP, presence of cardiac arrhythmias, homonymous hemianopia, mental retarded person, signs of deep vein thrombosis and patients with wernicke's aphasia were excluded. It was measured on the berg balance scale and TUG test.

OBSERVATIONS AND RESULTS:

TABLE-1

Comparison In Score On Berg Balance Scale In Group A And Group B Between Baseline And Post Intervention Sampling Stages

Sampling Stage & group	Score on BBS Mean ± SD	Mean Diff	t-statistic	LOS
Group A (Virtual Reality)				
Baseline	26.93±3.85	22.13 points	24.48	p<0.001 #
Post- intervention	49.07±3.20			
Group B (Conventional Therapy)				
Baseline	25.13±2.64	14.34 points	17.86	p<0.001
Post- intervention	39.47±3.91			

#The mean differences are highly significant at the 0.001 level of significance. [Mean Diff-Mean Difference; LOS-Level of Significance]

Table projects that the virtual reality and conventional exercises were the effective treatment protocols for improving the static and dynamic imbalance of stroke patients. In group A, the static imbalance was significantly differed and improved recorded after administration of a virtual reality exercises among stroke patients at post intervention stage as compared to baseline stage. The stroke patients in group B group also experienced improvement in static imbalance at post stage but less as compared to stroke patients of group A.

After administration of virtual reality exercises among stroke patients of group A group, the average of score (Mean ± SD) at post- intervention (49.07±3.20 points) was increased and improved as compared to score at baseline (26.93±3.85 points). Statistically, the differences in mean score of stroke patients of group A between baseline and post intervention (22.13 points) were large and thus strongly significant ($p<0.001$).

Less improvement noted among stroke patients of group B than group A at post intervention stage. In group B group, the differences in mean score (14.34 points) after administration of conventional exercise between baseline (25.13±2.64 points) and post intervention (39.47±3.91 points) was highly significant ($p<0.001$) that was confirmed statistically. The differences at post- intervention in mean score among stroke patients of group B found to be less (14.34 points) was measured on Berg balance scale as compared to patients of group A (22.13 points).

Moreover, it was inference statistically that stroke patients intervened with virtual reality exercises had more significantly improved static imbalance than stroke patients of group B treated with conventional exercise.

Furthermore, this study reported that virtual reality exercises on static and dynamic imbalance considered as a tool to combat the weak static imbalance statuses among stroke survivors.

TABLE-2

Comparison Between Group A And Group B In Berg Balance Scale Scoring At Baseline And Post Intervention Sampling Stages

Sampling Stage	Group	Score on BBS	Mean Diff	t- statistic	LOS
		Mean ± SD			
Baseline	Group A	26.93±3.85	1.80 points	1.50	p>0.05
	Group B	25.13±2.64			
Post-intervention	Group A	49.07±3.20	9.60 points	7.37	p<0.001 #
	Group B	39.47±3.91			

The mean difference is not significant (insignificant) at the 0.05 level of significance. #The mean difference is highly significant at the 0.001 level of significance. Post-treatment observations recorded after 4 weeks protocol. [Mean Diff-Mean Difference; LOS-Level of Significance]

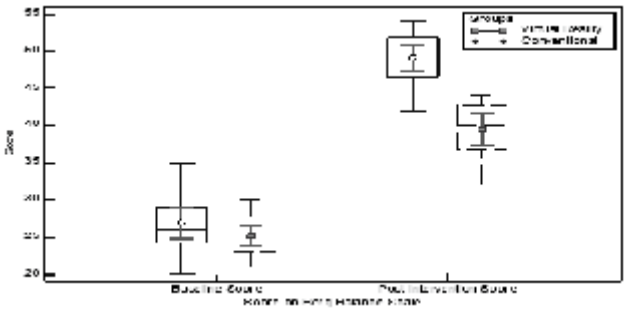

Figure -Box and Whisker diagram depicting the comparison of score on Berg Balance Scale at baseline and post intervention between group A and group B.

TABLE-3

Comparison In Time Of Tug Test Between Group A And Group B At Baseline And Post Intervention Sampling Stages

Sampling stage	Group	Time (second) on TUG Test	Mean Diff	t- statistic	LOS
		Mean ± SD			
Baseline	Group A	18.33±1.88	0.80 second	0.96	p>0.05
	Group B	19.13±2.62			
Post (At 4th week)	Group A	9.47±0.83	0.53 second	1.74	p>0.05
	Group B	10.00±0.85			

*The mean difference is not significant (insignificant) at the 0.05 level of significance. Post-treatment observations recorded after 4 weeks protocol. [Mean Diff-Mean Difference; LOS-Level of Significance]

TABLE -7

reports that the difficulty and functional status after administration of virtual reality exercises of stroke patients of group A was not significantly differed at post intervention sampling stage as compared to stroke patients of group B who received conventional exercises. This showed that both the methods had same potential to cope with dynamic imbalances among stroke survivors.

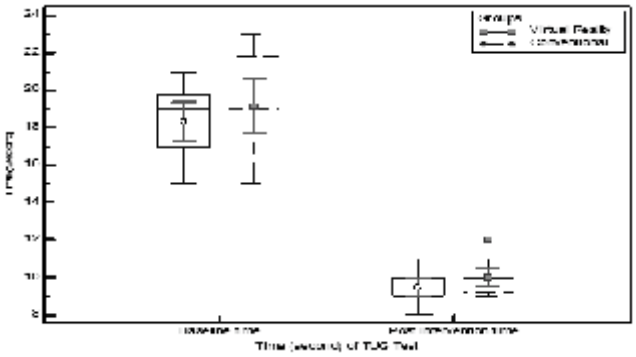

Figure - Box and Whisker diagram depicting the comparison of time (second) of TUG test between group A and group B at baseline and post intervention.

CONCLUSION

Hence, this was concreted statistically that patients with stroke intervened with virtual reality exercises had significantly improved static imbalances with better timings to overcome difficulties. Overall, present research highlighted that the virtual reality exercises is an effective conservative treatment for stroke survivors to improve static imbalances.

Ultimately, the present research showed that the physiotherapeutic regime such as virtual reality exercises on static imbalances are more effective intervention protocol in improving the balance and better functional status in patients with stroke. Finally, the above all statements and inferences from all the tables indicated the rejection of null hypothesis. Therefore, the alternative hypothesis is accepted which stated as "There will be more significant effect of virtual reality as compare to conventional therapy in static imbalance in stroke patients".

DISCUSSION

The aim of study to investigate the effect of virtual reality and conventional therapy in balance imbalance in stroke patients. Thirty subjects suffering from stroke were available for the study. The patients with stroke in group A received virtual reality with sitting, standing and maintenance of trunk stability in standing position while rest other stroke patients of group B received conventional therapy. The scores on Berg balance scale (BBS) and time on timed get up and go (TUG) test had collected prior to administration of exercises and after administration of exercises in groups, the scores had recollected at 4th week.

The result indicates that the stroke patients intervened with virtual reality exercises had significantly improved static imbalance than stroke patients intervened with conventional exercises.

Mancini et al 2002 says that conventional postural control training, which patients might find boring and aimless, leads to a low participation rate and decreased motivation.

Generally, balancing the body is by the coordination of three major systems, including visual, vestibular and proprioceptive sensation. The cortex area of brain, brainstem and cerebellum control the balance of body. The prefrontal cortex is one of the most important brain areas in controlling human balance (Nancy, 1980; Virk et al., 2006; Walker et al., 2010; Bolton et al., 2012).

They provided information about the position and motion of the head with respect to the surroundings, and based on information in the visual surroundings provided by visual cues. The main role of this proprioceptive and somatosensory system is to sense the distributed tactile input stimuli at the neural level, and to provide a relationship between limb position and the central nervous system. The vestibular system, located in the inner ear, is used to control and perceive the motion and position of the head in space (Virk et al., 2006). The function of these systems reduced after the brain is impaired. When one or two of these sensory input systems are dysfunctional the allocation of different gains to the sensory inputs can be exploited to compensate for the impaired systems (Nancy, 1980; Walker et al., 2010). Virk et al. (2006) proposed that such an adaptation can take place in everyday life or in a virtual environment virtual environment to train the eye-head movement, balance in older people can be improved and occupational falls are minimize. Balance control in standing is a complex sensorimotor action based on automatic and reflexive spinal programs under the influence of several distinct and separate supra-spinal centers in the brainstem, cerebellum and cortex (Drew et al., 2004).

Cortical areas were activated to these artificial environment tasks. The prefrontal cortex would be activated when participants performed spatial orientation tasks. Virtual reality training over 4 weeks could activate the region of the prefrontal cortex (Tachibana et al., 2011). Results suggest a corresponding relationship between the prefrontal cortex and spatial orientation ability.

Another study by Basso Moro also demonstrated that, when healthy participants performed an incremental swing balance task in a semi-immersive virtual reality environment, the effect of oxygenation increased in the prefrontal cortex of both hemispheres (Basso et al., 2014). The density of oxygenated hemoglobin increased, but that of deoxygenated hemoglobin was not found in the frontal cortices. Moreover other studies found a positive correlation between presence and parietal brain activation and a negative correlation between presence and frontal brain activation during interactive virtual reality training (Mihara et al., 2008).

The CPT protocol consisted of targeted lower extremity muscle strengthening and static, dynamic balance training, and gait training. A muscle-strengthening exercise for the gluteus medius and

quadriceps muscle (esp. rectus femoris) was activated for improvement of eccentric controlled mobility of pelvis. In addition, strengthening of the tibial anterior and Gluteius medius was facilitated for improvement ankle dorsiflexion and push off (propulsion) at swing phase, respectively. For static balance training, patients were induced to shift their weight onto the paretic limb by verbal and tactile cues. In addition, in dynamic balance training, patients were induced to shift their weight in the anterior posterior and medial lateral planes while performing a functional reaching task .It allowed them to shift their mobile weight during gait training.

Sisto et al 2002 says that A multi-disciplinary approach for postural control is required for patients to maximize restoring lost function The model of vasomotor training was demonstrated in eighteen healthy right-handed volunteers from the analysis of functional magnetic resonance imaging that showed extensive activity in frontal, parietal, temporal, cingulate and cerebellar areas (Prochnow et al., 2013).The head mounted devise will improve the head and trunk rotation and will improve the postural stability and balance .

The environmental based virtual reality system has demonstrated to provide benefits to stroke patients affected by motor impairments and in over study could be especially useful for balance rehabilitation under static conditions. This fact is well documented not only in the field of motor domain. Ultimately, the present research showed that the physiotherapeutic regime such as virtual reality exercises on static imbalances are more effective intervention protocol in improving the balance and better functional status in patients with stroke.

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EFFECT OF BMI ON MUSCULOSKELETAL PAIN AMONG TEACHERS OF ABUROAD

Dr.Arvind Kumar (PT)*, Darshana Patel **

ABSTRACT-

OBJECTIVE:

The objective of the study was to assess the effect of BMI on Musculoskeletal pain among teachers & its prevalence.

METHODS:

All Data were collected by a questionnaire. A questionnaire was distributed to all subjects, total 150 (75 males & 75 females), each subjects were passed to complete the self-administered questionnaire if they fulfil inclusion criteria.A standardized Nordic Musculoskeletal Questionnaire (NMQ general section) was used to collect data on Musculoskeletal symptoms (ache, pain, discomfort) from different regions of the body during last 12 months & the earlier seven days, as well as pain affecting work ability during the past 12 month.This was used as an assessment tool for Musculoskeletal pain in different body region. Also, reliability: 0.61 (Cronbach's, Alpha validity 0.71) Numerical Pain Rating Scale(NPRS) was used for the perception of pain intensity, which ranges 0-10 is applied,where 0 means no pain & 10 means 'the worst" unbearable pain.Numerical Pain rating Scale was widely used because it is easily administered & requires little to no training or equipment.

RESULTS:

A total 150 teachers (50% male & 50% female) selected in the study.The study showed significant relationship between the BMI & Musculoskeletal pain in mainly low back pain & knee joint, while other region like Neck, shoulder, Elbow, wrist, Upper back, hip & thigh & Ankle & feet did not show significant relationship with score.

Since the readings are in nominal scale, to find the relation,chi-square test is used. Any statistical test is said as significant if p-value is <0.05.The most reported musculoskeletal pain level showed prevalent of low back severe pain among teachers, followed by knee pain.

CONCLUSION:

This Study has shown that the most of the teachers were suffering from musculoskeletal pain & significant risk factors, & correlations were observed between BMI & Musculoskeletal pain symptoms in teachers.

Key Words: Work related musculoskeletal pain, Low back pain, WMSDs, BMI, Teachers.

INTRODUCTION

In many Countries the prevention of work-related musculoskeletal disorders has been considered as a national priority (1)

Several studies have been conducted on the prevalence of MSDs among teachers in many developed & developing countries of the world. These studies have identified teachers as one of the occupational groups that are at the risk of developing MSDs. (2)

Musculoskeletal disorder has a high impact for the individual as well as for society, the origin of MSDs

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is complex & Multi factorial. (3) Musculoskeletal disorders defined by the health & safety executive (HSE),The term musculoskeletal disorders (MSDs) includes any injury, damage or disorder of the joints or other tissues in the upper/lower limbs or the back.Uncomfortable working position, working too long without breaks and working in awkward posture. (4)

Musculoskeletal pain is defined as pain perceived related to musculoskeletal, when there is risk of tissue damage or when such damage has occurred, pain can signal that there is a need for recovery of tissues.(5)

Individual factors like age, sex, anthropocentric dimensions, muscle strength, physical fitness, mobility, psychological & social factors contribute to musculoskeletal disorders. (6)

Several studies have linked obesity with musculoskeletal disorders & repetitive work. (7) The epidemic of obesity has become pandemic defined as an epidemic occurring over a wide geographic area & affecting an exceptionally high proportion of populations. The risk in obesity rates was first noted in the United States, but has speed to other industrialized nation & it is even now being documented in developing countries, Indeed the global extent of obesity pandemic was formally recognized by the WHO in 1997, & worldwide obesity rates are increasing dramatically.(8)

Overweight & obesity are one of the world most challenging public health problems (WHO 2003). The prevalence of overweight has reached epidemic proportions in most western countries including Portugal. Overweight & obesity are high among employed adults & have shown a consistent increase over the past few decades. (7)

Obesity is defined as a physiological condition in which excess body fat has accumulated to an extent that can negatively affect health(8). Obesity occurs when energy intake exceed the energy expenditure. Humans expend energy through daily life, we can measure obesity by body mass index(BMI). (9)

Body mass index (BMI) is a ratio derived from the weight(Kg.) and height of a person(metres). The BMI is defined as the body mass divided by the square of the body height, and is expressed in units of kg/m2, resulting from mass in kilograms and height in metres, introduced as a Quetelet Index in 1830's several decades to estimate population trends in fat. (8)

A BMI value in the range of <18.5 kg/m2 is defined as underweight, 18.5 - 24.9 kg/m2 is defined as normal, 25 - 29.9 kg/m2 is overweight, 30-34.9 kg/m2 is obese class 1, 35 - 39.9 kg/m2 is obese class 2, & 40 > 49 kg/m2 is obese class 3/or morbidly obese..(8) High BMI is the independent risk factor for MSDs, for symptoms of neck shoulder upper & lower limbs, evidence was also found that high BMI is an independent risk factors for development of MSD's symptoms.(3)

Compared to normal weight patients, underweight patients & obese class two & three patients had higher odds of reporting moderate to severe pain. (11) According to public health prospective effective well documented initiatives for reducing weight improving physical capacity & reducing Musculoskeletal pain among health care workers are therefore needed.(7)

Some occupational factors have been associated with the development of work related musculoskeletal pain among many groups & these postures have great burden on their health & quality of life. Work-related musculoskeletal pain is the most common cause of chronic pain in general population, with estimated high lifetime prevalence of MSDs. (2)

Teachers have been identified as one of the occupational group that are at the risk of developing work related Musculoskeletal pain (WRMSP), this may due to the fact that teaching is one of most stressful jobs (2)& teaching profession is accompanied by occupational burden that arise from

the specific physiological demand of profession.(12)

College professors are exposed the numerous pressure sources which affect their quality of life & teaching activities. (13) Among these populations, college teachers who are having administrative activities, conciliating teaching research & extension are exposed to numerous pressure sources beyond those arising from changes in labour system, such as high work load, short pause for rest, intensive working place & requirements for beyond those arising from changes on labour & attraction. (13) When, such situations are associated to a high level of stress, quality of life of this category is considerable inspired including several health disorders such as Musculoskeletal problem which are prevalent among teachers.(13) Prolonged exposures to unfavourable working conditions during teaching become a health risk factors. Despite this the impact of muscular pain specifically has not been given sufficient attention in the literature. (14)

Not with standing studies discussing musculoskeletal disorder in this population are still scare in the literature. The incidence of work related Musculoskeletal disorders (WRMSDs) is increasing in recent years, due to organizational changes & work related requirement often leading to medical leaves & workers functional incapacity, so measuring WRMSDs reports is needed to collect data to quantify prevalence & to evaluate different affected populations.

Among tools to evaluate such symptoms, the Nordic Musculoskeletal questionnaire is a tool developed to standardize musculoskeletal pain & discomfort thus helping studies populations. There is much anecdotal evidence amongst education professionals about the aches & pains they experience at work & also from health care professionals (e.g. Physiotherapist, osteopaths, chiropractors) who treat them, (4) & it is worth stressing that these are few scientific studies related to Musculoskeletal risk factors among teachers & this deficit is even more severe with regard to college teachers since studies focus on teachers of other educational levels.

So, college teachers deserve attention on the potential health risk & problem related to their labour activity. (13)

AIM OF STUDY

To assess the effect of BMI on Musculoskeletal pain among teachers & its prevalence.

METHODOLOGY

Study design: Descriptive observational study

Study Setting: Abu Road

Population: Teachers of various school & colleges (Government & private) in Abu road.

Sample size: 170 subjects were being selected for this Study but 20 subjects were excluded from the study.

Sampling Techniques : Convenient sampling techniques.

Source of data collection: Teachers working in academic setup, Abu road (Rajasthan).

Method of data collection : Through the data available; contacts to the teachers working in academic field in Abu road & explain them about the study & procedure & those subject were willing to participate and meet inclusion & exclusion criteria. Then their written consent was being taken & collect their data.

Inclusion criteria:

- Teachers age group of 25 - 40 years.
- Both sex & gender are included.
- Minimum 2 years of job experience.
- Minimum 6 - 8 working hours /day, with minimum 3 lectures per day were accepted in this study.

Exclusion criteria:

- Teachers on leave.
- Part time teachers
- Chronic anomalies
- Any major surgery & other condition
- Any current fracture

Tools

1. Standardized Nordic Musculoskeletal questionnaire
2. Numerical pain rating scale

Material used for this study

1. Weight machine
2. Height measurement tape
3. Data collection form
4. Calculator

PROCEDURE

This Study was conducted at the Aburoad. Prior to the Study written consent was taken from all subjects & also explained about procedure & aim of the Study. Then subject was taken & collected the data, which covered

(1) Personal details (including Age, weight, height, job tenure, education, health, medical background)

(2) Musculoskeletal problem in different body regions

a) Measurement of BMI-

Height was measured in standing position without shoes, using a wall mounted height tape. Weight was measured when the subject was in light clothes, without shoes & empty pockets & then BMI was calculated as weight (kg)/height2 (m)

b). Musculoskeletal problem Assessment

All Data were collected by a questionnaire.

Questionnaire were distributed to all subjects total 150 (75male & 75 female), each subjects was passed to completed the self-administered questionnaire if they fulfil inclusion criteria.

Standardized Nordic questionnaire (NMQ general section) were used to collect data on Musculoskeletal symptoms (ache, pain, discomfort) from different regions of the body during last 12 month & the previous 7 days, as well as pain affecting work ability during the past 12 month. This was used as an assessment tool for musculoskeletal pain in different body region. Also reliability: 0.61(Cronbach's, Alpha validity 0.71) .

After that for the perception of pain intensity through the Numerical pain rating scale scored for 0-10 applied where 0 means no pain & 10 means worst unbearable pain & assessed it.

Numerical Pain rating Scale was widely use because it is easily administered & requires little to no training or equipment.

RESULTS:

Crosstab							
Count							
		LOWERBACK					Total
		4+	4++	0	1+	4+++	
BMI	Normal	20	18	32	1	3	74
	Obese	1	1	3	0	1	6
	Overweight	16	7	36	0	11	70
Total		37	26	71	1	15	150

Table 1:- Shows association between BMI and lower back, where $p \leqslant 0.05$.

Chi-Square Tests			
	Value	P-VALUE	RESULT
Pearson Chi-Square	11.390[a]	.052	P>0.05 NOT SIG

Table 2:- Therefore, we conclude that there is a significant association between BMI and lower back Pain.

Crosstab						
Count						
		KNEE				Total
		4+	4++	0	4+++	
BMI	Normal	19	3	49	3	74
	Obese	1	1	4	0	6
	Overweight	27	2	38	3	70
Total		47	6	91	6	150

Table 3:- The above table shows association between BMI and knee ($p \leqslant 0.05$)

Chi-Square Tests			
	VALUE	P-VALUE	RESULT
Pearson Chi-Square	6.110[a]	.071	P>0.05 NOT SIG

Table 4:-. Therefore from table 3 & 4, we conclude that there is a significant association between BMI and knee Pain.

DISCUSSION

This study analyzed correlation between prevalence of musculoskeletal pain & BMI. The high prevalence of Musculoskeletal disorders among school teachers was well documented (Erick & smith 2011, Durmus & llano 2012, Darkish & Al-unfair 2013, Abdulmonem et la 2014). (15) (16)

This study shows a high prevalence of musculoskeletal pain particularly low back pain & knee pain. According to this review the main risk supporting their causal relationship with low back & knee WMSDs were increase BMI. Similar finding were also reported on a systematic review conducted by the NRC/IOM. (17)

There, was however a paucity of literature MSDs amongst South African school teachers (kormas et al, 2011) this to determine the prevalence & association between BMI & Musculoskeletal symptoms. (4)

A recent study was founded that the causes of LBP to be associated with standing for a prolonged time, specific sitting habits a sudden change in posture & carrying heavy objects (Abolfotouch et al ,2015). This correlates with the current study in which highly significant relationships were founded between standing for a prolonged period of time & low back pain. (P = 0.05).

Standing for prolonged time was the second most common aggravating factors for low back pain & several epidemiological studies showed that the significant association among uncomfortable back support & LBP, & Mengestu & Zeke found the same result with low back pain. Prevalence of 57.5% & Abdulmonem A, Hunam A, Elaf A, Hammer T, Jehan A, also found the same result the prevalence of LBP 66.9% & more over study of Abdulmonem et al, also further confirmed these findings in teachers & concluded that Low back pain had the highest prevalence of all the Musculoskeletal regions in school teachers. (18)

Several study literatures showed that prolonged sitting may lead to acute low back pain (Anderson 1999) due to the compressive load on the spine & changed with in the passive structures. (Sheehan et all.2016). The predominance if Musculoskeletal pain & discomfort symptoms in lumbar spine of teachers was also found by carvalho & Alexander,who evaluated 2006, elementary school professors & have found a prevalence of 63.1% of Musculoskeletal symptoms in lumbar region. (19) (13)

After the low back pain, knee pain is the next most frequent site of musculoskeletal pain found in this study & same result found the previous similar study.

Several justifications presented in the literature for this high percentage among them, poor postures adopted during work, performing repetitive activities and lack of fitness (20) (13).Several study founded very high prevalence of Musculoskeletal pain among school teachers which is affecting their work by missing out working days & Eventually affecting the education system as a whole. (16)

The ministry of health points that preventing WRMSDs should be based on strategies improving worker's health in their workplaces, altering them about ergonomic & environmental risks including physiotherapeutic assistance to evaluate guide & if necessary treat possible disorders. (13)

CONCLUSION

This Study has shown that the most of teachers were suffering from musculoskeletal pain & significant risk factors, & correlations were observed between BMI & Musculoskeletal pain symptoms in teachers.

Based on the outcomes of this study the following conclusions are made:

There is a high prevalence BMI & low back pain & knee pain among teachers in Abu road.

This is needed to supply evidence for a global intervention for teachers, focus on preventing injuries linked to ergonomic strategies directed to movements, postures & the whole overload required during work, thus decreasing the prevalence of WRMSDs, improving teachers's quality of life & productivity.

Health is essential to efficiency of the highest attainable level in almost any line of work. It is peculiarity important for teachers, not only because of strenuous demand & energies but also because teacher's health is the corner stone of any effective school/college health program.

CONFLICT OF INTEREST:-None

SOURCE OF FUNDING:-Self

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THE EFFECTIVENESS OF ISOMETRIC EXRECISE AS COMPARED TO PNF IN MANAGEMENT OF NON SPECIFIC NECK PAIN

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BACKGROUND AND PURPOSE:

Mechanical neck pain is also known as nonspecific neck pain (1).It is also defined as generalized neck pain provoked by sustained neck posture, neck movement, pain on palpation of cervical musculature without pathologies. There is lack of literature comparing the isometric exercise with proprioceptive neuromuscular facilitation technique on chronic non-specific neck pain. Therefore, the purpose of present study is to compare that which of the two techniques i.e. isometric exercise and the proprioceptive neuromuscular facilitation technique is better to decrease pain, improve ROM and improve function in subjects with non-specific neck pain

OUTCOME MEASURES:

1. NDI: Neck disability index to test the functional improvement in neck pain.
2. VAS: Visual Analogue Scale to assess pain.

METHOD:

50 Participants were screened for inclusion and exclusion criteria. 30 were recruited for the study. Participants were divided into 2 groups. Group A: - PNF group and Group B: - Isometric exercises group. Samples were taken by simple random sampling method, consisting of 25 participants in each group. All the participants were assessed for outcome measures pre and post intervention. Both groups were treated for 4 weeks (4 days a week) and final analysis was done.

RESULTS:

Intragroup comparison of VAS and NDI showed significant improvement in both the groups. But in intergroup comparison VAS with p=0.000 and NDI with p=0.026, Group A showed significant improvement in improving function and reduction of pain in non specific neck pain.

CONCLUSION:

The final conclusion of the study is that, both the groups i.e., PNF and isometric group showed significant improvement in function and pain reduction but, when PNF exercise group was compared to isometric exercise group, the patients with non-specific neck pain showed more significant functional improvement and pain reduction in group A rather than group B. The study concludes that, PNF is more effective than isometric exercise in reducing pain and improving function.

Keywords: Proptioceptive neuromuscular facilitation, physical therapy, non specific neck pain, neck disability index, visual analogue scale, trans electrical nerve stiulation

INTRODUCTION:

Mechanical neck pain is also known as nonspecific neck pain (1).It is also defined as generalized neck pain provoked by sustained neck posture, neck movement, pain on palpation of cervical musculature without pathologies.

The annual prevalence of mechanical neck pain ranges in industrial countries from 27% to 48%.

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Prevalence is high in middle aged people.In the majority of cases, the pathologic basis for the neck pain is unclear and the complaints are labeled as "nonspecific or mechanical". Precise prognosis by clinical examination is problematic because signs and symptoms are frequently nonspecific.

Mechanical neck pain commonly seen in people involved in occupation like computer processing, clerical job, students and people with sedentary life style awkward occupational posture, heavy lifting and physically demanding work. In a wrong working position, neck extensor muscles would be excessively stretched during a long period of working with forward position of head and neck. The majority of cases of neck pain originate in mechanical factors: repetitive movements, lack of work breaks, static jobs and holding the head and arm position for long period of time.

The structures being deformed in mechanical neck pain may be the skin, subcutaneous tissue, capsule of synovial apophyseal joints, longitudinal ligaments, ligamentumflavum, interspinous ligament, and annulus fibrosus of intervertebral disc.

The symptoms of mechanical neck pain include neck pain with limited range of motion of the neck and a feeling of stiffness. Pain is aggravated by neck movements or sustained neck posturesand tenderness in neck and shoulder region.

Specific treatment for mechanical neck pain includes moist heat pack, cervical mobilization, cervical manipulation, strength training and postural re-education.Manual therapy is commonly used in the treatment of mechanical neck pain. Manual techniques include positional release technique, muscle energy technique, myofascial release technique, cyriax technique, NAGS and SNAGS, manual pressure release, proprioceptive neuromuscular facilitation and ischemiccompression.

PROPRIOCEPTIVE NEUROMUSCLULAR FACILITATION:

Proprioceptive Neuromuscular Facilitation (PNF) involves stretching, resisted movement, traction and approximation to ameliorate muscle decline, disharmony, atrophy and joint movement limitation.

It is very effective in improving flexibility, strength and range of motion.Recently, it has been used in orthopedic diseases of bones and PNF Technique is based on movement pattern to facilitate and correct sensory motor function it has been suggested that PNF correct the impaired impulses emerging from proprioceptive receptors in the muscle. Therefore, it decreases pain and desires to improve thestrength of muscles.

TRANSCUTANEOUS ELECTRICAL NERVE STIMULATION:

Transcutaneous electric nerve stimulation (TENS) isa common therapeutic device used in different painfulsituations in the everyday clinical practice. It is noninvasive, inexpensive and reveals hardly any major side effects.

TENS can be easily self-administered bythe patients following a short training, and the intensityof electrical stimulation can be adjusted by the patientsthemselves according to need.Previous meta-analysisand reviews have reported about the effect of TENS in various painful conditions butbecause of thelimited or contradictory data, the effect of TENS wasoften evaluated as inconclusive.

ISOMETRIC EXERCISE:

Isometric exercise is a static form of exercise in which a muscle contracts and produces force without an appreciable change in the length of the muscle and without visible joint motion. Although there is no mechanical work done, a measurable amount of tension and force output are produced by the muscle.

Sources of resistance for isometric exercise include holding against a force applied manually, holding a weight in a particular position, maintaining a position against the resistance of body weight, or pushing or pulling an immoveable object.

USES OF ISOMETRIC EXERCISE:

- To minimize muscle atrophy when joint movement is not possible owing to external immobilization like casts, splints, skeletal traction.
- To activate muscles to begin to re-establish neuromuscular control but protect healing tissues when joint movement is not advisable after soft tissue injury or surgery.
- To develop postural or joint stability.
- To improve muscle strength when use of dynamic resistance exercise could compromise joint integrity or cause joint pain.

To develop static muscle strength at particular points in the ROM consistent with specific task-related needs.

NEED OF STUDY:

There is lack of literature comparing the isometric exercise with proprioceptive neuromuscular facilitation technique on chronic non-specific neck pain. Therefore, the purpose of present study is to compare that which of the two techniques i.e. isometric exercise and the proprioceptive neuromuscular facilitation technique is better to decrease pain, improve ROM and improve function in subjects with non-specific neck pain.

OBJECTIVE:

To compare the effectiveness proprioceptive neuromuscular facilitation technique versus isometric exercises on chronic non-specific neck pain and functional impairment.

MATERIALS AND METHOD:

SOURCE OF DATA: Physiotherapy OPD under PSAH

STUDY DESIGN: Experimental Design [Comparative study]

RESEARCH DESIGN: Convenient sampling method.

SAMPLE SIZE: The study was done on Thirty (n=30) subjects andthey were divided into two groups.

INCLUSION CRITERIA:

- Age between 30 to 50 years.
- Male and female both
- Patients with non specific neck pain with/without radiculopathy.
- Patients who can understand English or Gujarati or Hindi language.
- Decreased functional performance
- Tenderness around the neck region.

EXCLUSION CRITERIA:

- Patients with neck or upper back injury in last 6 months.
- Patients suffering from giddiness or vertigo
- Patients with neck surgeries.
- Patients suffering from neurological disorders.
- Mentally and physically disabled patients.
- Patients with radiological diagnosis of spondylolisthesis.

OUTCOME MEASURES:

- 1.Neck Disability Index for functional impairment.
- 2.Visual Analog Scale for pain.
- **PROCEDURE:**

The subjects for the study were selected from ParulSevashram Hospital Physiotherapy OPD's for the subjects with neck pain. 50 subjects were screened for neck pain. Out of these 50 subjects, 40 were falling into the inclusion criteria, remaining were excluded because some were under the inclusion age, some had injuries to the cervical spine, some had undergone surgeries following cervical fractures, some had vertigo and some had spondylolisthesis.

The ones falling into the inclusion were assessed for neck pain according to the assessment format.All the participants at the outset falling into the inclusion criteria were explained in detail about the study and their role and importance in the study. Out of 40, 10

patients refused to participate in the study as they were reluctant to undertake exercise routine and/ or home program. The 30 patients willing to participate were asked to give a written informed consent.

Once the consent was signed by the subjects, they were then alternately distributed into 2 groups. Group 1(experimental group/PNF) and group 2 (control group/exercise).

GROUP A:-

PNF techniquesmethods:

The following movement patterns were performed.

A.Head and neck flexion with rotation to right.

B.Head and neck extension with rotation to left.

C.Head and neck extension with rotation to right.

D.Head and neck extension with rotation to left.

GROUP B:-

Isometric exercises:

A. Isometric flexion.
B. Isometric extension.
C. Isometric rotation.
D. Isometric side-flexion.

Stretching exercises:

A. Neck extensor stretching.
B. Neck flexor stretching.
C. Neck side flexor stretching.
D. Neck rotators stretching.
E. Pectoralis stretching.
F. Trapezius self-stretching.

Shoulder girdle exercises:

A. Shoulder circumduction.

B. Isometric shoulder girdle exercises.

RESULT AND INTERPRETATION:

As already mentioned out of 50 patients only 40 were falling into inclusion criteria out of which only 30 patients were included for the study as the rest were not willing to participate in the study.

Therefore the result presented here are of 30 patients of whom 17 were females and only 13 were males. All of these patients were suffering from neck pain. Their main complain was pain on strenuous activities, pain during neck movements and also complained of difficulties in ADL's due to pain and restricted ROM.

For statistical analysis data was collected before and after 4 weeks of intervention. VAS and NDI both were assessed pre and post intervention.

- t test- was used for the comparison between the pre and post values of outcome measures within the groups.
- t test- was used for the comparison between the post- post values of outcome measures between the groups.

The significance level adopted for the statistical tests was <0.05 and CI was kept at 95%

All statistical tests were performed using SPSS Version 16 software.

INTRA GROUP ANALYSIS

REPRESENTS INTRA GROUP COMPARISION FOR VAS AND NDI FOR GROUP A [paired T-test]:

GROUP	OUTCOME	PRE		POST		T-VALUE	P-VALUE
		MEAN	SD	MEAN	SD		
GROUP A (PNF)	VAS	6	1.06	3.8	0.74	12.91	0.000
	NDI	26	4.47	18	3.29	14.96	0.000

VAS: Intra Group Analysis (Group A): the above table shows the intra-group comparison of VAS score for functional assessment in Group A. The comparison was done through paired t test. The p value of Group A comparing pre and post treatment score of VAS is 0.000. The p value is < 0.05 which shows that group A is significant in improving VAS score.

NDI: Intra Group Analysis (Group A): the above table shows the intra-group comparison of NDI score for functional assessment in Group A. The comparison was done through paired t test. The p value of Group A comparing pre and post treatment score of NDI is 0.000. The p value is < 0.05 which shows that group A is significant in improving NDI score.

REPRESENTS INTRA GROUP COMPARISION FOR VAS AND NDI FOR GROUP B [paired T-test]:-

GROUP	OUTCOME	PRE		POST		T-VALUE	P-VALUE
		MEAN	SD	MEAN	SD		
GROUP B (ISOMETRIC)	VAS	7	1.17	5.4	1.24	11.22	0.000
	NDI	26	2.88	20.9	3.51	14.664	0.000

VAS: Intra Group Analysis (Group B): the above table shows the intra-group comparison of VAS score for functional assessment in Group B. The comparison was done through paired t test. The p value of Group B comparing pre and post treatment scores of VAS is 0.000. The p value is < 0.05 which shows that group A is significant in improving VAS score.

NDI: Intra Group Analysis (Group B):the above table shows the intra-group comparison of NDI score for functional assessment in Group B. The comparison was done through paired t test. The p value of Group B comparing pre and post treatment score of NDI is 0.000. The p value is < 0.05 which shows that group B is significant in improving NDI score.

INTER GROUP ANALYSIS

REPRESENTS INTER GROUP COMPARISION FOR VAS AND NDI (INDEPENDENT T- TEST):

	GROUP	MEAN	SD	T-VALUE	P-VALUE
VAS	A	3.86	0.74	4.271	0.000
	B	6	1.24		
NDI	A	18	2.78	2.358	0.026
	B	20.9	3.51		

Inter-group Analysis: The above table shows the inter-group comparison of post treatment NDI scores for functional assessment of Group A and B. The analysis was carried out by unpaired t-test. At baseline, the p value is > 0.05. It shows that there is no significant difference between the pre-treatment scores of both groups. Hence it shows the groups are homogenous. The p value comparing the post treatment score for Group A and B is 0.026 which is suggestive of significant improvement between groups.

DISCUSSION:

This study is done to investigate that whether PNF exercises for neck muscles when combined with TENS and neck mobility exercises helps in improving pain and quality of life in patients with non-specific neck pain. Isometric exercises have recently received increased interest as an effective inexpensive and non-invasive treatment in non-specific neck pain due to its ability to reduce pain and improve muscle strength.

Women of working agehad more neck pain than older ones, a phenomenon notseen among men. Chronic neck pain, defined as continuouspain of more than 6 months' duration, was commoner in women (22%) than men (16%).In a study from Sweden,17% of the population reported chronic neckpainwhile Brattberg reported a prevalence of neck painexceeding 6 months' duration in 19%. Hasvoldin a Norwegian study found that 15%of males and 25% of females complained of neckache weekly. Despite these differences in studydesign, epidemiological studies during a 10-yearperiod show similar prevalence.

In my study pain was assessed using VAS scale and functional disability was assessed using Neck Disability Index (NDI) scale.

The PNF group and the isometric exercise group showed significant reductions of VAS over time (p=0.000). After 4 weeks of the intervention, thePNF group showed a more significantreduction of VAS than the isometric exercise group (p=0.00). The PNF group and the isometric exercise group also showed significant improvement in the NDI scores post intervention (p=0.000). But when both the groups were compared to each other post intervention PNF group showed more significant improvement in VAS and NDI scores than isometric group showed in VAS and NDI score (VAS p=0.000, NDI p=0.026).

Previous study found that PNF techniques when

used is effective in decreasing pain, increasing ROM and improving function in subjects with chronic neck pain and scapular instability. Since majority of middle aged people suffers from neck pain, further study should investigate the best intensity and the rate of progression of strengthening exercises for neck pain. Also which specific exercises should be avoided or modified to provide relief from neck pain.

CONCLUSION:

The final conclusion of the study is that, both the groups i.e., PNF and isometric group showed significant improvement in function and pain reduction but, when PNF exercise group was compared to isometric exercise group, the patients with non-specific neck pain showed more significant functional improvement and pain reduction in group A rather than group B. The study concludes that, PNF is more effective than isometric exercise in reducing pain and improving function.

LIMITATIONS AND FURTHER RECOMMENDATIONS:

Limitation of the study was that the number of subjects recruited for the study were very few (30), 15 subjects in each group. The duration of study was also very short to conclude that the PNF is more effective in reduction of pain and functional improvement than isometric exercise in patients with non-specific neck pain. Effectiveness of treatment and data collection methods may have affected the result of the study.

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A STUDY TO FIND OUT THE EFFECT OF JOB STRAIN AMONG BLUE COLLARS AND WHITE COLLARS EMPLOYEES ON RISK OF CARDIOVASCULAR SYSTEM

Dr. Divya Tiwari

ABSTRACT

Background

The study have been conducted with the aim to find out the Job Stress between Blue Collar and White Collars and its risk on Cardiovascular System.Cardiovascular diseases due to job strain is biggest cause of death worldwide, though over last two decades.The objective of this study is to determine the co-relation between risk of cardiovascular diseases due to job stress between blue collars and white collars.

Conclusion

The result had been interpreted and support the previous studies done in association with this study and it had been concluded as follows, the results of this study shows the significant association between risk of heart attack due to job stress.

Key words

Blue Collars, White Collars, Job Strain.

Background

The cardiovascular system includes the heart and two networks of blood vessels: pulmonary circulation, which moves deoxygenated blood from the heart to the lungs, and returns oxygenated blood back to the heart; and systemic circulation, which carries oxygenated blood from the heart to the body's tissues and returns oxygen-depleted blood back to the heart. Blood is that sticky, red fluid which circulates throughout the body in a complex network of veins and arteries, transporting nutrients and oxygen to the body's tissues and removing waste products for disposal. The heart's contractions work to move oxygen into the blood; it also gathers carbon dioxide from the blood so it can be expelled through the lungs. While the lungs play an important role in this process, each of the body's cells is involved. The cardiovascular system includes organs which take up space throughout the body, including the heart and all of the body's veins, arteries and capillaries. The cardiovascular system is basic to life and the beat of one's heart is an automatic function which is controlled by the brain.

Cardiovascular diseases remain the biggest cause of deaths worldwide, though over the last two decades, cardiovascular mortality rates have declined in many high-income countries

Cardiovascular system diseases are the conditions that affect the heart and the blood vessels, which are the main components of the system. These diseases are often linked with a wrong or unhealthy lifestyle.

The human cardiovascular system is composed of a heart, blood, and a network of blood vessels, and is concerned with the circulation of nutrients, gases and hormones throughout the body. Any disease that affects the heart and the blood vessels is termed as a cardiovascular disease, which has become a common health concern mainly in the developed countries. These rising incidence of these cardiovascular diseases are basically attributed to wrong eating habits and a sedentary lifestyle.

A blue-collar worker is a member of the working class who performs manual labor. Blue-collar work

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may involve skilled or unskilled, manufacturing, mining,construction, mechanical, maintenance, technical installation and many other types of physical work. Often something is physically being built or maintained.

In contrast, the white-collar worker typically performs work in an office environment and may involve sitting at a computer or desk. The term white-collar worker refers to a person who performs professional, managerial, or administrative work.

It is often said that the stress is a bigger killer than any of the disease known and rightly so. Stress is an important risk factor in the development of diseases like hypertension, heart diseases, psychological disorders and sexual disorders.

We generally use the word "stress" when we feel that everything seems to have become too much - we are overloaded and wonder whether we really can cope with the pressures placed upon us. Anything that poses a challenge or a threat to our well-being is a stress.

Stress is the body's reaction to any change that requires an adjustment or response. The body reacts to these changes with physical, mental, and emotional responses.

Stress is a normal part of life. Many events that happen to you and around you -- and many things that you do yourself -- put stress on your body. You can experience stress from your environment, your body, and your thoughts.

Job Stress

Small things can make you feel stressed, such as a copy machine that never seems to work when you need it or phones that won't quit ringing. Major stress comes from having too much or not enough work or doing work that doesn't satisfy you. Conflicts with your boss, co-workers, or customers are other major causes of stress.

It's normal to have some stress. Stress releases hormones that speed up your heart, make you breathe faster, and give you a burst of energy. Stress can be useful when you need to focus on or finish a big project. But too much stress or being under stress for too long isn't good for you. Constant stress can make you more likely to get sick more often. It can also lead to long-term health problems such as heart disease, high blood pressure, back problems, and depression.

Causes of Job Stress

Most of the time, it's the major sources of stress that lead to job burnout and health problems. Job stress can affect your home life too. Here are some common sources of major job stress, with examples of each:

Lack of control- Feeling as if you have no control over your work or job duties is the biggest cause of job stress. People who feel like they have no control at work are most likely to get stress-related illnesses.

Increased responsibility- Taking on extra duties in your job is stressful. You can get more stressed if you have too much work to do and you can't say no to new tasks.

Job satisfaction and performance- Do you take pride in your job? If your job isn't meaningful, you may find it stressful. Are you worried about doing well at work? Feeling insecure about job performance is a major source of stress for many people.

Poor communication- Tension on the job often comes from poor communication. Being unable to talk about your needs, concerns, and frustrations can create stress.

A new job with more responsibility and better pay just opened up in Jill's department. Jill knows she can do this job. And she's been with the company longer than anyone else on her team. She waits for her manager to ask if she is interested. But after several weeks, a coworker is promoted to the new job. Jill feels hurt and angry, but she doesn't say anything.

Lack of support- Lack of support from your boss or coworkers makes it harder to solve other problems at work that are causing stress for you.

Jeff works in a busy office answering customer complaint calls all day. It would be easier to handle all the calls if he could at least trade tips with his coworkers. But everyone else is busy too. His coworkers never make it out of their cubicles during the day, even to let off a little steam.

Poor working conditions- Unpleasant or dangerous physical conditions, such as crowding, noise, or ergonomic problems, can cause stress.

Objective

To find out the effect of Job Strain among Blue collars and White collars employees on risk of cardiovascular system.

Procedure

A comparative study had been conducted to examine the Job Strain among White Collars and Blue Collars Employees. 200 subjects are selected out of which 100 are White Collars - Doctors and nurses and office workers and 100 are Blue Collars –Labourers and Truck and bus Drivers and Fourth class labourers.Permission was obtained from the concerned person. Prior information about the study was given to the subjects. The purpose of study was explained to all subjects an informed consent was taken in their own understandable language from each truck drivers. The subjects were selected based on inclusion and exclusion criteria. A suitable time was set up with the participants. Each one of them was allowed to answer the set of questions separately.

Any doubts regarding the questionnaire had beendecleared at the same time. All questions were explained to each one of the participants in simple words and adequate time was given to them to answer each of the questions. It is completed by the participants in the presence of invigilator. The answered question are collected at the end of the session from each participant.

Data analysis

A group of 200 subjects who had satisfied the inclusion and exclusion criteria were selected.

This is a descriptive research study in which a survey was conducted among blue collar and white collar employees.

Appropriate statistical test is applied to the data for analysis.

Statistical Method

We are using here T–test to find the relationship between BMI, Stress Test, Risk of Heart Attack of both white and blue collar employees.

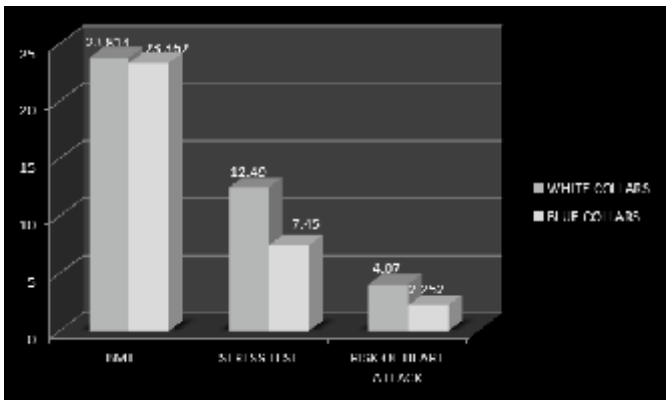
T test:

	BMI	Stressed test	Risk of HA
Mean white collar	23.814	12.49	4.07
SD White collar	2.586445633	3.927358071	1.037236032
Mean Blue collar	23.362	7.45	2.252525253
SD Blue collar	3.416944704	1.725477536	1.100495569

	BMI	Stressed test	Risk of HA
T	1.0596	11.756	12.039
df	198	198	198
Standard error of differences	0.428	0.429	0.151
P	0.2906	Less than0.0001	Less than0.0001

MEAN VALUE OF BMI, STRESS TEST, RISK OF HEART ATTACK

CATAGORY	BMI	STRESS TEST	RISK OF HEART ATTACK
WHITE COLLARS	23.814	12.49	4.07
BLUE COLLARS	23.362	7.45	2.252



This graph is showing Mean value of BMI, STRESS TEST, RISK of HEART ATTACK.

RESULT DISCUSSION

The result from the study furtherstrengthen the evidence that job strain has high risk of cardiovascular diseases.

The prevalence of job strain in this study was found more commonly among White Collars Employees.

Data from the similar studies based on Finnish Longitudinal Study on Municipal Employees showed high rate of Cardiovascular Diseases which caused death. (Mikaela B Von Bonsdorff 2012)

The wide variation in results may be due to many factors, including age, gender, high serum cholesterol level, high blood pressure and other factors like high job demand and high job control.

It is a known fact that excessive Job Stress can lead to Heart Diseases, Depression, Job Dissatisfaction. Stress is the body's reaction to any change that requires an adjustment or response. The body reacts to these changes with physical, mental, and emotional responses.

CONCLUSION

The main objective of this studyhas reached with the help of the methods, which had been used to conduct the study , statistical analysis and its interpretations. The result of this study gave the valuable suggestions in relation with job strain and risk of heart attack among the blue collar employees and white collar employees. In conclusion statistically significant associations were prevalence in job strain found more in white collar employees then blue collar employees.

The physiotherapists has therefore an important role in educating and preventing job stress in the employees. Scientific organisation of the work and stress regime is important. Perform other activities like exercises including breathing exercises, schedule time for fun, take good nutrition, stay positive, dorelaxation techniques - mediation, massage, or yogaetc should be encouraged.

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EFFECTIVENESS OF WILLIAM'S FLEXION EXERCISE VERSUS MULLIGAN'S TWO LEG ROTATION AND BENT LEG RAISE TECHNIQUE ON PAIN & DISABILITY IN INDIVIDUALS WITH MECHANICAL LOW BACK PAIN : A RANDOMIZED CONTROL TRIAL

Dr. Khyati Chavda*, Riya Parmar , Priyanka Halpati*****

ABSTRACT

INTRODUCTION:

Mechanical low back is the general term used to any type of back pain caused by strain on muscle of the vertebral column and abnormal stress. Williams explained to adhere to postural principles. The Mulligan bent leg raise technique has been described as a means of improving range of straight leg raise (SLR) in subjects with LBP and or referred thigh pain. The aim of this study is to compare the effectiveness of William's flexion exercise and Mulligan's two leg rotation and bent leg raise technique on patients with mechanical low back pain. This study has two outcome measures for evaluating pain and functional recovery in mechanical low back pain, Numeric Pain Rating Scale (NPRS) and Modified Oswestry Disability Index (MODI).

METHOD:

30 patients with mechanical low back pain, whose informed consents were obtained, were randomly assigned into 2 groups. Group A received William's flexion exercise and other Group B received Mulligan's technique 4 times in a week for 4 weeks. They were pre-tested using NPRS for pain intensity and MODI for functional disability.

RESULTS:

The results showed that there is statistically high significant difference($p<0.05$) showing improvement in means of NPRS and MODI for William's flexion exercise and Mulligan's technique before and after intervention in both the groups but group A showed more significant improvement in compared to group B.

CONCLUSION:

It has been concluded that William's flexion exercise and Mulligan's two leg rotation and bent leg raise technique both significantly improved the pain and disability in patients with mechanical low back pain but the group receiving William's flexion exercise improved more compared to Mulligan's technique.

KEY WORDS:

William's flexion exercise, Mulligan's two leg rotation, Mulligan's bent leg raise, mechanical low back pain.

INTRODUCTION

Low back pain (LBP) is a frequent complaint among adults with 70-85% having experienced at least one episode of LBP at some point in their lives.[1] In India, nearly 60% of people have significant back pain.[2] Low back pain is pain, muscle tension, or stiffness localized below the costal margin and above the inferior gluteal folds, with or without sciatica, and is defined as chronic when it persists for 12 weeks or more. Specific LBP is defined as symptoms caused by a specific pathophysiologic mechanism, such as herniated nuclei pulposus, infection, osteoporosis, rheumatoid arthritis,

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fracture, or tumour).[3] The remaining patients, who comprise the majority of patients, are commonly referred to as having “non-specific LBP” (NSLBP) or “axial LBP” (ALBP) or “Mechanical LBP.” [4] Mechanical low back is the general term used to any type of back pain caused by strain on muscle of the vertebral column and abnormal stress.[5] Because of related health costs, absenteeism and disability, low back pain is a substantial economic burden to society.[6,7]

Physical therapist use many exercise for back pain among these specific exercise, one is "Williams flexion exercise" also called lumbar flexion exercise. Williams flexion exercise program was developed in 1937 for patient with mechanical low back pain for men under 50 and female under 40 years who had exaggerated lumbosacral lordosis.[8] The solution, Williams explained, was to have the patient perform exercises and adhere to postural principles which serve to decrease the lumbar lordosis to a minimum, thereby reducing the pressure on the posterior elements of the lumbar spine.[9] Williams said: "The exercises outlined will accomplish a proper balance between the flexor and the extensor groups of postural muscles".[10] Williams suggested that a posterior pelvic-tilt position was necessary to obtain best results.[11]

Hamstrings muscle is a postural muscle and as it is biarticular, it has tendency to shorten even under normal circumstances.[12] This can give rise to number of postural problems and leave us open to muscle injury.[13] Prevalence and incidences of Hamstrings tightness in mechanical LBP individuals is high due to limited activity and lack of regular exercise.[14] Tight hamstring muscles limit anterior pelvic tilt of the pelvis in spinal flexion resulting in aggravated muscle and ligamentous tension in the lumbar region which leads to significantly higher compressive loads on the lumbar spine.[15] Anatomical causes of reduced muscle extensibility have been categorized as “muscle shortness” and “muscle stiffness”. Physiological cause of reduced muscle extensibility is related to the contractility of the muscle cell.[16] Mulligan BLR technique consist of gentle isometric stretching of hamstring in specific directions in progressively greater positions of the hip flexion, the expecting result are increased flexibility of hamstring muscle with increased ROM of active knee extension. Mulligan bent leg raise (BLR) technique has been described as a mean of improving range of straight leg raise (SLR) in subject with LBP and or referred thigh pain.[17]

There is lack of evidence revealing comparative effectiveness of William's Flexion Exercises in combination with Mulligan's two leg rotation and bent leg raise technique in patient with Mechanical LBP. Hence this study designed to find out the effect of William's Flexion Exercise as compared to Mulligan's two leg rotation and bent leg raise technique.

MATERIALAND METHODS

Thirty subjects fifteen in each group were taken from Parul Sevashram Hospital OPD and screened after finding their suitability as per inclusion and exclusion criteria. Subjects were randomly allocated in two groups with computer generated method. Group A was William's flexion exercise Group and Group B was Mulligan's technique Group. Treatment duration was 4 sessions per week for 4 weeks.

Individuals aged between 18 - 45 years and with complain of mechanical low back pain more than 3 months were included in the study. Individuals presenting symptoms of Sciatica, spinal tumors, low back pain due to road traffic accident, pregnancy, spinal stenosis, recent spinal fracture, lumbar spondylosis, abdominal surgery, back surgery, medication, muscle strain, spondylolisthesis were excluded from the study. All the study procedure was explained to the subjects prior to participation, and written in form concerned was obtained from all subjects. Initial evaluation of the patients having mechanical low back pain was done as per assessment format.

Pre - intervention outcome measures which were numerical pain rating scale and Modified Oswestry Disability Scale were assessed.

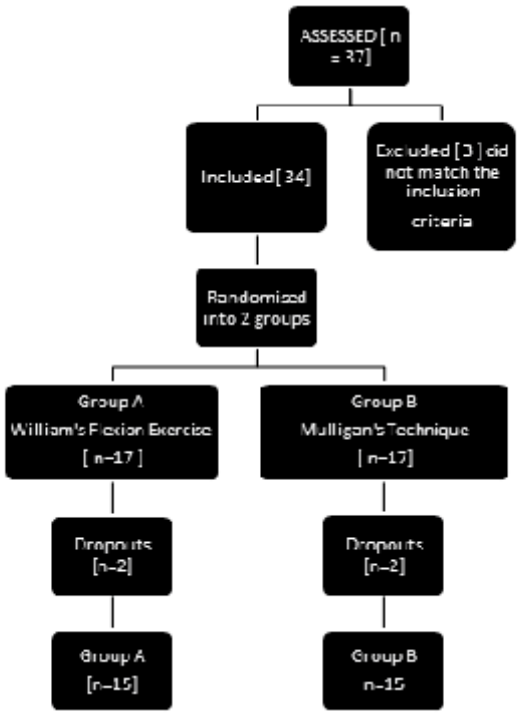


FIGURE 1: FLOWCHART OF SAMPLE RANDOMIZATION

Numeric pain rating scale (NPRS) is an 11-point scale ranging from 0-10. A 0 signifies "no pain" and a 10 indicates "the most intense pain imaginable". The scale continuum is as follows: 0 indicates "no pain", 5, "moderate pain" and 10, "the most intense pain imaginable". Participants verbally selected a value ranging from 0-10 that is most in line with the intensity of pain they currently experienced.[19]

The Modified Oswestry Disability Index (MODI)[18] is a self-administered questionnaire designed to evaluate level of function (disability) in activities of daily living for individuals rehabilitating for low back pain. The MODI consists of 10 sections with a scale ranging from 0 to 5, whereby the 5 represents the greatest disability. The total sum of the score is then multiplied with hundred and expressed as percentage. The MODI showed good construct validity at measuring disability cause by low back pain because it is consistent with other standard outcome measures which includes Low back outcome score, the Manniche Scale, the Aberdeen score, and The Curtin Scale. In addition, the test-retest reliability for the MODI is high with ranges r=0.83 to r=0.99 which vary based on the time interval between each measurements.The participants MODI scores were converted into percentage using the formula below:

Participants score / (50) x 100 = % The participants. (0 % to 20% - minimal disability, 21% to 40 % - moderate disability, 41% to 50% - severe disability, 61% to 80% - Crippled, 81% to 100% - bed-bound)

Table 1 - Treatment protocol performed by subjects in the Group A

PELVIC TILT	Lie on your back with knees bent, feet flat on floor. Flatten the small of your back against the floor, without pushing down with the legs. Hold for 5 to 10 seconds. 8-12 repetitions.
SINGLE KNEE TO CHEST	Lie on your back with knees bent and feet flat on the floor. Slowly pull your right knee toward your shoulder and hold 5 to 1seconds. Lower the knee and repeat with the other knee. 8-12 repetitions.
DOUBLE KNEE TO CHEST	Begin as in the previous exercise. After pulling right knee to chest, pull left knee to chest and hold both knees for 5 to 10 seconds. Slowly lower one leg at a time. 8-12 repetitions.
PARTIAL SIT UP	Do the pelvic tilt (exercise 1) and, while holding this position, slowly curl your head and shoulders off the floor. Hold briefly. Return slowly to the starting position. 8-12 repetitions.
HAMSTRING STRETCH	Start in long sitting with toes directed toward the ceiling and knees fully extended. Slowly lower the trunk forward over the legs, keeping knees extended, arms outstretched over the legs and eyes focus ahead.
HIP FLEXOR STRETCH	Place one foot in front of the other with the left (front) knee flexed and the right (back) knee held rigidly straight. Flex forward through the trunk until the left knee contacts the axillary fold (arm pit region). Repeat with right leg forward and left leg back.
SQUAT	Stand with both feet parallel, about shoulder's width apart. Attempting to maintain the trunk as perpendicular as possible to the floor, eyes focused ahead, and feet flat on the floor, the subject slowly lowers his body by flexing his knees. 8-12 repetitions.

Table 2 - Treatment protocol performed by subjects in the Group B	
Mulligan's Two Leg Rotation	Therapist stands at the limited hamstrings flexibility side of the supine subject on the plinth and grips the side of the plinth with the opposite side hand. Both legs will be flexed so that the feet are off the plinth. Keeping his (subject's) shoulders on the bed he takes hi s (subject's) legs slowly to the side of the limited hamstring muscle flexibility. When he (subject) reaches limit, the position is sustained for 30 seconds with over pressure applied by the therapist and then lower the legs to the plinth and repeat for 3 repetitions, and 1 minute rest between each stretch. And same procedure is done for the other side of limited hamstrings flexibility.
Mulligan's Bent Leg Raise	Therapist stands at the limited hamstrings flexibility side of the supine subject on the plinth. Therapist place the subject's flexed knee over his (therapist's) shoulder and now asks the subject to push the therapist with his leg and then relaxes. At this point therapist push his (subject's) bent knee up as far as possible in the direction of his (therapist's) shoulder on the same side. Sustain this stretch for 30 seconds and then lower the leg to the plinth and repeat for 3 repetitions, and 1 minute rest between each stretch. And same procedure is done for the other side of limited hamstrings flexibility.

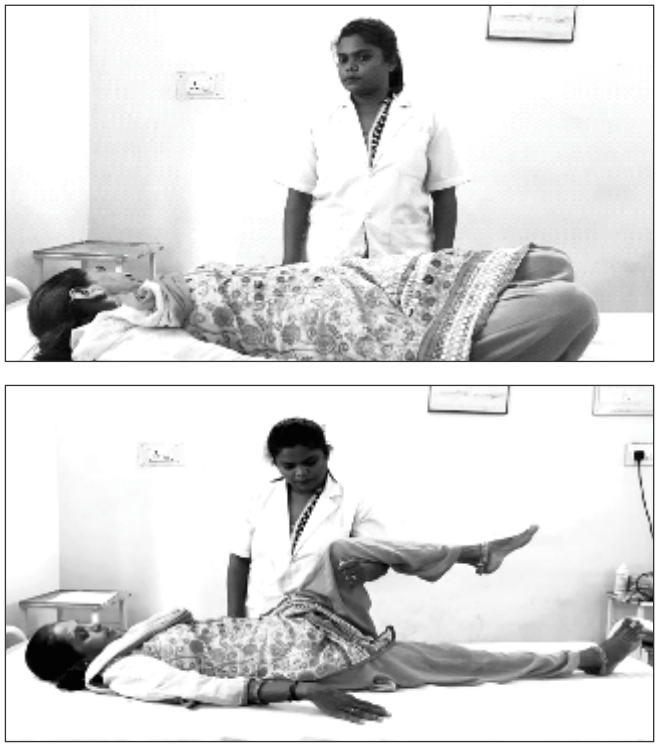


FIGURE – 3 Treatment protocol performed by subjects in the Group B

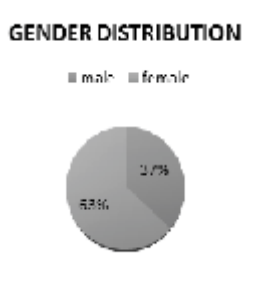
RESULT

Statistical Package for Social Sciences (SPSS) v20 was used for data analysis. Wilcoxon signed rank test were used to find the significance of parameters pre and post test. Mann-Whitney test were used to find the significance of difference between two groups. As the study included human subject ethical clearance was obtained from Parul University Institutional Ethics Committee for Human Research (PU – IECHR). Baseline characteristics and initial assessment of each outcome measure of the subjects were done. No meaningful differences existed between groups at baseline. In present study 34 subjects of age of 18 - 45 years were taken and divided into two groups. Group A (William's Flexion Exercise) and Group B (Mulligan's Technique). 30 individuals completed the study program without any complications. The data obtained in the groups are as follows.

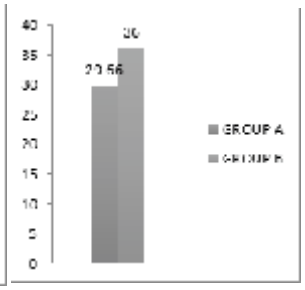
TABLE 1 : AVERAGE AGE OF BOTH GROUP

GROUP	No. of Patients	mean age
GROUP A	15	29.66
GROUP B	15	36
TOTAL	30	

GRAPH 3 GENDER DISTRIBUTION



GRAPH 1 AVERAGE AGE OF BOTH GROUP

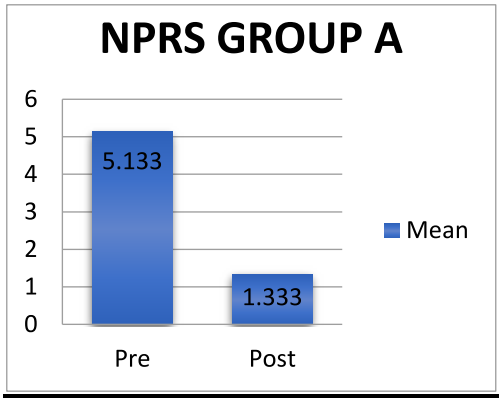


	Mean	SD	z - value	p - value
NPRS Group A				
Pre	**5.133**	**0.8338**	**3.460**	**0.001**
Post	**1.333**	**0.4879**		
NPRS Group B				
Pre	**5.466**	**0.7432**	**3.482**	**0.000**
Post	**3.266**	**1.0328**		
MODI Group A				
Pre	**37.466**	**7.57**	**3.415**	**0.001**
Post	**12.933**	**2.25**		
MODI Group B				
Pre	**23.60**	**7.45**	**3.424**	**0.001**
Post	**10.73**	**4.18**		

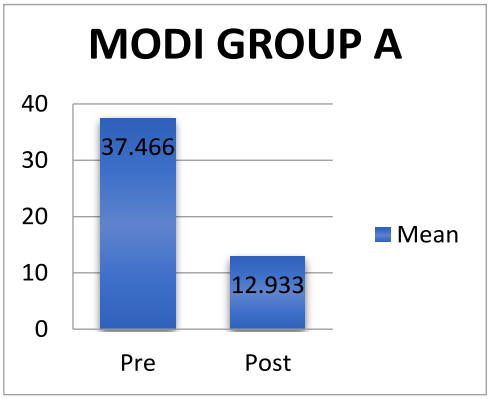
Table 3: Comparison of data pre and post treatment

	Mean difference	SD	z - value	p - value
Comparison of NPRS between Group A and B				
Group A	3.800	0.744	4.280	0.000
Group B	2.200	0.676		
Comparison of MODI between Group A and B				
Group A	24.53	7.229	4.025	0.000
Group B	12.86	4.845		

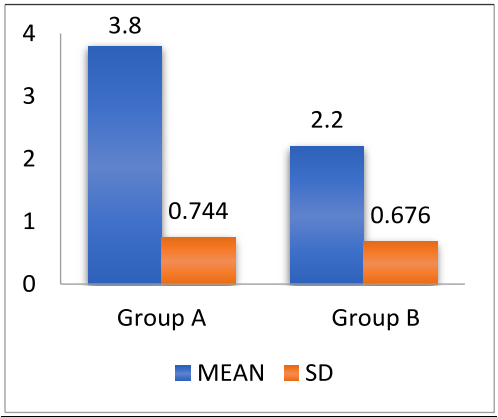
Table 4: Comparison of result between the groups after treatment



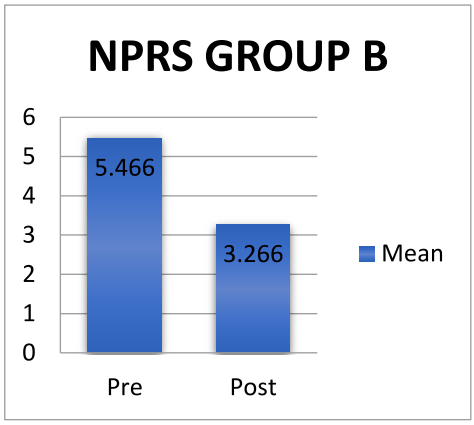
Comparison of pre and post data of NPRS in Group A



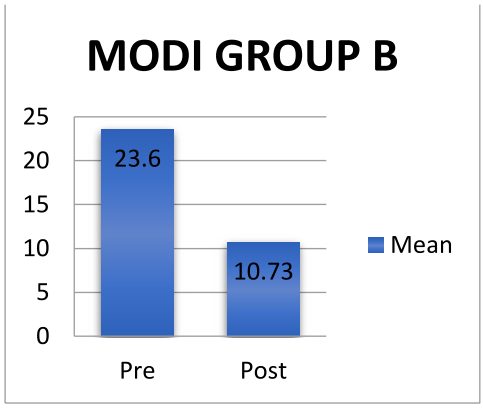
Comparison of pre and post data of MODI in Group A



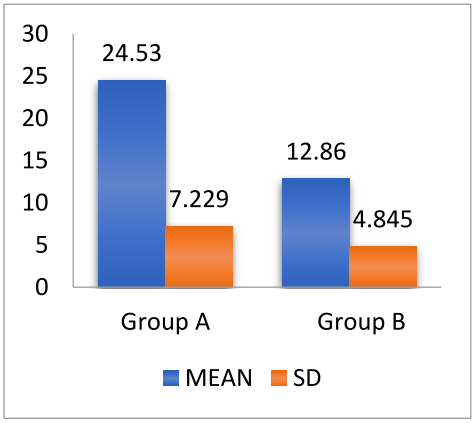
Graph 6: Comparison of NPRS in between Group A and Group B



Comparison of pre and post data of NPRS in Group B



Comparison of pre and post data of MODI in Group B



Comparison of MODI in between Group A and Group B

A summary of change scores and mean differences for each of the outcome measure are presented in table 2. Negative change scores on NPRS and MODI are indicative of improvement; A main effect for change over time was demonstrated as both groups significantly improved in all outcome measures by the end of 4 weeks. there is statistically high significant difference($p<0.05$) showing improvement in means of NPRS and MODI for William's flexion exercise and Mulligan's technique before and after intervention in both the groups but group A showed more significant improvement in compared to group B. The group B showed comparatively lower changes in any of the outcome measures, The mean of NPRS for Group A was 3.800 with the SD of 0.744. when it was compared with the mean of NPRS for Group B which was 2.200 after 4 weeks of intervention with the SD of 0.676, the obtained z-value was 4.280 . This finding had showed that there was a highly significant difference in NPRS for Group A and Group B. ($p<0.005$) Mean difference of Group A shows high significant improvement compared to mean difference of Group B after 4 weeks of intervention. The mean of MODI for Group A was 24.53 with the SD of 7.229. when it was compared with the mean of MODI for Group B which was 12.86 after 4 weeks of intervention with the SD of 4.845, the obtained z-value was 4.025 . This finding had showed that there was a highly significant difference in NPRS for Group A and Group B. ($p<0.005$) Mean difference of Group A shows high significant improvement compared to mean difference of Group B after 4 weeks of intervention.

DISCUSSION

The results of this study showed that the individual who participated in treatment program that included William's flexion exercise and the Mulligan's technique experienced greater improvements for pain and disability which has decreased mechanical low back pain to the individuals who participated in treatment program. Physical therapist use many exercise for back pain among this specific exercise William's flexion exercise has showed significant improvements. Mulligan's bent leg raise technique has been described as a means of improving range of straight leg raise (SLR) in subject of LBP. Williams flexion exercise reduces the pressure on the posterior element of lumbar spine and preventing recurrence of low back pain. These exercises restore functional strength of lower back is helpful for relieving symptoms of low back pain. Strengthening of abdominal and back muscle which maintain all structure align and prevent stress of lumbar spine. William flexion exercises using valsalva maneuver were particularly beneficial for patient with lumbar lordosis. It is effective to correct the faulty lumbar lordosis and decrease low back pain. During the sit-ups exercise the pelvis was found to be tilted and put the spine in hypertension before forward trunk displacement. [16]. posterior pelvic tilt requires moderate activity of internal and external oblique muscles their helps to generate the intra abdominal pressure. Curl ups exercise produce lumbar flexion and provided maximum activity of external and rectus abdominal muscle.

Pratik .A. Phansopkar, Vijay Kage demonstrated that both the treatment techniques that is Mulligan's Two Leg Rotation and Bent Leg Raise techniques are effective in increasing the hamstrings flexibility in subjects with acute non specific low back pain in terms of pain, range of motion and functional disability. Thus Mulligan's Two Leg Rotation can also be used commonly as other mulligan techniques in clinical practice for improving the hamstrings flexibility. [17]

Tight hamstring muscles limit anterior pelvic tilt of the pelvis in spinal flexion resulting in aggravated muscle and ligamentous tension in the lumbar region which leads to significantly higher compressive loads on the lumbar spine.[15] Anatomical causes of reduced muscle extensibility have been categorized as “muscle shortness” and “muscle stiffness”. Physiological cause of reduced muscle extensibility

is related to the contractility of the muscle cell.[18] Mulligan BLR technique consist of gentle isometric stretching of hamstring in specific directions in progressively greater positions of the hip flexion, the expecting result are increased flexibility of hamstring muscle with increased ROM of active knee extension. Mulligan bent leg raise (BLR) technique has been described as a mean of improving range of straight leg raise (SLR) in subject with LBP and or referred thigh pain.

CONCLUSION

It has been concluded that William's flexion exercise and Mulligan's two leg rotation and bent leg raise technique both significantly improved the pain and disability in patients with mechanical low back pain but the group receiving William's flexion exercise improved more compared to Mulligan's technique.

LIMITATIONS

Smaller number of subjects, lack of follow ups and long term effects can be included in limitations of this study.

FUTURE RECOMMENDATION

Future studies should be done on larger sample size and its effectiveness in various sample sizes.

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RANDOMISED CONTROL TRIAL TO EVALUATE EFFECT OF UTERUS MOBILIZATION WITH THERAPEUTIC TENS AS COMPARED WITH ONLY CONVENTIONAL TENS ON PRIMARY DYSMENORRHEA

Namita Chatwal* . Prof Maneesh R Arora , Dr Pooja Yadav*****

BACKGROUND: In India, prevalence of dysmenorrhea is 87.7%. Dysmenorrhea is a common problem among females. The purpose of this study was to examine the effect of Uterus Mobilization with TENS on primary dysmenorrhea and to compare it with only Transcutaneous Electrical Nerve Stimulation (TENS) in a randomized controlled trial study.

METHODOLOGY: Thirty female aged between 18-25 year randomly divided in two groups (Uterus Mobilization with TENS or only TENS). Participants' physical characteristics and menstrual history were recorded. Menstrual pain was measured by self-reported pain intensity using visual analog scale (VAS) before and just after treatment. Paired t-test and unpaired t-test was conducted to compare pain intensity between pre and post treatment within the group and between the two groups respectively.

RESULTS: The decrease in pain intensity after Uterus Mobilization with TENS and only TENS were both significant, (Experimental group: 8.67 ± 0.98 to 2.6 ± 2.06, $p<0.0001$; Control group: 7.27 ± 1.39 to 4.87 ± 2.2, $p<0.001$). However, pain intensity in experimental group was significantly decreased than the control group ($p=0.0001$).

Conclusions: This result supports that using Uterus Mobilization with TENS could be effective in pain reduction among females who suffered from primary dysmenorrhea.

Key Words: Transcutaneous Electrical Nerve Stimulation (TENS), Dysmenorrhea, Menstruation, Visceral Mobilization.

INTRODUCTION:

"Dysmenorrhea" is derived from Greek means difficult monthly flow but by usage refers to painful menstruation1. The pain of Dysmenorrhea includes cramping pain in lower abdominal area. The discomfort tends to remit as menstrual flow decreases. George and Bhaduri found Dysmenorrhea to be a common problem in India with prevalence of 87.7%4. Dysmenorrhea can feature different kinds of pain, including sharp, throbbing, dull, burning, or shooting pain. Dysmenorrhea may precede menstruation by several days or may accompany it, and it usually subsides as menstruation tapers off2, 3.

Dysmenorrhea can be classified into Primary and Secondary Dysmenorrhea. Primary Dysmenorrhea should be defined as painful period in which no macroscopically identifiable Pelvic Pathology is present. The prevalence of primary Dysmenorrhea decreases with increasing age and it is highest in between 20-24 years of age because of hyper contractility of uterus at menstruation in women with Primary Dysmenorrhea, blood now uterus is compromised and uterine ischemia occurs5. Thus, the pain is thought to be due three factors: increased abnormal uterine activity, uterine ischemia and sensitization of the nerve terminals to Prostaglandins6, 7.

"Visceral Mobilization" is organ specific fascial mobilization and is based on the premise that free movement within the body is vital, and thus any restriction will adversely affect health. Visceral mobilization treats functional and structural imbalances throughout the body. It evaluates and treats the dynamics of motion and suspension in

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relation to organs, membrane, fascia and ligaments and relieving symptoms of pain, dysfunction, and poor posture8.

Visceral mobilization returns physiologic motion to the tissues, thereby enhancing normal movement of the body, including the movement of visceral structures in relation to each other and the motion within each structure. It also increases communication within the body through improved functioning of nervous system, circulation, lymphatic, and respiratory systems by softening the fascia that surrounds each of these structures, thereby reducing pressure on them, as well as allowing better exchange of fluids. This improves breakdown and removal of waste products, reduces inflammation and pain, and improves the delivery of hormones and chemicals to the cells. Visceral Mobilization aims to find and resolves tensions in the tissue and thereby restore normal motion of the tissue. Visceral Mobilization is a hands-on manual therapy that only requires the skillful application of therapist's hand to evaluate and treat, along with an in-depth knowledge of anatomy. The treatment is through gentle compression, mobilization and elongation of the tissues.9

METHODOLOGY:

A total of 30 females aged between 18-25 years with dysmenorrhea pain participated in this study. All cases were diagnosed as primary dysmenorrhea on the basis of their menstrual history. Subjects were randomly assigned to experimental and control groups. All subjects were assessed and treated on 4 days before the day of their menstruation for experimental group and on the day of their menstruation for control group. The procedure was fully explained to the participants and they were required to sign the consent form. Subjects were not allowed to take any analgesics before this treatment. Intensity of menstrual pain was evaluated by a 0-10 visual analog scale (VAS), where "0" point indicated "no pain" and "10" indicated "unbearable pain." The VAS evaluations were performed before and just after treatment as the primary outcome.

In Control Group(group 1), a TENS device with a frequency of 0- 100/HZ and 90-100 pulse /seconds was applied for 20 minutes10, to increase circulation and to have pain relief at the first day of menstrual complaints without taking any analgesics. Patients lied in prone position with a thin pillow placed under their abdomen. Two electrodes were placed to the proximal margin of low back area, and two others were placed to the proximal of gluteal region laterally. The intensity of stimulation was increased up to the tolerated level without causing any contraction.

In Experimental Group(group 2), Uterus Mobilization was given 3 days before the first day of menses and TENS was given for 20 minutes on the first day of menses. The procedure for Uterus Mobilization is as follows:

Subject was asked to lie in supine position with both the knees flexed. Therapist placed his non dominant hand on the lumbosacral region and dominant hand over the bladder area for releasing the muscular tension and increasing the depth of the field which was palpated. It was begun by stretching the fundus from lateral to medial side and was holded for one minute and relaxed for one minute. The procedure was repeated 3 times per session for 3 days consecutively.

RESULTS:

Table 1 summarizes the mean average of VAS before and after the intervention. There was reduction in VAS by 2.4 which was found to be statistically very significant ($p < 0.001$).

	Mean ± SD	p value
Pre intervention	7.27 ± 1.39	<0.001 (Significant)
Post intervention	4.87 ±2.2	

Table showing Comparison of Mean & SD between pre and post value of Group 1

Table 2 summarizes the mean average of VAS before and after the intervention. There was reduction in VAS was 6.07 which was found statistically extremely significant.

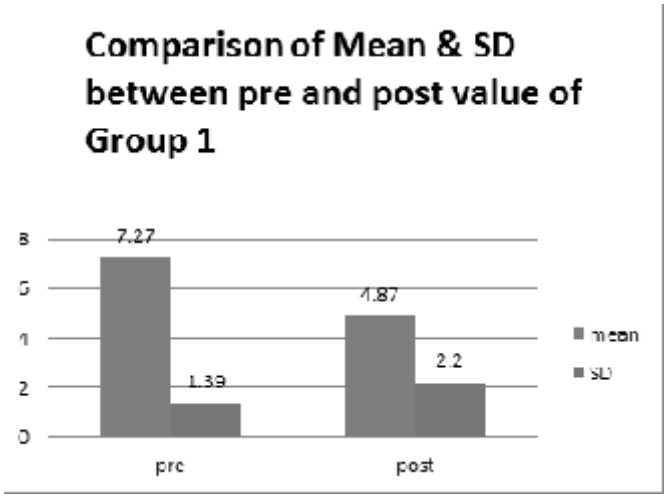
	Mean ± SD	p value
Pre intervention	8.67 ± 0.98	<0.0001 (Extremely Significant)
Post intervention	2.6 ± 2.06	

Table showing Comparison of Mean & SD between pre and post value of Group

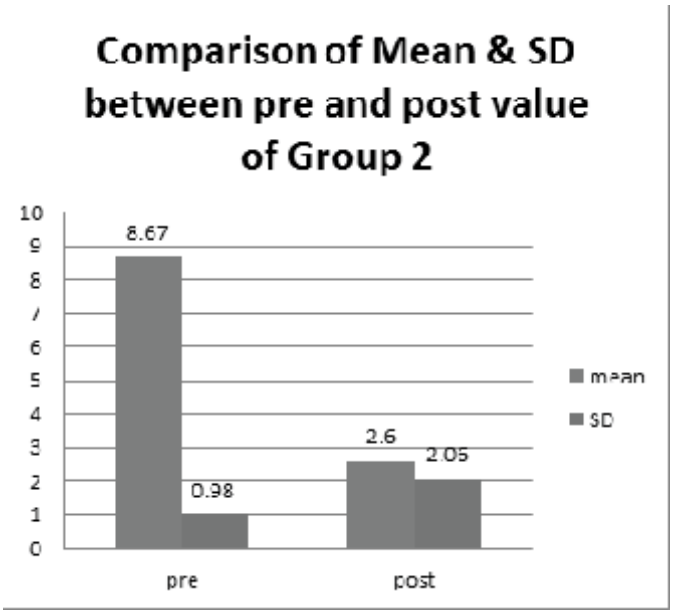
Table 3 summarizes the mean average of VAS of Group 1 and Group 2. There was reduction in VAS was 3.67 which was found statistically extremely significant.

	Mean ± SD	p value
Group 1	2.4 ± 2.35	=0.0001 (Significant)
Group 2	6.07 ± 2.12	

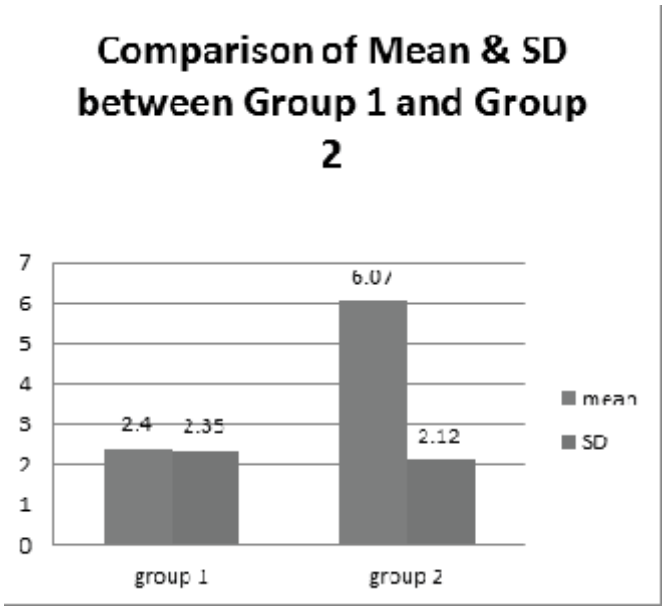
Table showing Comparison of Mean & SD between Group 1 and Group 2



Graph showing Comparison of Mean & SD between pre and post value of Group 1



Graph showing Comparison of Mean & SD between pre and post value of Group 2



Graph showing Comparison of Mean & SD between Group 1 and Group 2

DISCUSSION:

This study includes an experimental design consisting of two groups, Group 1 (conventional TENS), Group B (Uterus Mobilization with TENS). This study aims to compare the Effect of Uterus Mobilization with TENS and only TENS on pain in Young Females with Primary Dysmenorrhea.

After studying 30 subjects (15 Visceral mobilization with TENS, 15 TENS) and on the basis of hypothesis when mean difference in data was compared between group 1 and 2, we got significant improvements within the groups i.e. for uterus mobilization with TENS and only TENS. Therefore in this study, experimental hypothesis is accepted and there is significant difference in the VAS scores between Uterus Mobilization with TENS and only TENS and thus concludes by rejecting null hypothesis that there is no significant reduction in VAS scores between group 1 (conventional TENS) and group 2 (Uterus Mobilization with TENS). However, pain scores on VAS within the groups showed significant reduction in primary dysmenorrhea.

The primary findings of this study were a significant improvement from pretest to posttest variability of VAS scores after intervention with Uterus Mobilization with TENS ($p<0.0001$). The mean average of VAS before the treatment was 8.67 ± 0.98 and after the intervention was 2.6 ± 2.06. There was reduction in VAS was 6.07 which was found statistically extremely significant.

In previous study used a pragmatic design to assess the effect of osteopathic manipulative therapy (OMTh; manipulative care provided by foreign trained osteopaths) on women with diagnosed primary dysmenorrhea and the results were showed significant for reduction of pain intensity in the OMTh group, with mean (SD) NRS scores of 4.6 (1.2) before intervention and 1.9 (1.4) after intervention (P<.0005). The mean (SD) reported days of general pain was also significantly reduced in this group (4.5 [1.8] days before intervention to 2.2 [1.8] after intervention; P<.0005), as was reported duration of intense pain (2.2 [1.4] days before intervention to 0.2 [0.6] days after intervention; P<.0005). No changes in these measures were observed for the control group this study design produced dramatic reduction in the symptoms of primary dysmenorrhea, although it has not been used in many osteopathic research projects.11

In our study, Control group also shows significant improvement in VAS scores with Therapeutic TENS ($p \leqslant 0.001$). The mean average of VAS before the treatment was 7.27 ± 1.39 and after the intervention the VAS was 4.87 ± 2.2. There was reduction in VAS by 2.4 which was found to be statistically significant.

In one study which is done by Proctor ML et al (1994) who had compared the effectiveness of high and low frequency transcutaneous electrical nerve stimulation and acupuncture to each other, placebo, and no treatment, or medical treatment for primary dysmenorrhea and showed that high frequency TENS was more effective for pain relief than placebo TENS. Low frequency TENS was found to be no more effective in reducing pain than placebo TENS. Acupuncture is thought to excite receptors or nerve fibers which, through a complicated interaction with mediators such as serotonin and endorphins, blocks pain impulses.12

The result of current study is also supported by Deborah et al13(1989) who showed the effectiveness of acupuncture-like transcutaneous electrical nerve stimulation in treating primary dysmenorrhea and showed significant pain relief for the subjects receiving acupuncture-like TENS. Acupuncture-like TENS is believed to work via release of endorphins in the brain.14 Endorphins are a natural opiate that blocks the input of pain, possibly via the dorsolateral funiculus. These endorphins bind to receptors in the periaqueductal gray matter and lead to an antidromic inhibitory process that blocks the nocioceptive impulses from reaching the substantia gelatinosa. Another hypothesis was that the auricle has rich sensory innervations that have led investigators to believe that stimulation to the auricle may affect different areas of the body, depending on the area stimulated. Investigators have suggested that there is a link between sensory nerves of the auricle and the central nervous system that may produce analgesic effect.

Although the end results did exhibit statistical significant between the two groups of intervention ($p<0.05$), on the basis of mean difference between pre and post measurement of VAS scores. We found that Uterus mobilization with TENS was found to be more effective in reduction of pain scores in females suffering from primary dysmenorrhea than that of only therapeutic TENS treatment.

Limitation to the present study include the duration of treatment for experimental group was only 4 days as was hypothesized in that manner as there were no previous evidences in regard to that. The physiology of the Primary Dysmenorrhea pain can be multifactor. The difficulty in deferentially altering the techniques was not possible so the intervention was limited to a single protocol. Further studies should focus on conducted on larger sample size, Long duration of the study could have brought in more clarity in observed trends, It can also be done on different age groups.

Clinical implication of the study include that Dysmenorrhea is the most common Gynecological problem faced by the young females. It is a disease that refrains the females from physical activities like absence from work and college. Apart from this restriction of the physical activity, it also causes psychological, social and behavioral problems like Stress, Anxiety, Confusion, Social Fear, lack of Confidence, poor academic performances, disputes in Relationships etc. This study will be helpful in improving quality of life, decreasing the use of NSAID'S as they have numerous side effects and there are also very less treatment options available for this disease. So this study aims at use of Non-Pharmacological treatment and Non invasive treatment options which were found to be effective in decreasing the Pain in young females with Primary Dysmenorrhea and thus giving them the necessary options in avail. It can also be used in our OPD's as an adjunct to other treatment options available an additional option for prevention and control of dysmenorrhea.

CONCLUSION:

The present study concluded that 30 Females suffering from primary dysmenorrhea with increased VAS score were investigated and divided into two group i.e. Uterus mobilization with TENS and only TENS regime. The results showed significant improvement in VAS within the groups, but interestingly Uterus mobilization with TENS showed better improvement.

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The efficacy of two different frequencies NMES applications to gastrocnemius muscle on increase venous flow. A systematic review

Dr. Vinod Nair

Abstract

Introduction

Many individuals are at risk for developing deep vein thrombosis (DVT) or venous thrombo embolism (VTE), or both owing to immobilization, surgery, or trauma injury: venous stasis, endothelial damage or increased coagulation. There are 2 main types for preventing deep vein thrombosis: chemical and physical. Despite chemical prophylaxis being the preferred method, it has a high risk of bleeding and must be avoided in some patients. There is also increasing evidence supporting the use of mechanical devices as intermittent pneumatic compression (IPC) and compression stockings in surgical patients at high risk of developing deep vein thrombosis. These options can still have certain limitations such as patient discomfort, tissue injury, improper fitting or arterial insufficiencies in patients with peripheral arterial disease so alternative physical strategies like electrical stimulation (ES) are being investigated. Electrical stimulation has been shown to have an additive effect to compression stockings and to be at least as effective as intermittent pneumatic compression in terms of the venous hemodynamic response, and besides, to show some other advantages such as arterial and microcirculatory flux enhancement. In addition, electrical stimulation can also play a specific role by stimulating or replacing the neural supply to the veins, which has been proposed recently as the fourth factor in thrombus pathogenesis. Electrical stimulation may be even more necessary when early active motion is difficult or unavailable as in traumatology patients because of an immobilized extremity or muscle inhibition after surgery, and in critically ill patients. The primary objective of this study was to compare the effect of two frequency and electrode placement at the maximum tolerated intensity on hemodynamic popliteal venous flow and peak velocity (PV) using Doppler ultrasound in healthy volunteers. A further objective was to compare the participants' relative discomfort among the 2 applications using a visual analogue scale and verbal rating scoring index.

Methods :

Electrical stimulation devices neuromuscular electrical stimulation (NMES), have been used to enhance venous hemodynamics via skeletal muscles. NMES and TENS are different ES modalities, but there is confusion regarding the description of the Electrical stimulation forms among researchers and clinicians. As both Electrical stimulation modalities can be delivered by surface electrodes for stimulating muscles and nerves, the differences are related to their original purpose. TENS has been primarily developed for pain relief, whereas NMES has been primarily developed for the improvement of muscle strength eliciting smooth tetanic muscle contraction and relaxation, similar to an exercise therapy session. Therefore, an on-off time in seconds (duty-cycle) is necessary in NMES for minimizing muscular fatigue and discomfort.

Results :

Despite electrical stimulation having been experimentally proved to be effective in improving venous flow and velocity, the stimulation parameters vary greatly and it is necessary to clarify which parameters are optimal for venous return Frequencies from 1 to 10 Hz have been tested at muscle locations. To the best of the authors' knowledge, only one study has compared, but used different electrical stimulation frequencies and intensities for each placement.

Keywords :

(NMES) Neuromuscular electrical stimulation, (ES)electrical stimulation, deep vein thrombosis (DVT), venous thrombo embolism (VTE), immobilization, surgery, or trauma injury: venous stasis

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Abbreviations

BMI = body mass index, DVT = deep vein thrombosis, ES = electrical stimulation, FV = flow volume, IPC = intermittent pneumatic compression, NMES = neuromuscular electrical stimulation

Materials and methods

Design and sample

A large variation in hemodynamic response to electrical stimulation has been found in healthy population. Therefore, a within-subjects cross-over design was used to determine differences in hemodynamic effects and discomfort. A random assignment of the NMES was used to avoid possible systematic effects of order. The order of testing was introduced in opaque envelopes to be randomly selected by each participant, who was not aware of it. Study protocol was reviewed and approved by hospital. Informed consent was obtained from each subject before enrolment.

The optimal sample size was determined from a pilot sample of 12 subjects. The venous flow volume (FV), in ml per minute, was measured 3 times and the mean was considered, both basal and after the NMES protocol. The FV increment was computed relatively with respect to basal levels, and given as percentage. A 1-way analysis of variance with repeated-measures was used to compare the difference among the 3 electrical stimulation results. From the estimated correlation among repeated-measures of 0.7 and a standard deviation within each group of 90%, we obtained that, with a sample size of 24 subjects, the test would have a power of 0.8 to detect significant differences in the relative FV increments if they were 40%, 175%, and 150%, with a type I error of 0.05.

Participants

Students from the Faculty of Physical Therapy were initially invited to participate in a screening session. A university notice board was used to recruit the volunteers. The specific inclusion criteria were: healthy subjects aged between 18 and 39 years. Exclusion criteria included factors that might affect venous return or current flow: body mass index (BMI) <18 or >30 kg/m2, smokers, oral contraceptive use, recent surgery/trauma to lower limbs, any diagnosed disease that could affect hemodynamics, clinically significant varicose veins, or ulceration of the lower limbs. Among 30 volunteers assessed for eligibility, 4 women and 2 man were excluded for meeting some exclusion criteria. The pilot sample was included within the final sample of 24 subjects (12 men) selected for evaluation. All of them completed the experimental session.

Experimental procedure

All examinations were performed in the same room, in which the temperature was controlled

The subjects lay in the prone position 15 to 20 minutes before the experiment with their feet off the table and a soft cushion beneath the ankle. Stimulation electrodes sites were previously clipped of hairs. Three electrical stimulation protocols were applied using a 2-channel portable stimulator (NMES-BIOTECH) and matching self-adhesive electrodes. All the electrical stimulation protocols selected were delivered without a duty cycle (on-off time). Electrode placements on tibial nerve, and the motor points of the gastrocnemius muscle, where skin area was most responsive to electrical stimulation. A charge-balanced biphasic square wave with phase duration of 0.35 milliseconds was applied at 1 and 5 Hz over the muscle to obtain a twitch contraction. The frequency of 1 and 5 Hz was chosen instead of 10 Hz and 15 Hz, as 10 Hz and 15 Hz was felt uncomfortable and fatiguing because of the almost tetanic muscle response it originated without a resting time. Stimulation amplitude was increased gradually, 0.5 mA per second to find the pain threshold for each application in the random order assigned. The stimulation intensity was set 10% below the pain threshold, and the values (median, first–second quartiles) were 30.5 (22.1–43) mA, 20.0 (14.5–24.3) mA, when applying 1 Hz and 5 Hz on muscle site, respectively.

Primary outcome

A baseline duplex venous ultrasound scan was performed at least 5 minutes after the last pain threshold determination. The popliteal vein of the nondominant leg was examined with a 6 to 13 MHz linear transducer . It was placed at the back of the knee by a fixed-arm, once the optimal location was reached. Vein diameter was measured using B-mode. The venous FV (mm per minute) was calculated by the Doppler unit's software. The venous PV (centimeters per second) was recorded from the Doppler waveform. The electrical stimulation sequences were applied for 1 minute before recording echographic measures during stimulation. They were followed by a 5-minute recovery phase and a new baseline ultrasound was examined. Measurements were taken over a period of 16 seconds, to obtain several endogenous or ES-superimposed blood movement cycles. Three measurements were made for each condition and the mean of them was used for analysis. The same well-trained examiner with >6 years of experience performed all measurements and asked the subjects to remain stationary and maintain a stable breathing pattern during data collection.

Secondary outcome

Participants compared discomfort after the 2 TENS applications using a 100-mm visual analogue score (VAS). This scale was modified from traditional pain VAS with 0 mm denoting no sensation, and 100 mm indicating pain onset. Subjects' relative comfort perception was also assessed by a verbal rating score (VRS): 1, no sensation; 2, minimal discomfort; 3, mild discomfort; 4, moderate discomfort; and 5, severe discomfort.

Statistical analysis

Data are presented as mean ± standard deviation (SD); if the distribution is asymmetrical, median and first and third quartiles (Q1 and Q2) are also given. The Kolmogorov-Smirnov-Lilliefors test was used to test for normal distribution of the data. To compare the effects in hemodynamics and discomfort the 2 NMES applications, a 1-way ANOVA with repeated-measures, or Friedman test was carried out. To identify differences in the NMES results, post hoc pairwise comparisons were considered with Bonferroni correction. To ensure comparability, standardized effect sizes were calculated by the partial eta-squared η2p (partial variance explained in ANOVA). A P value <.05 was assumed to denote statistical significance. Statistical analyses were carried out using IBM SPSS for Windows, version 21.0 (IBM Corporation).

Results

Table1 presents the physical baseline characteristics of the participants. Typical Doppler waveforms of baseline and the 2 TENS protocols (1 and 5 Hz via muscle). The effect of the different NMES programs on both FV and PV was statistically significant. The increment of hemodynamics responses has been computed relatively from baseline and given as a percentage. The relative increments of the hemodynamic responses (in %) varied significantly with the NMES interventions for FV (P < .001) and PV (P < .001). FV was higher with NMES applications of 5 Hz than of 1 Hz (P<.001).

Table 1 : Subject physical characteristics.

	Male (n=12)	**Female (n=12)**
Age,Y	22.5±3.23	19.42±0.90
BMI, Kg/m2	24.17±2.41	22.17±1.90
Calf perimeter, cm	37.05±1.74	32.93±2.64

Table 2

	NMES	Baseline Median(Q1-Q2)	Stimulation Median(Q1-Q2)	Difference Mean	Effect Size	p
FV	1Hz	80.1 (65.3-100.6)	97.8 (73.9-153.1)	24.49 (9.08-39.91)	0.320	.003
	5Hz	75.1 (55.5-114.7)	174.0 (120.1-251.2)	115.26 (74.74-155.79)	0.601	<.001
PV	1Hz	13.4 (10.5-18.3)	55.1 (45.4-67.7)	39.93 (34.01-45.86)	0.894	<.001
	5Hz	13.1 (9.9-17.6)	48.9 (39.4-62.2)	34.61 (28.08-41.13)	0.839	<.001

Table 3: Comparison of the relative increment of FV and PV among the different protocols of electrical stimulation (n=24).

	1Hz	5Hz	Effect Size	p
FV(%)	32.6±46.1	146.8±115.9	0.482	<.001
PV(%)	291.9±136.2	258.6±126.8	0.585	<.001

Duplex Doppler ultrasound recordings used for blood flow analysis. Representative capture window measuring popliteal blood flow waveform in basal condition is displayed. The response to NMES stimulation at 1 Hz applied on gastrocnemius muscle is seen. The spikes reflect the altered flow pattern at the frequency delivered. Effect on waveform of NMES at 5 Hz on gastrocnemius muscle site. More spikes are seen as frequency is increased 5 times. The flow pattern obtained is different from previous electrical applications as the spikes are less pronounced and there is more regularity in the venous blood flow.

There were no adverse effects at the end of the intervention or reported afterwards by the subjects.

Discussion

This study compared the efficacy of 2 NMES applications. Increased FV and PV in the ipsilateral popliteal vein were seen in muscle stimulation, and using 1 and 5 Hz. This is concordant with the existing literature, despite NMES parameters' differences and missing data or discrepancies when reporting it. A review provided a range of 60% to 615% FV increasing from baseline and 25% to 650% for PV. The much higher values were from studies in operated on and healthy people at bed rest using NMES. This can be explained by 2 factors: bed rest causes a decline in venous blood flow, so a higher increase compared to resting values can be expected; in addition, in these researches only the NMES "on time" was compared to baseline, not considering off time where a subsequent cessation in blood flow might happen. Few studies have considered percentage of change, and lower range values have been reported stimulating common tibial nerve or different muscle locations, In healthy volunteers. In these studies a long-lasting hemodynamic recording of 15 seconds was used, as has been also recorded in the present study, to deal with cardiac and respiratory variations.

When looking for the differences among the 2 NMES protocols, NMES at 5 Hz (on muscle) obtained a higher FV than at 1 Hz on muscle site. The latter has not been shown in the previous study comparing nerve and muscle ES, but significantly lower VAS was achieved in nerve site. Likely, the discrepancies may be attributed to the distinctive current densities, muscle sites, and frequencies tested.

Current density is estimated as intensity per electrode area. Whereas in the mentioned study identical current densities were applied (same intensity and small sized electrodes for both locations), in the present study the highest tolerated intensity for each protocol was selected. Indeed, in consonance with ES-recommended parameters, greater electrode size was chosen on muscle. Tibial nerve was stimulated at a site where good accessibility is considered and small electrodes have been found more comfortable and selective for thin fat layers and superficial nerves.

Tibialis anterior was the chosen muscle site in Izumi et al's study, whereas gastrocnemius muscle was the stimulated muscle in the present research. When comparing tibialis anterior and soleus muscle, soleus muscle expelled higher volume and achieved lower peak velocities, which were on average 35% lower than tibialis anterior. In another study testing different muscles soleus was the only muscle where, besides an increased PV from baseline, a higher FV was detected. Explanations from the authors in both researches are in connection with the intimate relationship among the muscles and plexus of deep veins. The leg pump—located in the veins of the gastrocnemius which is the most important pump in the lower limb. The medial gastrocnemius veins play a major role pushing the blood column upwards and creating an aspiration effect in the popliteal roots below. These muscles are innervated from the tibial nerve. Stimulation of the tibial nerve produced nearly identical hemodynamics responses as voluntary contractions when controlling force, duty cycle, and active muscle mass.

Regarding the frequency, the previous study used

10 Hz on nerve and 50 Hz on muscle site, whereas in this study, 1Hz &5 Hz was used in muscle locations. Other studies have examined the effect of frequency on venous hemodynamics, with diverse results. Stimulating the tibial nerve (1–40 mA, 1–5 Hz), venous FV and PV have been enhanced, with both intensity and frequency showing moderate to strong positive correlations. In the present research, increased FV at higher frequency was also found, but the same relationship between frequency and PV was not. Different factors can be responsible for the differences. Likely, the most relevant is using the highest tolerated intensity, which was lower at 5 Hz than at 1 Hz, whereas the same intensities were selected by Izumi et al. Another study testing 0.13 to 2 Hz in a muscle location on the calf showed that different rates of stimulation had a different effect on PV and FV, as PV decreased and FV increased. Perhaps the effect of diminishing PV at increasing frequency is most patent when comparing to frequencies below 1 Hz, as seems to happen in the graphic data presented in this work.

ES at 5 Hz on gastrocnemius muscle rather than ES at 1 Hz on gastrocnemius muscle. First, 5 Hz on muscle site originated higher PV increment and it has been noted than an excessive increase in PV can be dangerous. NMES has obtained even higher PV than voluntary exercise when applied at high intensity and pulse duration. In IPC devices, a decline in blood flow velocity has been found in the first section of deflation phase. A negative pressure is generated in the inner vessel, and it pulls blood into the decompressed vessels. There is a possibility of a non desirable backward flow when a strong negative pressure—related to a high PV—is generated. This can be amplified when partial venous obstruction with stenosis or malfunctioning venous valves exists, as it creates the conditions for eddy blood flow. For this reason, other factors related to venous volume have been proposed to test the different applications. Second, when subjects compared the applications using VRS, 5 Hz on muscle was felt more comfortable (close to statistical significance). Discomfort assessment by VRS showed mild discomfort in 1 Hz muscle. This level of discomfort is in consonance with the application of 1 Hz TENS device at normal clinical use setting. Despite healthy subjects have been assessed in the present study, it would be useful for collecting normative data to help with better treatment choices in patient population.

Limitations

There are 2 main limitations to this study. First, although increasing venous flow is assumed to correlate with reduction of thrombosis risk, the data obtained from young healthy people might not be directly translated to patients with a vascular disease or at high risk of suffering it. Second, the medium- and long-term effects of NMES can differ from immediate-effects of a brief intervention investigated in this study.

Conclusions

In conclusion, when considering the highest venous FV increase, the lowest peak venous velocity change, and comparative tolerance, NMES at 5 Hz on gastrocnemius muscle is the most beneficial protocol. Future studies may investigate the electrical stimulation of tibial nerve and compare it to common peroneal nerve effects on hemodynamics. Furthermore, the influence of frequency and electrode location parameters on population at high risk from suffering DVT has to be established.

Footnotes

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PHYSIOTHERAPY & STRESS

Physiotherapy is the treatment of disease, injury, or deformity by physical methods such as massage, treatment by various modalities, and exercise rather than by drugs or surgery. It not only eases the song of one's stressful burden, but also stimulates both the mind and body to rebalance and usher in harmony and emotional poise.

Dr. Shailendra Mehta

Stress is your body's response to certain situations. It's subjective, so something that is stressful for you may not be stressful for someone else. There are many different kinds of stress and not all of them are bad. Stress can help you act quickly in an emergency or help you meet a deadline.

Stress can affect your physical and mental health, and your behavior. Your body responds to stress by producing chemicals and hormones to help you rise to the challenge. Your heart rate increases, your brain works faster, and you have a sudden burst of energy. This response is basic and natural and is what kept our ancestors from falling victim to hungry predators. But too much stress can have harmful effects. It's impossible to completely eliminate bad stress from your life, but you can learn to avoid and manage it.

Stress is an inevitable part of life and existence. It makes us ready for what is referred to as short term response, or 'fight-or-flight' response. Most of the biological changes that comeswith the stress response are designed to rally the body's fuel reserve-to convert them for immediate use. This includes providing extra oxygen required for the organs most likely to need it-for example, the brain and the muscles. Prolonged stress impacts the secretion of certain hormones, including the sex hormones,

Stress also acts as a go-between for one part of the nervous apparatus-called the sympathetic nervous system which deals with the body's maintenance functions under normal conditions. It is, therefore, well placed for rapidly re-adjusting our priorities.

CAUSES OF STRESS

Everyone has different stress triggers. Work stress tops the list, according to surveys. Causes of work stress include:

·Being unhappy in your job

- Having a heavy workload or too much responsibility
- Working long hours
- Having poor management, unclear expectations of your work, or no say in the decision-making process
- Physical illness
- Neglect by society or family
- Life stresses can also have a big impact. Examples of life stresses are:
- The death of a loved one
- Divorce
- Loss of a job
- Increase in financial obligations
- Getting married
- ·Moving to a new home

Sometimes the stress comes from inside, rather than outside. You can stress yourself out just by worrying about things. All of these factors can lead to stress:

Fear and uncertainty. When you regularly hear about the threat of terrorist attacks, global warming, and toxic chemicals on the news, it can cause you to feel stressed, especially because you feel like you have no control over those events.

What Are the Symptoms of Stress?

Stress can affect all aspects of your life, including your emotions, behaviors, thinking ability, and

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physical health. No part of the body is immune. But, because people handle stress differently, symptoms of stress can vary. Symptoms can be vague and may be the same as those caused by medical conditions. So it is important to discuss them with your doctor. You may experience any of the following symptoms of stress.

Emotional symptoms of stress include:

·Becoming easily agitated, frustrated, and moody

·Feeling overwhelmed, like you are losing control or need to take control

·Having difficulty relaxing and quieting your mind

·Feeling bad about yourself (low self-esteem), lonely, worthless, and depressed

- Avoiding others
- Physical symptoms of stress include:
- Low energy
- Headaches
- Upset stomach , including diarrhea, constipation, and nausea
- Aches, pains, and tense muscles
- Chest pain and rapid heartbeat
- Insomnia
- Frequent colds and infections
- Loss of sexual desire and/or ability
- Nervousness and shaking, ringing in the ear, cold or sweaty hands and feet
- Dry mouth and difficulty swallowing
- Clenched jaw and grinding teeth

Cognitive symptoms of stress include:

- Constant worrying
- Racing thoughts
- Forgetfulness and disorganization
- Inability to focus
- Poor judgment
- Being pessimistic or seeing only the negative side

Behavioral symptoms of stress include:

- Changes in appetite -- either not eating or eating too much
- Procrastinating and avoiding responsibilities
- Increased use of alcohol, drugs, or cigarettes
- Exhibiting more nervous behaviors, such as nail biting, fidgeting, and pacing

Types of stress

1. Acute stress

Acute stress is the most common type of stress. It's your body's immediate reaction to a new challenge, event, or demand, and it triggers your fight-or-flight response. As the pressures of a near-miss automobile accident, an argument with a family member, or a costly mistake at work sink in, your body turns on this biological response.

Acute stress isn't always negative. It's also the experience you have when riding a rollercoaster or having a person jump out at you in a haunted house. Isolated episodes of acute stress should not have any lingering health effects. In fact, they might actually be healthy for you, as these stressful situations give your body and brain practice in developing the best response to future stressful situations.

Severe acute stress such as stress suffered as the victim of a crime or life-threatening situation can lead to mental health problems, such as post-traumatic stress disorder or acute stress disorder.

2. Episodic acute stress

When acute stress happens frequently, it's called episodic acute stress. People who always seem to be having a crisis tend to have episodic acute stress. They are often short-tempered, irritable, and anxious. People who are “worry warts” or pessimistic or who tend to see the negative side of everything also tend to have episodic acute stress.

Negative health effects are persistent in people with episodic acute stress. It may be hard for people with this type of stress to change their lifestyle, as they accept stress as a part of life.

3. Chronic stress

If acute stress isn't resolved and begins to increase or lasts for long periods of time, it becomes chronic

stress. This stress is constant and doesn't go away. It can stem from such things as:

- poverty
- a dysfunctional family
- an unhappy marriage
- a bad job

Chronic stress can be detrimental to your health, as it can contribute to several serious diseases or health risks, such as:

- heart disease
- cancer
- lung disease
- accidents
- cirrhosis of the liver
- suicide

The Four Common Types of Stress

Dr Karl Albrecht, a management consultant and conference speaker based in California, is a pioneer in the development of stress-reduction training for businesspeople. He defined four common types of stress in his 1979 book, "Stress and the Manager."

Albrecht's four common types of stress are:

- Time stress.
- Anticipatory stress.
- Situational stress.
- Encounter stress.

1. Time Stress

You experience time stress when you worry about time, or the lack thereof. You worry about the number of things that you have to do, and you fear that you'll fail to achieve something important. You might feel trapped, unhappy, or even hopeless.

Common examples of time stress include worrying about deadlines or rushing to avoid being late for a meeting.

2. Anticipatory Stress

Anticipatory stress describes stress that you experience concerning the future. Sometimes this stress can be focused on a specific event, such as an upcoming presentation that you're going to give. However, anticipatory stress can also be vague and undefined, such as an overall sense of dread about the future, or a worry that "something will go wrong."

3. Situational Stress

You experience situational stress when you're in a scary situation that you have no control over. This could be an emergency. More commonly, however, it's a situation that involves conflict, or a loss of status or acceptance in the eyes of your group. For instance, getting laid off or making a major mistake in front of your team are examples of events that can cause situational stress.

4. Encounter Stress

Encounter stress revolves around people. You experience encounter stress when you worry about interacting with a certain person or group of people – you may not like them, or you might think that they're unpredictable.

Encounter stress can also occur if your role involves a lot of personal interactions with customers or clients, especially if those groups are in distress. For instance, physicians and social workers have high rates of encounter stress, because the people they work with routinely don't feel well, or are deeply upset.

This type of stress also occurs from "contact overload": when you feel overwhelmed or drained from interacting with too many people.

STRESS RESPONSE

In the wake of stress, your pulse, blood pressure, and breathing rate increase-to help boost the supply of available energy. The heart beats faster under stress and pumps a greater quantity of blood than usual with each beat.

The bronchial tubes dilate to assist the passage for more air with each breath. The blood vessels supplying the muscles expand just as well. The palms of the hands and the soles of the feet begin to

perspire, primarily because a damp surface provides a much better grip of things.

The pupils of your eyes dialate to let in more light and perk up your vision. Likewise, your mental alertness and reaction time are also speeded up.

During a stressful episode, long-term energy reserves such as stored fat are also broken down into fatty acids and glycerol to be metabolized right away. Likewise, carbohydrates stored in the liver are metabolised and converted into glucose, as blood is shunted from the extremities towards the heart, muscles and brain.

When stress goes far beyond one's control, the situation becomes terrifying for other part of the nervous system-the parasympathetic mechanism. This leads to involuntary urination [rushing to the washroom] and also stools.

What also happens is that your peripheral blood vessels constrict- you get cold hands and develop cold feet, a famed literary expresiion, in anticipation of an unpleasant event. This in effect, leads to the shutting down of energy consumption processes, including salivation. The result is a parched mouth, loss of appetite and troubled bowels. Put simply, these are nothing but physiological responses of our nervous system.

FACT-FILE

1.Stress has psychological causes as also psychological outcomes. It changes the way we perceive the world, our senses, memory, judgemet and also behavior.

2.During a stressful episode, your network of cells provides the boost to your general level of arousal and awareness-to make you more responsive to signals from your sensory organs and less receptive to information that is of no immediate significance. For example, in times of severe stress, an itchy or runny nose will not divert your attention.

3.It is not infrequent for people with severe stress to be subject to frequent colds and infections, or allergies, thanks to reduced immune system reaction time, or function. As a matter of fact, stress can set off skin condition such as itching and rashes, including atopic dermatitis [eczema] and psoriasis.

4.Panic [stress] attacks are characteristically distinct and intense. They have an abrupt onset with symptoms peaking in intensity within minutes of onset. Symptoms include feeling of terror and a fear of dying.

GOOD & BAD

The stress response is entirely normal. We have evolved to respond to stressors over the ages.it drives us to reach our goals faster. Yet, it is not surprising to find threats to our health and well-being unpleasant; so, we have the urge to avoid them. However, it is a totally different thing if stress is triggered several times a day, under unusual circumstances, or for long periods. This can lead to adjustment difficulties and also illness.

HORMONAL CHANGES IN STRESS

ADRENALINE

Commonly known as the fight or flight hormone, it is produced by the adrenal glands after receiving a message from the brain that a stressful situation has presented itself.

What It Does: Adrenaline, along with norepinephrine (more on that below), is largely responsible for the immediate reactions we feel when stressed. Imagine you're trying to change lanes in your car, says Amit Sood, M.D., director of research at the Complementary and Integrative Medicine and chair of Mayo Mind Body Initiative at Mayo Clinic. Suddenly, from your blind spot, comes a car racing at 100 miles per hour. You return to your original lane and your heart is pounding. Your muscles are tense, you're breathing faster, you may start sweating. That's adrenaline.

Along with the increase in heart rate, adrenaline also gives you a surge of energy -- which you might need to run away from a dangerous situation -- and also focuses your attention.

NOREPINEPHRINE

A hormone similar to adrenaline, released from the adrenal glands and also from the brain, says Sood.

What It Does: The primary role of norepinephrine, like adrenaline, is arousal, says Sood. "When you are stressed, you become more aware, awake, focused," he says. "You are just generally more responsive." It also helps to shift blood flow away from areas where it might not be so crucial, like the skin, and toward more essential areas at the time, like the muscles, so you can flee the stressful scene.

Although norepinephrine might seem redundant given adrenaline (which is also sometimes called epinephrine), Sood imagines we have both hormones as a type of backup system. "Say your adrenal glands are not working well," he says. "I still want something to save me from acute catastrophe."

Depending on the long-term impact of whatever's stressing you out -- and how you personally handle stress -- it could take anywhere from half an hour to a couple of days to return to your normal resting state, says Sood.

CORTISOL

A high cortisol- the stress chemical- level is a characteristic feature of stress. This is followed by a reduction in sensory acuity. When someone has high cortisol level, they will not be able to decode the presence of a weak resonance, but they will be able to tell 2-3 somewhat different sounds apart, because of the heightened state of sensitive-receptivity aroused by stress.

Whatever the nature of our evolutionalry origins, a readjustment in our sensory abilities makes good biological sense. It is established that a hormone released during the stress response- noradrenaline- also enhances the signal-processing capability of our sensory system. It must be remembered too that several parts of the brain plays a key role in processing information.

When your brain decides-consciously or unconsciously- that all is not well, the hypothalamus is activated. The hypothalamus is the seat of many electrical and chemical signals which trigger stress responses in our body. The hypothalamus also regulates functions such as eating, drinking and sensual pleasures.

During the preliminary phase of a stress response, the hypothalamus, as touched upon earlier, stimulus the nerve endingsin the sympathetic nervous system and the adrenal glands- this causes them to release the two hormones, adrenaline and noradrenaline. A slightly stressful activity, such as public speaking, may generally bring forth a 50 percent rise in noradrenaline. People having chronic stress or anxiety tend to have persistently raised levels of adrenaline and noradrenaline.

The Effects of Stress on Your Body

You're sitting in traffic, late for an important meeting, watching the minutes tick away. Your hypothalamus, a tiny control tower in your brain, decides to send out the order: Send in the stress hormones! These stress hormones are the same ones that trigger your body's “fight or flight” response. Your heart races, your breath quickens, and your muscles ready for action. This response was designed to protect your body in an emergency by preparing you to react quickly. But when the stress response keeps firing, day after day, it could put your health at serious risk.

Stress is a natural physical and mental reaction to life experiences. Everyone expresses stress from time to time. Anything from everyday responsibilities like work and family to serious life events such as a new diagnosis, war, or the death of a loved one can trigger stress. For immediate, short-term situations, stress can be beneficial to your health. It can help you cope with potentially serious situations. Your body responds to stress by releasing hormones that increase your heart and breathing rates and ready your muscles to respond.

Yet if your stress response doesn't stop firing, and these stress levels stay elevated far longer than is necessary for survival, it can take a toll on your

health. Chronic stress can cause a variety of symptoms and affect your overall well-being. Symptoms of chronic stress include:

- irritability
- anxiety
- depression
- headaches
- insomnia

Central nervous and endocrine systems

Your central nervous system (CNS) is in charge of your "fight or flight" response. In your brain, the hypothalamus gets the ball rolling, telling your adrenal glands to release the stress hormones adrenaline and cortisol. These hormones rev up your heartbeat and send blood rushing to the areas that need it most in an emergency, such as your muscles, heart, and other important organs.

When the perceived fear is gone, the hypothalamus should tell all systems to go back to normal. If the CNS fails to return to normal, or if the stressor doesn't go away, the response will continue.

Chronic stress is also a factor in behaviors such as overeating or not eating enough, alcohol or drug abuse, and social withdrawal.

Respiratory and cardiovascular systems

Stress hormones affect your respiratory and cardiovascular systems. During the stress response, you breathe faster in an effort to quickly distribute oxygen-rich blood to your body. If you already have a breathing problem like asthma or emphysema, stress can make it even harder to breathe.

Under stress, your heart also pumps faster. Stress hormones cause your blood vessels to constrict and divert more oxygen to your muscles so you'll have more strength to take action. But this also raises your blood pressure.

As a result, frequent or chronic stress will make your heart work too hard for too long. When your blood pressure rises, so do your risks for having a stroke or heart attack.

Digestive system

Under stress, your liver produces extra blood sugar (glucose) to give you a boost of energy. If you're under chronic stress, your body may not be able to keep up with this extra glucose surge. Chronic stress may increase your risk of developing type 2 diabetes.

The rush of hormones, rapid breathing, and increased heart rate can also upset your digestive system. You're more likely to have heartburn or acid reflux thanks to an increase in stomach acid. Stress doesn't cause ulcers (a bacterium called H. pylori often does), but it can increase your risk for them and cause existing ulcers to act up.

Stress can also affect the way food moves through your body, leading to diarrhea or constipation. You might also experience nausea, vomiting, or a stomachache.

Muscular system

Your muscles tense up to protect themselves from injury when you're stressed. They tend to release again once you relax, but if you're constantly under stress, your muscles may not get the chance to relax. Tight muscles cause headaches, back and shoulder pain, and body aches. Over time, this can set off an unhealthy cycle as you stop exercising and turn to pain medication for relief.

Sexuality and reproductive system

Stress is exhausting for both the body and mind. It's not unusual to lose your desire when you're under constant stress. While short-term stress may cause men to produce more of the male hormone testosterone, this effect doesn't last.

If stress continues for a long time, a man's testosterone levels can begin to drop. This can interfere with sperm production and cause erectile dysfunction or impotence. Chronic stress may also increase risk of infection for male reproductive organs like the prostate and testes.

For women, stress can affect the menstrual cycle. It

can lead to irregular, heavier, or more painful periods. Chronic stress can also magnify the physical symptoms of menopause.

Immune system

Stress stimulates the immune system, which can be a plus for immediate situations. This stimulation can help you avoid infections and heal wounds. But over time, stress hormones will weaken your immune system and reduce your body's response to foreign invaders. People under chronic stress are more susceptible to viral illnesses like the flu and the common cold, as well as other infections. Stress can also increase the time it takes you to recover from an illness or injury.

Stress-related illness

Prolonged stress puts your body in a continuous state readiness for physical action. When your body has no time to re-establish equilibrium, it becomes overworked and your immune system weakens, making you susceptible to sickness. Many essential bodily processes are disrupted and your risk of health problems increases.

Some common effects include:

- memory impairment
- depression
- skin conditions, such as eczema
- difficulty sleeping
- obesity
- heart disease
- digestive problems
- autoimmune diseases

10 Health Problems Related to Stress

- **Heart disease:** Researchers have long suspected that the stressed-out, type A personality has a higher risk of high blood pressure and heart problems. We don't know why, exactly. Stress can directly increase heart rate and blood flow, and causes the release of cholesterol and triglycerides into the blood stream. It's also possible that stress is related to other problems -- an increased likelihood of smoking or obesity -- that indirectly increase the heart risks.Doctors do know that sudden emotional stress can be a trigger for serious cardiac problems, including heart attacks. People who have chronic heart problems need to avoid acute stress -- and learn how to successfully manage life's unavoidable stresses -- as much as they can.
- **Asthma:** Many studies have shown that stress can worsen asthma. Some evidence suggests that a parent's chronic stress might even increase the risk of developing asthma in their children. One study looked at how parental stress affected the asthma rates of young children who were also exposed to air pollution or whose mothers smoked during pregnancy. The kids with stressed out parents had a substantially higher risk of developing asthma.
- **Obesity:** Excess fat in the belly seems to pose greater health risks than fat on the legs or hips -- and unfortunately, that's just where people with high stress seem to store it. "Stress causes higher levels of the hormone cortisol," says Winner, "and that seems to increase the amount of fat that's deposited in the abdomen."
- **Diabetes:** Stress can worsen diabetes in two ways. First, it increases the likelihood of bad behaviours, such as unhealthy eating and excessive drinking. Second, stress seems to raise the glucose levels of people with type 2 diabetes directly.
- **Headaches:** Stress is considered one of the most common triggers for headaches -- not just tension headaches, but migraines as well.
- **Depression and anxiety:** It's probably no surprise that chronic stress is connected with higher rates of depression and anxiety. One survey of recent studies found that people who had stress related to their jobs -- like demanding work with few rewards -- had an 80% higher risk of developing depression within a few years than people with lower stress.

- **Gastrointestinal problems:** Here's one thing that stress doesn't do -- it doesn't cause ulcers. However, it can make them worse. Stress is also a common factor in many other GI conditions, such as chronic heartburn (or gastroesophageal reflux disease, GERD) and irritable bowel syndrome (IBS), Winner says.
- **Alzheimer's disease:** One animal study found that stress might worsen Alzheimer's disease, causing its brain lesions to form more quickly. Some researchers speculate that reducing stress has the potential to slow down the progression of the disease.
- **Accelerated aging:** There's actually evidence that stress can affect how you age. One study compared the DNA of mothers who were under high stress -- they were caring for a chronically ill child -- with women who were not. Researchers found that a particular region of the chromosomes showed the effects of accelerated aging. Stress seemed to accelerate aging about 9 to 17 additional years.
- **Premature death:** A study looked at the health effects of stress by studying elderly caregivers looking after their spouses -- people who are naturally under a great deal of stress. It found that caregivers had a 63% higher rate of death than people their age who were not caregivers.

Effects of Stress on Your Health

When you are in a stressful situation, your body launches a physical response. Your nervous system springs into action, releasing hormones that prepare you to either fight or take off. It's called the "fight or flight" response, and it's why, when you're in a stressful situation, you may notice that your heartbeat speeds up, your breathing gets faster, your muscles tense, and you start to sweat. This kind of stress is short-term and temporary (acute stress), and your body usually recovers quickly from it.

But if your stress system stays activated over a long period of time (chronic stress), it can lead to or aggravate more serious health problems. The constant rush of stress hormones can put a lot of wear and tear on your body, causing it to age more quickly and making it more prone to illness.

If you've been stressed out for a short period of time, you may start to notice some of these physical signs:

- Headache
- Fatigue
- Difficulty sleeping
- Difficulty concentrating
- Upset stomach
- Irritability

When stress becomes long-term and is not properly addressed, it can lead to a number of more serious health conditions, including:

- Depression
- High blood pressure
- Abnormal heartbeat (arrhythmia)
- Hardening of the arteries (atherosclerosis)
- Heart disease
- Heart attack
- Heartburn, ulcers, irritable bowel syndrome

Stress Fantasies vs. Stress Realities

Stress Fantasy: Overwhelmed by the relentless p_a_c_e of it all, I decide to abandon the Internet and live a simpler life founded on principles of health and self-sufficiency. I move to an organic farm and learn to make my own yogurt.

Reality: I cannot boil water, let alone handle live cultures. I become incredibly sick after eating the yogurt and blog about it before I die.

Stress Fantasy: After a series of increasingly terrible interactions with garbage humans, I swear off all sexual relations forever. Untouched, my skin takes on the radiant glow of the Virgin Mary. My hair grows long because no man's hands ever get tangled up in it. Increasingly brilliant thoughts fire at a rapidfire rate in my pure, smooth brain.

Stress Reality: I buy a vibrator and halfheartedly text inappropriate people until I develop a new crush.

Stress Fantasy: I move to Montreal, where everyone is young and beautiful even when they're not, and all my friends live for their art and make their own brunch because they have the time for happiness.

Stress Reality: I find myself desperately trying to befriend 21-year-olds because everyone my age either lives with their partner and infant child in NDG or does not speak English. A 21-year-old feels bad for me and takes me to parties, where I stand around with a Maudite beer trying to talk to 21-year-olds; eventually I give up and try desperately to befriend a 48-year-old in a contemporary flute ensemble. I splurge on a beautiful Mile End one-bedroom that resembles a beautiful New York one-bedroom for four times the price, but run out of money because it's still a beautiful Mile End one-bedroom. I never once make my own brunch.

Stress Fantasy: I take a month off to read every book I've ever said I would read. I read every book I didn't read because I dropped out of university; I read every book every friend has ever recommend. I read every book referenced in the books written by my favorite authors. I never check my phone. Behind my eyes, a bottomless pool of hard-won knowledge becomes visible.

Stress Reality: I abandon this project ten minutes in because lol oh my god I can't believe he retweeted me.

Stress Fantasy: I give up on trying to make rent in the city and move to Dartmouth and buy a husky for companionship.

Stress Reality: I realize I've never even been to Dartmouth, I just like that the houses are painted pretty colors and the rent seems sustainable on a savings budget, but more people get the same idea and the rent rises and soon I'm priced out of my sweet Dartmouth apartment (are there sweet Dartmouth apartments?) and into a cabin somewhere. I also realize that a "mild dog allergy" is a major dog allergy in a cabin full of airborne dog fur and I'm a million miles from all my friends but I can't afford an Internet connection.

Stress Fantasy: I become an itinerant hippie. Living on the road, I never have to worry about domestic business. I make friends all over the world and their love follows me wherever I go.

Stress Reality: I plan the first leg of my journey very poorly and spend most of my time at the hostel. I hate everyone I meet and want to go home.

Stress Fantasy: I learn code and make a shit ton of money through very little effort. The money funds my "work."

Stress Reality: I am incapable of learning code, make no money, and spend my free time napping.

Stress Fantasy: I kill myself.

Stress Reality: I die.

Self-treatment

In some cases, a person can treat an anxiety disorder at home without clinical supervision. However, this may not be effective for severe or long-term anxiety disorders.

There are several exercises and actions to help a person cope with milder, more focused, or shorter-term anxiety disorders, including:

- **Stress management:** Learning to manage stress can help limit potential triggers. Organize any upcoming pressures and deadlines, compile lists to make daunting tasks more manageable, and commit to taking time off from study or work.
- **Relaxation techniques:** Simple activities can help soothe the mental and physical signs of anxiety. These techniques include meditation, deep breathing exercises, long baths, resting in the dark, and yoga.
- **Exercises to replace negative thoughts with positive ones:** Make a list of the negative thoughts that might be cycling as a result of anxiety, and write down another list next to it containing positive, believable thoughts to replace them. Creating a mental image of

successfully facing and conquering a specific fear can also provide benefits if anxiety symptoms relate to a specific cause, such as in a phobia.

- **Support network:** Talk with familiar people who are supportive, such as a family member or friend. Support group services may also be available in the local area and online.
- **Exercise:** Physical exertion can improve self-image and release chemicals in the brain that trigger positive feelings.

Stress Management

Stress and its management in the community is a growing issue for many health practitioners.

Physiotherapists offer a number of stress management techniques and treatments which can help to improve a patient's health and well-being, whether it be specially designed stress management programs, exercise programs, massage, muscle relaxation or general fitness advice.

Role of physiotherapy

Physiotherapists use an initial assessment to clarify the nature of the problem and develop strategies and treatment which are acceptable to the individual.

Treatment can take the form of individual consultation, group relaxation classes, relaxation audio tapes or information sessions for the general public. As part of the treatment program, physiotherapists offer close professional follow up with the patient to ensure a positive treatment outcome.

Physiotherapists with a special interest in stress management can offer many different types of relaxation therapy including guided imagery, progressive muscle relaxation, breathing techniques, thought stopping, stretching, massage and general fitness advice.

Benefits of physiotherapy

Research continues to indicate a positive correlation between a person's ability to cope with stressors and the likelihood of disease during their lifetime. **Physiotherapy can assist by:**

- reducing muscle tension;
- increasing vitality and decreasing reported tiredness;
- improving concentration span;
- improving feeling of general well-being;
- decreasing blood pressure;
- reducing risk of cardiovascular disease;
- improving attitude to work and leisure activity;
- reducing pain states such as headache, chronic pain syndromes and work related anxiety;
- Possibly decreasing dosage of psycho-active medication.

OBESITY STIGMA IN ONLINE NEWS: A VISUAL CONTENT ANALYSIS

Dr. Satya Bhushan Nagar,

ABSTRACT : This study conducted a content analysis to examine the types of images that accompany online news stories about obesity and to determine how obese people are portrayed in news photographs. Images were selected from news articles about obesity obtained from 5 major news Web sites, during 2011-2018. Images accompanying news stories about obesity 859 were systematically coded. Of 441 individuals identified in news photographs, 65% were overweight / obese and 27% were non overweight. Overall, 72% of images that depicted an overweight or obese person were portrayed in a negative, stigmatizing manner. Overweight/obese individuals were significantly more likely to have their heads cut out of the photos, to be portrayed showing only their abdomens or lower bodies, and to be shown eating or drinking than were non overweight individuals. Overweight/obese individuals were significantly less likely to be shown fully clothed, wearing professional clothing, or exercising than were non overweight individuals. Obese individuals are frequently stigmatized in online news photographs; this phenomenon has important implications for public perceptions of obese persons and may reinforce pervasive prejudice and discrimination. The study revealed that as a result of social weight stigma, overweight individuals are vulnerable to serious health complications, and they face disadvantages in health care, employment, education, and beyond. Just as the news media have the power to perpetuate these disparities, they may also play a vital role in correcting them.

Key words: obesity stigma, Overweight, portrayed

As obesity presents a major public health challenge, stigma against obese individuals threatens to undermine efforts to confront this challenge (Puhl & Heuer, 2010). Obese people are highly stigmatized in our society in important domains of living, including education, employment, and health care (Puhl & Brownell, 2001; Puhl & Heuer, 2009). The mass media is an especially compelling example of the social acceptability of weight stigma. Weight stigmatization is common in several forms of popular media (Puhl & Heuer, 2009). Overweight and obese persons are frequently ridiculed and stereotyped in popular television shows and movies (Fouts

Address correspondence to Rebecca M. Puhl, Rudd Center for Food Policy and Obesity, Yale University, 309 Edwards Street, New Haven, CT 06511, USA. E-mail: rebecca.puhl@ yale.edu & Burggraf, 1999, 2000; Fouts & Vaughan, 2002; Greenberg, Eastin, Hofshire, Lachlan, & Brownell, 2003; Herbozo, Tantleff-Dunn, Gokee-Larose, & Thompson, 2004; Himes & Thompson, 2007; Klein & Shiffman, 2005, 2006; Robinson, Callister, & Jankoski, 2008), and the news media often takes a victim-blaming approach in their coverage of obesity (Boero, 2007; Bonfiglioli, Smith, King, Chapman, & Holding, 2007; Kim & Willis, 2007; Lawrence, 2004; Rich & Evans, 2005). Research demonstrates that the news media disproportionately frames obesity in terms of personal responsibility, focusing on individual-level causes and solutions while ignoring important societal and environmental contributors (Bonfiglioli et al., 2007; Kim & Willis, 2007; Lawrence, 2004). As the news media tends to cast blame on obese persons, weight stigmatization can be perpetuated (Crandall & Reser, 2005; Weiner, Perry, & Magnusson, 1988). To date, research in this area has primarily analyzed written content of news reports about obesity.

These studies are guided by Goffman's (1974) frame

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analysis theory, which provides the theoretical foundation for the stereotyping process. Framing theory explains the process by which a source (e.g., a news story) defines a particular social issue and outlines the fundamental problems and considerations relevant to that issue (Nelson, Oxley, & Clawson, 1997). Framing theory has often been used in media studies as a basis for studying how a communication source (e.g., a news organization) constructs social or political problems (Nelson et al., 1997).

Visual framing, or pictorial framing, of an issue is also of particular importance because viewers tend to accept visual images as reality while being unaware of the influence of visual framing (Messaris & Abraham, 2001). According to Messaris and Abraham, "Pictorial framing is worthy of investigation not only because images are capable of conveying unverbalized meanings, but also because awareness of those meanings may be particularly elusive." Furthermore, news photos may be noticed even when the accompanying story is not read, and photographs help readers interpret news stories (Messaris & Abraham).

Studies guided by framing theory have used visual content analysis techniques and demonstrated that news photographs can communicate stereotypes (Fahmy, 2004) and racial, gender, and age biases (Entman, 1992; Martindale, 1990; Rodgers & Thorson, 2000).

To our knowledge, no study has investigated the ways in which obese individuals are visually depicted in the news. Thus, this study aimed to conduct a content analysis to examine the types of images that accompany online news stories about obesity and to determine how obese people are portrayed in news photographs.

Methods

Sample

We selected photographs by searching five major news Web sites for articles about obesity: MSNBC.com, CNN.com, ABCnews.com, CBSnews.com, and FOXnews.com. We also considered Web sites of major online newspapers (e.g., NYTimes.com, WashingtonPost.com), but subsequently excluded them because we discovered that these sites often did not include images with their archived news stories. In addition, recent research reveals that the majority of Americans are more likely to get their news from online sources, as opposed to print sources (Pew Research Center Publications, 2009).

Therefore, we chose to analyze photographs that were featured with online news articles in order to obtain a sample of images that may have a high level of exposure to a greater number of viewers. After testing several search terms (e.g., fat, obese, weight, overweight) and examining the types of articles produced by each Web site, we determined that the search term obesity produced the most news articles relevant to this study.

After typing obesity into the search box of each Web site, thousands of results were produced, which were automatically sorted by each Web site according to their relevance to the topic of obesity. We conducted searches on each of the five Web sites during a 2-week period in September of 2009. Because the goal of the present study was to examine visual images accompanying articles about obesity, every article produced by our search results was screened to determine whether the primary topic (or a major topic) of the article was about obesity. For some articles, the word obesity appeared in the headline, but for many articles' obesity was prominently discussed in the text of the article. Thus, each article was read by coders in order to determine whether the main focus of the article was obesity.

Articles were selected for inclusion in the content analysis if they met the following criteria:

1. The main topic or a major topic in the article was obesity (e.g., health care spending on obesity, obesity treatment, health consequences of obesity).
2. The article was accompanied by an image.

Because of the high volume of articles produced by each Web site search (e.g., 78,200 articles about obesity were retrieved on MSNBC.com), only the first 500 results on each Web site were included as potential sources of images for this study. After reviewing the first 500 results on each Web site, exclusions were made if the online report was not accompanied by an image or photograph (which was the primary reason for exclusion), and if after reading the article it became apparent that obesity was not a primary focus of the content. Using this exclusion process, 859 images were ultimately retrieved to be included in the content analysis (170 images from MSNBC.com, 367 images from CBSnews.com, 209 images from ABCnews.com, 65 images from CNN.com, and 48 images from FOXnews.com).

Measurement

The unit of analysis in this study was individual images accompanying news stories about obesity (N¼549). To conduct a content analysis, a comprehensive coding tool was developed with specific variables that were chosen to document demographic characteristics and describe the portrayals of obese persons in the photographs. Variables were also chosen to capture ways in which images may be stigmatizing or stereotypical. Variables included the following:

1. News source of the image 2. Date the article was published 3. Story topic 4. Image credit (Associated Press, a stock image, or credited to the news source itself) 5. Demographic characteristics of the person in the image (gender, age, and race) 6. Body weight (underweight, normal weight, overweight, obese, very obese, or pregnant) 7. How the body was portrayed in the image (most of the body, head=face, abdomen, or lower body) 8. Whether the head was cut out of the image 9. Whether the person in the image was clothed (fully clothed, partially clothed, or mostly unclothed) 10. Clothing style (professional, casual, or exercise) 11. Fit of clothes (appropriate or inappropriate; coded as inappropriate only if an obese individual's clothing was distinctly too tight) Images were also coded according to the main role or activity of the person(s) portrayed in the image.

These included the following:

1. Eating and=or drinking 2. Selling, shopping for, serving, and=or cooking food 3. Exercising 4. Being an expert, researcher, advocate, or journalist 5. Being a patient 6. Being a health professional 7. Being the feature of a weight loss success story 8. Being shown as an isolated body part (e.g., only the abdomen is shown) 9. Walking down the street 10. Engaging in sedentary behavior (e.g., watching television, playing a video game) 11. Being featured in a personal interest story (e.g., a photograph of a couple who were denied adoption because of their obesity) 12. Other activities

If there was food or drink present in the photograph, it was coded as either healthy (e.g., fruit, vegetables, water) or unhealthy (e.g., potato chips, fast food, soda). All images were systematically coded by a team of four trained coders. We assessed interrater reliability by having each of the four coders independently code 25% of articles in the sample (n¼137). Because the coded variables were nominal, we calculated reliability using Cohen's kappa for multiple raters. This calculation corrected for chance agreement among coders. Reliability scores in this study ranged from 0.72 (lowest) to 1.0 (highest), which indicates a high level of agreement among all four coders. The lowest score was for the variable assessing the story topic of the news article. Before coding the remaining 75% of the articles, all four coders arbitrated in order to resolve any outstanding coding inconsistencies.

Results

Sample Characteristics

Of the total sample of 859 images, 188 (22%) were excluded from analysis because they did not contain people (these were mostly images of food or other health-related graphics). This exclusion left 671

images published in online news articles about obesity from 2002 to 2009. Among these articles, 15 different categories of story topics were identified. The most prevalent story topics were about the health consequences of obesity (13%), community or government initiatives to prevent obesity (10%), obesity prevalence (9%), and weight loss surgery or drugs (9%). The majority of the images accompanying these reports were credited to the Associated Press (54%). When more than one person was depicted in an image, each person was coded separately, resulting in 441 individual people in the final sample.

Table 1 shows the demographic characteristics of individuals in our sample. Overall, 56% of the sample was male, and 44% was female. The majority of individuals were White (79%), and 18% were racial=ethnic minorities (e.g., Black, Latino, Asian). In addition, 70% were adults and 29% were youths. Sixty-five percent of the sample was overweight=obese, and 27% were nonoverweight. The original weight categories of "overweight," "obese," and "very obese" were collapsed into one "overweight=obese" category, because of relatively small percentages of individuals who were coded as "overweight" or "very obese." The remaining 8% were either pregnant or their weight category could not be determined; thus, they were subsequently excluded from further analysis. All subsequent analyses compare nonoverweight with overweight= obese persons.

Portrayals of Overweight/Obese Persons

Table 2 compares the percentage of overweight=obese persons versus nonoverweight persons who were portrayed with specific characteristics of interest. We performed chi-square tests to determine significant differences between portrayals of overweight=obese people and nonoverweight people. In addition, we calculated odds ratios to maximize the interpretability of the chi-square results. Although there were no differences in gender or race among overweight=obese persons versus nonoverweight persons, several other significant findings emerged. Youths depicted in images were twice as likely to be overweight=obese than were adults who were portrayed in images, v2(1, N¼400) ¼6.75, p¼.009. There were several significant differences in how individuals' bodies were portrayed in the photographs. More than half of overweight=obese people (52%) were portrayed in images with only their abdomens or lower bodies shown, whereas nonoverweight people were never portrayed in this way, v2(1, N¼404) ¼98.44, p<.001. Overweight=obese individuals were 23.3 times more likely to have their heads cut out of the photos than were nonoverweight individuals, v2(1, N¼404)¼97.16, p<.001.

Overweight=obese individuals were also more likely to be photographed from the side and rear view (rather than from the front) than nonoverweight individuals, odds ratio¼2.61, v2(1, N¼403)¼14.26, p<.001. Overweight=obese people were less likely to be appear fully clothed, odds ratio¼0.32, v2(1, N¼400)¼5.73, p¼.02, and were less likely to appear in professional clothing compared with nonoverweight persons, odds ratio¼0.13, v2(1, N¼370)¼65.80, p<.001. Overweight=obese and nonoverweight persons also differed in the types of activities in which they were portrayed in photographs. Overweight=obese individuals were 3.5 times more likely to be shown consuming food compared with nonoverweight persons, v2(1, N¼404)¼4.66, p¼.03. Conversely, nonoverweight individuals were 3.9 times more likely to be shown exercising compared with overweight=obese individuals v2(1, N¼404)¼16.91, p<.001. Nonoverweight individuals were 50 times more likely to be shown as experts, advocates, or journalists than were overweight=obese individuals, v2(1, N¼404)¼90.99, p<.001, and were also more likely than overweight=obese persons to be shown as healthcare providers, odds ratio¼7.69, v2(1,

N¼404)¼34.95, p<.001. There were no significant

Table 1. Demographic characteristics of individuals portrayed in online news images (N¼441) Online news source

Variable	MSNBC (N¼70)	CBS (N¼202)	ABC (N¼103)	CNN (N¼42)	FOX (N¼24)	Total Sample (N¼441)
Weight						
Nonoverweight	39%	24%	33%	61%	71%	33%
Overweight/ Obese	19%	45%	27%	71%	45%	65%
Could not be determined	0%	8%	4%	10%	29%	7%
Sex						
Male	69%	55%	47%	61%	54%	56%
Female	31%	45%	52%	46%	44%	39%
Age						
Youth	30%	26%	34%	19%	29%	8%

differences for being shown in the role of a patient or engaging in sedentary behaviors between overweight=obese and nonoverweight persons.

Characteristics of Individual News Source

Because the sample included images from five distinct news sources, we conducted analyses to determine whether significant differences emerged between each news source for demographic characteristics.

The Breslow-Day Test determined whether there was homogeneity in the odds ratio between news sources, with the criterion for significance set with an alpha of .10.

First, analyses revealed that there were differences between the news sources regarding gender and weight: Breslow-Day v2(4)¼16.55, p¼.002. Specifically, within CBSnews.com, men were 4.2 times more likely to be overweight=obese than were women, v2(1, N¼182)¼14.74, p<.001. There were no significant differences for gender among the other news sources. Second, there were also differences between sources for weight and age of images portrayed: Breslow-Day v2(4)¼8.03, p¼.09. Specifically, within CBSnews.com, the odds of a youth being overweight=obese were 3.6 times greater than the odds of adults being overweight=obese, v2(1, N¼181)¼7.86, p¼.005. There were no significant differences for age among the other sources.

Stigmatizing Portrayals Images were also analyzed to determine whether the portrayals of overweight=obese individuals were stigmatizing. An image was considered stigmatizing if it met one or more of the following criteria:

1. Disproportionately emphasized an overweight=obese person's abdomen or lower body 2. Portrayed an overweight=obese person's abdomen without clothes 3. Featured an overweight=obese person with their head cut out of the image

Table 2. Comparison of portrayals for overweight=obese persons versus nonoverweight persons in online news reports about obesity

Overweight=obese (N¼287)

Nonoverweight (N¼119)

Negative characteristic "Headless" 59% 6% Shown from side or rear angle 40% 20% Only abdomen or lower body shown 52% 0% Shown without clothes or bare midriff 12% 4% Inappropriate fitting clothing 6% 0% Shown eating and=or drinking 8% 3% Engaged in sedentary activity 5% 3% Positive characteristic Wearing professional clothing 11% 50% Shown exercising 6% 20% Portrayed as expert or advocate 1% 33% Portrayed as health care provider 4% 22%

4. Portrayed an overweight=obese person with inappropriately fitting clothing (e.g., a shirt that is distinctly too tight) 5. Portrayed an overweight=obese person eating=drinking an unhealthy food=drink 6. Portrayed an overweight=obese person engaging in a sedentary activity

Overall, 72% of images that portrayed an overweight or obese person met at least one of the aforementioned criteria. Overweight=obese men were slightly more likely than overweight=obese women to be portrayed in a stigmatizing way, odds ratio¼1.6, v2(1, N¼437) ¼5.95, p¼.02. In addition, overweight=obese White individuals were twice as

likely to be portrayed in stigmatizing ways than overweight= obese minorities, v2(1, N¼426) ¼7.85, p¼.005. There were no significant differences by age. Among all the images in the sample for each news source, CBSnews.com had the highest percentage of stigmatizing images (43%), followed by ABCnews.com (35%), MSNBC.com (26%), CNN.com (19%), and FOXnews.com (18%).

Among photos credited to the Associated Press, 46% were stigmatizing. Among the stock photos, 33% were stigmatizing, and 19% of images that were credited to the individual news sources were stigmatizing. Last, news stories about the genetic causes of obesity contained the highest percentage of stigmatizing images (70%), followed by health care spending (63%), and prevalence of obesity (58%). The lowest percentages of stigmatizing images were paired with stories on food=diet (5%) and exercise (8%). There were no significant differences in stigmatizing portrayals by the year of an article's publication.

Discussion

This study demonstrates that the majority (72%) of overweight and obese individuals depicted in online news photographs were stigmatized. Overweight and obese individuals were more likely to have their heads cut out of photos, to be shown from the side or the rear, to be portrayed with only their abdomens or lower bodies shown, and to be partially clothed (e.g., bare stomachs showing) than nonoverweight individuals. These findings confirm the phenomenon of the "headless stomach," which is the tendency for news reports to show obese people with their heads cut out of images. This phenomenon has been fervently discussed by writers in online communities (Cooper, 2007), but it has never been empirically studied. Some may argue that obese individuals' heads and faces are omitted from news photos to protect their privacy. However, images that place unnecessary emphasis on particular body parts seem to intentionally evoke a sense of disgust, rather than merely portray a obese person with their identity concealed. This is especially apparent when news articles are accompanied by stock images that show unclothed obese people (e.g., with no shirt). By isolating certain body parts and emphasizing unflattering portrayals of excess weight, news photographs degrade and dehumanize obese individuals. Consequently, obese people are reduced to being symbols of the epidemic, rather than valued members of society who deserve compassion and respect. In addition to the abundance of negative images of overweight individuals observed in the present study, there was also a considerable lack of positive portrayals. Overweight and obese individuals were less likely to be shown wearing professional-looking clothing, and were far less likely to be portrayed as experts,

advocates, journalists, or healthcare providers than those who were not overweight. In addition, overweight persons were less likely to be shown exercising and more likely to be portrayed eating or drinking than were nonoverweight persons. Such portrayals perpetuate negative weight-based stereotypes about obese persons. Millions of Americans rely on the Internet for their news (Pew Research Center Publications, 2009). Thus, the number of Americans who are exposed to these stigmatizing portrayals of obese persons is vast, which may affect the pervasive stigma and discrimination directed toward obese individuals. Experimental research shows that people who read a news story about obesity that is paired with a stigmatizing photograph subsequently express higher levels of weight bias than do those who read the same news story about obesity paired with a nonstigmatizing photograph (McClure et al., 2011).

As these negative images of obese people have become commonplace, they help to shape societal beliefs about obese persons. In addition to perpetuating societal stigma, negative news images of obese persons may also contribute to the physical and emotional health consequences suffered by persons who experience weight stigma. An

accumulation of research demonstrates that obesity stigma poses a significant threat to psychological and physical health, including increasing vulnerability for depression, anxiety, low self-esteem, disordered eating, lower levels of physical activity, and weight gain (Ashmore, Friedman, Rechmann, & Musante, 2008; Carels et al., 2009; Puhl & Brownell, 2006; Puhl & Heuer, 2009; Puhl, Moss-Racusin, & Schwartz, 2007; Vartanian, Herman, & Polivy, 2005; Vartanian & Shaprow, 2008). Obese individuals who view these stigmatizing images in the news may be vulnerable to internalizing negative weight-based stereotypes, which can, in turn, lead to emotional and physical health consequences (Puhl et al., 2007). Considering both the pervasiveness of negative visual content in the news, and the prevalence of overweight and obesity in American children and adults, the public health impact of these stigmatizing portrayals may be substantial.

Some critics may argue that the use of "positive" (e.g., nonstigmatizing) images of obese persons could potentially normalize obesity in a way that reduces motivation to maintain a healthy weight. However, scientific evidence suggests that weight stigma is not a beneficial tool for motivating weight loss. Weight stigma is counterproductive for public health and increases the likelihood for unhealthy eating behaviors, avoidance of physical activity, impaired weight loss efforts, and decreased use of preventive health services (Amy, Aalborg, Lyons, & Keranen, 2006; Ashmore et al., 2008; Carels et al., 2009; Puhl & Brownell, 2006; Puhl & Heuer, 2010). In contrast, studies suggest that communicating acceptance and providing support, rather than instilling stigma and shame, are more appropriate and effective strategies to promote healthy lifestyle behaviors in obese persons (Lillis, Hayes, Bunting, & Masuda, 2009). The present findings also have potential implications for public health policy. The news media have tremendous power to shape the public's perception of social issues, and, in doing so, can influence the agenda of policymakers (McCombs & Shaw, 1972). To the extent that news images stigmatize obese individuals, they reinforce blame on obese persons (Crandall & Reser, 2005). The media's attribution of obesity as a problem with obese individuals themselves (rather than a more complex societal and public health issue) is underscored by the inclusion of stigmatizing images. When obese individuals are blamed, the need for government involvement and public policy efforts to address obesity is curtailed.

Thus, negative visualframing of obese persons in the news could adversely influence public policy efforts to address obesity. At the same time, the news media can play an important role in reducing societal stigma toward obese individuals by changing the visual content of their news reports about obesity. It is not uncommon for media outlets to establish ethical guidelines that advise journalists against stereotyping and bias.

For example, the Society of Professional Journalists' Code of Ethics states, "Journalists should avoid stereotyping by race, gender, age, religion, ethnicity, geography, sexual orientation, disability, physical appearance or social status" (Society of Professional Journalists, 2010) The Code of Ethics for the National Press Photographers Association states that visual journalists should "avoid stereotyping individuals and groups" (National Press Photographers Association, 2010).

Therefore, it is reasonable to expect the news media to make a concerted effort to correct bias in their visual content when it is exposed. In the present study, more than half of images were credited to the Associated Press, and 46% of these images were found to be stigmatizing. According to the Associated Press Statement of News Values and Principles, "Always and in all media, we insist on the highest standards of integrity and ethical behavior when we gather and deliver the news....

That means we abhor inaccuracies, carelessness, bias or distortions" (Associated Press, 2010). Thus,

in keeping with their stated values and standards, it would be consistent and appropriate for the Associated Press to improve their photographic depictions of obese individuals, as should other mainstream online news outlets. There are several limitations of the present study. First, the sample consisted of Web-based news reports and therefore it is unknown whether images that accompany print articles (e.g., newspapers, magazines) about obesity differ from images used in online news. Additional research is needed to establish the generalizability of these findings to other media sources. Second, it would be useful to obtain larger and more diverse samples of images from online news sources to more closely examine potential differences in portrayals of obese persons related to issues of race, age, sexual orientation, and other characteristics that were beyond the scope of this study. Last, the sample of images selected for this study focused on online news coverage of obesity-related topics. It would be informative for future research to examine whether portrayals of obese and nonobese persons documented in the present study are similar in news stories on topics unrelated to body weight.

Obesity stigma in the mass media contributes to the social acceptability of weight prejudice and its consequences for those who are affected (Puhl & Heuer, 2009). News images of obese persons may be a particularly powerful and insidious source of obesity stigma, especially given that these images are prevalent and rarely challenged.

Our study revealed that the prevalence of stigmatizing images accompanying news stories about obesity remained consistent throughout a 7-year period from 2011to 2018. As this problem persists, efforts are clearly needed to address the visual portrayals of obese persons in the media to help reduce stigma. Photographers, journalists, and editors must be mindful of the power of their photographic content to communicate biases to their readers. As a result of societal weight stigma, overweight individuals are vulnerable to serious health complications, and they face disadvantages in health care, employment, education, and beyond. Just as the news media have the power to perpetuate these disparities, they may also play a vital role in correcting them. Further research is needed to examine the effect of a shift toward positive portrayals of obese individuals in obesity news on public attitudes and approaches to address obesity.

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IMMEDIATE EFFECTS OF COST-EFFECTIVE STRAP ON Q-ANGLE AND KNEE FUNCTIONAL PERFORMANCE FOR NON-ATHLETIC UNIVERSITY STUDENTS WITH ANTERIOR KNEE PAIN

Dr. Manash Kanti Chakraborty

ABSTRACT

Objective: To find out immediate effects of cost-effective strap on Q-angle and knee functional performance for non-athletic university students with anterior knee pain. Methods: A quasi experimental single group pre and post study was designed with convenient sampling of 110 non-athletic university students with anterior knee pain. The study has been conducted in SRM University, Kattankulathur campus, Chennai. The Q- angle and Visual analog scale was measured followed by collection of Kujala Patellofemoral pain syndrome scoring sheet and Werner functional knee score for anterior knee pain. The score was tabulated as pre-test measurement .The cost-effective strap which was influenced by the use of Theratogs, was applied over the mid-thigh region with 50% resistance anteroposterior and medial to lateral direction. Then the measurement of Q-angle, visual analog score with Kujala Patellofemoral pain syndrome score and Werner functional knee score were repeatedly taken from the subjects and compared with pre-test measurement score. Results: The statistical analysis of paired t-test showed significant reduction on the measurement of Q- angle($p=0.000$) and visual analog scale($p=0.000$).The study also showed significant improvement on Kujala Patellofemoral scoring sheet($p=0.000$) and Werner functional knee score for anterior knee pain($p=0.000$) at 95% C.I. Conclusion: The study showed significant reduction on Q-angle and improvement of functional knee performance immediately after applying over the subjects with anterior knee pain. So it could concluded that the strap can be used as a conservative physiotherapy management for subjects with anterior knee pain which is also cost effective while comparing with Theratogs.

Key pints: Anterior knee pain, Cost-effective strap, functional knee performance.

INTRODUCTION

The term anterior knee pain is used to describe all symptoms of pain around the front of the knee, which may be caused by a number of conditions such as patellar tendinopathy and patellofemoral pain syndrome.1 Anterior knee pain, diagnosed as Patellofemoral Pain Syndrome (PFPS), is one of the most common musculoskeletal disorders .28

Anterior knee pain and Patellofemoral pain syndrome (PFPS) accounted for 34% of knee injuries as one of the most common orthopedic conditions, particularly in active, young females,8,9 while anterior knee pain is of high socioeconomic relevance as it occurs most frequently in young and active patients. The rate is around 15-33% in active adult population and 21-45% of adolescents.23 The main activities associated with anterior knee pain are sporting, stair climbing and walking which are common in student.8,9They frequently experience pain with prolonged sitting (watching a movie, riding on an airplane) and feel that they have to occasionally straighten their legs out to decrease discomfort.

The onset of symptoms is frequently associated with the start of a new activity or increase in level of intensity of a pre-existing activity. The pain is usually exacerbated by squatting and kneeling. It is generally an aching pain, but can become sharp in nature and even be associated with a burning sensation. This occurs particularly when going down

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the stairs. With knee flexion and extension, the patella glides through a groove in the distal femur. When the bones in the lower leg are not lined up ideally, it can cause the gliding between the patella and femur to become abnormal. Shortening of the quadriceps muscles, hamstrings and iliotibial band, and relative weakness of the quadriceps muscles are probably the most common causes.

Alignment of the hip, knee and ankle is thought to play a key role in the load distribution at the knee so biomechanical changes resulting from abnormal alignment may influence joint loads, mechanical efficiency of muscles, and proprioceptive orientation and feedback from the hip and knee, resulting in altered neuromuscular function and control of the lower extremities.2, 3

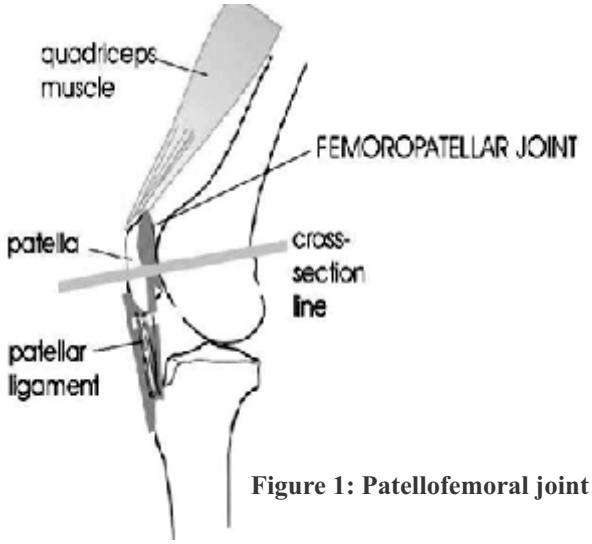


Figure 1: Patellofemoral joint

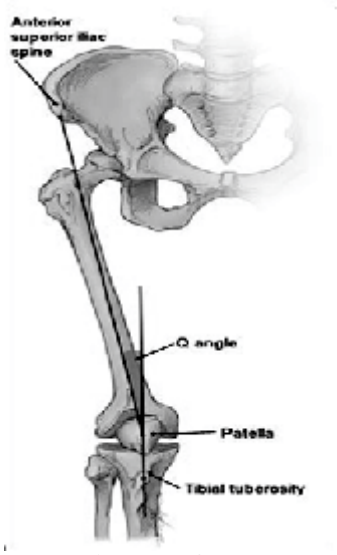


Figure 2: Q- angle

Among these lower extremity alignment variables, the quadriceps angle (Q -Angle) has been frequently studied, which is defined as the angle formed by a line from the anterior superior iliac spine to the patella center and a line from the patella center to the tibial tuberosity.4Q angle is a composite measure of pelvic position, hip rotation, tibial torsion, patella position and foot position.7, 11

As Q angle represents the direction of the quadriceps muscle force vector in the frontal plane, excessive angulation is thought to predispose individuals to injuries caused by abnormal quadriceps forces acting at the patellofemoral joints.5, 6

Altered foot and ankle kinematics may contribute to hip and knee joint mechanics thought to increase patellofemoral joint stress.10,11 The patellofemoral joint reaction force, a measurement of patellar compression against the femur, is influenced by the knee angle as well as the quadriceps force.

This study was aimed to find out the immediate efficacy of a cost effective strap in anterior knee pain which is a custom made elastic material, self-administrative and which can be used under garments easily is mechanically similar with THERATOGS.

THERATOGS is an orthotic undergarment and strapping system that gives clients with sensorimotor impairment a new modality for improving postural alignment and stability, movement skill and precision and joint stability. THERATOGS were designed and developed by Beverly Cusick, PT, MS and provide a Latex free, breathable, comfortable, Velcro sensitive “external skin” for clinicians engaged in sensorimotor training of clients with developmental disabilities, and for clients in rehabilitation after brain injury, stroke, orthopedic surgery, or neurosurgery.

The materials of the strap is not containing any chemicals so that it can be used for longer duration comparing to crepe bandage or other therapeutic

device which are used for conservative pain reducing management without any skin irritation.

Method: The study was designed as a quasi-experimental single group pre and post-test. The study was performed at SRM University, Kattankulathur campus with subjects who were recruited based on the following criteria: 18- 30 years non atheletic male and female participants with diagnosed Anterior Knee Pain or Petellofemoral Pain Syndrome scoring less than 85/100 on Kujala Patellofemoral Pain Syndrome (KPFPS) score-sheet, whose pain intensity was in between 3-7 on Visual analog scale (VAS) and scoring 0-30 on Werner Functional Knee Score (WFKS) for anterior knee pain scoring sheet. The subjects were excluded by presence with any cardiopulmonary disease, any other knee pathology, recent fracture of lower extremities, taking physiotherapy treatment for knee, any inflammatory or degenerative disease for lower extremity or recently undergone for any surgery for lower extremity.

Pre and post measurement of Q- angle with universal goniometer, pre and post score of Visual Analog scale, pre and post score of Kujala Ptellofemoral Pain Syndrome scoring sheet,pre and post score of Werner functional knee score for anterior knee pain were used as the out-come measure for this study.

Procedure: 110 subjects were selected based on the inclusion and exclusion criteria. The purpose of the study was explained to the subjects and signed printed informed consent form was taken. Before performing the main study a small pilot study was performed with 10 samples to identify the complications may occur during the main study. Pre-test measurement of Q -angle in standing position with 50 flexion of knee, Visual analog score, Kujala Patellofemoral pain syndrome score and Werner functional knee score for anterior knee pain was recorded individually for analysis.

The cost effective customized strap was applied over thigh region started the first wrap by rotating the thigh in external rotation with 50% resistant and wrap around the thigh in antero-posterior and medial to lateral direction and finished at below the knee joint. Subjects were asked to perform short-walk, kneeling, stair-climbing up and down, sitting in a chair with 900 knee flexion for 5 minutes to identifying any uneasiness existing or not.

Figure 6: Q-angle performed in standing

Figure 7: Anterior view

Figure 8: Posterior view

Post-test measurement of Q –angle and VAS was measured immediately and subjects were asked to continue some functional activities which were needed as a part of examination of Kujala Patellofemoral pain syndrome score and Werner functional knee score for anterior knee pain by wearing the strap under the garments. The subjects were asked repeatedly for any kind of uncomforting while performing the functional activities such as walking 2 km, climbing steps (up-down), sitting in chair for 30 minutes, etc. All the scoring sheets were kept securely for analysis.

After furnishing of valuable scoring, the subjects were asked to untie the strap and the applied area was examined thoroughly for any skin rash.

	Mean	Std. Deviation	Std. Error Mean	t	df	Sig-(2 -tailed)
Q-angle pre – Q-angle post	5.54545	1.39880	.13337	41.579	109	.000*

Data analysis: The recorded data were tabulated. The data was analyzed using statistical package for social science (SPSS) to present the finding of the immediate effects of cost-effective strap on q-angle and knee functional performance for non-athletic university students with anterior knee pain. Data analysis was done with SPSS Software version 20.0. "p" value was set at less than 0.05 as significance for all analysis, "paired t" test was done.

Table 1: Comparison of pre and post-test measurement of Q-angle in patient with anterior knee pain following strapping

	Mean	Std. Deviation	Std. Error Mean	t	df	Sig-(2 -tailed)
Visual analog pre - Visual analog post	2.56364	.68439	.06525	39.287	109	.000*

*p<0.05

The table shows that there is a significant difference in Q-angle between the pre-test and post-test in patients with anterior knee pain. This indicates that there was a significant reduction in Q-angle following strapping in patient with anterior knee pain. (p<0.05)

Table 2: Comparison of pre and post-test measurement of Visual analog scale in patient with anterior knee pain following strapping *p<0.05

The table shows that there is a significant difference in Visual analog scale between the pre- test and post-test in patients with anterior knee pain. This indicates that there was a significant reduction in Visual analog scale following strapping in patient with anterior knee pain. (p<0.05)

	Mean	Std. Deviation	Std. Error Mean	t	df	Sig-(2 -tailed)
Werner functional knee score pre - Werner functional knee score post	-18.41818	3.42249	.32632	-56.442	109	.000*

Table 3: Comparison of pre and post-test measurement of Kujala Patellofemoral pain syndrome score in patient with anterior knee pain following strapping

*p<0.05

	Mean	Std. Deviation	Std. Error Mean	t	df	Sig-(2 -tailed)
Kujala Patellofemoral pain syndrome score pre – Kujala Patellofemoral pain syndrome score post	-21.01818	3.45610	.32953	-63.783	109	.000*

The table shows that there is a significant difference in Kujala Patellofemoral pain syndrome score between the pre-test and post-test in patients with anterior knee pain. This indicates that there was a significant improvement in Kujala Patellofemoral pain syndrome score following strapping in patient with anterior knee pain. (p<0.05)

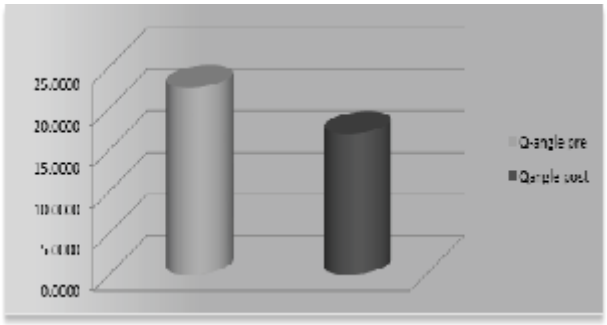
Table 4: Comparison of pre and post-test measurement of Werner functional knee score in patient with anterior knee pain following strapping

*P<0.05

The table shows that there is a significant difference in Werner functional knee score between the pre-test and post-test in patients with anterior knee pain. This indicates that there was a significant improvement in Werner functional knee score pain syndrome score following strapping in patient with anterior knee pain.(p<0.05)

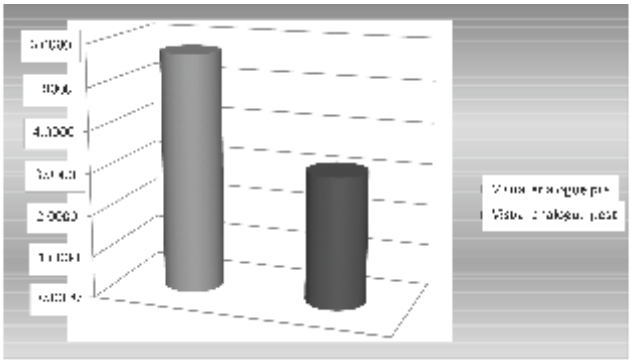
Results: According to TABLE –1 there is a significant difference in Q-angle between the pre-test and post-test in patients with anterior knee pain. This indicates that there was a significant reduction in Q-angle following strapping in patient with anterior knee pain. (p<0.05)

Graph 1: Comparison of pre and post-test measurement of Q-angle in patient with anterior knee pain following strapping



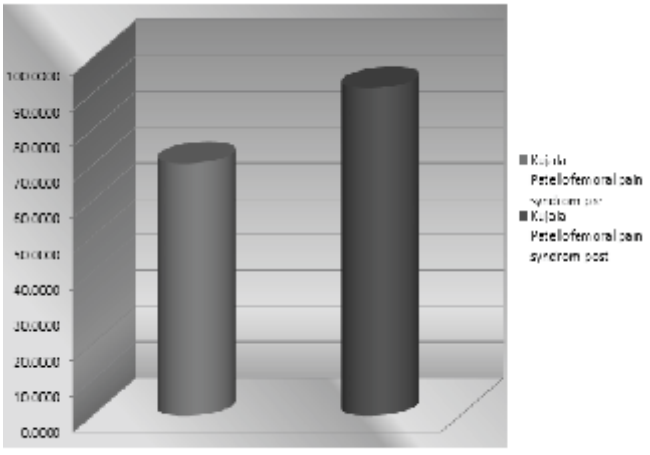
According to TABLE -2 there is a significant difference in Visual analog scale between the pre-test and post-test in patients with anterior knee pain. This indicates that there was a significant reduction in Visual analog scale following strapping in patient with anterior knee pain. (p<0.05)

Graph 2: Comparison of pre and post-test measurement of visual analog scale in patient with anterior knee pain following strapping



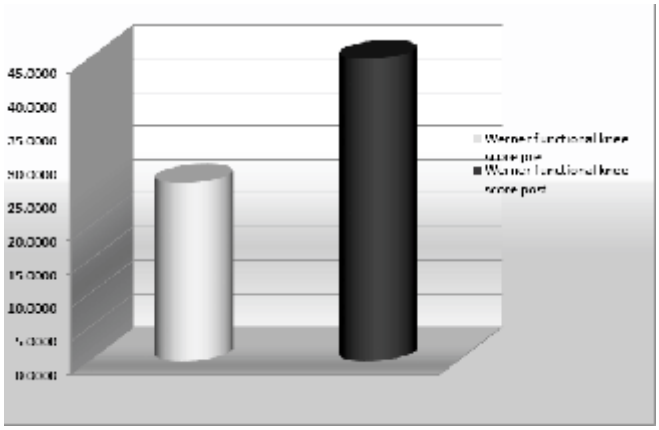
According to TABLE -3 there is a significant difference in Kujala Patellofemoral pain syndrome score between the pre-test and post-test in patients with anterior knee pain. This indicates that there was a significant improvement in Kujala Patellofemoral pain syndrome score following strapping in patient with anterior knee pain. (p<0.05)

Graph 3: Comparison of pre and post-test measurement of Kujala Patellofemoral pain syndrome score in patient with anterior knee pain following strapping



According to **TABLE-4** there is a significant difference in Werner functional knee score between the pre-test and post-test in patients with anterior knee pain. This indicates that there was a significant improvement in Werner functional knee score pain syndrome score following strapping in patient with anterior knee pain.($p<0.05$)

Graph 4: Comparison of pre and post-test measurement of Werner functional knee score in patient with anterior knee pain following strapping



Discussion: The aim of the study was to find out the immediate effect of cost effective strap on Q- angle and knee functional performance on non-athletic university students with anterior knee pain. Total 110 subjects (35 females, 75 males) were selected for the study. The statistical result showed that there was a significant effect on Q-angle and knee functional performance immediately after applying of cost effective strap for the non-athletic university students with anterior knee pain.

There are many researches done over the anterior knee pain to identify the cause, prevalence, effective conservative treatments etc. Arlene M. Goodman, Jon G. Divine et al (2009) concluded that the prevalence of anterior knee pain is as high as 1 in 4 females and females are two times more likely to demonstrate anterior knee pain symptoms than male in general population .64In this study Q-angle was measured with a universal goniometer and only in standing position with 50 knee flexion.

The statistical analysis of this study shows that the cost effective strap helped in reduction of the Q-angle which is increased in subjects with anterior knee pain. Mark S. Juhn (1999) reported that, increased Q-angle was one of the four causes for anterior knee pain.50 As the Q-angle reduced, the pain also reduced and the functional performance of knee improved for those subjects.John P. Fulkerson (2002) concluded that non- operative treatment is effective in most subjects. Prone hamstring muscle stretches, static quadriceps strengthening, friction massages, manual therapy techniques, and effective bracing helped most of the subjects with anterior knee pain.43Based on the statistical analysis, there was significant reduction on the Q- angle. The Q-angle measurement is an important integral part for the subject with anterior knee pain. Large Q-angle is thought to create excessive lateral force on the patella that may predispose to pathological changes. An excessively large Q-angle (>200) is usually an indicator of structural malalignment. Increased Q-angle may promote a greater lateral force to deviate the medial femoral torsion. The strap wrapped over the thigh region produced resistance on quadriceps muscles and adductor compartment which reduced the femoral anteversion, this in turn decreased the lateral tilting of patella and similarly in the measurement of Q-angle.

The pain intensity measured with visual analog scale also showed significant reduction in the study. As the strap wrapped over quadriceps muscles indirectly attributes to the strength of hip external rotators and abductors so, during the weight bearing activities the compressive forces on the patellofemoral joint is reduced and it passively reduced the knee pain.

Furthermore, the reduction of the Q-angle and knee pain showed significant improvement of knee functional performance on Kujala Patallofemoral pain syndrome score as well as Werner functional knee score for anterior knee pain.Further research should be done to find out its efficacy in other orthopaedic conditions.

As the THERATOGS is comparatively costly so the customized cost-effective strap was used in the study which is easy to administer,. This study examined only the unilateral problem; future study should be performed with bilateral knee problems and on other knee pathology.

The statistical analysis of this study shows that cost effective strap has a high influence on Q-angle and thereby reducing pain and improving the functional performance of knee in subjects with anterior knee pain. Due to its advantage of user guidelines and cost effectiveness, it can be widely used in the practice of physiotherapy management for improving the functional performance in patients with anterior knee pain.

Conclusion: The study found that the cost effective strap showed immediate effect on reduction of Q-angle and improvement on knee functional performance for the subjects so it concluded that the strap should be used as a conservative treatment for anterior knee pain.

Limitations and recommendations: Limited numbers of samples within the age groups of 18 – 30 years non athletic university students were included for whom immediate effects were only examined in the study so it recommend that The subjects of different age group can be studied, among different institutions, other interventions may compared, long term effect can be compared, bilateral comparison can be studied. Even BMI effect can be observed and Q- angle should measure in every possible position such as supine lying, at 100, 200 and 240 knee flexion.

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COMPARISON OF PROPRIOCEPTIVE NEUROMUSCULAR FACILITATION (PNF) STRETCHING VERSUS NEURAL MOBILIZATION BY USING H- REFLEX ON LOW BACK PAIN

Dr. Dharmendra Kumar Sharma

AIM:-

- To compare the effect of PNF stretching versus Neural-mobilization by using H-reflex in low back pain.

Objectives:-

- To study the effect of PNF stretching by using H-reflex in low back pain.
- To study the effects of Neural-mobilization by using H-reflex in low back pain.
- Compare the effects of PNF stretching & neural mobilization by using H-reflex in low back pain.

Design:- Comparative Study.

Setting:- Dr.D.Y.Patil Physiotherapy (OPD) & Department of Neuro-physiotherapy

Participants:- Low back pain patients with radiating unilateral or bilateral, and SLR 2 +ve.

Intervention:- All the patients were randomly assigned to group A (PNF hold relax stretching hamstring) and group B (Neural mobilization tibial nerve) after signing of consent form. Assessment of LBP with radiculopathy by using SLR test & NPRS scale for severity of pain. And check H- reflex. PT sessions included hamstring stretching to group A & Neural mobilization to group B. After the treatment recheck H-reflex and NPRS score.

Results:- Both the group are effective in reducing low back pain, but group B (Neural Mobilization $p < .0001$) more effective than group A (PNF stretching($p < .0001$). Both groups are equally effective to reducing H latency, M Latency & increase H amplitude. But mean of group B is 1.9415 and Group A is 0.5535 shows that there is more reduction in H Latency in group B than group A, and mean difference of group A is 0.3345 & group B is 0.3445 shows that Group B more increase in H amplitude than group A. Conclusion-The study concludes that Neural Mobilization leads to better improvement in reducing pain, H-latency, & M-latency & increasing H-amplitude as compared to PNF Hamstring stretching in low back pain.

INTRODUCTION

Low back pain is a very common condition, with about 80% of people suffering from it. Most frequently in people between the age of 20 to 50 years.According to Len Kvaritz, "Low back pain is the pain in the low back area related to problems with lumbar spine, the disc between the vertebra, the ligaments around the spine, the spinal cord, the nerve roots, muscles of the low back, internal organs of pelvis and abdomen or the skin covering the lumbar area" Low back pain can refer to pain, which remains centered in the low back region, as well as, pain, which radiates from the low back to the buttocks and/or legs.

Depending on the presence or absence of neurologic symptoms and signs LBP can be divided into: Radicular &non-radicular low back pain. Radicular LBP is radiated along the dermatome of a nerve root (radiculopathy) at its connections to the spinal column. A common form of radiculitis is sciatica, or

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radicular pain radiates along the sciatic nerve. It radiates up to thighs, calf &foot. Non-Radicular LBP is not associated with neurologic symptoms or sign or not associated with spinal nerve root compression. Pain is localized to the spine and paraspinal regions and does not radiate into the leg.

Proprioceptive Neuromuscular Facilitation (PNF) is a more advanced form of flexibility training that involves both the stretching and contraction of the muscle group being targeted. PNF stretching was originally developed as a form of rehabilitation. While there are several variations of PNF stretching, they all have one thing in common; they facilitate muscular inhibition. Various PNF stretching techniques based on Kabat's concept are: Hold Relax, Contract Relax, and Contract Relax Antagonist Contract (CRAC) etc. The Hold Relax (HR) technique involves an isometric contraction of the shortened muscle against maximum resistance followed by relaxation phase

Neural mobilization is used for treatment of low back pain. Neural mobilization techniques are passive or active movements that focus on restoring the ability of the nervous system to tolerate the normal compressive, friction and tensile forces associated with daily and sport activities. It is hypothesized that these therapeutic movements can have a positive impact on symptoms by improving intraneural circulation, axoplasmic flow and neural connective tissue viscoelasticity and by reducing sensitivity of abnormal impulse generating sites.(10)

METHODS

Subjects were selected according to inclusion criteria. 40 patients were randomly allocated in two different groups. Written informed consent was taken & whole study was explained to them prior to treatment. Pre- treatment and Post–treatment H-latency, H-amplitude, M- latency, & pain score on NPRS was recorded.

Group A received PNF Hold relax stretching (hams)

Group B received neural mobilization. (Tibial nerve)

Position of The Patient During Recording –

The H-reflex latency was recorded while the patient will lie down comfortably in prone lying position on bed in a quiet room. The head maintained in mid position to control the possible effects of asymmetrical tonic reflex. The examined leg was placed mid-way between abduction and adduction at hip joint. The knee was slightly flexed by placing a small cushion under the ankle to relax the gastrocnemius to reduce any depressive influence on the H-reflex and ankle was freely positioned in planter flexion outside the plinth.

Stimulation - The H-reflex was elicited by stimulation of the posterior tibial nerve at the popliteal fossa little bit to lateral aspect by stimulating electrode as shown in.

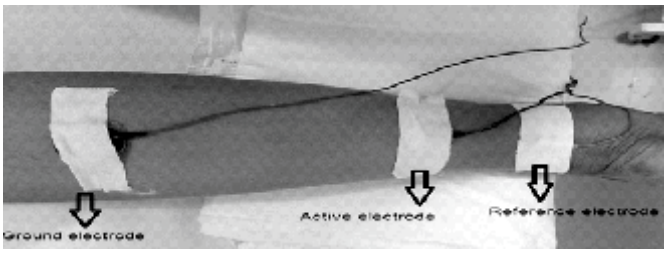


FIG.1ELECTRODE PLACEMENT FOR H-REFLEX

After recording the H-reflex

GROUP A RECEIVED PNF- HOLD RELAX STRETCHING.

PROCEDURE-The subjects were in supine position with their lower extremity strapped down the table. Pre-determined time intervals for stretching, contracting and relaxing was used to standardize the method. For each stretch, the investigator stretched the hamstring muscle by passively flexing the hip with knee fully extended, allowing no hip rotation. The lower leg was rest on the investigators right shoulder. The hamstring muscle was stretched until the subject first reported a mild stretch sensation; this position was held for 7 sec. Next, the subject then isometrically contracted

the hamstring muscle for 3 sec by attempting to push his leg down towards the table against the resistance of the investigator. Following this, the subject was asking to relax for 5 sec. The investigator then passively stretched the muscleuntil a mild stretch sensation is reported. This stretch was maintained for 7sec. This sequence was repeated 5 times.

FIG.2PNF- HOLD RELAX STRETCHING FOR HAMSTRING MUSCLE

GROUP B- RECEIVED NEURAL MOBILIZATION.

PROCEDURE– Patient in supine, the leg was supported so that the hip was in approximately 45° flexion and the leg is in horizontal position. The foot was held so that the therapist's fingers can control the ankle, forefoot and toes. Dorsiflexion/Eversion of the ankle and forefoot and dorsiflexion of the toes are the first movements and these should be taken as far as practicable into the range. Then knee extension was the next and while stabilizing the ankle joint and the rest of the limb, release of dorsiflexion of the forefoot and toes will the final movement to release distal tension from the digital nerves and allowed the tibial part to displace in a proximal direction. Again the hip was flexed to approximately 45° and the leg held horizontal as the starting position. This will release proximal tension and allow distal sliding. The foot and toes will move into dorsiflexion/eversion and the toes into dorsiflexion to move the nerve distally in its tunnel. The same procedure was repeated again and again for approximately 10 repetitions for 3 times for the one session of neural mobilization

DATA ANALYSIS

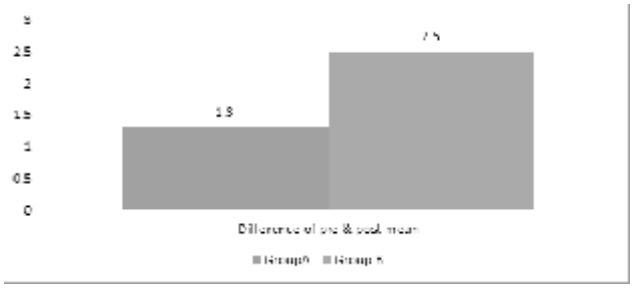
TABLE 1: COMPARISON OF PRE & POST MEANS DIFFERENCE OF NPRS BETWEEN GROUP A & B

Group	Pre & post Mean Difference	Pre & post S.D. Difference	D.B.M	t	D.F	p-value	Level of significance
A	1.3000	0.8013	1.2000	3.40	38	0.002	Significant
B	2.5000	1.3572					

* D.B.M.-Difference between mean..

*** D.F.-Degree of freedom

GRAPH 1



Inference:- Pre & post mean difference of group A was 1.30 (0.8013) & group B was 2.50 (1.3572).

Difference of pre & post mean difference of group A & B was 1.20 & p value is 0.002 which is statistically significant.

Showing that both the groups are effective in reducing low back pain.But group B more effective than group A.

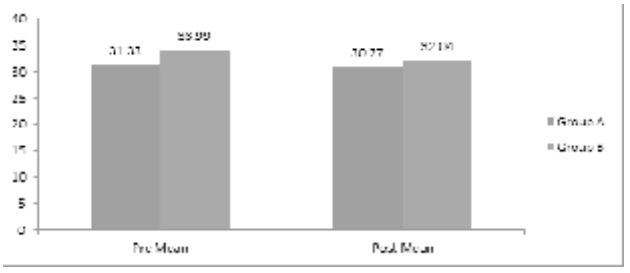
TABLE2: COMPARISON OF PRE& POST MEAN DIFFERENCE OF H-LATENCYBETWEEN GROUP A & B

Group	Pre Mean	S.D.	Post mean	S.D.	D.B.M	t	D.F	p-value	Level of significance
A	31.3325	2.9508	30.7790	2.8680	*0.9101	1.798	37	0.080	Not Significant
B	33.9900	4.1732	32.0485	3.7062					

* D.B.M.-Difference between mean.

**D.S.D.-Difference of Standard deviation.

*** D.F.-Degree of freedom



Inference:- Group A pre H-latency mean score of was 31.33 (2.95) & post H-latency score was 30.77(2.86) Group B pre H-latency mean Score of was 33.99 (4.173) & post H-latency score was 32.04 (3.706)

P value was 0.080 which is statistically not significant.

Showing that both groups are equally effective to reducing H latency in Low back pain.

**ANCOVA using pre value as covariant.

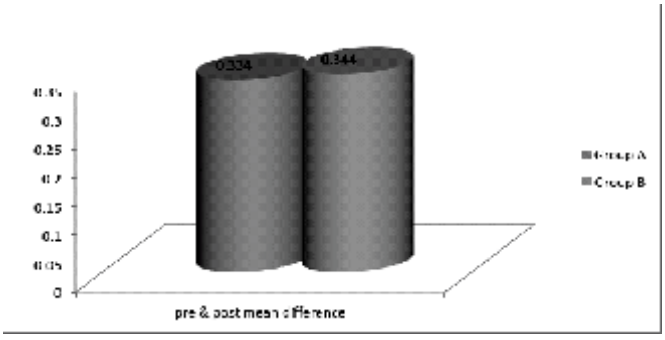
TABLE 3: COMPARISON OF PRE& POST MEAN DIFFERENCE OF H-AMPLITUDE BETWEEN GROUP A& B

Group	Pre & post Mean Difference	Pre & post S.D. Difference	D.B.M	t	D.F	p-value	Level of significance
A	0.3345	0.3163	0.0100	0.10	38	0.925	Not Significant
B	0.3445	0.3481					

* D.B.M.-Difference between mean.

*** D.F.-Degree of freedom

GRAPH 3



Inference:- Pre & post mean difference of group A was 0.3345 (0.3163) & group B was 0.3445(0.3481).

Difference of pre & post mean difference of group A & B was 0.0100 & p value is 0.925 which is statistically not significant.

Showing that both the groups are equally effective to increasing H amplitude in Low back pain.

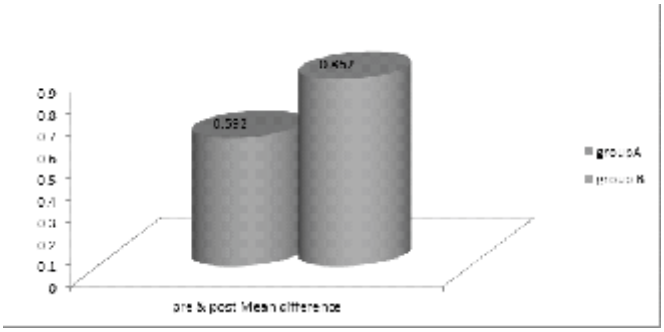
TABLE 4: COMPARISON OF DIFFERENCE OF PRE & POST M-LATENCY BETWEEN GROUP A& B

Group	Pre & post Mean Difference	Pre & post S.D. Difference	D.B.M	t	D.F	p-value	Level of significance
A	0.5920	0.8191	0.2700	0.91	38	0.369	Not Significant
B	0.8620	1.0455					

* D.B.M.-Difference between mean.

**D.F.-Degree of freedom.

GRAPH 4



Inference:- Pre & post mean difference of group A was 0.5920 (0.8191) & group B was 0.8620(1.0455).

Difference of pre & post mean difference of group A & B was 0.2700 & p value is 0.369 which is statistically not significant.

Showing that both the groups are equally effective to reduce M-Latency in Low back pain.

DISCUSSION

The results of this study showed that interventions in form of hamstring stretching, neural mobilization of Tibial Nerve were effective for pain relief and reduce in H latency, M latency & increase in H amplitude in Low Back pain with radiculopathy. But overall improvement with group B that received Neural Mobilization was greater as compared to Group A that received Hamstring stretching.

Pain relief: Pain relief was measured with numerical scale. The reported reliability of NPRS is ICC= 0.85(12) and validity is r = 0.847(13).

The reduction in the pain in the Hamstring stretching group(A) was highly significant ($p<0.01$) when calculated.

In the Neural Mobilization treatment method the reduction of pain was also highly significant ($p<0.01$). The results of study confirm hypothesis

that straight leg raising (SLR) stretching may be beneficial in the management of patients with LBP. SLR stretching was beneficial in improving pain, and promoting centralization of symptoms in this group of patients. Centralization of symptoms in patients with LBP indicates a favorable prognosis and is typically used to guide treatment in patients with low back and lower extremity symptoms.

The result shows that patient with low back pain had increase in H- latency decrease in H-amplitude & increase in M-latency. After the PNF hamstring stretching & neural mobilization reduce H-latency, increase in H- amplitude and decrease in M-latency.

Our results showed H-reflex amplitude asymmetry was more evident than latency changes in patients with radiculopathy. This was represented in the smaller value of the H-reflex where as the latency differences were not always evident. We also noticed that changes in amplitude and latency were associated with chronic low back pain with radiculopathy.(31)

Changes in the amplitude of the reflex can be explained by at least three possibilities: first is alteration in the excitability of the motor neurons, second is variation in the amount of neurotransmitter released by the afferent terminals and third is variation in the intrinsic properties of the motoneurons.

The normal value of H-latency is 30.3 +1.7 (MS) & H-Amplitude is 9.8+-6.1(MV)

But in our result the mean of Group A H latency was 31.3325 & group B 30.7790 which is Normal but the Mean of H amplitude of group A 0.778 & group B 0.620 So it indicate that H-reflex amplitude, compared to latency, may be an earlier indicator of S1 nerve root involvement.

CONCLUSION

The study concludes that Neural Mobilization leads to better improvement in reducing pain, H-latency, & M-latency & increasing H-amplitude as compared to PNF Hamstring stretching in low back pain.

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"EFFICACY OF PHYSIOTHERAPY IN BEHAVIOURAL PROBLEMS OF PEDIATRIC NEUROLOGY PATIENTS AND CAREGIVERS."

Dr. Prexa Mistry*, Dr. Ramakrishnan.K.S*, Dr. Advita Neville*, Dr. Swati Patel****

Background and Purpose: Neurological condition leads to mental, physical, psychological and cognitive disabilities or a combination of all. A person may be physically independent but many have various psychological problems. Psychological problems are common complications following cerebral palsy and have an impact on all aspects of recovery. To study the effect of physiotherapy treatment on the behavioural changes of pediatric patients and caregivers of patients with neurological condition.

Subjects: 30 subjects with pediatric patients of neurological condition.

Method: A semi structured questionnaire including the Psychological General Well-being Index (PGWBI) and Gross motor function classification scale (GMFCS) will be used to collect information about Physiotherapy in behavioural problems of neurological condition of pediatric patients and their caregivers.

Result: The final sample was compose of 30 subjects, having mean age of 5.29 years old. (+3.85 SD) physiotherapy interventions were effective in reducing some of the behavioural disturbances ($Z=-4.78$, $p<0.00001$) in patients as well as their caregivers.

Conclusion: Our result indicates physiotherapy treatment may be effective in reducing the behavioural disorders and subjective burden among caregivers.

Keywords: Behavioural problems, Pediatric neurology patient, Caregivers, Physiotherapy

1.INTRODUCTION[1,2]

Cerebral palsy is primarily a disorder of movement and posture. It is defined as an "umbrella term covering a group of non-progressive, but often changing, motor impairment syndromes secondary to lesions or anomalies of the brain arising in the early stages of its development".

Motor sequelae in the cerebral palsy are commonly followed by disorders in the sensation, perception, cognition, communication, and behaviour by epilepsy and secondary muscle skeletal problems.Therefore, brain changes present in the person suffering from cerebral palsy are a biological limitation that may hinder the typical brain development, causing intellectual impairment or specific cognitive disorders.

It may be stated as a static encephalopathy in which, even though the primary lesion, anomaly or injury is static, the clinical pattern of presentation may change with time due to growth and developmental plasticity and maturation of the central nervous system.

1.1 Incidence: The cause of CP to birth trauma and this view has persisted for several decades. Recent advances in neonatal management and obstetric care have not shown a decline in the incidence of CP. On the contrary ,with a decline in infant mortality rate, there has actually been an increase in the incidence and severity of CP. The incidence in premature babies is much higher than in term babies. For the vast majority of term infants who develop CP, birth asphyxia or obstetric complications cannot be ascribed as the cause.

1.2 Classification: CP may be classified by the type of movement disorder, anatomical location of the

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child's impaired motor function, and scope of motor dysfunction. The type of movement Disorders can be described as spastic, hypotonic, dyskinetic, or ataxic.

1.3 Spastic: Spasticity occurs in approximately 75% of all children with CP. It is the most common neurologic abnormality seen in children with CP, including those with diplegia, hemiplegia, and quadriplegia. Spasticity is a complex motor abnormality, often difficult to describe, but a common definition is "hypertonia in which resistance to passive movement increases with increasing velocity of movement."

1.4 Diplegia: Diplegia is the most common form of spastic CP. A white matter infarct in the periventricular areas caused by hypoxia can lead to spastic diplegic CP. It primarily affects bilateral LEs, resulting in issues with gait, balance, and coordination. In standing, children with diplegia often present with an increased lumbar spine lordosis, anterior pelvic tilt, bilateral hip internal rotation, bilateral knee flexion, intoeing, and equinovalgus foot position.

1.5 Hemiplegia: Hemiplegia is a subtype of spastic CP in which the child's upper and lower extremity on the same side of the body are affected. Four main types of brain lesions result in hemiplegic CP. Periventricular white matter abnormalities have been reported as the most common diagnostic finding in children with hemiplegic CP. Cervical–subcortical lesions, brain malformations, and nonprogressive postnatal injuries have also been identified as the main causes of hemiplegia. The UE is typically more affected than the LE, and both tend to have more distal involvement than proximal involvement. Muscle spasticity on the affected side decreases muscle and bone growth, resulting in decreased range of motion (ROM). Therefore, children with hemiplegia often present with contractures and limb-length discrepancies on the involved side. The affected side of the child with hemiplegia often presents with shoulder protraction, elbow flexion, wrist flexion and ulnar deviation, pelvic retraction, hip internal rotation and flexion, knee flexion, and forefoot contact only due to plantar flexed foot. Children with hemiplegia tend to achieve all gross and fine motor milestones but not within the typical time frame.

1.6 Quadriplegic: Quadriplegia is a subtype of CP in which volitional muscle control of all four extremities is severely impaired. This subtype is also often accompanied by neck and trunk involvement. Like diplegic CP, periventricular white matter lesions are the most frequently observed neuroimaging finding in children with quadriplegic CP. Extensive lesions affecting the basal ganglia or occipital area often lead to visual impairments and seizures, both commonly seen in children with this subtype of CP.Cognition can vary from normal to severely impaired and is unique to each child with quadriplegia. It is important to note thatchildren with quadriplegia who are unable to speak are often regarded as being cognitively impaired. However, once provided a means of effective communication, some are able to express their level of understanding and critical thinking.

1.7 Dyskinetic: Dyskinesia and movement disorders result in generally uncontrolled and involuntary movement that includes athetosis, rigidity, tremor, dystonia, ballismus, and Choreoathetosis. Common abnormalities found in imaging include deep gray matter lesions and, to a lesser extent, periventricular white matter lesions.Athetosis always has involuntary movements that are slow and writhing; abnormal in timing, direction, and spatial characteristics; and are usually large motions of the more proximal joints. Athetosis is rare as a primary movement disorder and is most often found in combination with chorea. Rigidity is muchless common and is felt as resistance to both active and passive movement and is not velocity dependent. Tremor, a rhythmic movement of small magnitude, usually of the

smaller joints, rarely occurs as an isolated disorder in CP but rather in combination with athetosis or ataxia. Dystonia is a slow motion with a torsional element that may involve one limb or the entire body and in which the pattern itself may change over time. Ballismusis the most rare movement disorder and involves random motion in large,fast patterns usually of a single limb. Choreoathetosis involves jerky movement, commonly of the digits and varying in the ROM.

1.8 Ataxic: Ataxic CP is primarily a disorder of balance and control in the timing of coordinated movements along with weakness, incoordination, a wide-based gait, and a noted tremor. This type of CP results from deficits in the cerebellum and often occurs in combination with spasticity and athetosis.The cerebellum is a major sensory processing center, and when impaired, ataxia will result.

1.9 Hypotonic: Hypotonia in a child with CP can be permanent but is more often transient in the evolution of athetosis or spasticity and might not represent a specific type of cp.

2.AIMS & OBJECTIVES:

2.1 AIMS:

- To evaluate efficacy of physiotherapy in behavioural problems of pediatric neurology patients and caregivers.

2.2 OBJECTIVES:

- To know efficacy of physiotherapy in behavioural problems of pediatric neurology patients and caregivers.
- To determine the efficacy of physiotherapy in behavioural problems of pediatric neurology patients and caregivers.

3. MATERIAL USED:

1. Informed consent form
2. Questionnaire/ Scales
3. Google forms
4. Mobile
5. Paper/ Pencil/pen

4. METHODOLOGY:

- **SOURCES OF DATA:**

  Parul Sevashram Hospital

  Kashiben Govardhandas Patel children's Hospital

- **STUDY DESIGN:** This is aConvenience sampling.
- **STUDY TYPE:** This is a pre & post survey.
- **SAMPLE SIZE:** In this 30 (n=30) Pediatric patient with neurological condition & Caregivers of patients are taken.
- **STUDY POPULATION:** Pediatric patients (with neurological Condition) & Caregivers of patients.

5. RESULT:

Table-1: Gender distribution of subjects:

Gender	No. of Subjects	Percentage
Female	9	30%
Male	21	70%
Total	3	100%

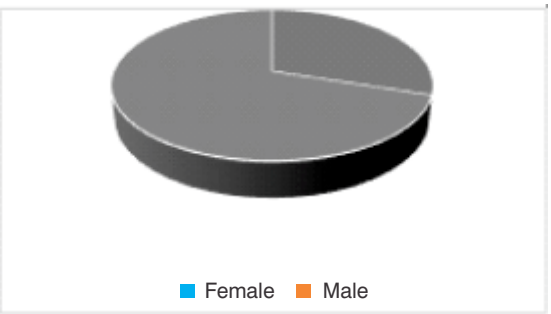

Figure 1. Gender distribution of subjects.

Inference: The above pie graph shows 70% of males and 21% of females are affected with neurological conditions.

5.2 Table-2: Age distribution of subjects studied.

Age in years	No. of subjects
0-2	9
2-4	4
4-6	9
6-8	1
8-10	3
10-12	2
12-14	2
14-16	0

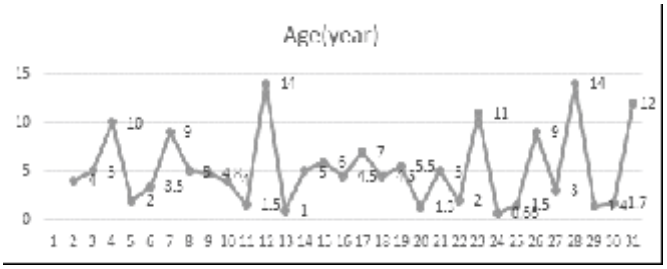

Figure 2. Age distribution of subjects studied

Inference: The age group of 0-2, 2-4, 4-6 years are commonly affected.

5.3 Table-3: Analysis of Psychological General Well-being Index (PGWBI)

Parameters	Pre	Post
Mean	44.3333	85.1333
SD	7.94955	10.1565
Z value	-4.7821	
p value	<.00001	

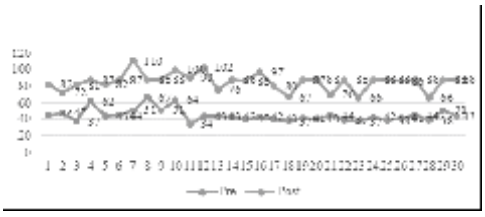

Figure 3. Analysis of psychological well-being index

Inference: The above line graph shows the difference in the mean score and individual score of the applied scale.

5.4 Table-4: Analysis of Gross motor function classification scale (GMFCS).

Parameters	Pre	Post
Mean	2.03333	3.1
SD	0.76489	0.643268
Z value	-4.7821	
p value	<.00001	

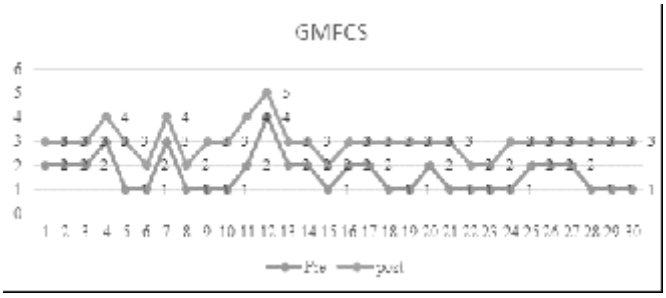

Figure 4. Analysis of gross motor function classification scale

Inference: The graph indicates difference in the change of motor function improvement after physiotherapy treatment.

Interpretation of scales:

Psychological General Well-being Scale: The instrument has qualities that make it suitable also for monitoring well-being during interventions for stress-related exhaustion/clinical burnout.

Gross motor Functional Classification of Scale: The Gross Motor Function Classification System (GMFCS) for cerebral palsy is based on self-initiated movement, with emphasis on sitting, transfers, and mobility.

6. Discussionand Conclusion:

Cerebral palsy leads to mental, physical, psychological and cognitive disabilities or a combination of all. A person may be physically independent but many have various psychological problems.

Psychological problems are common complications following cerebral palsy and have an impact on all aspects of recovery. Children with CP are at increased risk of behavioural and emotional problems, with 1 in 4 developing a behavioural disorder.

Studies investigating behaviour in children with cerebral palsy have found that these children are more likely than there non-disabled peers to struggle with behavioural disorders. The rate of diagnosed disorders in the cerebral palsy population is higher than in the general population of children. As much as 25 to 30 percent of children with cerebral palsy also struggle with a behaviour disorder. It is harder to pinpoint exactly why children with cerebral palsy are more likely to have behavioural challenges. Some risk factors seem to be having learning disabilities, having a seizure disorder, being male, having multiple disabilities, and having communication difficulties. Outside factors may also contribute, including lack of proper care or stress and an inability to cope in the parents. Difficulty with communication seems to be a major factor in challenging behaviours. If a child with cerebral palsy is unable to communicate effectively, he or she may act out to get her needs met. The psychological symptoms were slightly less intense and less frequent in the follow up after a period of six weeks of physiotherapy treatment. Parents and other caregivers of children with cerebral palsy must be aware of the signs of a behavioural disorder so that the child can be evaluated and treated by experts. Living with behavioural challenges is difficult for everyone, for parents and caregivers, for the child with cerebral palsy, and for family members. Recognizing and addressing the problem behaviours early is crucial for helping a child cope and learn new and more appropriate behaviours.

There are several behavioural disorders that have been named and can be diagnosed, including attention deficit hyperactivity disorder, autism, and oppositional defiant disorder, but what is more important for parents and caregivers is to be able to recognize specific behaviours that are frequent, persistent, and problematic. The behavioural problems include Self-injury, Harming other people, Threatening others, Destroying property, Lying, Stealing, Disobedience, Hyperactivity, Impulsivity, These are just some of the potentially problematic behaviours that could indicate a behavioural disorder in a child with cerebral palsy. The general rule is that any behaviour that is inappropriate for a child's developmental age, such as tantrums in a ten year old, is problematic. Problematic behaviours that persist for six months or more may indicate a behavioural disorder.

6.1 The analysis of the data collected showed:

The average score for sample subjects post PT treatment had increased which determined the improvement in the personal wellbeing of the patients as compared to pre PT treatment. (Refer graph 3) During the study it was found that more of males were affected than females. (Refer graph 1). Most of the patients affected by CP were in the age group of 0-2 years, 2-4 years and 4-6years. (Refer graph 2). The difference in the individual scores shows an improvement in the post PT treated patients than the pre PT treated. (Refer graph 4). The rate of improvement in the satisfaction of life as a whole is more in the CP patients post the PT treatment then the pre PT treatment. (Refer graph 4, 5). There is an increase in the standard of living post the PT treatment than the pre PT treatment. (Refer graph 4). Post PT treatment shows increase in the health improvement in CP patients than in the patients before the PT treatment. (Refer graph 4,5) The graph shows an increase improvement in the personal relationships post the PT treatment than in the patient's pre PT treatment. (Refer graph4,5). The feeling of one's safety in CP in more post the PT treatment than in pre PT treated patients. (Refer graph 5). The satisfaction of feeling a part of the community is slightly more in the post PT treated patients than pretreated. (Refer graph 4,5) The study shows that patients post PT treated are more satisfied with their future security than they were pre PT treatment. (Refer graph 4,5)

Parents and other caregivers that believe a child with cerebral palsy is struggling with problem behaviours should consult with professionals who can evaluate the child, make a diagnosis, and help develop a treatment plan. As a parent, you may want to start

with your child's school. A school psychologist or social worker may be able to do an evaluation or direct you to an appropriate professional. For a younger child, a pediatrician is a good place to start. A Pediatric Physiotherapist & behavioural health expert can evaluate your child through a series of observations and tests. Even if your child doesn't meet the criteria for a diagnosis, an expert can still guide you to the appropriate resources or professionals that can help. Any challenging behaviours, even those not labeled as a disorder, are disruptive and should be evaluated and addressed, both for the child and the child's family.

Positive parent-child relationship, encouraging desirable behaviour, teaching new skills and behaviours, managing misbehaviour, and managing high-risk situations. Parents made specific goals for change and were supported in enacting plans for managing challenging parenting situations. This illustrates the urgent need for clinical services to address behavioural and emotional problems in children with CP, as well as the good fit between this clinical need and the efficacy of parenting intervention. Parenting interventions, are ideally translatable. Pediatric Physiotherapy is designed for population-level dissemination, easily implemented within health or educational services, deliverable in high- and low-resource areas, and available in 25 countries.

Anyone may struggle with behavioural conditions or disorders, with challenging behaviours like aggression, impulsiveness, self-harm, and others. Children with cerebral palsy may be more vulnerable to these struggles because of the challenges that the physical disability presents or even because of the underlying brain damage that led to cerebral palsy.

Exactly what causes behaviour disorders is not fully understood, but it is important for parents and other adults to look out for signs of problematic behaviours in children living with cerebral palsy. Experts in behaviour and mental health can help parents and their children cope with and learn to change problem behaviours so that a child living with cerebral palsy can also learn to live with the best quality of life possible.

6.2 Behaviour and Cerebral Palsy:

Studies investigating behaviour in children with cerebral palsy have found that these children are more likely than there non-disabled peers to struggle with behavioural disorders. The rate of diagnosed disorders in the cerebral palsy population is higher than in the general population of children. As much as 25 to 30 percent of children with cerebral palsy also struggle with a behaviour disorder.

It is harder to pinpoint exactly why children with cerebral palsy are more likely to have behavioural challenges. Some risk factors seem to be having learning disabilities, having a seizure disorder, being male, having multiple disabilities, and having communication difficulties. Outside factors may also contribute, including lack of proper care or stress and an inability to cope in the parents. Difficulty with communication seems to be a major factor in challenging behaviours. If a child with cerebral palsy is unable to communicate effectively, he or she may act out to get her needs met.

Parents and other caregivers of children with cerebral palsy must be aware of the signs of a behavioural disorder so that the child can be evaluated and treated by experts. Living with behavioural challenges is difficult for everyone, for parents and caregivers, for the child with cerebral palsy, and for family members. Recognizing and addressing the problem behaviours early is crucial for helping a child cope and learn new and more appropriate behaviours.

There are several behavioural disorders that have been named and can be diagnosed, including attention deficit hyperactivity disorder, autism, and oppositional defiant disorder, but what is more important for parents and caregivers is to be able to recognize specific behaviours that are frequent, persistent, and problematic. These may include:

These are just some of the potentially problematic behaviours that could indicate a behavioural disorder in a child with cerebral palsy. The general rule is that any behaviour that is inappropriate for a child's developmental age, such as tantrums in a ten year old, is problematic. Problematic behaviours that persist for six months or more may indicate a behavioural disorder.

6.3Diagnosis and Treatment :

Parents and other caregivers that believe a child with cerebral palsy is struggling with problem behaviours should consult with professionals who can evaluate the child, make a diagnosis, and help develop a treatment plan. As a parent, you may want to start with your child's school. A school psychologist or social worker may be able to do an evaluation or direct you to an appropriate professional. For a younger child, a pediatrician is a good place to start.

A behavioural health expert can evaluate your child through a series of observations and tests. Even if your child doesn't meet the criteria for a diagnosis, an expert can still guide you to the appropriate resources or professionals that can help. Any challenging behaviours, even those not labeled as a disorder, are disruptive and should be evaluated and addressed, both for the child and the child's family.

Pediatric Physiotherapy & Cognitive behavioural therapy is a typical type of treatment or intervention for behavioural disorders. It is a type of therapy that helps patients become more aware of their behaviours, realize that they are problematic, and learn to change those behaviours by targeting troubling thoughts and emotions. It is an effective type of treatment that helps many people, adults and children, learn to change negative behaviours and replace them with those that are positive and productive.

Recognizing and getting treatment for a child struggling with cerebral palsy-associated behavioural disorders is crucial. These are the first steps toward helping a child learn to cope with negative emotions and other challenges that have led to problematic behaviours. Parents, family, friends, and caregivers of the child must also participate in supporting the treatment and encourage positive changes

Factors that support a child learning to change behaviours include providing all adequate care for cerebral palsy. A child that is not receiving the care he needs will continue to struggle with problematic behaviours. A stress-free home environment is also important. Some studies have shown that a parent's stress level can impact a child's behaviour in a negative way. A calm and caring environment can help support a child as he learns to make positive changes.

Conclusion:

Our result indicates physiotherapy treatment may be effective in reducing the behavioural disorders and subjective burden among caregivers.

Acknowledgements

First and foremost we would like to dedicate this work to all those who contributed to various researches and studies done earlier in the field of physiotherapy and to all those who contributed a lot to add to our knowledge of Physiotherapy.

The path towards this dissertation has been circuitous. Its completion is thanks in large part to the special people who challenged, supported, and stuck with us along the way.

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The Effects of Hamstrings Muscles Energy Technique and Postural Correction Exercise in People with Forward Head Posture: A randomized controlled trail

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ABSTRACT

Objective: To check the effects of hamstring muscle energy technique and postural correction exercises in subjects with forward head posture. **Study design:** Randomized controlled trial.
Method: 40 healthy subjects with forward head posture (FHP) of both gender ages between 20 to 50 years were randomly assigned to experimental and control groups. Both groups were given postural correction exercises but experimental group were given hamstring muscle energy technique (MET). Protocols were performed for 4 sessions per week for 4 weeks. And follow up has been taken in experimental group after 3 months. CVA measurement and popliteal angle measurement has been taken.
Results: within group analysis revealed significant improvements in all variables ($p<0.05$) and between group revealed improvement in CVA ($p<0.05$) in the experimental group in comparison with the control group.
Discussion: Gajdosik et.al. Stated that shortened hamstring muscle would lead to problems at the pelvis and spine, and stretching of the hamstring muscle would restore the normal posture.[20] Muscle chains are essential for the maintenance of the body posture. If any postural problems are in muscle segments, it will lead to shortening or lengthening of the muscles, which can interfere in the physiology of the postural muscles.[9]
Conclusion: Hamstring MET with postural correction exercises was effective in FHP healthy subjects. But this effect was not beneficial for long term. And only postural correction exercises in control group is also effective in FHP healthy subjects.

Key Words: forward head posture, Muscle energy technique, postural correction exercises.

INTRODUCTION

Prevalence of postural abnormalities were including Forward head posture (66%), thoracic kyphosis (38%).[2] The head is move forward is called Forward Head posture, it causes the exaggerated anterior curve of the lower cervical spine and posterior curve of the upper cervical spine maintain the neck balance, it is known as forward head posture.[3]It is mainly caused by the excessive use of mobile phone (text neck), computer workers, abnormal breathing patterns and a backpack on cervical spine.[4,5,6,7] Prolonged adopted posture may results the sub occipital muscle shortening, neck flexors muscle imbalance, which leads the chronic neck pain, neck movement restriction, fatigue and also the joint and muscle loading.[8]

Forward head posture causes the weakness of deep cervical flexors and mid thoracic retractors [rhomboids, serratus anterior, middle and lower fibers of trapezius] so, strengthening of these muscles and stretching exercise for shorten muscles [pectoralis muscles, cervical extensors] may help for the correction of FHP.[7]
Some epidemiological studies suggested that muscle groups are responsible for posture maintenance are arranged and controlled by following a pattern known as “muscle chain”. Muscle chains are essential for the maintenance of the body posture. If any postural problems are in muscle segment, it leads to shortening or lengthening of the muscles, which can interfere in the physiology of the postural muscles. Postural changes are analyzed due to shortening of the different muscle chains. The muscles of orthostatic position against the gravitational action. For this reason, they are known as antigravity muscles.[9]
Posterior chain is composed of the muscle that sole of the foot, triceps surae, hamstrings, spinal erectors, sub occipital muscles.[9] The general statement that can be made about any of these anatomy trains lines is that strain, tension [good and bad], trauma and movement tend to be passes through the structure along with this fascial lines of transmission.[10] The superficial back line is continuting line of fascia and muscles from head to heel with includes both the sub occipital and hamstring. The superficial backline helps to keep us in upright position and connected by the one neural system. The very small sub occipital muscle have a link to the duramater and because of these are often described as a control centre of the SBL, having an effect on the movement of the muscles with the SBL, particularly the hamstring group.[10]
Some postural compensation patterns associated with the superficial back line includes-ankle dorsiflexion limitation, knee hyperextension, hamstring shortness, anterior pelvic tilt, sacral nutation, lordosis, extensor widening in thoracic flexion, sub occipital limitation, It leads to upper cervical hyperextension, anterior shift or rotation of the occiput on the atlas and eye-spine movement disconnection.[10]
There are some simple methods to lengthen the non-contractile or contractile components of the muscle tendinous unit, such as the active stretching, passive stretching applied manually, the active inhibition and self-stretching.11 Other stretching methods can also be used as the ballistic stretching, static stretching and also the stretching techniques by proprioceptive neuromuscular facilitation.12The muscle energy techniques (MET) constitute osteopathic procedures that have the function to lengthen fascias, muscles and also joints. MET is based on the fact that soon after a pre stretching contraction of a determined muscle retracted, this muscle will relax as a result of autogenic inhibition and it will be more easily stretched.[13]
The effect of MET on shortened muscle are neurological effects of loading of the Golgi tendon organ of the skeleton muscle by means of isometric contraction, which produces a post iso metric relaxation effects on shortened muscle. This isometric contraction seems to set the muscle to the new length by inhibiting via influence of the Golgi tendon organ. [13]
There are some studies has been done on the hamstring muscles by treating the sub occipital muscles. Previous studies were not focused on the postural correction. This study is intended to find out the relation of cervical postural correction by increasing hamstring flexibility.

AIM AND OBJECTIVES

The aim of the study to check the effects of hamstring muscle energy technique and postural correction exercises in people with forward head posture.

HYPOTHESIS

NULL HYPOTHESIS-

There will be no significant effects of hamstring MET and postural correction exercise in subjects with forward head posture.

RESEARCH HYPOTHESIS-

There will be significant effects of hamstring MET and postural correction exercise in subjects with forward head posture.

METHODS AND MATERIALS

STUDY DESIGN-Randomized controlled trial

STUDY POPULATION- Healthy subjects with forward head posture

SAMPLING- Purposive sampling

SAMPLE SIZE- 40

RANDOMIZATION-

Block randomization was done to equally distribute the subjects in to two Groups.

STUDY DURATION-April 2018 to May 2019.

STUDY SETTING-

Srinivas Physiotherapy College and research Centre OPD and other government and private clinics in Mangalore [Karnataka] and Surat [Gujarat].

INCLUSION CRITERIA AND EXCLUSION CRITERIA

INCLUSION CRITERIA[3, 13, 20]

- Asymptomatic individuals both male and female with age group 20-50 years.
- Subjects with Cranio- vertebral angle (CVA) less than 50 degree in forward head posture.
- Tight hamstring [Inability to achieve 160˚ of knee extension with hip 90˚ flexion].

EXCLUSION CRITERIA[21]-

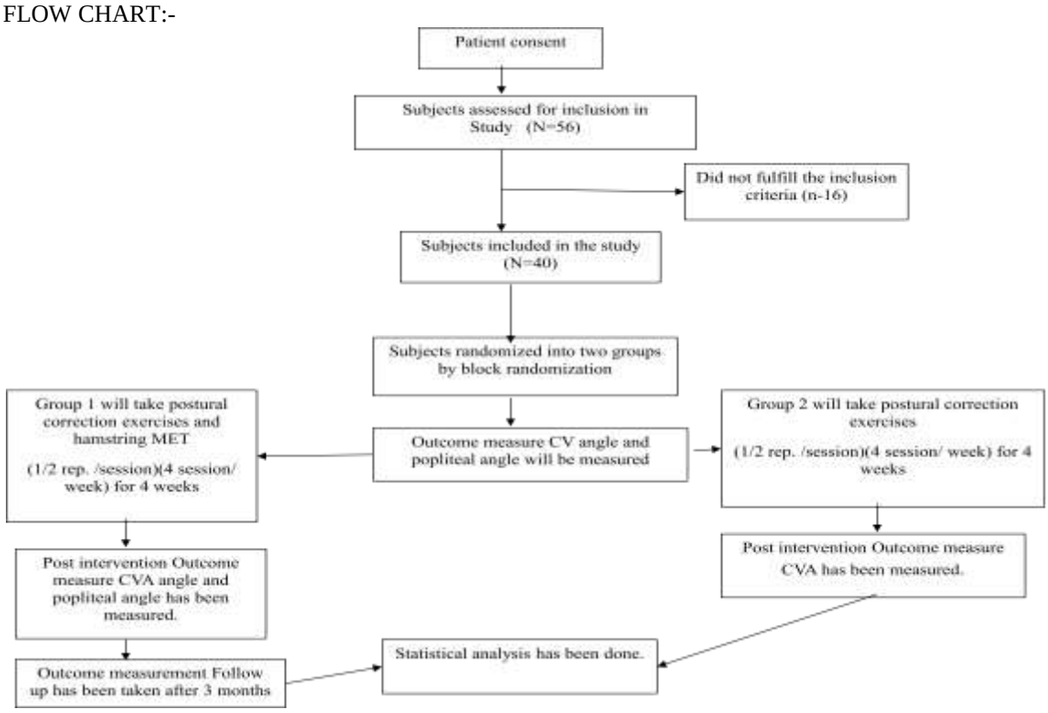
- Recent Cervical fracture or trauma
- Recent Cervical surgery
- Idiopathic scoliosis
- Torticolis
- Acute and chronic hamstring injury

PROCEDURE

The subjects with forward head posture referred for Physiotherapy was screened for inclusion and exclusion criteria. A total of 56 Subjects were screened. In that 40 subjects met the inclusion criteria. The purpose of the study was explained to all the subjects and was asked to sign the written consent form stating the voluntary acceptance to participate in this study. Then, the demographic information (i.e. age, gender, height and weight) was collected from all the subjects. By block randomization, the 40 subjects were assigned randomly into experimental or control group. The pre-treatment measurement for CVA and popliteal angle were taken. Experimental group (n=20) was treated with hamstring MET and postural correction exercises Control group (n=20) was treated with postural correction exercises.

The treatment was given for 4 sessions in a week for a period of four weeks. Post treatment score were evaluated after the last treatment session and follow up was taken after 3 months for experimental group. The data was analyzed and interpreted.

FLOW CHART:-



RESULTS

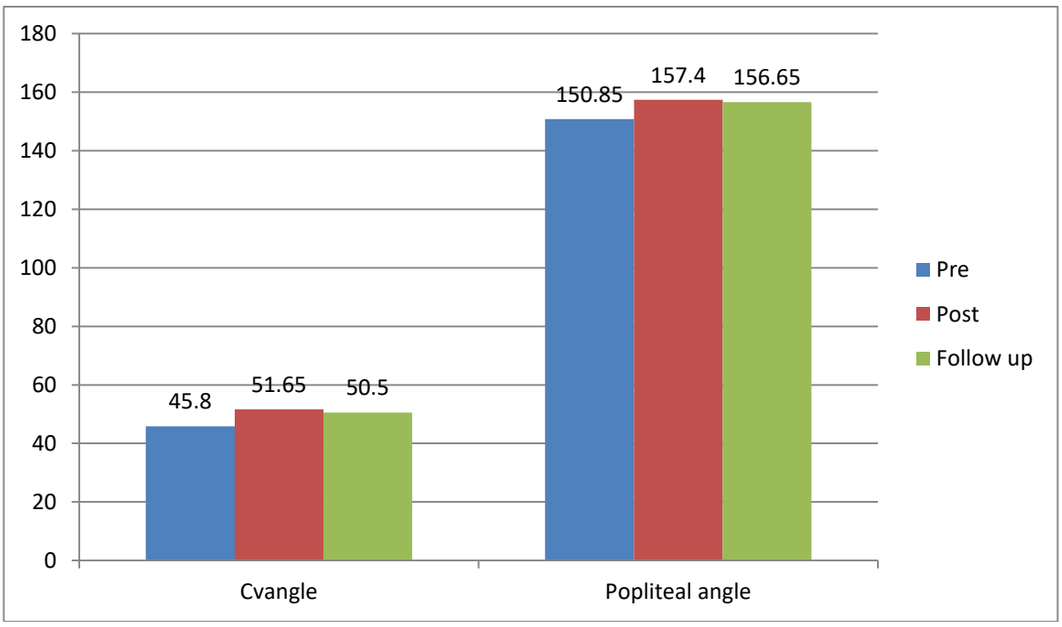
A Total 40 subjects were taken in the study and divided into experimental group and control group. Experimental group consisted of 20 subjects 9 males and 11 females with mean age of 30.35, whereas control group had 20 subjects 7 males and 13 females and mean age 29.35.

Statistical analysis was done using SPSS v.16 Descriptive statistics were subjected to tests of normality and inferential statistics was done using paired t test to compare differences within the groups and repeated measure ANOVA to compare the variables which was based on repeated observations and independent t test was used for analysis between the groups. Confidence interval (CI) for the tests was kept at 95%.

Results showed statistical significance within the groups post intervention in both groups- experimental and control ($p<0.05$) for outcome measures. Between groups post intervention analysis revealed significant differences in CVangle ($p<0.05$).

PARAMETERS		MEAN DIFFERNCE	P VALUE
CVANGLE	PRE	45.80±2.30	0.00
	POST	51.65±2.46	0.00
	FOLLOW UP	50.50±2.66	0.00
POPLITEAL ANGLE	PRE	150.85±4.56	0.00
	POST	157.40±4.63	0.00
	FOLLOW UP	156.65±4.51	0.00

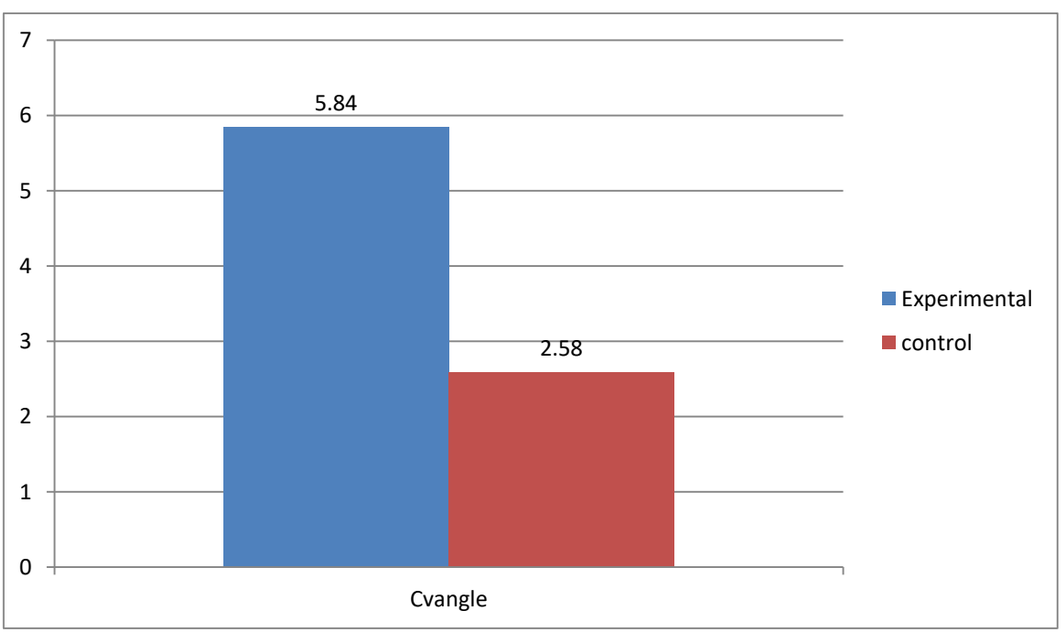
TABLE:1 Shows the mean value of pre, post and follows up of CVangle and popliteal angle in experimental group.



GRAPH:1 shows the mean value of pre, post and follows up of the CVangle and popliteal angle for experimental group.

TABLE:2 shows the mean and standard deviation of post intervention CVangle in experimental and control groups. The mean difference and the significance level (p- value) shows CVangle have p-values<0.05 showing Stastical differences.

PARAMETERS	EXPERIMENTAL	CONTROL	MEAN DIFFERNCE	P VALUE
CVANGLE	5.84±1.45	2.58±1.06	3.26	0.00



GRAPH:2- shows the mean value of post intervention CVangle measurement of experimental and control groups.

DISCUSSION

Prolong adopted posture may result in sub occipital muscle shortening, neck flexors muscle imbalance, which leads to chronic neck pain, neck movement restriction, fatigue and also the joint and muscle loading.8 Forward head posture is the highly prevalent abnormality which may lead to weakness in deep cervical flexors. Forward head posture is usually treated by postural correction exercises.

Gajdosik et.al. Stated that shortened hamstring muscle would lead to problems at the pelvis and spine, and stretching of the hamstring muscle would restore the normal posture. One previous study showed that passive stretching of muscles of the hamstring restore the length of the muscles related to the spine and pelvis, length of those muscles also restore the normal postures.[20]

The successful effects of stretching exercises lies in its physiological mechanism which have been attributed firstly to neurophysiological mechanism in which inhibition of the muscles decreases the activity of the contractile component and result in an increased extensibility of the muscle and an increase in range of motion as well. Secondly to the Biomechanical mechanism that is based on viscoelastic property in which muscles like biologic tissues react viscoelastically to stretch. Elastic behavior refers to the property of a structure to elongate when a force is applied, and to return to its original length when the force is withdrawn.[14] Meanwhile, viscous behavior refers to the property of a structure to elongate when a load is applied and elongation of a muscle is determined by the exerted force and force rate. Due to the above fact, this has been suggested that during the passive hamstring stretching technique subjects shown significant improvement may be due to the changes in viscoelastic property of the muscle.[14]

Likewise a study was done by Schleip and Aparicio et. Al. considered that if the tone of subocipital muscles is decreased, the length of the hamstring muscles and the increase in the amplitude of hip flexion will be greater.14 Some epidemiological studies showed that muscle groups are responsible for posture maintenance and are arranged and controlled by following a pattern known as “muscle chain”. Muscle chains are essential for the maintenance of the body posture. If any postural problems are in muscle segments, it will lead to shortening or lengthening of the muscles, which can interfere in the physiology of the postural muscles.9
Previous studies performed on healthy subjects, aiming to increase the cervical range of motion with giving treatment of hamstring stretching. And the result of this study shown the significantly improved the range of motion in cervical.19
Other study performed to check the effect of sub occipital muscle inhibition technique to improve the flexibility in hamstring. This was showed the effective.[16] But no study could be retrieved on correction of FHP by treating hamstring flexibility. So aim of the current study is to check the effects of hamstring muscle energy technique and postural correction exercises in subjects with forward head posture.
The technique MET was developed and popularized by Mitchell and although many texts promotes the use of MET, it is unforeseen how research, with regards to its effectiveness, is so limited. Of the few studies published to date, most have examined the effects of sub occipital muscles on hamstring muscles. Previous studies not focused on postural correction. Some studies proved that hamstring Proved that hamstring MET treatment is very much effective compare to stretching or other techniques.[20]
The follow up value is reduced because treatment was not given for 3 months. This proves that there is no any long term effect of treatment of this study. But if the treatment will give regularly than it is beneficial to reduce the forward head posture.

LIMITATIONS

1. Limited follow up period.
2. In this study there is only experimental group follow up. There is no follow up for control group.
3. Healthy subjects were included in the study.
4. Homogeneity was not maintained in the genders as in our study. Male participants are less in comparison than females.
5. Small sample size.

RECOMMANDATIONS FOR FURTHER RESEARCH

1. A long term follow up of 6 months to 1 year period can be taken to check the long term effects of MET and postural correction exercises on forward head posture.
2. Study can be done with symptomatic subject.

CONCLUSION

- Hamstring MET with postural correction exercises was effective in FHP healthy subjects. But this effect was not beneficial for long term.
- And only postural correction exercises in control group is also effective in FHP healthy subjects.

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ORIGINAL RESEARCH PAPER

Physiotherapy

KEY WORDS: Hereditary Spastic Paraparaesis, Consecutive Eight Week Rehabilitation Programme, Lower Limb Spasticity.

RESPONSE OF A HEREDITARY SPASTIC PARAPARESIS PATIENT TO CONSECUTIVE EIGHT WEEK REHABILITATION PROGRAM (CEREP) – A SINGLE CASE STUDY

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Priya kanjani Student, USB college of Physiotherapy, Aburoad

Ravi Kumar Joshi Student, USB college of Physiotherapy, Aburoad

ABSTRACT

BACKGROUND: Hereditary spastic paraparesis(HSP) is a genetic disorder characterized by progressive weakness and spasticity of lower limbs. There has not been any single case study on intensive rehabilitation on hereditary spastic paraparesis patient. The objective of the study was to assess the response of a HSP patient to consecutive Eight Week Rehabilitation Program.

CASE DESCRIPTION: This case involved a 16 year old girl with spastic paraparesis that was 5-6 years in duration and slowly worsening. Her complaints mainly included difficulty in walking and keeping feet straight on ground since last 6 years. Both subjective and objective examination was conducted and neurological assessment was done. No bowel,bladder or any loss of sensory system was found.

METHOD: Balance was measured using Berg Balance Scale, 10 Meter Walk Test(10MWT) and Timed Up and Go(TUG) Test. Pre measurements were taken before the treatment began and in the end at 8th week. Data were computed using SPSS 17 software package.

INTERVENTIONS: This included stretching, strengthening, MAT Exercises and gait training for the period of 8 weeks. Each treatment lasted for 60-90 minutes per day, 5-6 days a week.

RESULTS: The result of the study is not quite a lot statistically significant, but clinically there is significant change in patient condition.

CONCLUSION: The findings of the study show that an 8 week rehabilitation program improves overall balance and gait patterns in patient.

INTRODUCTION:

HSP is also known as Hereditary Spastic Paraplegia, Familial Spastic Paraplegia, French Settlement disease or Strumpell - Lorrain disease. The symptoms are a result of dysfunction of long axons in the spinal cord. The affected cells are the primary motor neurons, therefore the disease is an upper motor neuron disease.[1] Worldwide, the prevalence of all Hereditary Spastic Paraplegias combined is estimated to be 2 to 6 in 100000 people.[2] Briefly, the clinical picture in pure HSP is of a slowly progressive, predominately symmetrical, spastic paraplegia. This is frequently accompanied by minor sensory abnormalities (such as absent vibration sensation) and neurological bladder involvement, but bowel involvement is rare.[3] In complex HSP, on addition wide range of neurological features including ataxia, extra pyramidal signs, epilepsy, mental retardation, dementia and peripheral nerve involvement occurs.[4] In pure HSP, life span is not affected.[5] People with HSP complain of muscle stiffness, pain, spasm and cramps, tripping over their toes due to weakness of ankle dorsiflexors and hip flexion, loss of balance, effortful walking and progressively more flexed standing posture[3]. Eventually, walking becomes impossible for some patients, due to a combination of (a) spasticity, (b) weakness particularly of ankle dorsiflexors, (c) loss of range of movement at ankle, knees and hip, making it impossible to stand straight, and (d) loss of motor control leading to delayed postural reflexes and loss of balance. Initial diagnosis of HSP relies upon family history, the presence or absence of additional signs and the exclusion of other non - genetic causes of spasticity.[6] A home exercise program supervised by a patient concentrating on stretches to maintain ROM and reduced spasticity, accomplished by balance exercises in patients with more advanced disease, is the cornerstone of management.[7] There is a recent literature supporting the use of intensive physical therapy i.e. stretching, strengthening, functional re-educative exercises about HSP and fatigue management[8] All these elements attracted our attention and curiosity about how patient with HSP perceive physical therapyand so we devised eight week rehabilitation programme.

CASE REPORT AND ASSESSMENT:

The patient is a 16 years old girl who began facing problems in walking at 10 years of age which was slowly worsening, showing cardinal features of hereditary spastic Para paresis.She has developed scissoring type of gait pattern, has weakness of Gluteus Maximus muscle on the left side. Neurophysiological study shows UMN type of weakness in left lower limb.The case was diagnosed by consulting pediatrician 1 month ago and was referred for physical therapy intervention.She showed no familial history of inheritance or even related disorder. Subject was born out of normal vaginal delivery.Subject's mother has a history of frequent fever during the gestational period and even after the delivery.First symptom began to appear when patient was 10 years old. Spasticity was found in adductors group. Deformities like anterior pelvic tilt, internal femoral torsion, internal tibial torsion,genu valgum, pes planus and toeing out was present. Deep Tendon Reflex examination showed positive plantar reflex bilaterally. Electrophysiological testing of left lower limb showed UMN type of weakness.

Figure 1: Foot arches, left foot signifying pes planus.

Figure 2: Gait pattern of the individual showing scissoring type of pattern.

ASSESSMENTS: Balance was assessed using BBS and TUG, while walking ability by 10MWT . Pre and post measurements were taken before initiating the program and at the end of 8th week. Written informed consent was obtained regarding publication of their case reports.

PHYSIOTHERAPY INTERVENTIONS: Consecutive eight week rehabilitation program was designed to improve functional performance. Stretching, strengthening, gait training and MAT exercises were added. Duration of session was 60-90 minutes/day for 5-6 daysa week which lasted for 8 weeks. Intensities were increased gradually based on performance.

Figure 3: Individual performing MAT exercises.

TABLE 1: Consecutive eight week rehabilitation program for patient with HSP.

INTERVENTION	INTENSITY
1) STRETCHING OF TA, ILIOPSOAS, ADDUCTORS, HAMSTRINGS	20 sec hold/ 4 reps
2) CORE MUSCLE TRAINING (supported bridging)	10 sec/ 10 reps
3) SPINAL MOBILIZATION	
4) STRENGTHENING EXERCISE (SLR, Gluteus medius with assistance and squatting)	10 reps
5) MAT EXERCISE (kneeling, half kneeling)	10 sec/ 10 reps
6) GAIT TRAINING (forward and sideway walking)	

STATISTICAL ANALYSIS:
After the collection of data according to BBS, 10 MWT and TUG, it was analyzed by SPSS 17 software package.

Table 1:

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Prewtr	3	10.50	10.90	10.6667	.20817
Valid N (listwise)	3				

The mean value for 3 consecutive Pre 10 Meter Walk Test at regular speed was 10.6+-0.20

Table 2:

	N	Minimum	Maximum	Mean	Std. Deviation
Pre 10MWT fast	3	9.60	9.80	9.7000	.10000
Valid N (listwise)	3				

The mean value for the 3 consecutive Pre 10 Meter Walk Test at fast speed was 9.7±0.10.

Table 3:

	N	Minimum	Maximum	Mean	Std. Deviation
Post 10MWT regular	3	9.70	9.80	9.7667	.05774
Valid N (listwise)	3				

The mean value for the 3 consecutive Post 10 Meter Walk Test at regular speed was 9.7±0.5.

Table 4:

	N	Minimum	Maximum	Mean	Std. Deviation
Post 10MWT fast	3	8.20	8.70	8.5000	.26458
Valid N (listwise)	3				

The mean value for the 3 consecutive Post 10 Meter Walk Test at fast speed is 8.5±0.2.

Table 5:

	N	Minimum	Maximum	Mean	Std. Deviation
Pre TUG	3	11.40	11.43	11.4133	.01528
Valid N (listwise)	3				

The mean value for the 3 consecutive Pre Timed Up and Go test is 11.41±0.1.

Table 6:

	N	Minimum	Maximum	Mean	Std. Deviation
Post TUG	3	8.60	8.80	8.7000	.10000
Valid N (listwise)	3				

The mean value for the 3 consecutive Post Timed Up and Go test is 8.7±0.1.

DISCUSSION:
The main aim of this study is to show that a course of 8 week rehabilitation program improves the functional ability of the patient affected with HSP.

The evaluation of walking speed is widely used in physiotherapy assessment for patient with neurologic diseases (according to Molteni F and et. al). A gait speed of less than 1m/s identifies a person at high risk for negative health outcomes. As well as a study done by Mark Braschinnskyet.al.in 2009 showed that person with HSP represent a high risk group for the 10 min walk test and walking speed in the HSP was more influenced by ROM of hip muscle. In our study we used 3 main outcome measures namely: 10 meter walk test, Berg Balance Scale and Timed Up and Go Test. The values over 8 week didn't show that much statistical improvement but clinically the walking speed and balance was improved. The possible reason for this could be that the patient was regular for 1st four weeks but after that due to some personal reason she wasn't able to follow up, despite this the condition didn't deteriorate. The possible reason being that she was following the home program being given to her. There were significant improvement in Range Of Motion and Manual Muscle Strength Testing following CEREP. A previous study done by Mark et. al. showed that limited Active ROM and increase spasticity on Modified Ashworth Scale results in reduction in walking speed. So this support our results, walking was improved as spasticity was reduced, AROM increased along the course of time. (voluntary muscle grading (VGC) was more than 4).

These results would have been statistically significant if the treatment would have been regular for whole 8 weeks. Patient was also taking intervention prior to the initiation of this study which could also be a reason for marked improvement in gait, balance, ROM and MAS. The results of this study should be interpreted carefully, and it should be verified over larger patient population.

CONCLUSION
The findings of the study show that an 8 week rehabilitation program improves overall balance and gait patterns in patient. Clinically improvements were seen but not relevant statistically. The improvement confirms the therapeutic benefits and benefits of home program both.

LIMITATIONS AND RECOMMENDATIONS: Although the data analysis revealed significant findings to support our result, there are still limitations in this study.

LIMITATIONS:

1) Short duration of study as patient was not able to follow up till the end
2) Limited sample
3) Aspects of cardiac endurance were not tested which are often associated with impaired gait.

RECOMMENDATIONS:

1) Long term effect should be seen
2) Study over larger population can be done
3) Fatigue management technique can be incorporated
4) Comparative study can be done with other neurological disease.

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ORIGINAL RESEARCH PAPER

Physiotherapy

KEY WORDS: Diabetes Mellitus, cross sectional study, prevalence in urban community

PREVALENCE OF DIABETES AND ITS CORRELATES IN URBAN POPULATION

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ABSTRACT

Objective: The aim of this study is to see the overall prevalence of diabetes and stratified prevalence in urban area, To Identify the anthropometric, personal and behavioral correlates for diabetes along with OR (odd ratio), and to identify personal habits especially sedentary and physical activity correlates for diabetes along with OR (odd ratio).

Methodology: The cross-sectional study was carried out including total 300 people (121 males, 179 females) from urban area of Ahmadabad. A questionnaire was administered to obtain information about demographic characteristics and risk factors of the Diabetes mellitus and anthropometric and Blood pressure measurements were obtained from participants.

Result: Higher waist circumference, >100 cm for males and >90 cm for females, is the maximum influence on diabetes prevalence with OR of 3.08 ($p<0.001$). Longer sitting time affects diabetes prevalence (OR 1.26) and self-reported hypertension negatively affects diabetic prevalence (OR 0.40). Hypertension based on SBP increase the diabetic prevalence (OR 1.41, $p=0.005$).

Discussion: Over-all prevalence of diabetes in present study is 21.9%. Present study results showed that diabetes increase as age advances. Obesity assessed by BMI is positively associated with diabetes. Waist circumference also positively increases diabetes prevalence. It is also discussed that watching TV more than 2 hrs/day is associated with incidence of diabetes in both men (OR 1.16) and women (OR 1.49) as compared to 1 hr/day TV watching. Physical inactivity is also a major risk factor for diabetes that is supported by several longitudinal studies.

Conclusion: Over-all prevalence of diabetes is 21.9% in this urban community living in Ahmadabad.

Introduction

Diabetes mellitus is one of the most prevalent metabolic, non-communicable disorders in the world. It is estimated, in 2014 there are 422 million adults that having diabetes (nearly doubled since 1980). Prevalence of diabetes has risen faster in low and middle income countries. There are about 1.5 million deaths accounted in 2012 due to diabetes. Increased blood glucose caused an additional 2.2 million deaths due to cardiovascular and other diseases (WHO 2016). The prevalence of diabetes mellitus is predicted to double globally from 171 million in 2000 and 366 million in 2030 with a maximum increase in India (Wild et al. 2014). The etiologies of diabetes mellitus in India include environmental factor, living standard, urbanization, obesity and sedentary life style. The study also shows that the culture, ethinicity, socio-economic conditions also are the major risk factors for diabetes in India. According to ICMR (Indian Council Of Medical Research), the prevalence of diabetes mellitus in Northern India states is greater as compared to South Indian states (Wild et al. 2014, Anjana RM et al. 2011). Indians are more prone to develop complications of diabetes aged between 20 to 48 years as they are genetically predisposed for coronary artery diseases due to dyslipidemia and low level of high density lipoproteins (Mohan et al. 2013). According to a National survey on diabetes and Impaired Glucose Tolerance the age adjusted prevalence was 12.1% for diabetes and 14% for IGT (Ramachandran et al. 2000).

The so called "Asian Indian Phenotype" refers to certain unique clinical and biochemical abnormalities in Indians which include increased insulin resistance, greater abdominal adiposity i.e., higher waist circumference despite lower body mass index, lower adiponectin and higher high sensitive C-reactive protein levels. This phenotype makes Asian Indians more prone to diabetes and premature coronary artery disease. At least a part of this is due to genetic factors. However, the primary driver of the epidemic of diabetes is the rapid epidemiological transition associated with changes in dietary patterns and decreased physical activity as evident from the higher prevalence of diabetes in the urban population.Even though the prevalence of microvascular complications of diabetes like retinopathy and nephropathy are comparatively lower in Indians, the prevalence of premature coronary artery disease is much higher in Indians compared to other ethnic groups. The most disturbing trend is the shift in age of onset of diabetes to a younger age in the recent years (Mohan et al., 2007). Prevalence estimates of diabetes and impaired glucose tolerance (IGT) are high for all Asian countries and are expected to increase further in the next two decades (Unwin et al., 2009).

Diabetes is the name given to a group of different conditions in which there is too much glucose (sugar) in the blood. The pancreas either cannot make insulin or the insulin it does make is not enough and cannot work properly. The effects of diabetes mellitus include long– term damage, dysfunction and failure of various organs. Diabetes mellitus may present with characteristic symptoms such as polydypsia, polyphasia, polyuria, blurring of vision, and weight loss. In its most severe forms, ketoacidosis or a non–ketotic hyperosmolar state may develop and lead to stupor, coma and, in absence of effective treatment, death. Often symptoms are not severe, or may be absent, and consequently hyperglycaemia sufficient to cause pathological and functional changes may be present for a long time before the diagnosis is made. The long–term effects of diabetes mellitus include progressive development of the specific complications of retinopathy with potential blindness, nephropathy that may lead to renal failure, and/or neuropathy with risk of foot ulcers, amputation, Charcot joints, and features of autonomic dysfunction, including sexual dysfunction. People with diabetes are at increased risk of cardiovascular, peripheral vascular and cerebrovascular disease.

Several pathogenetic processes are involved in the development of diabetes. These include processes which destroy the beta cells of the pancreas with consequent insulin deficiency, and others that result in resistance to insulin action. The abnormalities of carbohydrate, fat and protein metabolism are due to deficient action of insulin on target tissues resulting from insensitivity or lack of insulin.

METHODOLOGY

Study Design: Cross sectional study using questionnaire

Sampling method: Random sampling
Response rate: 85.7% (350 people were asked for consent)
Sample size: 300 (121 males, 179 females)

Sample characteristics: Mean ± SD (minimum-maximum values) for age, height, and weight were 47.21 ± 13.54 yrs (30-94), 166.04 ± 9.53 cm (149.20-194.30), 67.01 ± 12.02 Kg (40112) respectively.

Outcome variable: Fasting blood glucose in mg.dL^{-}
Determinants:
1. Age
2. Sex
3. Community
4. Education
5. Income
6. BMI
7. Waist circumference
8. Smoking
9. Alcohol consumption
10. Fruit and vegetable usage (FV)
11. Veg or Non-veg (VNV)
12. ADL for house-hold activities
13. Sleep time
14. TV watching
15. Mobile talking
16. Self-reported hypertension
17. Hypertension
18. Hand-grip strength

Methodology:
Interviewer/investigator, 2 physiotherapists, visited door-to-door and invited the house holders to participate in this study. If they agree (85.7%), informed written consent was taken from all individual members from that house who aged 30 or more. Pre-designed questionnaire (in English), modified from pilot study done in 2015, and was administered to the individual participants and therapist assisted if there was a problem to understand. Following parameters were self-reported: age (in years), height (in centimeters), weight (in kilogram), community (classified into general, backward or schedule), education (classified into illiterate, upto 5th class, 6th-10th class, 11th and 12th class, undergraduate, postgraduate, MPhill, PhD), income (in Rs per month), smoking (yes/no), alcohol habits (yes/no), FV use (no and <14 serves vs>14 serves per week), VNV use (Vegetarian vs Non-vegetarian including egg use), ghee use (no and <7 spoons vs >7 spoons per week), ADL activity (hours per week), TV watching (hours per week), sitting (hours per week), mobile talk (minutes per week), self-reported HTN, family history of HTN, family history of diabetes. BMI was measured using following formula:Weight (Kg).Height^{-2} (in meters).

Following parameters were measured by therapists:
- Waist circumference (WC):
- Blood Pressure (BP) measurement:
- Fasting Blood Glucose (FBG) measurement:
- Hand-grip strength (HGS) measurement:

Definition of Parameters:
Abdominal obesity: 100 cm or more for men; 90 cm or more for women Diabetes: FBG 120 mg.dL^{-1} or more Hypertension: SBP 130 mmHg or more; DBP 85 mmHg or more Obesity: BMI 23 Kg.m^{-1} or more.

After explaining the study population characteristics, we used cross tabulation for chi square test. For the convenience of statistics/results following parameter (continuous values) were qualified (categorical values): age, income PM, ADL at home, sitting time, TV watching time, BMI, WC, BP, FBG, mobile talking, duration of sleep per day, hand-grip strength. Irrespective of significance we calculated OR for all parameters with 95% CI. If there was a significant difference chi-square test, we entered them in multiple logistic regression [enter or forward conditional, backward conditional] and used the best model that explain the diabetes prevalence in this population. All the calculation was done using IBMSPSS (20.0 versions).

RESULT

Table 1. Characteristics of selected variables with percentage (n=300)

S.no	Variable Name	Sub-groups (n)	Percentage
1	Sex	Female (179)	59.7
		Male (121)	40.3
2	Education	Illiterate (50)	16.7
		Primary to higher secondary (135)	45.0
		Graduation or more (115)	38.3
3	Community	General (131)	43.7
		Socially backward (169)	56.3
4	Smoking	No (269)	89.7
		Yes (31)	10.3
5	Alcohol	No (262)	87.3
	Consumption	Yes (38)	12.7
6	Fruit-Vegetable	No-up to 14 serving (222)	74.0
	use	More than 14 serving (78)	26.0
7	Food habit	Vegetarian (263)	87.7
		Non-vegetarian including eggs only (37)	12.3
8	Ghee use	No to 7 spoons per week (75)	25.0
		Greater than 7 spoons per week (225)	75.0

Table 1 shows characteristics, which cannot be quartiled, of selected Ahmedabad urban population. Females were significantly higher than males; only 16.7% of total population was illiterate; socially backward class is significantly higher than general population. 10.3 % of population was smokers and 12.7% of population has taken alcohol; these two parameters should be interpreted cautiously as only men normally do these activities and only 40% of total population was males. 26% of population was taking at least 14 servings/week of fruit and vegetables in their diets and 12.3% were non-vegetarians. 75% of studied population was taking 7 or more spoons/week ghee in their diet.

Table 2. Best model of binary logistic regression when all 6 risk factors* entered

Sno	Variable	Chi square	Significance	OR with 95% CI
Backward Stepwise (Conditional) with Constant 78% correctness				
1	Age		0.052	1.33 (1.00-1.78)
2	WC	25.84	0.004	2.48 (1.35-4.58)
3	Self-reported HTN		0.035	0.35 (0.27-0.95)
Forward Stepwise (Conditional) with Constant- 80.9% correctness				
1	WC		0.002	2.66 (1.45-4.88)
2	Self-reported HTN	25.82	0.018	0.47 (0.26-0.88)
3	HTN based on SBP		0.050	1.82 (1.00-3.33)

*Age, education, WC, sitting time, self-reported HTN and HTN based on SBP

Table 2 shows the best model in binary logistic regression,

when all 6 significant variables were entered, that explains the prevalence of diabetes. We used all the three models (i.e) enter, forward stepwise (conditional) and backward stepwise (conditional)-all three were with constant and found forward stepwise (conditional) with constant that explains 80.9% of diabetes prevalence followed by backward stepwise (conditional) with constant. Four parameters collectively explain in these two models. They are age (OR 1.33), waist circumference (OR 2.66), hypertension based on SBP (OR 1.82) and self-reported hypertension (OR 0.47).

DISCUSSION

Over-all prevalence of diabetes in present study is 21.9%. Present study results showed that diabetes increase as age advances. This is supported by Anjana et al., 2011; Pouranik et al., 2011; Kumar et al., 2008; Ramachandran et al., 2008; Mohan et al., 2003; Haffner et al., 1991. Females are more prone to diabetes than their male counterparts (Hillier et al., 2001; Haffner et al., 1991). However, Indian studies show males are more prone to diabetes than females (Anjana et al., 2011; Ramachandran et al., 2008; Mohan et al., 2003). Diabetes prevalence decrease as the education level progress is supported by Haffner et al., 1991.

Obesity assessed by BMI is positively associated with diabetes [Hartwig et al., 2015 (OR 1.70); Adegbija et al., 2015 (HR 1.8); Bao et al., 2015 (HR 1.16); Gaikwad et al., 2014; Anjana et al., 2011; Berentzen et al., 2011 (HR 1.18); Mohan et al., 2003; Haffner et al., 1991]. Waist circumference also positively increase diabetes prevalence which is supported by Snidjer et al., 2016; Hartwig et al., 2015; Adegbija et al., 2015 and Berentzen et al., 2011 in their longitudinal studies. In India, several cross-sectional studies supported central obesity as a risk factor in diabetes (Anjana et al., 2011; Vijayakumar et al., 2009; Kumar et al., 2008; Ramachandran et al., 2008 and 2004; Mohan et al., 2003).

Dunstan et al., (2004) reported watching TV more than 2 hrs/day is associated with incidence of diabetes in both men (OR 1.16) and women (OR 1.49) as compared to 1 hr/day TV watching. Hu et al., (2003) also reported similar findings (RR 1.10 and 1.30 for 2-5 hrs/week and 6-20 hrs/week as compared to 0-1 hr/week) in their longitudinal study. Long sleep (greater than 7 hours) is associated with higher incidence of diabetes in longitudinal studies [Chaput et al., (2008) (OR 1.58 for 9-10 hrs sleep); Yaggi et al., (2006) (RR 3.12 for >8 hrs sleep); Gottlieb et al., (2005) (OR 1.85 for >9 hrs sleep); Ayas et al., (2003) (RR 1.47 for 9 hrs sleep)].

Hypertension is risk factor for diabetes which is supported by many Indian studies (Gaikwad et al., 2014; Anjana et al., 2011; Vijayakumar et al., 2009; Kumar et al., 2008; Mohan et al., 2003.

Physical inactivity is a major risk factor for diabetes that is supported by several longitudinal studies (Kabeya et al., 2015; Waller et al., 2010; Ansari, 2009; Dunstan et al., 2004; Ramachandran et al., 2004; Helmrich et al., 1991).

CONCLUSION

Based on the results, present study can be concluded with following points

- Over-all prevalence of diabetes is 21.9% in this urban community living in Ahmedabad.
- Age, female sex, obesity (both general and abdominal), low education, lower income, smoking, alcohol habit, being non-vegetarian, low physical activity, longer sitting time with or without TV watching, longer sleeping, hypertension, low hand-grip strength are associated with higher odds for diabetes.
- Out of these 14 variables, age, education, abdominal obesity, sitting time and hypertension based on SBP, self-reported hypertension are significantly influence the diabetes prevalence.
- Out of these 6 variables, 4 variables (i.e) age, abdominal obesity, hypertension based on SBP and self-reported hypertension- explains more than 70% of prevalence of diabetes.

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The effect of education classes in addition to home exercise program in community based middle-aged hypertensive adults

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ABSTRACT

The aims of this study is: To see the effect of education on blood pressure BMI, HR, QOL in community based middle aged hypertensive adults; To see the effect of education classes in addition to home exercise program on blood pressure BMI, HR, QOL in community based middle aged hypertensive adults; and Finally, to compare the effects of education class & education classes in addition to home exercise program on BP, BMI, HR & QOL in community based middle aged hypertensive adults. The study is conducted to see the effect of education classes and education classes in addition to home exercise program on 1.BMI, 2. Heart rate, 3. Systolic BP, 4. Diastolic BP and 5. Quality of life using SF-36. It is a quasi-experimental study. he main findings of the present study were that difference in means of BMI, Systolic BP, Diastolic BP and PCS score and MCS score scores of SF-36 (QOL) questionnaire were found to be statistically significant within group A and group B using paired t-test. In Group C an increase in BMI, HR Systolic BP and Diastolic BP were found, which were statistically significant. There was no change in PCS and MCS scores of SF-36 in group C. The change in Heart Rate, was not significant in group A, B & C. The present study was done to see the effect of education classes in addition to home exercise program in community based middle-aged hypertensive adults with mean age of 47.27±5.869 years in Group A, 44.87±3.720 years in Group B and 47.33±4.964 in Group. In the present study mean difference of HR was not found to be statistically significant within 3 groups. Mean difference of HR was not found to be statistically significant between three group A, B and C. In the present study mean difference of Systolic BP and Diastolic BP in Group A was found to be statistically significant. Mean difference of Systolic BP and Diastolic BP was found to be statistically significant between groups A, B and C. Difference in PCS and MCS scores of SF-36 (QOL) within the group A was found to be statistically significant in the present study. Mean difference of PCS and MCS between groups A & B was also found to be statistically significant. Difference in means in Group C of BMI, Systolic BP, Diastolic BP were increased and statistically significant. Difference in HR was not found to be statistically significant. In Group C PCS & MCS scores did not change pre & post intervention. As a result, it was concluded that, Education classes in middle aged hypertensive subjects decreases BMI, BP & improves QOL. Education + Home Exercise Program for 6 weeks decreases BMI, BP & improves QOL in middle aged hypertensive subjects. Education + exercise in more effective than education alone in decreasing BMI, BP & improves QOL.

Keywords— *Hypertension, Health education, BMI, QOL*

1. INTRODUCTION

The American Heart Association (AHA) defines hypertension as blood pressure of 140 over 90 or higher. Hypertension is sustained high blood pressure (≥140/90mmHg). Blood pressure follows a circadian rhythm in a normal individual. Blood pressure falls during sleep and rises rapidly just before one wake, which is when the risk of cardiovascular events is the highest.[1] Hypertension is an important public health challenge worldwide because of its prevalence. The estimated total number of adults with hypertension in 2000 was 972 million. Of these, 333 million were estimated to be in economically developed countries and 639 million in economically developing countries.[2,3] By 2025, the number of people with hypertension will increase by about 60% to a total of

1.56 billion as the proportion of elderly people will increase significantly. Other reasons are the continuing population increase and change in lifestyle, which includes a diet rich in sugar and high- fat processed foods and sedentary behavior.[2,3]

2. MANAGEMENT OF HYPERTENSION[5]

The goals of antihypertensive therapy are the reduction of cardiovascular and renal morbidity and mortality,with the focus on controlling the systolic BP, as most patients will achieve diastolic BP control when the systolic BP is achieved.[17,18,19] Prehypertension (systolic 120-139 mm Hg, diastolic 80-89 mm Hg) requires health-promoting lifestyle modifications to prevent the progressive rise in blood pressure and cardiovascular disease.[17,18,20] It should be used for the pharmacologic treatment of most cases. In specific high-risk conditions, there are compelling indications for the use of other antihypertensivedrugs.[17,18,19,20] Health

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education and hypertension: Counseling in hypertension is related to lifestyle changes, i.e. non- pharmacological treatment regarding smoking, alcohol, weight, diet, physical activity and stress and is aimed at reducing complications such as stroke and myocardial infarction. Many patients have several risk factors to deal with.[6,7,8]

According to National guidelines (1998), the major objective for hypertension management is to empower patients to actively become involved in the management of their hypertension through lifestyle modification and to ensure that they understand the importance of compliancy to treatment through continued patient health education. In most facilities patients are offered advice on lifestyle modification during consultation because there is not enough time to conduct group education.[9,10,11] According to the data, health workers seem to adhere to the recommendations made in the guidelines with regard to lifestyle modification and patient education. It appears that almost all health workers in all the facilities advice their patients to restrict salt intake in their food, to follow a prudent diet, to do regular physical exercises and to control their body weight.[12,13,14]

3. AIMS AND OBJECTIVE

The aims of the study are:

(a) To see the effect of education on blood pressure BMI, HR, QOL in community based middle-aged hypertensive adults.
(b) To see the effect of education classes in addition to home exercise program on blood pressure BMI, HR, QOL in community based middle-aged hypertensive adults.
(c) Finally, to compare the effects of education class & education classes in addition to home exercise program on BP, BMI, HR & QOL in community based middle-aged hypertensive adults.

The objective of the study is:
To see the effect of education classes and education classes in addition to home exercise program on 1.BMI, 2.Heart rate, 3.Systolic BP, 4.Diastolic BP and 5.Quality of life using SF-36.

4. HYPOTHESIS

Null Hypothesis (0):
There is no significant difference in effect of education classes, education classes in addition to home exercise program and no intervention in community based middle-aged hypertensive adults.
Alternative Hypothesis (H1):

There is significant difference in effect of education classes, education classes in addition to home exercise program and no intervention in community based middle-aged hypertensive adults.

5. MATERIAL AND MATHODOLOGY

5.1 Study Design

A quasi experimental study to see the effect of education classes with and without home exercise program in community based middle-aged hypertensive adults.

5.2 Study Setting

Intervention was conducted in the community of Ahmedabad.

5.3 Study Duration

Total study duration was 12 months; all subjects underwent intervention for 6 weeks.

5.4 Sample Size

45 subjects were divided in three groups.
GROUP A: 15 subjects (Education+ Home exercise) GROUP B: 15 subjects (Education)
GROUP C: 15 subjects (Control group)

5.5 Sampling Design

Convenient sampling

5.6 Inclusion Criteria

(a) Age: 40 to 60 years
(b) Gender: Both males and females
(c) Subjects with clinical diagnosis of hypertension.

5.7 Exclusion Criteria

(a) Doing regular exercise
(b) Any associated systemic involvement
(c) Any musculoskeletal problem
(d) Any neurological problem
(e) Any respiratory and cardiovascular diseases

5.8 Outcome Measures

(a) BMI- Body Mass Index
(b) HR- Heart Rate

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(c) Systolic Blood Pressure
(d) Diastolic Blood Pressure
(e) SF-36(QOL) questionnaire

5.9 Data collection and Procedure

45 subjects from various hospitals & clinics of Ahmedabad were included. Education was given to group A and B. For the education three classes were held. Classes were composed of a half-hour lecture on patho-physiology of hypertension, nutritional advice and effect of exercise on hypertension.

Following suggestions were given in session 2:

(a) Have your blood pressure checked and then monitor it regularly,
(b) Maintain a healthy body weight, reduce intake of dietary saturated fat and cholesterol,
(c) Exercise regularly,
(d) Eat a healthy diet rich in whole grain, more fruits, vegetables and low-fat dairy products,
(e) Reduce sodium in diet,
(f) Maintain an adequate intake of dietary potassium and calcium,
(g) Cut back on caffeine,
(h) Avoid tobacco products & second hand smoke,
(i) Limit alcohol intake,
(j) If prescribed blood pressure medication, take it as directed,
(k) Manage stress, get support from family and friends, for encouragement and emotional or morale boost.

Group A also performed exercises with the following principles:

(a) Intensity: Moderate intensity at RPE 11-13
(b) Frequency: 5days/week
(c) Type:
  - Walking
  - Stretching exercise as warm up
  - 5 minutes cool down exercise (including very slow walking, stretching and relaxed breathing)
(d) Duration: Each session lasted for 30- 45 minutes Session 1: (5 days per week)
(e) Flexibility Exercises (5-repetitions, 10-second hold)
  Hamstring stretches
  Calf stretches
  Thoraco-lumbar fascia stretch Overhead arm stretch and bend
(f) Wall push-ups
(g) Abdominal muscles (5 repetitions), Curl-ups with arms forward (as much as possible)
(h) Walking for 20 minutes.
(i) Cool down exercise: slow walking, stretching and relaxed breathing exercise.

Session 2: (5 days per week)

(a) Flexibility exercises (as above)
(b) Upper limb muscles (Wall pushups 10 repetitions)
(c) Abdominal muscles (5-10 repetitions)
(d) Forward stepping (5 repetitions)
(e) Brisk walking for 30 minutes
(f) Cool down exercise as above Session 3: (5 days per week)
(g) Flexibility exercises (5 repetitions,15 second hold)
(h) Upper limb muscles (Wall pushup 10-15 repetitions)
(i) Abdominal muscles (10 repetitions)
(j) Brisk walking for 30 minutes
(k) Cool down exercise as above.

6. Education Classes

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Fig. 1: Stretch and bend

Fig. 2: Wall Pushups

Fig. 3: Hamstring stretching

Fig. 4: Calf stretching

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Fig. 5: Curl Ups

7. RESULTS

The present study comprised of 45 middle aged hypertensive adults, 15 in each group, all 45 subjects completed the study satisfactorily. Group A was given education for hypertension control and home exercise, Group B was given education for hypertension control and Group C was control group (no intervention).

Table 1: Mean difference in BMI between groups A, B & C

GROUP	BMI		H	p Value
	Mean	SD		
Group A	-0.5053	0.3596	25.92	<0.0001
Group B	-0.2813	0.1940		
Group C	0.2587	0.3507		

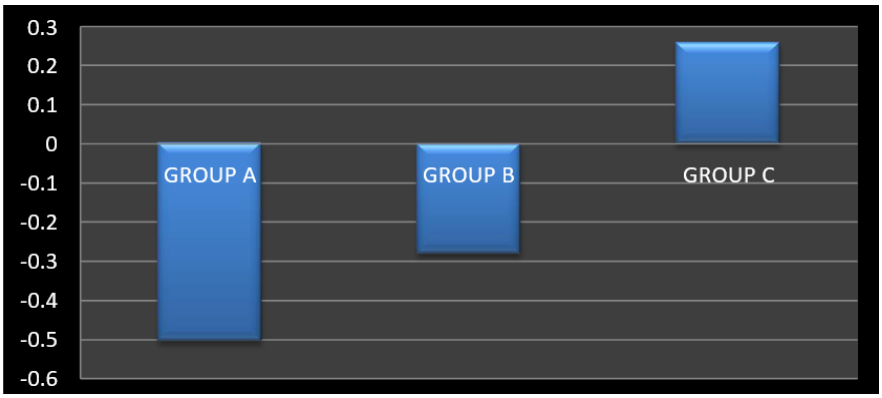

Fig. 6: Mean difference in BMI between groups A, B & C

Here Kruskal Wallis test was performed to compare difference in BMI value was found to be statistically significant at p<0.0001. Mean difference of Systolic BMI in Group A was found to be statistically more significant between 3 groups.

Table 2: Mean difference in HR between groups A, B & C

GROUP	HR		H	p Value
	Mean	SD		
Group A	2.4	4.421	4.517	0.1045
Group B	2.8	5.747		
Group C	-0.8	3.764		

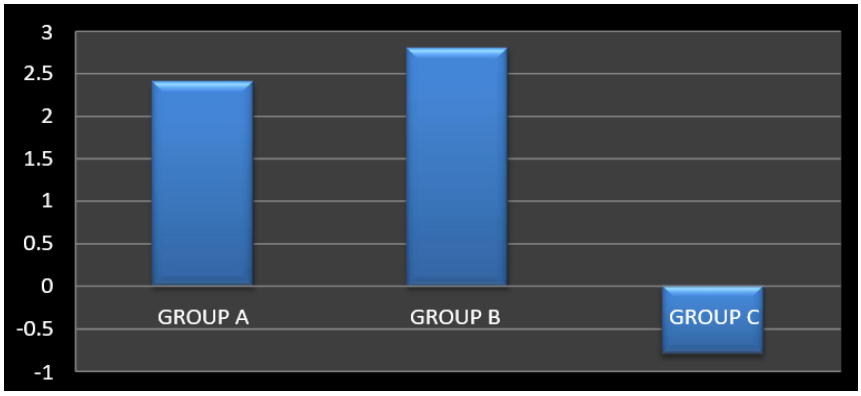

Fig. 7: Mean difference in HR between groups A, B & C

Here Kruskal Wallis test was performed, mean difference in HR was not significant at p= 0.1045

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Table 3: Mean difference in Systolic BP between groups A, B & C

Group	Systolic BP		H	p Value
	Mean	SD		
Group A	-8.263	3.770	30.14	<0.0001
Group B	-7.467	2.875		
Group C	0.8000	1.014		

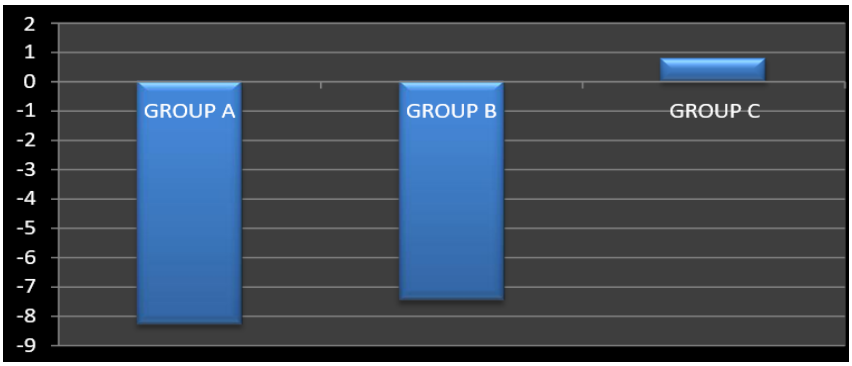

Fig. 8: Mean difference in Systolic BP between groups A, B & C

Here Kruskal Wallis test was performed. Mean difference in Systolic BP was found to be statistically significant at p<0.0001. Mean difference of Systolic BP in Group A was found to be statistically more significant between 3 groups.

Table 4: Mean difference in Diastolic BP between groups A, B & C

Group	Diastolic BP		H	p Value
	Mean	SD		
Group A	-4.000	4.000	18.83	<0.0001
Group B	-1.333	1.447		
Group C	0.8000	1.014		

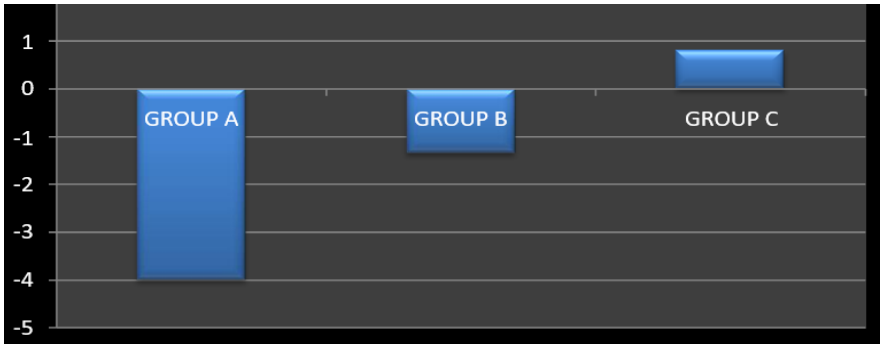

Fig. 9: Mean difference in Diastolic BP between groups A, B & C

Here Kruskal Wallis test was performed, mean difference in Diastolic BP was statistically significant at p<0.0001. Mean difference of Diastolic BP in Group A was found to be statistically more significant between 3 groups.

Table 5: Mean difference in PCS SCORE OF SF-3 between groups A, B & C

Group	PCS		t Value	p Value
	Mean	SD		
Group A	18.32	3.232	3.379	0.0045
Group B	13.96	4.034		
Group C	0.0	0.0		

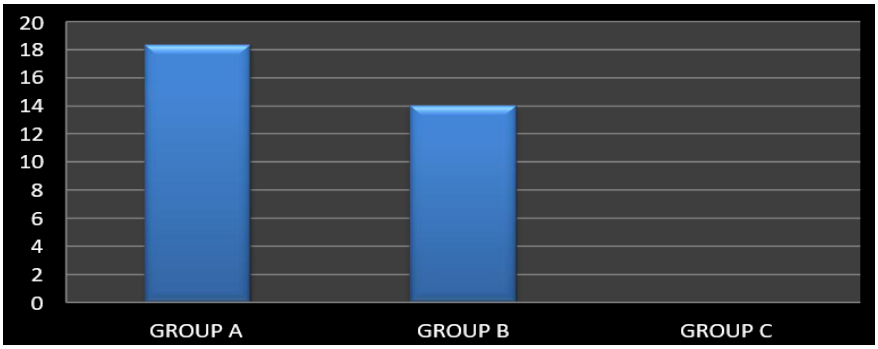

Fig. 10: Mean difference in PCS SCORE OF SF-3 between groups A, B & C

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Here, paired t test was performed for analysis for mean difference in PCS score of SF-36 between groups A & B. t=3.379 and p=0.0045 was found statistically significant. Increase in PCS score of Group A was found to statistically more significant. There was no difference in PCS score of Group C (control group).

Table 6: Mean difference in MCS score of SF-36 between groups A, B & C

Group	MCS		t Value	p Value
	Mean	SD		
Group A	2.907	2.367	2.338	0.0248
Group B	1.340	1.169		
Group C	0.0	0.0		

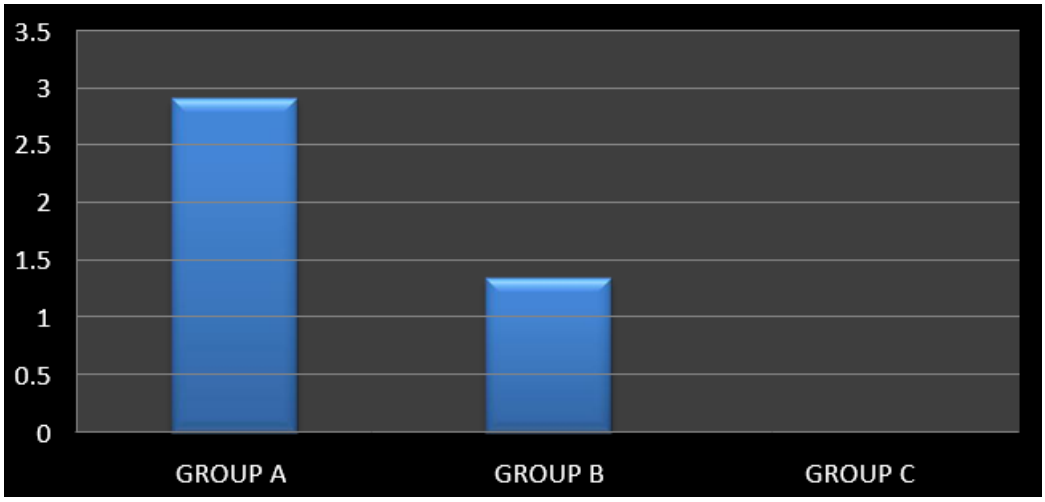

Fig. 11: Mean difference in MCS score of SF-36 between groups A, B & C

Here, paired t test was performed for analysis for mean difference in MCS score of SF-36 between groups A & B. t=2.338 and p=0.0248 was found statistically significant. Increase in MCS score of Group A was found to statistically more significant. There was no difference in MCS score of Group C (control group).

8. DISCUSSION

The present study was done to see the effect of education classes in addition to home exercise program in community based middle-aged hypertensive adults with mean age of 47.27±5.869 years in Group A, 44.87±3.720 years in Group B and 47.33±4.964 in Group. In the present study mean difference of HR (Group A t=2.103, p=0.0541, Group B t=1.887, p=0.0801 & Group C t=0.8231, p=0.4243) was not found to be statistically significant within 3 groups. Mean difference of HR (H=4.517, p=0.1045) was not found to be statistically significant between three group A, B and C.

In the present study mean difference of Systolic BP (t=8.493, p<0.0001), and Diastolic BP in Group A(t=3.873, p=0.0017) was found to be statistically significant. Mean difference of Systolic BP (H=30.14, p<0.0001) and Diastolic BP (H=18.83, p<0.0001), was found to be statistically significant between groups A, B and C.

Difference in PCS (Group A t=21.95, p<0.0001) and MCS (Group A t=4.475, p=0.0003) scores of SF-36 (QOL) within the group A was found to be statistically significant in the present study. Mean difference of PCS (t= 3.379, p= 0.0045) and MCS (t= 2.338, p= 0.0248) between groups A & B was also found to be statistically significant
Difference in means in Group C of BMI (t=), Systolic BP, Diastolic BP were increased and statistically significant. Difference in HR () was not found to be statistically significant. In Group C PCS (pre & post score=33.16) & MCS (Group C pre & post score=32.66) scores did not change pre & post intervention.

8.1 Limitations

- Long term follow-up was not taken
- Subjects were not under daily observation
- Some days were missed out by subjects during their exercise program

8.2 Future Study

The future study can be done with a larger sample size and for longer time duration.

8.3 Clinical Implication

Along with antihypertensives, middle aged adults with hypertension can be advised for the exercise and education programs.

9. CONCLUSION

Education classes in middle aged hypertensive subjects decreases BMI, BP and improves QOL. Education + Home Exercise Program for 6 weeks decreases BMI, BP & improves QOL in middle aged hypertensive subjects. Education + exercise is more effective than education alone in decreasing BMI, BP and improving QOL in middle aged hypertensive subjects. Education +

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exercise and education alone has no effects on HR in middle aged hypertensive subjects.

t=14.10, p<0.0001 & Group B t=5.615, p<0.0001), Systolic BP (Group A t=8.493, p<0.0001 & Group B t=10.06, p<0.0001), Diastolic BP (Group A t=3.873, p=0.0017 & Group B t=3.568, p=0.0031) and PCS score (Group A t=21.95, p<0.0001 & Group B t=13.40, p<0.0001) and MCS score (Group A t=4.475, p=0.0003 & Group B t=4.439, p=0.0006) scores of SF-36 (QOL) questionnaire were found to be statistically significant within group A and group B using paired t-test. In Group C an increase in BMI (t=2.856, p=0.0284), HR (t=0.8231, p=0.4243) Systolic BP (t=3.055, p=0.0086) and Diastolic BP (t=3.055, p=0.0086) were found, which were statistically significant. There was no change in PCS (pre & post score=33.16) and MCS (pre & post score=32.66) scores of SF-36 in group C. The change in Heart Rate (Group A t=2.103, p=0.0541, Group B t=1.887, p=0.0801 & Group C HR t=0.8231, p=0.4243), was not significant in group A,B & C,

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Validity of St. George's respiratory questionnaire in lung cancer population

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ABSTRACT

The main aim of this study is: to determine the concurrent validity of St. George Respiratory Questionnaire with Chronic Respiratory Questionnaire as a gold standard measure to measure health related quality of life in respiratory (chronic airflow limitation) diseases. The research was objected to check the validity of St. George Respiratory Questionnaire in lung cancer population. A Cross Sectional Study design was followed. As the result it was found out that there is high to moderate correlation between domains of SGRQ and CRQ & there is moderate correlation between domain of SGRQ and SF – 36. One way of capturing the personal and social context of patients is to use HRQoL measures. The inclusion of HRQoL in clinical investigations has increased significantly during the last two decades, as has the development of psychometrically sound HRQoL instruments to measure a variety of health conditions. In present study, Results indicate high correlation (r = -0.826, p<0.05) between SGRQ and CRQ and moderate correlation (r = -0.697, p<0.05) between SGRQ and SF-36, because SF-36 is generic health related questionnaire while CRQ is disease specific questionnaire. Our results suggest that the SGRQ is a valid measure to assess HRQOL in subject with Lung cancer. The SGRQ is valid and compares well with the CRQ and SF-36. There was an excellent concurrent validity for SGRQ and CRQ, moderate concurrent validity of SGRQ with SF-36 in lung cancer.

Keywords— *Health Related Quality of Life, Lung Cancer, St. George Respiratory Questionnaire (SGRQ), Chronic Respiratory Questionnaire(CRQ)*

1. INTRODUCTION

Cancer is the leading cause of death worldwide, it accounted for 7.4 million deaths (around 13% of all deaths) in 2004[1]. In 2005, cancer killed approximately 826,000 people in India[2].Lung cancer is among the five main types of cancer leading to overall cancer mortality contributing about 1.3 million deaths/year globally[1]. Lung cancer accounts for 7% of total cancer DALY (Disability Adjusted life years) in India[3]. Cancer is defined as abnormal and uncontrolled division of cells that then invade and destroy the surrounding tissues[4]. Lung cancer is defined as any cancer arises from air passages is called lung cancer[5] Pulmonary symptoms are Dysnea, cough, wheeze, blood stain sputum and hoarseness.[6,7] Dyspnoea, an uncomfortable awareness of breathing, is a very common symptom of patients with lung cancer. Shortness of breath greatly affects the quality of life of these patients.[8] Dyspnea predominant in 80% of lung cancer patients.[9] Dyspnea is a one of symptoms that causes greatest stress to caregivers.[9] Dyspnea causes loss of physical stamina, so that even activities of daily leaving (ADL) became difficult or even impossible.

Quality of life can be defined as a composite measure of physical and social wellbeing as perceived by each individual or by group of individual.[10] HRQOL refers to multidimensional assessments that include at least the physical, emotional (or psychological) and social domains, and may also include other domains such as cognitive functioning. HRQOL instrument require the little technical support and can be used in high resources and in low resources areas[12], but there is no disease specific instrument that has been validated for persons with lung cancer.

The St. George Respiratory Questionnaire (SGRQ) is an Index designed to measure and quantify health-related health status in patients with chronic airflow limitation.[11] SGRQ, an existing instrument that has been validated for use in patient with several types of lung diseases. I.e. COPD, cystic fibrosis, bronchial asthma and bronchiectasis[11] and pulmonary tuberculosis.[12] there is no study has been done to measure HRQoL by using SGRQ in lung cancer population.

The SGRQ divided into three sections component of "symptoms", "activity" and "impacts" Chronic Respiratory Questionnaire (CRQ) measures physical and emotional function divided into four dimensions: dyspnoea, fatigue, emotion, and mastery.

Medical Outcomes Short Form 36: is a generic health-related quality-of-life instrument, which has been used to assess quality of life in a variety of chronic medical conditions including COPD and asthma[35-36.]

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Its validity, reproducibility, and responsiveness to changes over time have been well demonstrated. SGRQ is measures respiratory disease specific HRQOL and reliability and validity of this questionnaire is done in many of the respiratory diseases, till now no study has been done to measure HRQOL in Lung Cancer by using Respiratory disease specific Questionnaire. So, the purpose of this study is to find out the concurrent validity and measurement of Health related QOL in lung cancer patients by using St. George Respiratory Questionnaire.

2. AIMS AND OBJECTIVES

2.1 Aim

To determine the concurrent validity of St. George Respiratory Questionnaire with Chronic Respiratory Questionnaire as a gold standard measure to measure health related quality of life in respiratory (chronic airflow limitation) diseases.

2.2 Objective

Primary objective: To check the validity of St. George Respiratory Questionnaire in lung cancer population.
Secondary objective: To measure the health-related quality of life in lung cancer patients using self administered questionnaire.

3. METHODOLOGY

3.1 Study Design

Cross-sectional study design

3.2 Source of data

The participants with Lung Cancer of this study were recruited from the following hospital

- Gujarat cancer research institute, Ahmedabad.
- Vedant hospital, Ahmedabad.
- Apollo hospital, Ahmedabad.

Permission with the ethical clearance was obtained from the ethical committee of Srinivas College of Physiotherapy and Research Center and also from the above-mentioned hospitals.

3.3 Sampling Technique

Since the study was done on Lung cancer patients and subject were chosen based on the selectivity criteria. Hence purposive sampling was done.

3.4 Sample Size

A total 59 number of cancer subjects were selected for the study. Out of 59 subjects 34 included in study as 17 subjects were not willing to take participation and 8 did not meet the inclusion criteria

3.5 Criteria for selection

(a) Inclusion Criteria

- Patient with histopathologically diagnosed as lung cancer.
- Age more than eighteen years.

(b) Exclusion criteria

Subject with history of:

- Psychiatric disorders.
- Neurological impairments.
- Muscular dystrophies.
- Cognitive impairments.
- Pediatrics.
- Medically unstable.

4. PROCEDURE

The participants who meet the inclusion criteria were asked to sign an informed consent form approved by the institution. Pre participation data was taken for each subject prior to study which includes Name, Age, Sex, Socioeconomic status, Concurrent disease, and Type of Lung cancer. Subjects were asked to fill the questionnaire which was design to measure their level of health-related quality of life by using SGRQ, CRQ and SF-36 respectively. The participants, who do not know to read and write, were explained about the questionnaire in their mother tongue and response was noted by the person interviewing.

4.1 Data Recording and Tabulation

Data was collected in hard copies of all questionnaires, than the data for SGRQ was feeded in the SGRQ Microsoft Excel based calculator as recommended by the developer, while for the CRQ the scoring was done on a 7 point likert scale higher the score better the quality of life as suggested by developer and for SF – 36 the same Microsoft Excel based calculator as recommended by the developer**.**

4.2 Statistical Analysis

Basic characteristics of subjects age, gender, height, weight and BMI was analyzed by Descriptive statistics. Concurrent validity of SGRQ with CRQ and SF-36 was validated with Spearman's correlation test. Statistical analysis done by using SPSS Version 14.0.

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5. RESULTS

Table 1: Descriptive data of total scores of SGRQ, CRQ and SF-36

	Mean	Standard Deviation
Total SGRQ	**54.2544**	**17.68**
Total CRQ	**75.2353**	**18.35**
Total SF-36	**46.5588**	**18.76**

Table 1 shows the descriptive statistics i.e. mean and Standard Deviation of SGRQ, CRQ and SF-36 score(x = 54.25 SD = 17.68, x = 75.23 SD =18.35 and x = 46.55 SD = 18.76 respectively).

Table 2: Descriptive data of Domains of SGRQ, CRQ and SF-36.

		Mean	Standard Deviation
SGRQ	Symptoms	65.5368	17.09
	Activity	59.0712	20.11
	Impact	47.6065	18.63
CRQ	Dysnea	20.8235	4.69
	Fatigue	14.9706	3.97
	Emotional Functioning	25.2941	6.96
	Mastery	14.5588	4.11
SF-36	Physical functioning	52.5000	20.53
	Role-Physical	36.0294	29.63
	Bodily-Pain	42.0294	18.60
	General Health	39.5000	15.95
	Physical health Component Score	42.8235	18.32
	Vitality	44.5588	17.89
	Social Function	52.0294	21.17
	Role Emotional	50.9706	36.08
	Mental Health	55.0588	19.39
	Mental health Component Score	48.2941	18.46

Table 2 describes the descriptive statistics for subjects age and all the domains of SGRQ, CRQ and SF-36.

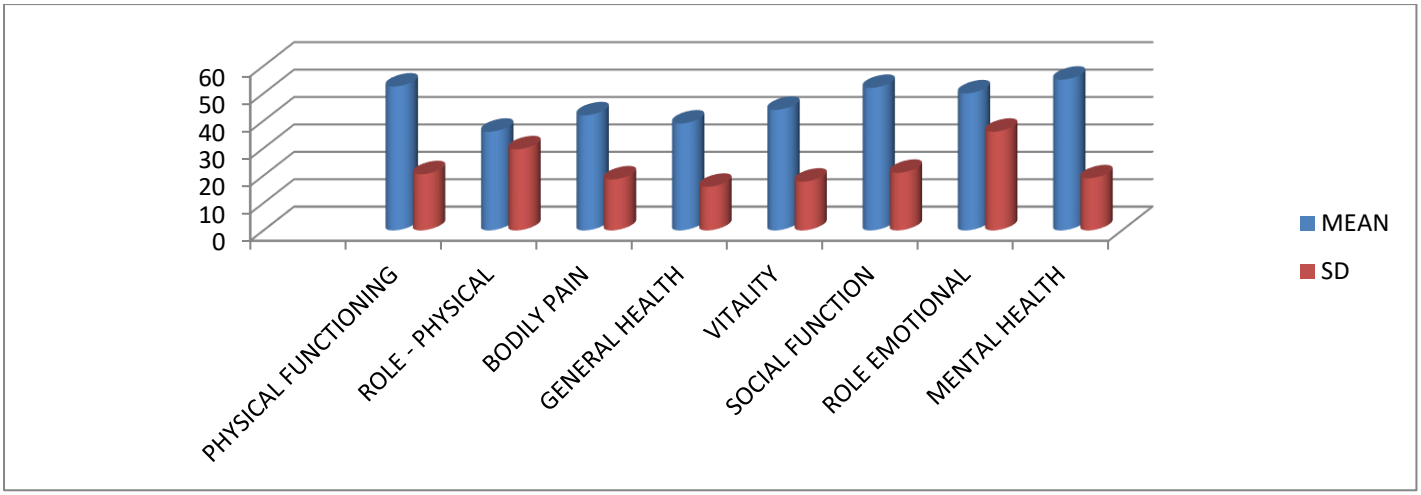

Fig. 1: Shows descriptive data of Domains of SF-36

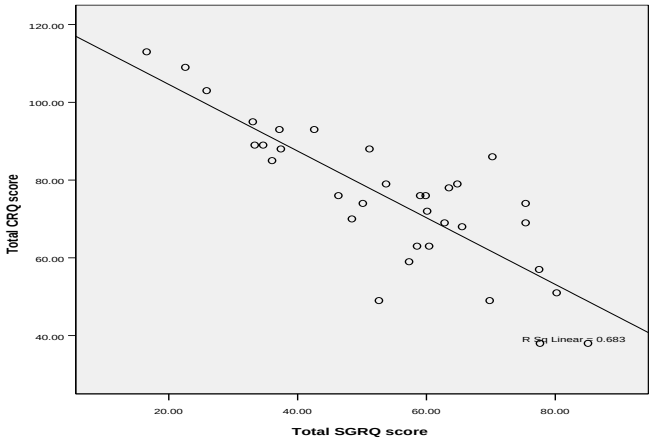

Fig. 2: Shows correlation between total score of SGRQ and total score of CRQ

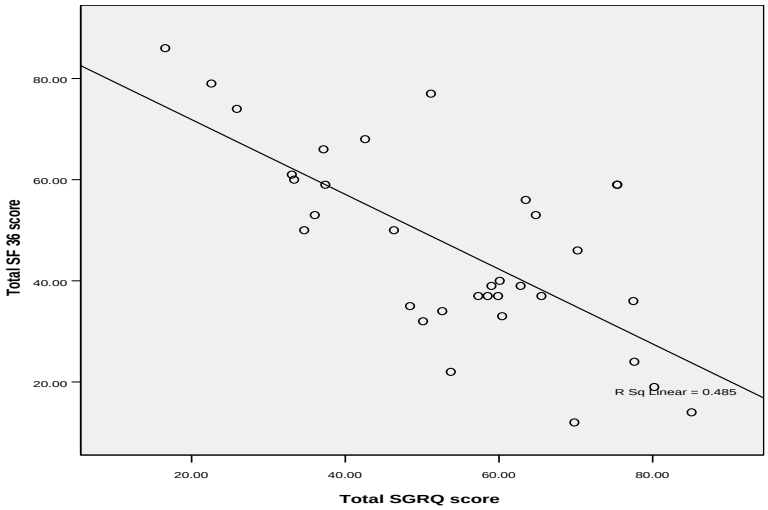

Fig. 3: Shows correlation between total score of SGRQ and total score of SF-36

Table 3: Correlations between the SGRQ domains and the CRQ

SGRQ Domains	CRQ Domains	Correlation(r)	Significance (p)
Symptoms	Dysnea	-0.396*	0.020
	Fatigue	-0.596**	0.0001
	Emotional function	-0.719**	0.0001
	Mastery	-0.751***	0.0001
Activity	Dysnea	-0.570**	0.0001
	Fatigue	-0.495*	0.0003
	Emotional function	-0.691**	0.0001
	Mastery	-0.619**	0.0001
Impacts	Dysnea	-0.609**	0.0001
	Fatigue	-0.460*	0.0006
	Emotional function	-0.711**	0.0001
	Mastery	-0.641**	0.0001
Total Score	Dysnea	-0.601**	0.0001
	Fatigue	-0.528**	0.001
	Emotional function	-0.757*	0.0001
	Mastery	-0.699**	0.0001

***= high correlation **=moderate correlation *=low correlation.

Table 3 shows correlation between domains of SGRQ and CRQ

Table 4: Correlations between the SGRQ domains and the SF-36.

SGRQ Domains	SF-36 Domains	Correlation(r)	Significance (p)
Symptoms	PCS score	-0.669**	0.0001
	MCS score	-0.541**	0.001
Activity	PCS score	-0.676**	0.0001
	MCS score	-0.586**	0.0001
Impacts	PCS score	-0.662**	0.0001
	MCS score	-0.636**	0.0001
Total Score	PCS score	-0.716**	0.0001
	MCS score	-0.646**	0.0001

***= high correlation **=moderate correlation *=low correlation.

Table 4 shows correlation between domains of SGRQ and SF-36.

6. DISCUSSION

The evaluation of lung function does not fully reflect the impact of the disease on a patient and, therefore, should be supplemented by using quality-of-life questionnaires.[15]One way of capturing the personal and social context of patients is to use HRQoL measures. The inclusion of HRQoL in clinical investigations has increased significantly during the last two decades, as has the development of psychometrically sound HRQoL instruments to measure a variety of health conditions.

In present study, Results indicate high correlation($r = -0.826$, $p<0.05$) between SGRQ and CRQ and moderate correlation($r = -0.697$, $p<0.05$) between SGRQ and SF-36, because SF-36 is generic health related questionnaire while CRQ is disease specific questionnaire.[13] Molken et al also found well correlation ($r = -0.725$; $P<0.001$ and our result is $r = -0.826$; $P<0.001$) between total of SGRQ and total score of CRQ. The total scores of both questionnaires (SGRQ and CRQ) correlated best with each other and with the each domain scores. [9] Even in our study also the total score of SGRQ correlated well with each domains.

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Moderate to high significant correlation found between various domains of SGRQ and total score of CRQ ($p<0.05$) similarly same results were found by a previous study.[9]

Results of our study are supporting the results of studies[10, 11] being done previously to measure the correlation between SGRQ and SF-36 in different diseases. Moderate to high significant correlation was found between and total score of SGRQ and PCS and MCS score of SF-36. Carolyn BW et al[11] other two previous studies, [12,13] found overall, SGRQ scores were more strongly associated with the PCS than MCS of SF-36. In general, scores of SF-36 were better correlated with the Impact component of the SGRQ than the Symptoms or Activity component. These may be due to Impacts component contains similar aspects as in PCS and MCS components of SF-36.

We found moderate significant correlation found between various domains of SGRQ and total score of SF-36($p<0.05$) (table 5.7). So, SGRQ is valid tool to measures HRQOL in various Respiratory Diseases as same as the gold standard tool CRQ. Moreover, SGRQ measures larger aspects of HRQOL compare to CRQ thus provide better idea about HRQOL of subjects and allow clinician/physiotherapist to measure impact of a disease on a patient's daily life and they can be especially valuable in clinical trials design to access the benefits, side effects and cost of different treatments.

SGRQ is available in 48 languages including 11 Indian languages while CRQ is available in only 8 languages (no Indian language) so SGRQ is better applicable to measure HRQOL in disease specific conditions in Indian scenario.

7. LIMITATIONS

- Smaller sample size.
- To precisely know HRQOL, how long its impact remains longitudinal study should be done.

8. FURTHER RECOMMENDATIONS

- Further research should be focused on specific type of locally language adapted questionnaire.
- Further research should be done with Cancer specific questionnaire along with HRQOL questionnaire.
- The SGRQ emerges as an excellent discriminative and a good evaluative instrument for LC subjects, and its use should be encouraged in routine assessment of patients' health status.
- Psychometric properties of Questionnaire should be done in Lung cancer.

9. CONCLUSION

Our study leads to following conclusions:

- Our results suggest that the SGRQ is a valid measure to assess HRQOL in subject with Lung cancer.
- The SGRQ is valid and compares well with the CRQ and SF-36.
- There was an excellent concurrent validity for SGRQ and CRQ, moderate concurrent validity of SGRQ with SF-36 in lung cancer.
- There was moderate to high significant correlation found between the domains of SGRQ and CRQ, except there was low significant correlation between SGRQ domain symptoms and CRQ domain dysnea, SGRQ domain activity and CRQ domain fatigue and SGRQ domain impacts and CRQ domain fatigue.
- Similarly, moderate to high significant correlation was found between the total score of SGRQ and various domains of CRQ.
- Moderate to high significant correlation found between various domains of SGRQ and PCS and MCS score of SF-36, and total score of SGRQ and PCS and MCS score of SF-36.
- High significant correlation found between various domains of SGRQ and total score of CRQ.
- Moderate significant correlation found between various domains of SGRQ and total score of SF-36.
- The SGRQ emerges as an excellent discriminative and a good evaluative instrument for Lung cancer subjects, and its use should be encouraged in routine assessment of patients' health status.

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TO SEE EFFECT OF PANCHAM KRIYA IN CHRONIC LOWER BACK PAIN

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ABSTRACT

Objective

The aim of the study was to check the effect of *PANCHAM KRIYA* in chronic lower back pain.

Methodology

Total 10 subjects fulfilling selection criteria participated in the study. All of them were told about the procedure of study. All their queries were answered satisfactorily and informed consent was taken from them.*Pancham kriya* exercises were given to the participants. In the beginning of treatment, they were given VAS disability questionnaire.They were asked to fill these questionnaires. After 10 days of protocol of *Pancham kriya* exercises, they were again told to fill these outcome measures.

Result

It shows statistically significant improvement in Pre intervention or post intervention scores of VAS.

Discussion

It is important to note that *Pancham kriya* exercises are significant in the patients with low back pain than general exercises. There were greater improvements in the group that received this therapy. It is also discussed that transverse abdominal muscle, which was the focus of specific strengthening exercises programme for low back pain can significantly decrease the laxity of sacro -illiac joint.

Conclusion

Pancham kriya exercises were efficient in reducing pain and disability of low back pain patient.

Key words:- *Pancham kriya,* Low back pain, VAS.

INTRODUCTION

Low back pain is common,painful,irritative & unpleasant condition affecting the lower portion of the spine.it can be caused by injury to a muscle(strain) or ligament(sprain).common causes for low back pain include improper lifting,poor posture,lack of regular exercises,a fracture,ruptured disc or arthritis,it can be due to prolonged sitting and laying down in one position,sometimes lower back pain can be due to some other cause e.g. osteomyelitis,ankylosing spondylitis etc.

According to the NATIONAL INSTITUTE OF NEUROLOGICAL DISORDERS AND STROKE (NINDS) low back pain is the most common cause of job related disability. Over 80% of population suffer from lower back pain during their lives mainly because of adoption of bad posture while activities of daily living

PANCHAM KRIYA is sustained movements with co-ordination and regular simultaneous movements from distal to proximal direction in lower limbs to relieve chronic low back pain.In this treatment exercises were scheduled from ankle joint to lumbo-sacral joints.

Aim and Objective of the study:

The aim and objective of the study is to check the effect of core strengthening exercises in low back pain.

Hypothesis:

Experimental Hypothesis:

There is effect of ***PANCHAM KRIYA*** exercises in low back pain with visual analogue scale and questionnaire.

Null Hypothesis:

There was less effect of ***PANCHAM KRIYA*** exercise in low back pain with visual analogue scale questionnaire.

METHODOLOGY

For this study method sample selection was random in which 10 subjects were fulfilling the criteria for study with ***PANCHAM KRIYA*** exercises to relieve chronic low back pain in females age group 20-40 years. Pre and Post intervention were noted down to get proper results and conclusions.

Study design:
Experimental study design.

Sample:
Random Sampling
A total number of 10 subjects were included for the study.

Study center:
Merchant Physiotherapy college, Mehsana, HNGU(Patan)

Inclusion criteria:-

- ✓ Females of age group 20-40 yrs.
- ✓ Females having chronic low back pain

Exclusion criteria:-

- ✓ History of surgery of back
- ✓ History of recent fractures
- ✓ History of back deformity
- ✓ History of pathologies around knee/ankle
- ✓ History of trauma
- ✓ History of steroidal medication since last months.

Outcomes measures:-

- ✓ Visual analogue scale

Procedure: 10 subjects fulfilling selection criteria participated in the study. All of them were told about the procedure of study. All their queries were answered satisfactorily and informed consent was taken from them.***PANCHAM KRIYA*** exercises were given to the participants. In the beginning of treatment, they were given VAS disability questionnaire. They were asked to fill theis questionnaire. After 10 days of protocol of ***PANCHAM KRIYA*** exercises, they were again told to fill these outcome measures.

Pancham kriya is combined and simultaneous activities for lower spine as well as lower limbs from distal to proximal direction. Activities in ***pancham kriya*** should be given in following sequence are as under:-

(1) Ankle dorsiflexion-Planterflexion (ankle pump)
Exercises:-They were asked to lie down on back and asked to go for Dorsiflexion-Planterflexion at a time
Repetitions :-5-5 repetations and twice a day

(2) Knee flexion –extension
Exercises:- They were asked to lie down on back and asked to go for Knee flexion –extension B/L
Repetitions :- 5-5 repetations and twice a day

(3) Hip flexion-back to starting position
Exercises:- They were asked to lie down on back and asked to go for Hip flexion-back to starting position B/L
Repetitions :- 5-5 repetations and twice a day
(4) Knee to heel
Exercises:- They were asked to lie down on back and asked to flex both knees and asked to touch heels by opposite knees
Repetitions :- 5-5 repetations and twice a day

(5) Pelvic rotation
Exercises:- They were asked to lie down on back and asked to flex both knees and asked to go for pelvic rotation by turning both knees one side and head towards another side
Repetitions :-5-5 repetations both sides

The participants were selected for the inclusion and exclusion criteria of the study. The patient should be comfortable and relaxed.

DATA ANALYSIS

Variable	VAS
Mean	2.35
Standard Deviation	1.786
S.E	0.436
T value	4.161

Conclusion:- T-value is highly significant at 1% level
Pancham Kriya exercises are highly significant for chronic lower back pain.

RESULTS
It shows statistically significant improvement in:
Pre intervention or post intervention scores of VAS.

DISCUSSION
The results of this study supported hypothesis that ***PANCHAM KRIYA*** exercises were significant in the patients with low back pain than general exercises. There were greater improvements in the group that received ***PANCHAM KRIYA*** therapy. Using the criteria of **Ferreira PH, and Rackwitz B,** also reported that specific Progressive exercises was better than ordinary medical care and treatment by a general practitioner for reducing pain. ***PANCHAM KRIYA*** exercises were found very effective as part of yoga also,major effects on back muscles with help of simultaneous movements to lower limbs from distal to proximal without having any side effects.

Limitations: This study was characterized by some limitations . The first common limitation was that the findings were based on short data. Another limitation was that some article did not contain much sufficient information for evaluating the quality and clinical relevance of data.

CONCLUSION
PANCHAM KRIYA exercises were more efficient in reducing chronic low back pain and disability of low back pain of patient.

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Validity of St. George's respiratory questionnaire in lung cancer population

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[1,2]Assistant Professor, Venus Institute of Physiotherapy, Swarrnim Startup and Innovation University, Gandhinagar, Gujarat

ABSTRACT

The main aim of this study is: to determine the concurrent validity of St. George Respiratory Questionnaire with Chronic Respiratory Questionnaire as a gold standard measure to measure health related quality of life in respiratory (chronic airflow limitation) diseases. The research was objected to check the validity of St. George Respiratory Questionnaire in lung cancer population. A Cross Sectional Study design was followed. As the result it was found out that there is high to moderate correlation between domains of SGRQ and CRQ & there is moderate correlation between domain of SGRQ and SF – 36. One way of capturing the personal and social context of patients is to use HRQoL measures. The inclusion of HRQoL in clinical investigations has increased significantly during the last two decades, as has the development of psychometrically sound HRQoL instruments to measure a variety of health conditions. In present study, Results indicate high correlation (r = -0.826, p<0.05) between SGRQ and CRQ and moderate correlation (r = -0.697, p<0.05) between SGRQ and SF-36, because SF-36 is generic health related questionnaire while CRQ is disease specific questionnaire. Our results suggest that the SGRQ is a valid measure to assess HRQOL in subject with Lung cancer. The SGRQ is valid and compares well with the CRQ and SF-36. There was an excellent concurrent validity for SGRQ and CRQ, moderate concurrent validity of SGRQ with SF-36 in lung cancer.

Keywords— *Health Related Quality of Life, Lung Cancer, St. George Respiratory Questionnaire (SGRQ), Chronic Respiratory Questionnaire(CRQ)*

1. INTRODUCTION

Cancer is the leading cause of death worldwide, it accounted for 7.4 million deaths (around 13% of all deaths) in 2004[1]. In 2005, cancer killed approximately 826,000 people in India[2].Lung cancer is among the five main types of cancer leading to overall cancer mortality contributing about 1.3 million deaths/year globally[1]. Lung cancer accounts for 7% of total cancer DALY (Disability Adjusted life years) in India[3]. Cancer is defined as abnormal and uncontrolled division of cells that then invade and destroy the surrounding tissues[4]. Lung cancer is defined as any cancer arises from air passages is called lung cancer[5] Pulmonary symptoms are Dysnea, cough, wheeze, blood stain sputum and hoarseness.[6,7] Dyspnoea, an uncomfortable awareness of breathing, is a very common symptom of patients with lung cancer. Shortness of breath greatly affects the quality of life of these patients.[8] Dyspnea predominant in 80% of lung cancer patients.[9] Dyspnea is a one of symptoms that causes greatest stress to caregivers.[9] Dyspnea causes loss of physical stamina, so that even activities of daily leaving (ADL) became difficult or even impossible.

Quality of life can be defined as a composite measure of physical and social wellbeing as perceived by each individual or by group of individual.[10] HRQOL refers to multidimensional assessments that include at least the physical, emotional (or psychological) and social domains, and may also include other domains such as cognitive functioning. HRQOL instrument require the little technical support and can be used in high resources and in low resources areas[12], but there is no disease specific instrument that has been validated for persons with lung cancer.

The St. George Respiratory Questionnaire (SGRQ) is an Index designed to measure and quantify health-related health status in patients with chronic airflow limitation.[11] SGRQ, an existing instrument that has been validated for use in patient with several types of lung diseases. I.e. COPD, cystic fibrosis, bronchial asthma and bronchiectasis[11] and pulmonary tuberculosis.[12] there is no study has been done to measure HRQoL by using SGRQ in lung cancer population.

The SGRQ divided into three sections component of "symptoms", "activity" and "impacts" Chronic Respiratory Questionnaire (CRQ) measures physical and emotional function divided into four dimensions: dyspnoea, fatigue, emotion, and mastery.

Medical Outcomes Short Form 36: is a generic health-related quality-of-life instrument, which has been used to assess quality of life in a variety of chronic medical conditions including COPD and asthma[35-36.]

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Its validity, reproducibility, and responsiveness to changes over time have been well demonstrated. SGRQ is measures respiratory disease specific HRQOL and reliability and validity of this questionnaire is done in many of the respiratory diseases, till now no study has been done to measure HRQOL in Lung Cancer by using Respiratory disease specific Questionnaire. So, the purpose of this study is to find out the concurrent validity and measurement of Health related QOL in lung cancer patients by using St. George Respiratory Questionnaire.

2. AIMS AND OBJECTIVES

2.1 Aim

To determine the concurrent validity of St. George Respiratory Questionnaire with Chronic Respiratory Questionnaire as a gold standard measure to measure health related quality of life in respiratory (chronic airflow limitation) diseases.

2.2 Objective

Primary objective: To check the validity of St. George Respiratory Questionnaire in lung cancer population.
Secondary objective: To measure the health-related quality of life in lung cancer patients using self administered questionnaire.

3. METHODOLOGY

3.1 Study Design

Cross-sectional study design

3.2 Source of data

The participants with Lung Cancer of this study were recruited from the following hospital

- Gujarat cancer research institute, Ahmedabad.
- Vedant hospital, Ahmedabad.
- Apollo hospital, Ahmedabad.

Permission with the ethical clearance was obtained from the ethical committee of Srinivas College of Physiotherapy and Research Center and also from the above-mentioned hospitals.

3.3 Sampling Technique

Since the study was done on Lung cancer patients and subject were chosen based on the selectivity criteria. Hence purposive sampling was done.

3.4 Sample Size

A total 59 number of cancer subjects were selected for the study. Out of 59 subjects 34 included in study as 17 subjects were not willing to take participation and 8 did not meet the inclusion criteria

3.5 Criteria for selection

(a) Inclusion Criteria

- Patient with histopathologically diagnosed as lung cancer.
- Age more than eighteen years.

(b) Exclusion criteria

Subject with history of:

- Psychiatric disorders.
- Neurological impairments.
- Muscular dystrophies.
- Cognitive impairments.
- Pediatrics.
- Medically unstable.

4. PROCEDURE

The participants who meet the inclusion criteria were asked to sign an informed consent form approved by the institution. Pre participation data was taken for each subject prior to study which includes Name, Age, Sex, Socioeconomic status, Concurrent disease, and Type of Lung cancer. Subjects were asked to fill the questionnaire which was design to measure their level of health-related quality of life by using SGRQ, CRQ and SF-36 respectively. The participants, who do not know to read and write, were explained about the questionnaire in their mother tongue and response was noted by the person interviewing.

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4.2 Statistical Analysis

Basic characteristics of subjects age, gender, height, weight and BMI was analyzed by Descriptive statistics. Concurrent validity of SGRQ with CRQ and SF-36 was validated with Spearman's correlation test. Statistical analysis done by using SPSS Version 14.0.

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Table 1 shows the descriptive statistics i.e. mean and Standard Deviation of SGRQ, CRQ and SF-36 score(x = 54.25 SD = 17.68, x = 75.23 SD =18.35 and x = 46.55 SD = 18.76 respectively).

Table 2: Descriptive data of Domains of SGRQ, CRQ and SF-36.

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Table 2 describes the descriptive statistics for subjects age and all the domains of SGRQ, CRQ and SF-36.

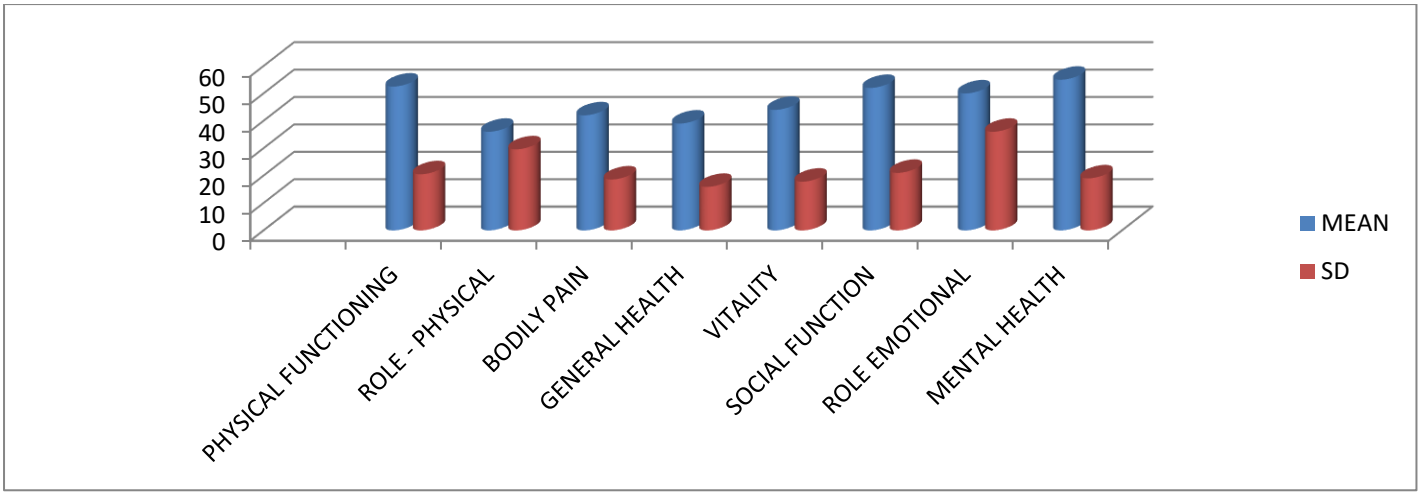

Fig. 1: Shows descriptive data of Domains of SF-36

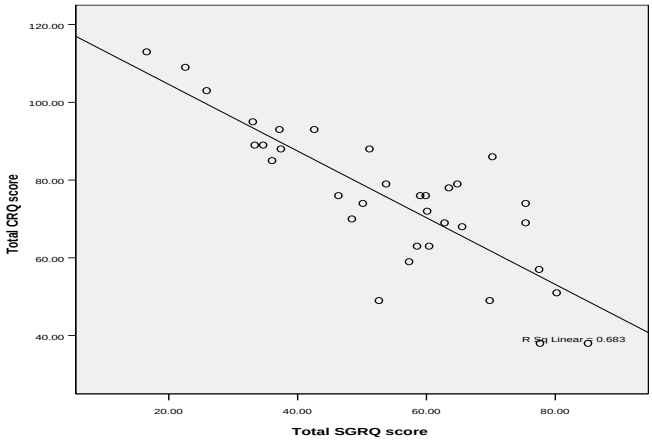

Fig. 2: Shows correlation between total score of SGRQ and total score of CRQ

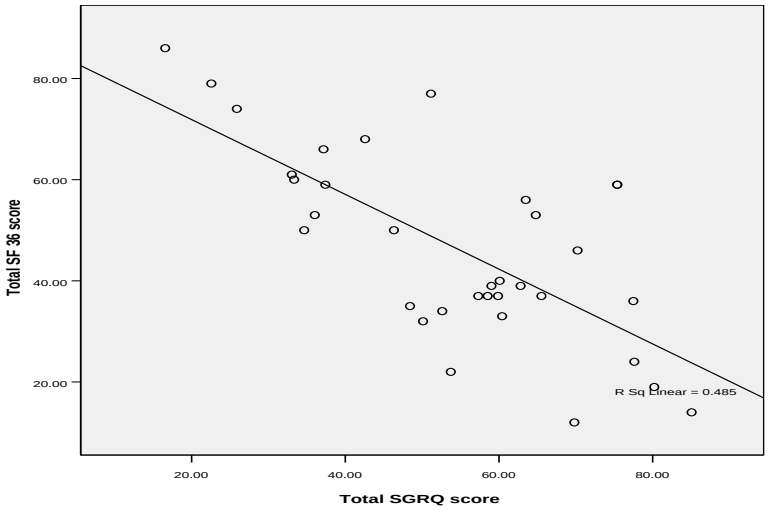

Fig. 3: Shows correlation between total score of SGRQ and total score of SF-36

Table 3: Correlations between the SGRQ domains and the CRQ

SGRQ Domains	CRQ Domains	Correlation(r)	Significance (p)
Symptoms	Dysnea	-0.396*	0.020
	Fatigue	-0.596**	0.0001
	Emotional function	-0.719**	0.0001
	Mastery	-0.751***	0.0001
Activity	Dysnea	-0.570**	0.0001
	Fatigue	-0.495*	0.0003
	Emotional function	-0.691**	0.0001
	Mastery	-0.619**	0.0001
Impacts	Dysnea	-0.609**	0.0001
	Fatigue	-0.460*	0.0006
	Emotional function	-0.711**	0.0001
	Mastery	-0.641**	0.0001
Total Score	Dysnea	-0.601**	0.0001
	Fatigue	-0.528**	0.001
	Emotional function	-0.757*	0.0001
	Mastery	-0.699**	0.0001

***= high correlation **=moderate correlation *=low correlation.

Table 3 shows correlation between domains of SGRQ and CRQ

Table 4: Correlations between the SGRQ domains and the SF-36.

SGRQ Domains	SF-36 Domains	Correlation(r)	Significance (p)
Symptoms	PCS score	-0.669**	0.0001
	MCS score	-0.541**	0.001
Activity	PCS score	-0.676**	0.0001
	MCS score	-0.586**	0.0001
Impacts	PCS score	-0.662**	0.0001
	MCS score	-0.636**	0.0001
Total Score	PCS score	-0.716**	0.0001
	MCS score	-0.646**	0.0001

***= high correlation **=moderate correlation *=low correlation.

Table 4 shows correlation between domains of SGRQ and SF-36.

6. DISCUSSION

The evaluation of lung function does not fully reflect the impact of the disease on a patient and, therefore, should be supplemented by using quality-of-life questionnaires.[15]One way of capturing the personal and social context of patients is to use HRQoL measures. The inclusion of HRQoL in clinical investigations has increased significantly during the last two decades, as has the development of psychometrically sound HRQoL instruments to measure a variety of health conditions.

In present study, Results indicate high correlation($r = -0.826$, $p<0.05$) between SGRQ and CRQ and moderate correlation($r = -0.697$, $p<0.05$) between SGRQ and SF-36, because SF-36 is generic health related questionnaire while CRQ is disease specific questionnaire.[13] Molken et al also found well correlation ($r = -0.725$; $P<0.001$ and our result is $r = -0.826$; $P<0.001$) between total of SGRQ and total score of CRQ. The total scores of both questionnaires (SGRQ and CRQ) correlated best with each other and with the each domain scores. [9] Even in our study also the total score of SGRQ correlated well with each domains.

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Moderate to high significant correlation found between various domains of SGRQ and total score of CRQ ($p<0.05$) similarly same results were found by a previous study.[9]

Results of our study are supporting the results of studies[10, 11] being done previously to measure the correlation between SGRQ and SF-36 in different diseases. Moderate to high significant correlation was found between and total score of SGRQ and PCS and MCS score of SF-36. Carolyn BW et al[11] other two previous studies, [12,13] found overall, SGRQ scores were more strongly associated with the PCS than MCS of SF-36. In general, scores of SF-36 were better correlated with the Impact component of the SGRQ than the Symptoms or Activity component. These may be due to Impacts component contains similar aspects as in PCS and MCS components of SF-36.

We found moderate significant correlation found between various domains of SGRQ and total score of SF-36($p<0.05$) (table 5.7). So, SGRQ is valid tool to measures HRQOL in various Respiratory Diseases as same as the gold standard tool CRQ. Moreover, SGRQ measures larger aspects of HRQOL compare to CRQ thus provide better idea about HRQOL of subjects and allow clinician/physiotherapist to measure impact of a disease on a patient's daily life and they can be especially valuable in clinical trials design to access the benefits, side effects and cost of different treatments.

SGRQ is available in 48 languages including 11 Indian languages while CRQ is available in only 8 languages (no Indian language) so SGRQ is better applicable to measure HRQOL in disease specific conditions in Indian scenario.

7. LIMITATIONS

- Smaller sample size.
- To precisely know HRQOL, how long its impact remains longitudinal study should be done.

8. FURTHER RECOMMENDATIONS

- Further research should be focused on specific type of locally language adapted questionnaire.
- Further research should be done with Cancer specific questionnaire along with HRQOL questionnaire.
- The SGRQ emerges as an excellent discriminative and a good evaluative instrument for LC subjects, and its use should be encouraged in routine assessment of patients' health status.
- Psychometric properties of Questionnaire should be done in Lung cancer.

9. CONCLUSION

Our study leads to following conclusions:

- Our results suggest that the SGRQ is a valid measure to assess HRQOL in subject with Lung cancer.
- The SGRQ is valid and compares well with the CRQ and SF-36.
- There was an excellent concurrent validity for SGRQ and CRQ, moderate concurrent validity of SGRQ with SF-36 in lung cancer.
- There was moderate to high significant correlation found between the domains of SGRQ and CRQ, except there was low significant correlation between SGRQ domain symptoms and CRQ domain dysnea, SGRQ domain activity and CRQ domain fatigue and SGRQ domain impacts and CRQ domain fatigue.
- Similarly, moderate to high significant correlation was found between the total score of SGRQ and various domains of CRQ.
- Moderate to high significant correlation found between various domains of SGRQ and PCS and MCS score of SF-36, and total score of SGRQ and PCS and MCS score of SF-36.
- High significant correlation found between various domains of SGRQ and total score of CRQ.
- Moderate significant correlation found between various domains of SGRQ and total score of SF-36.
- The SGRQ emerges as an excellent discriminative and a good evaluative instrument for Lung cancer subjects, and its use should be encouraged in routine assessment of patients' health status.

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TO SEE EFFECT OF TADASANA(MOUNTAIN POSE) IN FLAT FOOT

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ABSTRACT

Objective

The aim of the study was to check the effect of ***TADASANA*** in Flat Foot condition.

Methodology

Total 10 subjects fulfilling selection criteria participated in the study. All of them were told about the procedure of study. All their queries were answered satisfactorily and informed consent was taken from them.***TADASANA*** was given to the participants. In the beginning of treatment, they were given VAS disability questionnaire.They were asked to fill these questionnaires. After 10 days of protocol of ***TADASANA*** they were again told to fill these outcome measures.

Result

It shows statistically significant improvement in Pre intervention or post intervention scores of VAS.

Discussion

It is important to note that ***TADASANA*** is significant in the patients with Flat Foot than general exercises. There were greater improvements in the group that received this therapy. It is also discussed that Gastrocnameous & Hamstrings muscles, which were the focus of specific strengthening exercises programme for Flat Foot can significantly decrease the laxity of Knee joint & Ankle joint.

Conclusion

TADASANA is efficient in reducing pain due to Flat Foot and walking disability of lower limb in patient.

Key words:- ***TADASANA***, Hamstring, Gastrocnameous, VAS.

INTRODUCTION

Flat Foot is common,painful,irritative & unpleasant condition affecting the lower limb. it can be caused by sedentary life style, height more than normal parameters of WHO, poor posture, poor locomotion.common causes for Hamstring Tightness include ,poor posture,lack of regular exercises,a fracture, it can be due to prolonged sitting and laying down in one position,sometimes Hamstring Tightness can be due to some other cause e.g. Osteomyelitis, Rheumatoid arthritis, Osteoarthritis etc.

According to the NATIONAL INSTITUTE OF NEUROLOGICAL DISORDERS AND STROKE (NINDS) weak arches is the most common cause of above related disability. Over 53% of population suffer from planter surface and gastrocnameous pain during their lives mainly because of adoption of bad posture due to Flat Foot while activities of daily living.

TADASANA is sustained movements with co-ordination and simultaneous exercises from shoulder joint ankle joints and segment to relieve Hamstring Tightness and pain due to flat foot condition.

Aim and Objective of the study:

The aim and objective of the study is to check the effect of ***TADASANA*** **i**n Flat Foot.

Hypothesis:

Experimental Hypothesis:

There is effect of ***TADASANA*** in Flat Foot with VAS scale and questionnaire.

Null Hypothesis:

There was less effect of ***TADASANA*** in VAS with questionnaire.

METHODOLOGY

For this study method sample selection was random in which 10 subjects were fulfilling the criteria for study with TADASANA to relieve pain due to Flat Foot in females age group 20-40 years. Pre and Post intervention were noted down to get proper results and conclusions.

Study design:

Experimental study design.

Sample:

Random Sampling

A total number of 10 subjects were included for the study.

Study center:

YOG-NIKETAN Sankul, Maharaja Sayajirao University, Vadodara.

Inclusion criteria:-

- ✓ Females of age group 20-40 yrs.
- ✓ Females having Flat Foot.

Exclusion criteria:-

- ✓ History of surgery of lower limb and ankle region
- ✓ History of recent fractures
- ✓ History of Knee and ankle deformities
- ✓ History of pathologies around knee and ankle
- ✓ History of trauma
- ✓ History of steroidal medication since last months.

Outcomes measures:-

- ✓ VISUAL ANALOUGE SCALE for pain due to Flat Foot.

Procedure: 10 subjects fulfilling selection criteria participated in the study. All of them were told about the procedure of study. All their queries were answered satisfactorily and informed consent was taken from them.***TADASANA*** was given to the participants. In the beginning of treatment, they were given VAS scale questionnaire. They were asked to fill theis questionnaire. After 10 days of protocol of ***TADASANA*** was given, they were again told to fill these outcome measures.

Tadasana:-

This is "*Sanskrit*" word, which means "*samasthiti*"

"*Tad*" means "Mountain and "*Asana*" means "Position"

This asana is practiced in 4 stages:-

(1) Posture is entered by standing with the feet together.
(2) Groundly evenly through the feet and lifting up through the crown of the head.
(3) The thighs are lifted, the waist is lifted and the spine is elongated.
(4) It is important as it allows the body and consciousness to integrate the experience of the preceding *asana* and to prepare for the position.

The participants were selected for the inclusion and exclusion criteria of the study. The patient should be comfortable and relaxed.

DATA ANALYSIS

Variable	**FASH**
Mean	**5.35**
Standard Deviation	**3.786**
S.E	**0.793**
T value	**5.091**

Conclusion:- T-value is highly significant at 2% level

TADASANA highly significant for Flat Foot.

RESULTS:-

It shows statistically significant improvement in:

Pre intervention or post intervention scores of VAS scale.

DISCUSSION

The results of this study supported hypothesis that ***TADASANA*** is significant in the patients with Flat Foot than general exercises. There were greater improvements in the group that received ***TADASANA*** therapy. Using the criteria of **Ferreira PH, and Rackwitz B,** also reported that specific Progressive exercises was better than ordinary medical care and treatment by a general practitioner for reducing stretching pain. ***TADASANA*** was found very effective as part of yoga also,major effects on thigh,calf and planter surface muscles with help of simultaneous movements to lower limbs from distal to proximal without having any side effects.

Limitations: This study was characterized by some limitations . The first common limitation was that the findings were based on short data. Another limitation was that some article did not contain much sufficient information for evaluating the quality and clinical relevance of data.

CONCLUSION

TADASANA was more efficient in reducing Flat Foot pain and disability of lower limb of patient.

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"PREVALENCE OF PROLAPSED INTERVERTEBRAL DISC (PIVD) IN CAB DRIVERS: A CROSS SECTIONAL STUDY"

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ABSTRACT:

TITLE:

Prevalence of Prolapsed Intervertebral Disc (PIVD) in Cab Drivers: A cross sectional study

BACKGROUND:

Low backpain is very common and usually occupation related. This study aimed at determining the prevalence of PIVD in cab drivers by seeing at the low back disability index due to bad posture of sitting and duration of driving in the cab drivers.

METHODOLOGY:

It is cross-sectional study in which 200 cab drivers has been screened for the presence of PIVD. 200 participants who were fulfilling the inclusive criteria has been taken. Then the researcher has explained about the research and the topic of research to the participants. Researchers has also explained about the PIVD, LBP which may further leads to PIVD and proper ergonomics while driving to prevent the PIVD. Participants with acute or sub-acute low back pain has been recruited. And their consent has been taken. SLR Special Test has been used to diagnose the PIVD. Then the researcher has explained about the special test and had

performed it on the participant. If the test of a participant has been positive, he has been advised further for the radiological investigations to check the severity of the bulge and further the physiotherapy treatment has been provided to the participant.

RESULT:

Total 200 patients were included in this study based on the inclusion and exclusion criteria. After filling the online consent form. Special test (SLR Test) is performed on the individual to diagnose the PIVD. Statistical analysis was done. All outcome measure(ODI) were analysed at the end of study. After doing the pivot study on the collected data we have found that around 41% of the cab drivers have radiating pain. among which 32% of drivers had moderate low back disability,7.5% had severe disability,1% were crippled and 0.5% had minimal low back disability resulting in hampering performance with the daily life activities and social life. Study identified the duration of driving and type of seating posture while driving as risk factors for low back pain which can further leads to PIVD among the participants.

CONCLUSIONS:

Study concludes that 41% drivers where having radiating pain among which 32% of drivers had moderate low back disability,7.5% had severe disability,1% were crippled and 0.5% had minimal low back disability resulting in hampering performance with the daily life activities and social life. Study identified the duration of driving and type of seating posture while driving as risk factors for low back pain which can further leads to PIVD among the participants.

KEYWORDS:

Low back pain, Cab drivers, Posture, Prolapsed Intervertebral Disc

INTRODUCTION

INTRODUCTION

Back pain is a very common malady next only to headache and affects nearly 80% of population. Low back pain is the pain which occurs at the lower back region due to muscle tension or stiffness. LBP is the most common problem and it is reported that more than 70% of people in developed countries suffers from LBP.[1]

Most common cause of back pain is bad posture which increases the strain on the Intervertebral disc and ligaments causing faster disc degeneration. Pain can arise from Intervertebral disc, ligaments, joints, muscles, nerves, etc. Other Causes of LBP- Muscles Strain or sprain, PIVD, disc degeneration, sciatica, spinal stenosis, spondylolisthesis, etc.[1]

Any abrupt, unbalanced and unwarranted movements upset the stabilizing function of the back muscles increasing the load on the disc. Hence bad posture, over loading and abrupt unbalanced movements are the cause of disc prolapsed or disc rupture.[1]

Mechanical LBP: 80% of LBP are due to mechanical cause like back muscle strain, ligament sprain and disc problems. Muscles strain and sprains are due to sudden unaccustomed activities and improper postures.[1]

There are 23 discs throughout the spine. It is thinnest in the thoracic region and thickest in the lumbar region. Each disc is interposed between the pair of vertebral bodies.[1]

Intervertebral disc in adults are avascular, the cells within it are sustained by diffusion of nutrients into the disc through the pores in the bodies.[1]

Degeneration of the disc may be prompted by changes in the permeability of cartilage end plate. Movement and weight bearing helps in diffusion of disc.[1]

Disc consist of two parts centrally it is nucleus pulposus and peripherally it has annulus fibrosis. It is thick anteriorly and thin posteriorly more so in the posterolateral aspect. Hence posterolateral disc prolapse is more common.[1]

With age, water content of the disc decreases fibrous tissue and cartilaginous cells increases and the nucleus becomes granular and friable. Disc apart from giving the spine its mobility, functions as a shock absorber.[1]

Non-mechanical LBP: It is defined as low back pain not attributable to a recognizable, known specific pathology e.g., Infections, Tumors, Osteoporosis, Spine fracture, Cauda equine syndrome.[1]

Heavy lifting, repetitive movements & sitting at a desk all day can take a troll on your back.[1]

Common cause of occupational LBP: natural curves, which exerting to much force on back can cause injury. Repeating certain movements can lead to muscle fatigue or injury. Slouching can lead to muscle fatigue & injury. Percentage of prevalence: 73.5% in drivers

Intervertebral disc is under constant pressure with degenerative changes and weak state of disc the annulus can bulge into the space containing the nerve root causing pain due to compression.[1]

Types of Disc Prolapse- Disc Protrusion, Disc Extrusion, Disc Sequestration. LBP (Low Back pain) is a serious occupation disease. Driving is the job causing occupational LBP. Occupational LBP: It is the largest single health problem related to work observation and the most common cause of incapacity among workers, younger than 45 years old world wide, 37% of LBP was attributed to occupation. Employees whose job involves lifting, bending, twisting or repetitive spinal movements are, most at risk for these injuries.

It has been pointed out that the factors leading to occupational LBP includes exposure to vibration, repeatedly lifting any heavy objects, strained posture and sitting or standing work for prolong period of time.[2]

Due to driving car for prolonged period of time and poor comfort the stress on the spine increase which further can result to back pain and then to severe conditions like, PIVD (prolapsed Intervertebral disc), musculoskeletal problems, spondylolisthesis, etc.[2]

Can drivers have been found to have high prevalence rates of back problems.[2]

Due to prolong sitting in particular position while driving car can cause stiffness in the back and also in legs and driving the car on rough roads without understanding proper ergonomics can lead to major problems.[2]

Due to uncomfortable seat and without knowing the proper ergonomics driving car for prolong period of time can cause major spine problems.[2]

Some studies have shown that driving professional is associated with the risk factors. Various environmental factors combine to overload the vertebral column and its supportive structures. During car driving excessive exposure to whole body vibration due to rough roads or potholes.[3]

Due to the rough & uneven roads as well as poor & prolonged sitting posture will create major stress on spinal area. Although, it is the major contributing factors for the higher onset & development of musculoskeletal conditions among professional cab or car drivers. [4]

Lesion in an Intervertebral disc are the most common cause of low back pain & sciatica. The annual incidence of low back pain is estimated at 5% but only 1% develops radiculopathy lumbar disc prolapsed is a disease most common between 30-50 years' age with a male preponderance as associated with repeated mechanical force. It may occur at any level but 95% of disc prolapse occur at L4-L5 or L5-S1.[4]

Symptoms of lumbar disc herniation are relatively common in the general population although the prevalence rates vary widely different studies symptoms severity also varies and in many patient pain

and loss of function may lead to disability and some measure spine problems. Physiotherapy treatment is choice in patient with symptoms caused by lumbar disc herniation.[4]

In clinical practice a broad range of physio therapeutic modalities such as TENS, ULTRASOUND, IFT, SWD, TRACTION and cryotherapy has been revealed to be helpful.[4]

Study aimed to investigate the prevalence of male cab drivers who operates cabs. Usual history of lumbar disc herniation is of repetitive LBP, radiating to the buttocks and decreased by rest.[5]

Pain is increased by flexion, sitting, straining, sneezing, coughing, etc. Pain is decreased by rest and in semi-fowler positions. Radiculopathy- This refers to pain in the distribution of the sciatica nerve and is invariably due to disc herniation this is called sciatica.[6]Nerve root compression about 95% of disc prolapse takes place through the L4-L5 region compressing the L5 nerve root. The other nerve roots commonly involved are L4 and S1 due to disc prolapsed between L3-L4 and L5-S1 respectively [7]

REVIEW OF LITERATURE

REVIWE OF LITRATURE:

1. **Occupational factors associated with low back pain in urban taxi drivers.**

   Jiu - Chiuan Chen, Wen – Ruey and David Christiani (2005)[8]

A cross- sectional data was collected from the taxi drivers. Health study standardized instrument were used to collect the information on personal factors, work related, physical & psychosocial factors and driving time profiles LBP prevalence was assessed using the modified Nordic Musculoskeletal Questionnaire. The results show that of 1242 drivers, 5% reported LBP in the past 12 months they found that driving time >4hrs/day, frequently bending / twisting activities while driving are the major occupational factors significantly associated with higher LBP prevalence in taxi drivers. ($p<0.001$)

2. **Low back pain disorders in agricultural tractor drivers exposed to whole- body vibration and postural stress.**

   Massimo Bovenzi, Alberto Betta (1994)[9]

Occurrence of LBP was investigated in a population of 1155 tractor drivers exposed to whole body vibration & postural stress (response rate 91.2%) & in a control group of 220 office worker (response rate 92.2%) subjects were questioned about several types pf low back symptoms and various work & individual related risk factors, by using a standard questionnaire. Prevalence of LBP was found to be greater in the tractor drivers. LBP were found to be significantly associated with both vibration and postural loads. Prolong sitting or standing in one position and due to poor posture the stress on the spine increases which can leads to musculoskeletal problems & may further lead to PIVD. More exposure data are needed in order to improve the knowledge of relationship between whole body vibration exposure & LBP among professional drivers. ($p<0.05$)

3. **Manual Therapy for Management of Lumbar PIVD- an Innovative Approach.**

   P P Mohanty, Monalisa Pattnaik (2015)[10]

Disc Prolapse mainly occurs in L4-L5 or L5-S1 and these is most common in 30-50-year age group peoples. In this study 75 subjects with acute or sub-acute LBP due to PIVD were recruited &randomly distributed in one of the three groups. Outcome measures: pain by visual analog scale (VAS) & functional outcome measures by Oswestry disability index (ODI). Result of the study shows significant change in pain & function for all the groups after 4 weeks of treatment. At the end of treatment there was significant difference between the groups for functions.

4. Driving of motor vehicles as a risk factor for acute herniated lumbar intervertebral disc.

Jennifer L. Kelsey and Robert J. Hardy (1975)[11]

In this study of the epidemiology of the acute herniated lumbar intervertebral disc in New Haven, connected area it was found that driving a motor vehicles was associated with an (increased) risk for developing herniated disc. In this study the participants are divided into the two group and diagnosed by the examiner with the special test by the SLR & x-ray. The study shows that the men who spend half or more of their job a motor vehicles are about three times as likely to develop acute herniated lumbar disc those who do not hold such jobs. Some of the limitation of the study such as disappointing response rate (78%), the lack of control group of general population, small sample size.

5. Prevalence of low back pain in car drivers and non-drivers.

Lenka Gallais (2008)[12]

This study investigated whether there is evidence of an associated between car driving and LBP & evidence that whole body vibration contributes to LBP in car drivers. There are many limitations that arise from factors such as the study design choice of study population, sample size, response rate and the large number of factors that can influence back pain. Some studies have reported (increased)

driving, but number study has shown that the risk of LBP is greater with increased exposure to the whole body vibration from car driving further studies are needed to verify the relationship between risk factor & LBP in car divers.

6. **Therapeutic effects of selective nerve root block in case of lumbar PIVD- A prospective study.**

   Sanjiv Kumar, Reetu Verma, Gaurav Chahal, Ashish Kumar, Shah Walliulah (2019)[13]

This prospective analytic study was designed to assess the efficacy of selective nerve root block with corticosteroids in the management of pain associated with PIVD that didn't get relief from non-surgical pharmacological treatment. In this study 40 known cases of lumbar PIVD not responding to the pharmacological treatment were given guided root & results were evaluated using VAS, ODI & SLR test over the period of 1,3,6 & 12 months. Result show that the lifetime prevalence of lumbar radiculopathy has been reported to be 5.3% in men and 3.7% in women.5, 6 Lumbar radiculopathies due to a prolapsed disc resolves spontaneously in 23-48% of patients, but up to 30% will still have pronounced symptoms after one year, 20% will be out of work, and 5-15% will undergo surgery.

7. **Health survey of professional drivers.**

   Backman AL (1983)[14]

In Finland an investigation carried out in 1979- 1980 included both a health screening and an inquiry about the work conditions of active drivers. A cross-sectional health survey comprising of 633 male drivers showed that the, frequencies of complaints, for instance pain in the back, shoulder & neck increased in old age groups. The study showed that the most common health problem was back pain & shoulder pain. About 70% of drivers had suffered from the back pain & shoulder pain during the last month ergonomic factors concerning work posture & movements will probably explain the high frequencies of back & shoulder.

8. Drivers of international variation in prevalence of disabling low back pain.

D. Coggon et.al. (2018)[15]

This study investigated the prevalence of disabling LBP among working population is not explained by known risk factors. Baseline information about musculoskeletal pain and risk factors was elicited from 11710 participants aged 20-59 years. Who were sampled from 45 occupation groups in 18 countries. After allowance for other known and suspected risk factors, pain propensity showed the strongest association with disabling LBP. The findings indicate that difference in general propensity to musculoskeletal pain are a major driver of large international variation in the prevalence of disabling LBP among people of working age.

9. A Comparison between the low back pain scales for patients with lumbar disc herniation: validity, reliability, and responsiveness

Min Yao at.al (2020)[16]

Study aimed to compare the following scales ODI, NPRS, SF-36, RMDQ, JOABPEQ in lumbar disc herniation patients receiving conservative treatment to select the better option to assess the severity of disease. Total 353 LDH patients were enrolled for this study. The relationship of these scales were evaluated by the person correlation coefficient the results shown that the NPRS, ODI or RMDQ is recommended in studies related to LDH patients. While if the quality of life also is needed to observe, the NPRS & JOABPEQ would be the more appropriate rather than SF-36.

10. The Sensitivity and Specificity of the Slump and the Straight Leg Rising Tests in Patients with Lumbar Disc Herniation

Javid Majlesi, Halit Togay, Halil Unalan, Sadik Topark (2008)[17]

Study aimed to measure the sensitivity & specificity of the slump test and compare it with SLR test in patient with & without lumbar disc herniation. 75 patients with complaints suggestive of lumbar disc herniation were enrolled both slump and SLR test were performed on the patients. Result shown that the slump test was more sensitive than SLR in the patient with lumbar disc herniation however, the SLR was found to be slightly move specific test than slump test

NEED OF STUDY

NEED OF THE STUDY

To investigate the prevalence of PIVD and its risk factors among cab drivers.

There are so many studies have been provided the information regarding the relation of LBP with various spinal conditions. Also some articles gave the information about prevalence of LBP in various workers. But no study has been done on cab drivers, so this study will provide proper prevalence of PIVD in cab drivers.

To improve knowledge of cab drivers by making them understanding about the proper ergonomics which reduces the risk of PIVD.

OBJECTIVES OF THE STUDY

OBJECTIVE OF THE STUDY

To determine whether the PIVD is more prevalent in car drivers.

To improve knowledge of cab drivers by making them understand about the proper ergonomics.

To improve understanding of the risk factors which may contribute to the development or progression of the symptoms of PIVD.

HYPOTHESIS

HYPOTHESIS

Null hypothesis: There is no correlation between lumbar PIVD and cab drivers.

Research hypothesis: There is correlation between lumbar PIVD and cab drivers.

MATERIALS AND METHODS

MATERIALS AND METHODS

STUDY DESIGN: A cross sectional study

SOURCE OF DATA: Cab drivers from Ahmedabad (Gujarat)

POPULATION: PIVD (age: 25- 60years)

METHOD OF COLLECTION OF DATA: Convenient Method

SAMPLE SIZE: 200

DURATION OF STUDY: 6 Months

MATERIALS AND TOOLS

Mat: For performing the special test on participant to diagnose PIVD participant had lie down on the mat

Pen: For writing the details of participants

Paper: To write the details of participants

Scales: To measure the outcomes

METHOD OF COLLECTION OF DATA

INCLUSION CRITERIA:

1. Patient complaining of low back pain along with or without radiculopathy in one leg or both the legs.
2. Time duration of car driving is 4-5hrs/day.
3. Acute or sub-acute low back pain which is not chronic.
4. Limited straight leg rise(SLR) 30°-70° or positive sciatica syndrome. (sciatica syndrome- sciatic nerve becomes pinched, usually by a herniated disk in your spine or overgrowth of bone on your vertebrae)
5. Lumbar flexion, extension and side flexion to the painful side will produce original symptom**.** Numbness in genital area, Pain behind the shoulder blade or in buttocks, Tingling in one or both arms or legs, Loss of control of bladder/ bowels.

EXCLUSION CRITERIA:

1. Patient /Cab driver who don't have any symptoms of back pain and leg pain.
2. The exclusion criteria included:
3. patients with prior back surgery
4. impending Cauda equine syndrome or with Cauda equine syndrome
5. back or leg pain due to other etiologies.

OUTCOME MEASURES

- **Oswestry disability index (ODI):** The Oswestry disability index is an index derived from the Oswestry Low Back Pain Questionnaire used by clinicians and researchers to quantify disability for low back pain.

METHODOLOGY

METHODOLOGY

1. It is cross-sectional study in which 200 cab drivers has been screened for the presence of PIVD.
2. 200 participants who will fulfilling the inclusive criteria has been taken.
3. Then the researcher has explained about the research and the topic of research to the participants.
4. Researchers has also explained about the PIVD, LBP which may further leads to PIVD and proper ergonomics while driving to prevent the PIVD.
5. Participants with acute or sub-acute low back pain has been recruited.
6. And their consent has been taken.

Examination of the Back –

1- Inspection (Note any postural defect)

2- Palpation – Tenderness

- Movements (All the movements of spine has been tested)

3- Evaluation of neurological system:

- Dermatomal and myotomal distribution are carefully analyzed to detect the level of lesion

4- Clinical Test: Test are based on stretching of the sciatica nerve over the prolapsed disc.

a) Forward bending to touch the toes.
b) Sitting and alternatively extending one leg and then the other.
c) Slump test: Sitting bent forward and extending one leg and then the other.
d) Straight Leg Raising Test (SLRT): Participant is in supine position. the examiner raises the leg of the patient straight one after the other. Up to 30° nerve is not put under stretch between 30°-70° nerve comes into contact with the prolapsed disc and the participant complains of pain. Beyond 70° if participant complains of pain it is usually not due to disc prolapsed but could be due to sacroiliac joint involvement

7. SLR Special Test has been used to diagnose the PIVD.
8. Then the researcher has explained about the special test and had performed it on the participant.
9. If the test of a participant has been positive, he has been advised further for the radiological investigations to check the severity of the bulge and further the physiotherapy treatment has been provided to the participant.
10. Researcher has explained about the proper sitting ergonomics while driving to prevent the PIVD.
11. Back Ergonomics: This is an extremely important aspect of back pain management as it helps in preventing recurrence. It consists of:

a) Proper postural habit

b) Proper work environment

c) Back exercises

d) Modifications of Daily routine activities

a) Sit close the steering wheel as is comfortable.
b) Place a small pillow beneath the lumbar curvature to preserve the normal lordosis.
c) Use the rear view mirror frequently and do not turn back those the vehicles.
d) Keep the knee bent.
e) Avoid stress in life by proper planning and meditation.

FLOW CHART:

Participants has been selected by the inclusive and exclusive criteria.

↓

Subjects has been selected by the convenience sampling method.

↓

Participants with LBP has been selected.

↓

Participants consent has been taken.

↓

Special test had been performed to diagnose the prevalence of PIVD.

↓

Outcome measures has been taken.

↓

Participants with PIVD has been selected for this study.

↓

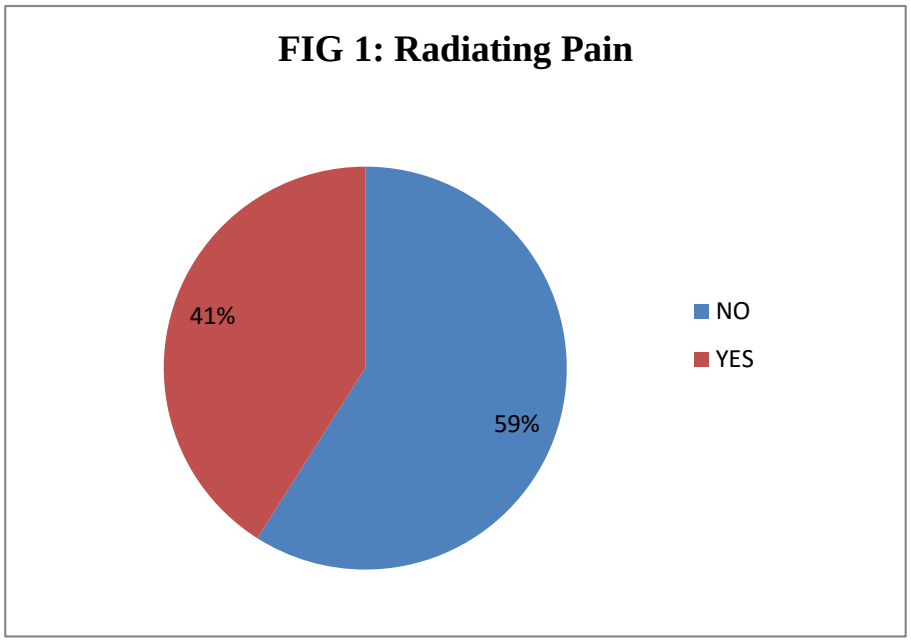
Statistical Data analysis has been done.

RESULT

RESULT:

Total 200 patients were included in this study based on the inclusion and exclusion criteria. After filling the online consent form. Special test (SLR Test) is performed on the individual to diagnose the PIVD.

Statistical analysis was done. All outcome measure(ODI) were analysed at the end of study.



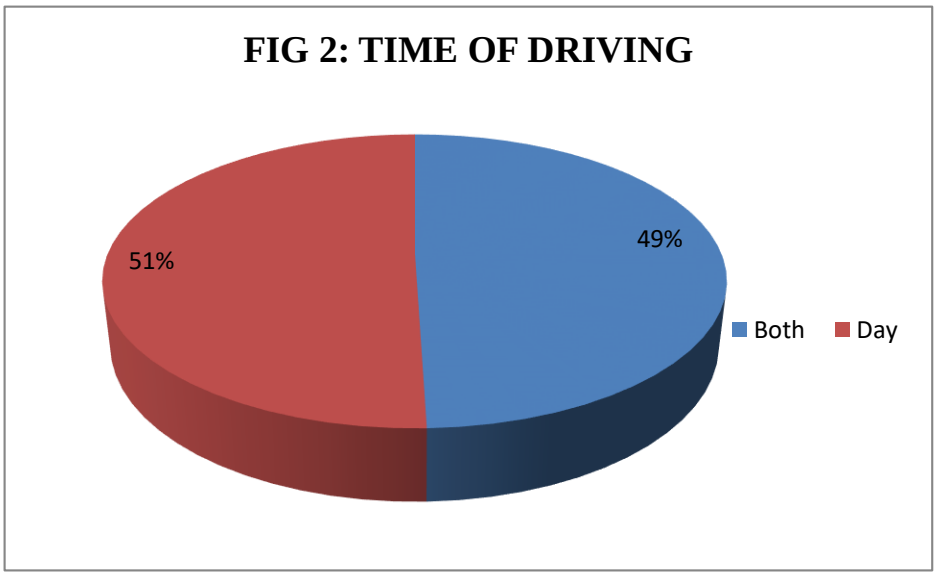


FIG 2: TIME OF DRIVING
49%
51%
Both
Day

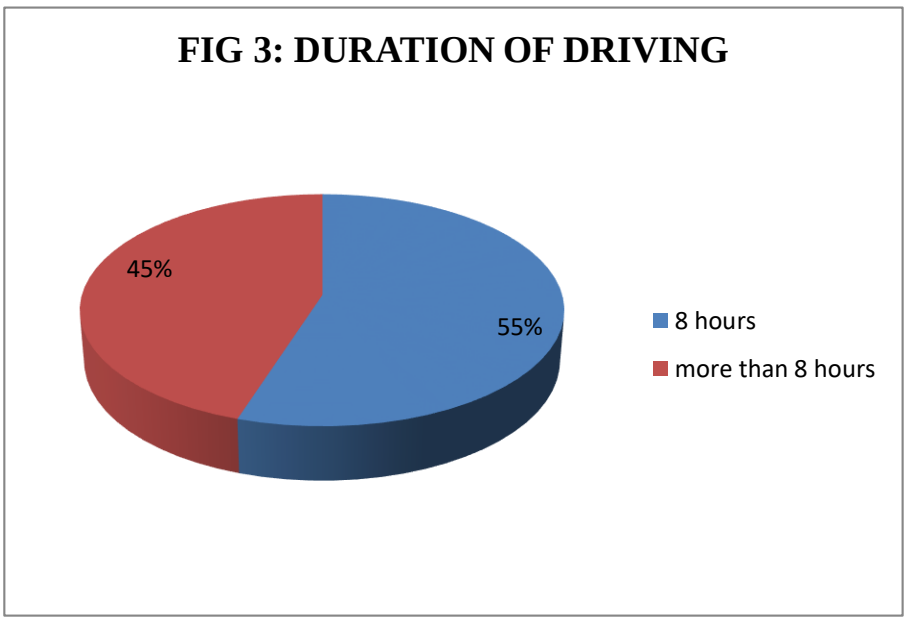


FIG 3: DURATION OF DRIVING
45%
55%
8 hours
more than 8 hours

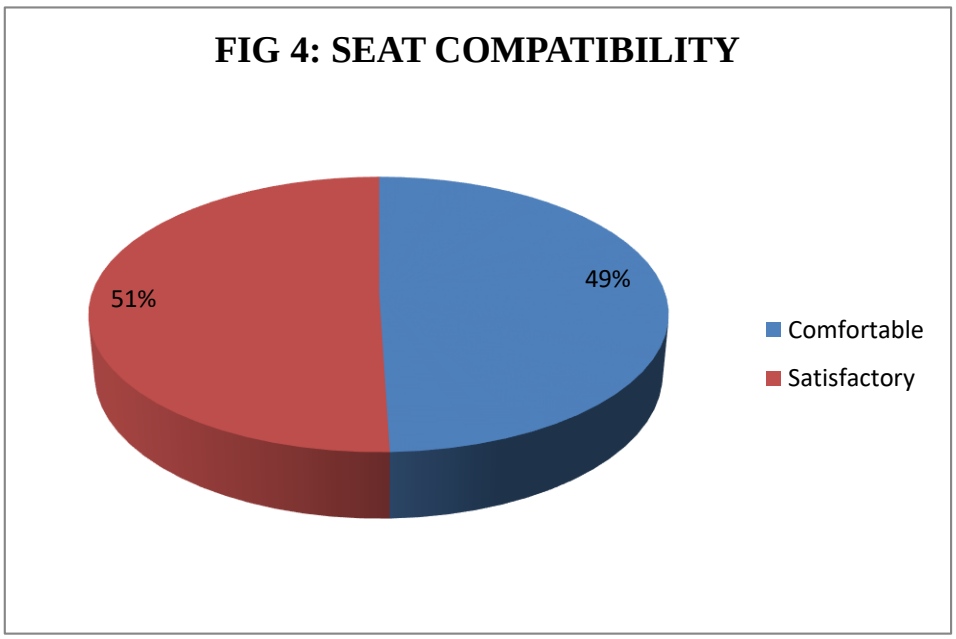


FIG 4: SEAT COMPATIBILITY
49%
51%
Comfortable
Satisfactory

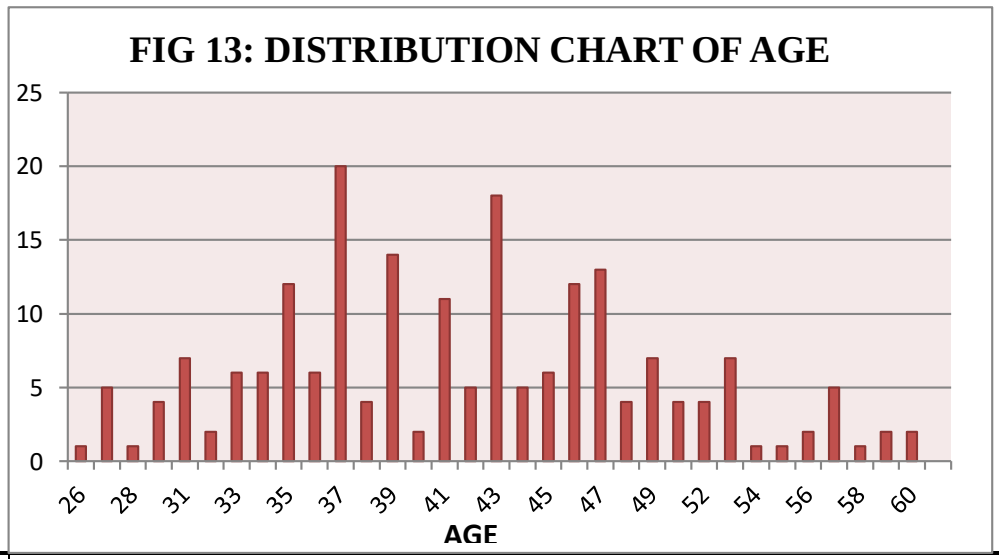


FIG 13: DISTRIBUTION CHART OF AGE
25
20
15
10
5
0
26
28
31
33
35
37
39
41
43
45
47
49
52
54
56
58
60
AGE

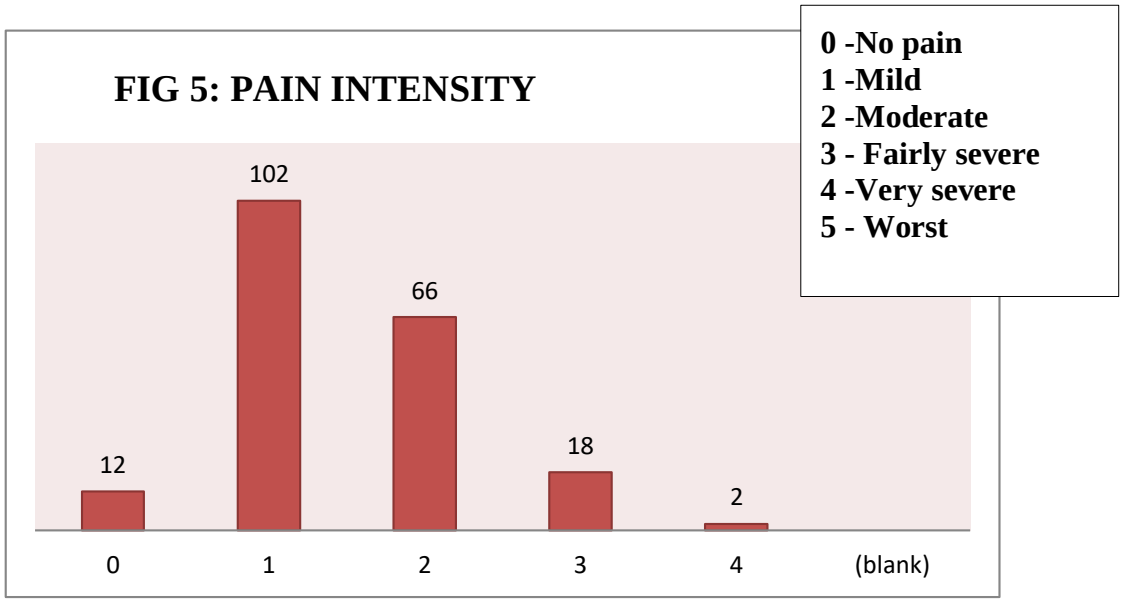


FIG 5: PAIN INTENSITY
0 -No pain
1 -Mild
2 -Moderate
3 - Fairly severe
4 -Very severe
5 - Worst
102
66
12
18
2
0
1
2
3
4
(blank)

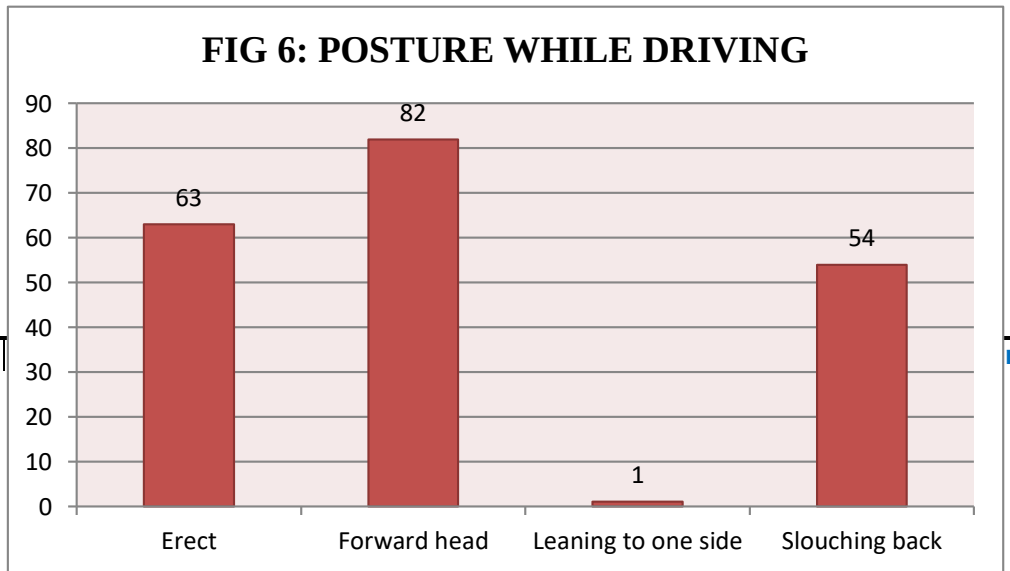


FIG 6: POSTURE WHILE DRIVING
90
80
70
60
50
40
30
20
10
0
63
82
1
54
Erect
Forward head
Leaning to one side
Slouching back

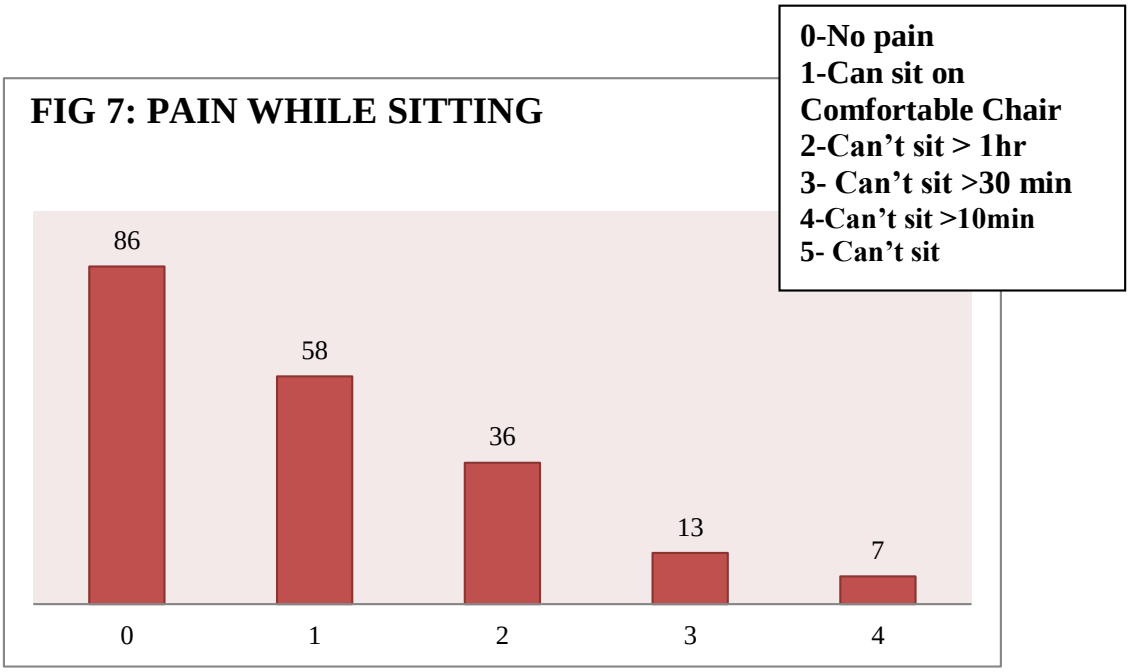


FIG 7: PAIN WHILE SITTING
0-No pain
1-Can sit on Comfortable Chair
2-Can't sit > 1hr
3- Can't sit >30 min
4-Can't sit >10min
5- Can't sit
86
58
36
13
7
0
1
2
3
4

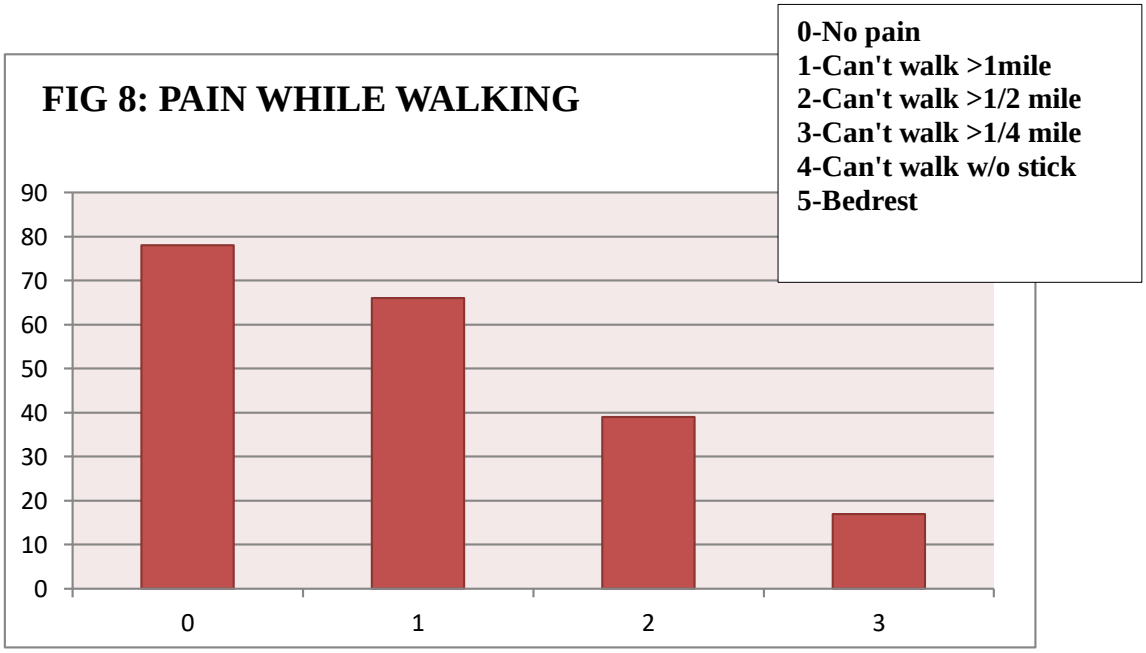


FIG 8: PAIN WHILE WALKING
0-No pain
1-Can't walk >1mile
2-Can't walk >1/2 mile
3-Can't walk >1/4 mile
4-Can't walk w/o stick
5-Bedrest
90
80
70
60
50
40
30
20
10
0
0
1
2
3

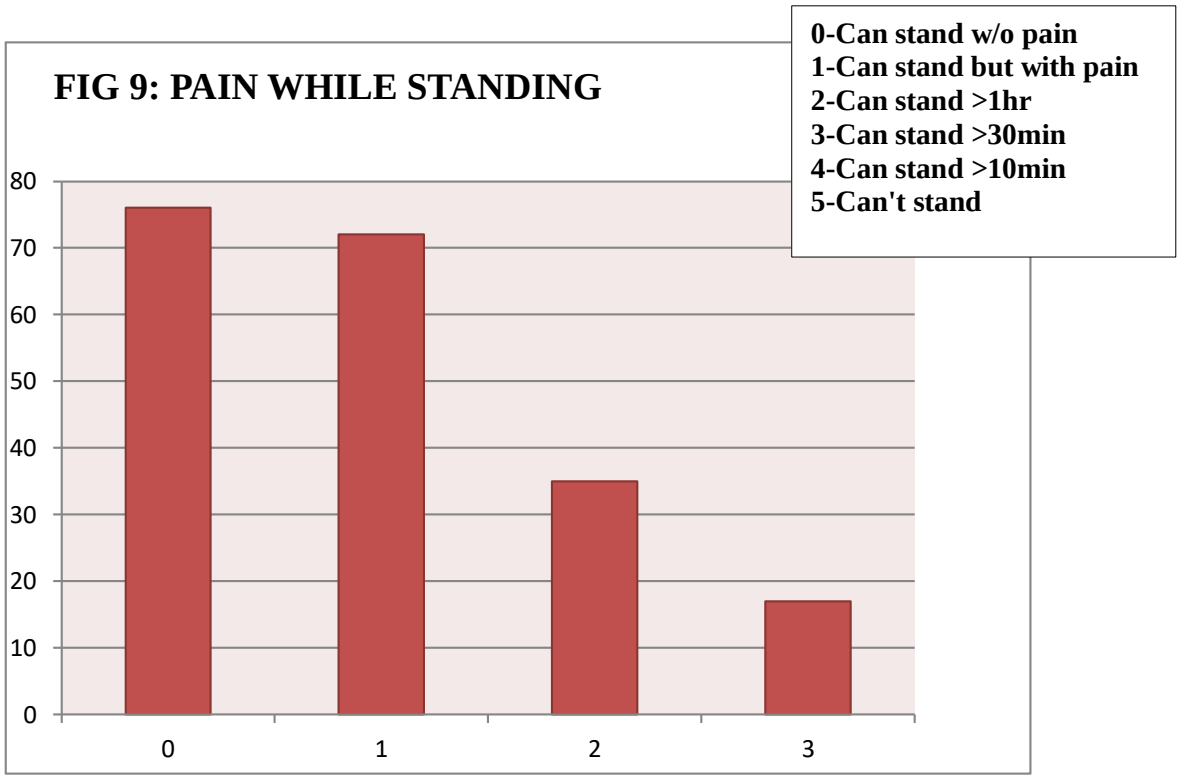


FIG 9: PAIN WHILE STANDING
0-Can stand w/o pain
1-Can stand but with pain
2-Can stand >1hr
3-Can stand >30min
4-Can stand >10min
5-Can't stand
80
70
60
50
40
30
20
10
0
0
1
2
3

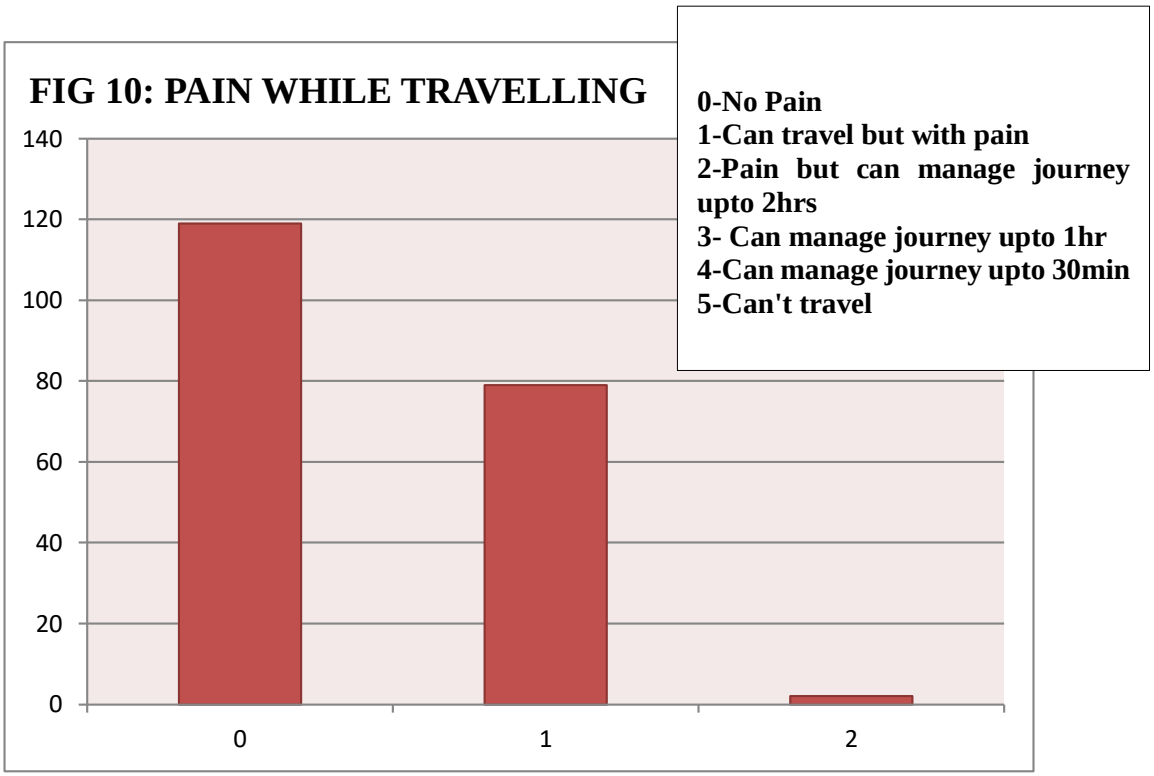


FIG 10: PAIN WHILE TRAVELLING
140
120
100
80
60
40
20
0
0
1
2
0-No Pain
1-Can travel but with pain
2-Pain but can manage journey upto 2hrs
3- Can manage journey upto 1hr
4-Can manage journey upto 30min
5-Can't travel

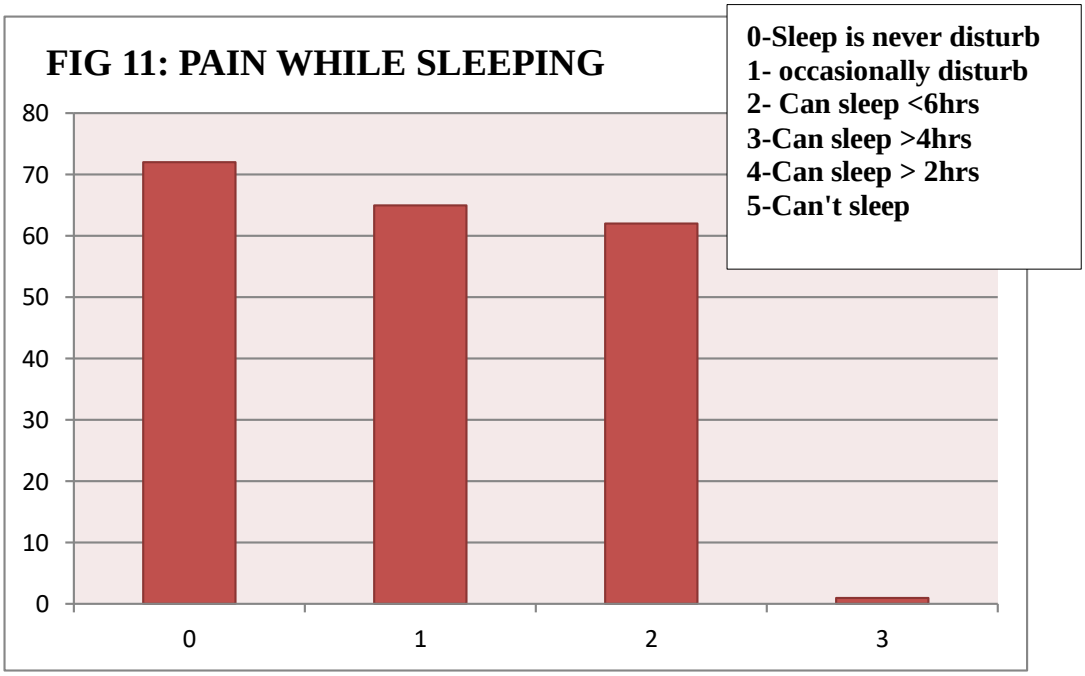


FIG 11: PAIN WHILE SLEEPING
80
70
60
50
40
30
20
10
0
0
1
2
3
0-Sleep is never disturb
1- occasionally disturb
2- Can sleep <6hrs
3-Can sleep >4hrs
4-Can sleep > 2hrs
5-Can't sleep

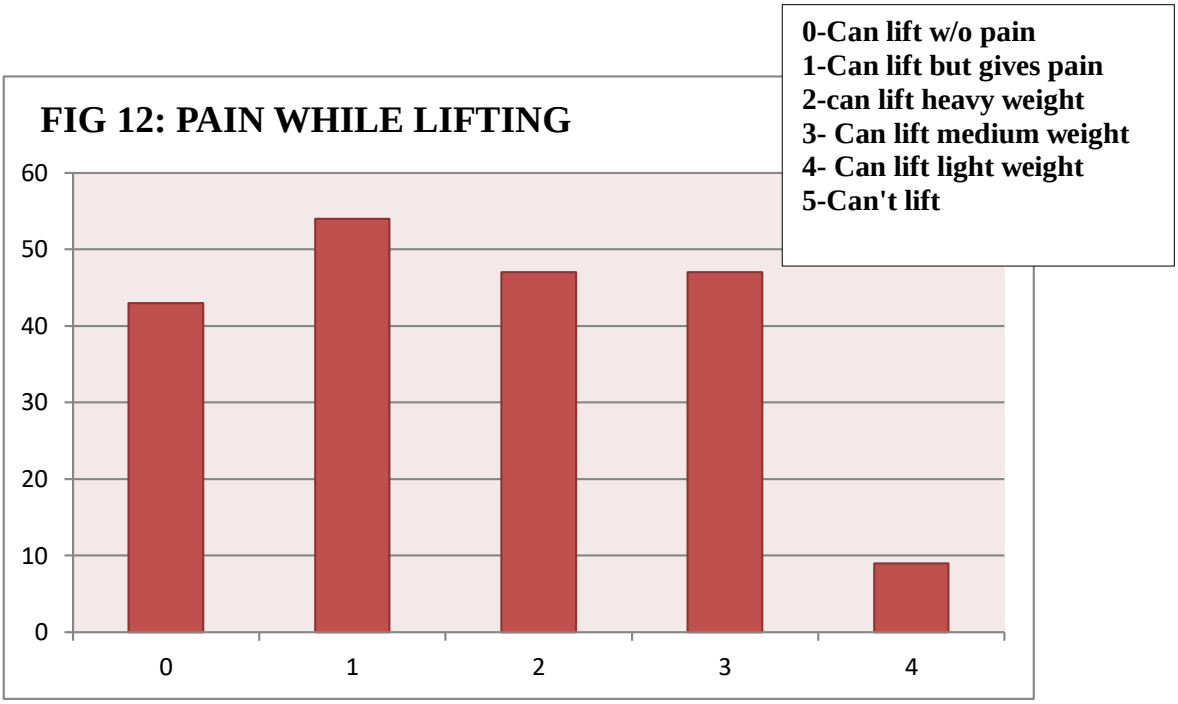


FIG 12: PAIN WHILE LIFTING
60
50
40
30
20
10
0
0
1
2
3
4
0-Can lift w/o pain
1-Can lift but gives pain
2-can lift heavy weight
3- Can lift medium weight
4- Can lift light weight
5-Can't lift

FIG NO	NAME OF THE GRAPH		RESULTS
1	RADIATING PAIN (% OF PEOPLE HAVING RADIATING PAIN)		
	A	YES	41%
	B	NO	59%
2	TIME OF DRIVING		
	A	DAY	51%
	B	BOTH	49%
3	DURATION OF DRIVING		
	A	8 HOURS	55%
	B	MORE THAN 8 HOURS	45%
4	SEAT COMPACTIBILITY		
	A	COMFORTABLE	49%
	B	SATISFACTORY	51%
5	PAIN INTENSITY		
	A	NO PAIN	6%
	B	MILD PAIN	51%

	C	MODERATE	33%
	D	FAIRLY SEVERE	9%
	E	VERY SEVERE	1%
	F	WORST	0%
6	POSTURE WHILE DRIVING		
	A	ERECT	31%
	B	FORWARD HEAD	41%
	C	SLOUCHING BACK	27%
	D	LEANING TO 1 SIDE	1%
7	SITTING		
	A	0-NO PAIN	43%
	B	1-CAN SIT ON COMFORTABLE CHAIR	29%
	C	2-CAN'T SIT > 1HR	18%
	D	3- CAN'T SIT >30 MIN	6%
	E	4-CAN'T SIT >10MIN	4%
8	WAKING		
	A	0-NO PAIN	39%
	B	1-CAN'T WALK >1MILE	33%

	C	2-CAN'T WALK >1/2 MILE	19%
	D	3-CAN'T WALK >1/4 MILE	9%
9	STANDING		
	A	0-CAN STAND W/O PAIN	38%
	B	1-CAN STAND BUT WITH PAIN	36%
	C	2-CAN STAND >1HR	17%
	D	3-CAN STAND >30MIN	9%
10	TRAVELLING		
	A	0-TRAVEL W/O PAIN	59%
	B	1-CAN TRAVEL BUT WITH PAIN	40%
	C	2-PAIN BUT CAN MANAGE JOURNEY UPTO 2HRS	1%
11	SLEEPING		

	A	0-SLEEP IS NEVER DISTURBED	36%
	B	1- OCCASIONALLY DISTURBED	32%
	C	2- CAN SLEEP <6HRS	31%
	D	3-CAN SLEEP >4HRS	1%
12	LIFTING		
	A	0-CAN LIFT W/O PAIN	21%
	B	1-CAN LIFT BUT GIVES PAIN	27%
	C	2-CAN LIFT HEAVY WEIGHTS	23%
	D	3- CAN LIFT MEDIUM WEIGHTS	24%
	E	4- CAN LIFT LIGHT WEIGHT	5%
13	INTERPRETATION OF SCORES		
	A	MINIMAL LOW BACK DISABILITY	0.50%
	B	MODERATE LOW BACK DISBILITY	32%

C	**SEVERE LOW BACK DISABILITY**	**7.50%**
D	**CRIPPLED**	**1%**

INTERPRETATION OF DATA(ODI SCALE)		**PREVALENCE OF PIVD IN CAB DRIVERS**	
0-20	MINIMAL DISABILITY	1	0.50%
20-40	MODERATE DISABILITY	64	32%
41-60	SEVERE DISABILITY	15	7.50%
61-80	CRIPPLED	2	1%
81-100		0	0%

FROM THE SAMPLE SIZE OF 200 WE HAVE FOUND THAT AROUND 41% OF THE CAB DRIVERS HAVE RADIATING PAIN.

AMONG WHICH 32% OF CAB DRIVERS ARE HAVING MODERATE DISABILITY,7.5%CAB DRIVERS HAVE SEVERE DISABILITY,1% ARE CRIPPLED AND 0.5% ARE AT MINIMAL DISABILITY RISK.

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DISCUSSION

DISCUSSION

In our study, prevalence rate of radiating pain was 41% among which 32% of cab drivers are having moderate disability it shows there is relation between cab drivers and PIVD the risk was identified among cab drivers on an average whose duration of driving was 8 hours or more than 8 hours and those who are driving from last 8-10years on an average.

In our study 51% of cab drivers were driving in daytime and 49% of cab drivers were driving during day and night both.

40% of drivers have travel difficulties due to pain,64% of drivers have sleep disturbances due to pain.

Almost all men in occupation involving professional driving had a statistically significant elevated risk of PIVD.

There are many limitations arise from factors such as the study design, the choice of sample population, sample size, type of question, response rate and large number of factors that can influence the backpain.

The reviewed studies mostly conclude that car driving is associated with increased risk of low backpain. Some studies have reported increased risk of low backpain with increased driving but no study shown that the risk of low backpain is greater with increased exposure to whole body vibrations from car driving.

In these cross sectional baseline study,45% of taxi drivers,53% of police drivers and 46% of police non-drivers reported experiencing low backpain for at least one day during the past

12 months (chi square test; p=0.09)

Chen JC et.al in this study the cross sectional analyses of data suggested that the urban taxi drivers were at high risk group for work related low backpain they observed association between long duration of car driving and low backpain conforms to previous studies on other occupational groups

often operating small auto mobiles. Found that driving a car or van for >4h/day was associated with a high prevalence of low backpain in past 12 months.[1]

27% of drivers has slouching back posture and 41% have forward head posture which further leads low backpain and neck pain respectively. Sitting for prolonged period of time can be major cause of backpain, because Sitting for prolonged periods of time can be a major cause of backpain, because increased stress of the back, neck, arms and legs and can add a tremendous amount of pressure to the back muscles and spinal discs. Additionally, sitting in a slouched position can overstretch the spinal ligaments and strain the spinal discs. When seated with a lumbar support, the intrinsic and abdominal muscles are no longer active. They cease to support your spine as it rests. Weight on each disc becomes uneven, and disc bulge occurs. The extrinsic and intrinsic muscles (which are smaller and shorter) become weaker and overstretched. Using the lumbar support found in all seats also reduces circulation to these muscles as person lay against them. Most of the people do not use seats upright properly, and over time, may slouch while seated. Here the pelvis develops a posterior tilt, leading to greater disc imbalance and risk or injury.

Placing arms and hands steering wheel, allows us to relax the upper body further. Relaxing exacerbates the curve in spine. Our natural and balanced lumbar S-shaped curve becomes a C-shaped curve. Other muscles like the abdominals and the transverse abdominals relax, resulting in less support. Hamstring and quadriceps muscles become progressively shorter (and weaker). The progression causes them to pull on the pelvis during activity, thereby reducing our pelvic mobility. The progression causes them to pull on the pelvis during

activity, thereby reducing our pelvic mobility. The inclination of the seat back to an angle of 100-110 is preferred as, this angle decreases the pressure on the discs in the low back. And in our study 61% of drivers was having difficulties while walking and 79% of them were having difficulties while lifting. The extensor muscles are attached to back of the spine. They enable standing and lifting objects. These muscles include the large paired muscles in the lower back, called erector spine, which help hold up the spine, and gluteal muscles. The flexor muscles are attached to the front of the spine and enable flexing, bending forward, lifting, and arching the lower back. The oblique

muscles are attached to the sides of the spine and help rotate the spine and maintain proper posture. Overusing, bad posture leads to malalignment of muscles which leads to inflammation in the muscle and then pain. Which results in activity limitations such as lifting heavy objects and walking. And 62% of drivers have pain on prolonged standing. The extensor muscles are attached to back of the spine. They enable standing and lifting objects. These muscles include the large paired muscles in the lower back, called erector spine, which help hold up the spine, and gluteal muscles. The flexor muscles are attached to the front of the spine and enable flexing, bending forward, lifting, and arching the lower back. The oblique muscles are attached to the sides of the spine and help rotate the spine and maintain proper posture. Overusing, bad posture leads to malalignment of muscles which leads to inflammation in the muscle and then pain. Which results in activity limitations such as lifting heavy objects and walking. The association between bending, twisting movements while behind the wheel and higher prevalence of LBP is also supported by recent reports from biomechanical experiments. Because LBP is such a common musculoskeletal disorder, it is possible that prolonged driving may not be an etiological factor but an occupational factor related to progression or recurrence of

existing LBP symptoms. High LBP frequency in taxi drivers was associated with prolonged driving time frequent bending, twisting activities while driving.

In this study Bovenzi et.al. a significant trend of increasing occurrence of disc protrusion was threefold higher among the tractor drivers compared with the controls. It has been reported that the professional drivers have an excess risk of herniated disc or rupture of annulus fibrosus.[2]

LBP has been identified as one of the costliest disorder in the worldwide population and activities such as sitting, whole body vibration and awkward postures have been associated with the risk of developing LBP. Uncomfortable seats, back support and gear level were observed to be associated with the higher prevalence of LBP.

Previous studies show that some type of car seats contribute to the development of LBP, particularly in people who drive for prolong period of time. The car seat and its backrest usually keeps the drivers hip in an angle of 90° or less, thus predisposing the lower lumbar disc to a great pressure: the

resultant forces subsequently contributes to injury of the low back and degeneration of lumbar spine. Additionally, sitting in a slouched position can overstretch the spinal ligaments and strain the spinal disc.

Study identified the duration of driving, type of seating posture, radiating pain and pain while doing any ADL (Activity of Daily Living) while driving as risk factors for PIVD among the cab drivers. Thus, our aim of study was to find out is there any relation between PIVD and cab drivers in Indian Cab Drivers. And our objective of the research which to analyses the prevalence of PIVD in cab drivers with LBP concludes that 41% of drivers had radiating pain among which 32% had moderate disability,7.5% had severe disability,1% were crippled and 0.5% had minimal disability.

CONCLUSION AND SUMMARY

CONCLUSION: Study concludes that 41% drivers where having radiating pain among which 32% of drivers had moderate low back disability,7.5% had severe disability,1% were crippled and 0.5% had minimal low back disability resulting in hampering performance with the daily life activities and social life. Study identified the duration of driving and type of seating posture while driving as risk factors for low back pain which can further leads to PIVD among the participants.

SUMMARY:

TITLE: Prevalence of Prolapsed Intervertebral Disc (PIVD) in Cab Drivers: A cross sectional study

AIMS & OBJECTIVES: To determine whether the PIVD is more prevalent in car drivers. To improve knowledge of cab drivers by making them understand about the proper ergonomics. To improve understanding of the risk factors which may contribute to the development or progression of the symptoms of PIVD.

BACKGROUND: Low backpain is very common and usually occupation related. This study aimed at determining the prevalence of PIVD in cab drivers by seeing at the low back disability index due to bad posture of sitting and duration of driving in the cab drivers.

METHODOLOGY: It is cross-sectional study in which 200 cab drivers has been screened for the presence of PIVD. 200 participants who was fulfilling the inclusive criteria has been taken. Then the researcher has explained about the research and the topic of research to the participants. Researchers has also explained about the PIVD, LBP which may further leads to PIVD and proper ergonomics while driving to prevent the PIVD. Participants with acute or sub-acute low back pain has been recruited. And their consent has been taken.SLR Special Test has been used to diagnose the PIVD. Then the researcher has explained about the special test and had performed it on the participant. If the test of a participant has been positive, he has been advised further for the radiological investigations to check the severity of the bulge and further the physiotherapy treatment has been provided to the participant.

RESULT: Total 200 patients were included in this study based on the inclusion and exclusion criteria. After filling the online consent form. Special test (SLR Test) is performed on the individual to diagnose the PIVD. Statistical analysis was done. All outcome measure(ODI) were analyzed at the end of study. After doing the pivot study on the collected data. We have found that around 41% of the cab drivers have radiating pain among which 32% of drivers had moderate low back disability,7.5% had severe disability,1% were crippled and 0.5% had minimal low back disability resulting in hampering performance with the daily life activities and social life. Study identified the duration of driving and type of seating posture while driving as risk factors for low back pain which can further leads to PIVD among the participants.

KEYWORDS: Low back pain, Cab drivers, Posture, Prolapsed Intervertebral Disc

LIMITATIONS

LIMITATIONS:

-Small sample size

-Only done in the particular area

FUTURE RECOMMENDATIONS:

Future research should replicate these findings in other large samples, area and investigate between the other musculoskeletal problems related with driving.

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ANNEXURE

MASTER CHART

NAME	Mukesh	Krishna	Ritesh	Ashok	Ajay	Dev	Raj	Deep
AGE	47	27	46	51	36	41	39	55
PAIN INTENSITY	1	0	0	2	1	1	0	1
RADIATING PAIN	No	No	Yes	Yes	No	Yes	No	Yes

DURATION OF DRIVING	8 hours	More than 8 hrs.	8 hrs.	8 hrs.	More than 8 hrs.	8 hrs.	More than 8 hrs.	8 hrs.
TIME OF DRIVING	Day	Both	Day	Day	Both	Day	Both	Day
SEAT COMPATIBILITY	Comfortable	Satisfactory	comfortable	Comfortable	Satisfactory	Comfortable	Satisfactory	Comfortable
POSTURE WHILE DRIVING	Forward head	Erect	Slouching back	Forward head	Erect	Slouching back	Forward head	Erect
PERSONAL CARE	1	0	0	0	0	0	0	0
SITTING	2	0	1	1	0	1	0	1
WALKING	1	0	0	0	0	0	0	0
STANDING	1	0	0	0	0	0	0	0
LIFTING	2	0	0	1	1	0	1	1
SLEEPING	1	0	0	0	0	0	0	0
TRAVELLING	1	0	1	0	0	0	0	0

PATIENT INFORMATION FORM

Name:

Age:

Gender

- Male
- Female

Mobile Number:

Q.1 Pain Intensity

- No pain
- Mild
- Moderate
- Severe
- Very severe
- Worst

Q.2 Radiating Pain

- Yes
- No

Q.3 Duration of Driving

- 8 hours
- More than 8 hours

Q.4 Time of Driving

- Day

- Night
- Both

Q.5 Seat Compatibility

- Comfortable
- Satisfactory

Q.6 Posture while Driving

- Slouching back
- Forward head
- Erect
- Leaning to one side

Q.7 Personal Care (washing, Dressing etc.)

- I can look after myself normally without Causing extra pain
- I can look after myself normally but it causes extra pain
- It is painful to look after myself and I am slow and careful
- I need some help but manage most of my personal care
- I need help every day in most aspects of self-care
- I do not get dressed, I was with difficulty and stay in bed

Q.8 Sitting

- I can sit in any chair as long as I like
- I can only sit in my favorite chair as long as I like
- Pain prevents me sitting more than 1 hours

- Pain prevents me from sitting more than 30 minutes
- Pain prevents me from sitting more than 10 minutes
- Pain prevents me from sitting at all

Q.9 Walking

- Pain does not prevent me walking any distance
- Pain prevents me from walking more than 5 minutes
- Pain prevents me from walking more than 10 minutes
- Pain prevents me from walking more than 15 minutes
- I can only walk using a stick or crutches
- I am in bed most of the time

Q.10 Standing

- I can stand as long as I want without extra pain
- I can stand as long as I want but it gives me extra pain
- Pain prevents me from standing for more than 1 hours
- Pain prevents me from standing for more than 30 minutes
- Pain prevents me from standing for more than 10 minutes
- Pain prevents me from standing at all

Q.11 Lifting

- I can lift heavy weights without extra pain
- I can lift heavy weights but it gives extra pain
- Pain prevents me from lifting heavy weights off the floor, but I can manage if they are conveniently placed eg. On a table

- Pain prevents me from lifting heavy weights, but I can manage light to medium weights if they are conveniently positioned
- I can lift very light weights
- I cannot lift or carry anything at all

Q.12 Sleeping

- My sleep is never disturbed by pain
- My sleep is occasionally disturbed by pain
- Because of pain I have less than 6 hours sleep
- Because of pain I have less than 4 hours sleep
- Because of pain I have less than 2 hours sleep
- Pain prevents me from sleeping at all

Q.13 Travelling

- I can travel anywhere without pain
- I can travel anywhere but it gives me extra pain
- Pain is bad but I manage journeys over 2 hours
- Pain restricts me to journeys of less than 1 hours
- Pain restricts me to short necessary journeys under 30 minutes
- Pain prevents me from travelling except to receive treatment

CONSENT FORM

Subject's Name:

Age:

Address of the subject:

Investigators: YASH SHARMA

PRUTHVIBEN UPADHYAY

I have been explained regarding the research project entitled "PREVALENCE OF PROLAPSED INTERVERTEBRAL DISC (PIVD) IN CAB DRIVERS: A CROSS SECTIONAL STUDY" have been explained in details about the therapy which were given to me. I understand that my participation in the study is voluntary and that I am free to withdraw at any time, without giving any reason, without my medical care or legal right being affected. I understand that the data obtained through the study may be used for research paper publication and I also understand that my identity will not be revealed in any information released to third parties or published. I agree to take part in the above study.

Signature of the subject: ----------

Investigator Sign: ----------

Date: ----------

SCALE

Oswestry Low Back Pain Disability Questionnaire

Section 1- Pain Intensity

- No pain
- Mild
- Moderate
- Severe
- Very severe
- Worst

Section 2- Personal Care (washing, dressing etc.)

- I can look after myself normally without Causing extra pain
- I can look after myself normally but it causes extra pain
- It is painful to look after myself and I am slow and careful
- I need some help but manage most of my personal care
- I need help every day in most aspects of self-care
- I do not get dressed, I was with difficulty and stay in bed

Section 3- Lifting

- I can lift heavy weights without extra pain
- I can lift heavy weights but it gives extra pain
- Pain prevents me from lifting heavy weights off the floor, but I can manage if they are conveniently placed eg. On a table
- Pain prevents me from lifting heavy weights, but I can manage light to medium weights if they are conveniently positioned
- I can lift very light weights
- I cannot lift or carry anything at all

Section 4- Walking

- Pain does not prevent me walking any distance
- Pain prevents me from walking more than 5 minutes
- Pain prevents me from walking more than 10 minutes
- Pain prevents me from walking more than 15 minutes
- I can only walk using a stick or crutches
- I am in bed most of the time

Section 5- Sitting

- I can sit in any chair as long as I like
- I can only sit in my favorite chair as long as I like
- Pain prevents me sitting more than 1 hours
- Pain prevents me from sitting more than 30 minutes
- Pain prevents me from sitting more than 10 minutes
- Pain prevents me from sitting at all

Section 6- Standing

- I can stand as long as I want without extra pain
- I can stand as long as I want but it gives me extra pain
- Pain prevents me from standing for more than 1 hours
- Pain prevents me from standing for more than 30 minutes
- Pain prevents me from standing for more than 10 minutes
- Pain prevents me from standing at all

Section 7- Sleeping

- My sleep is never disturbed by pain
- My sleep is occasionally disturbed by pain
- Because of pain I have less than 6 hours sleep
- Because of pain I have less than 4 hours sleep
- Because of pain I have less than 2 hours sleep
- Pain prevents me from sleeping at all

Section 8- Travelling

- I can travel anywhere without pain
- I can travel anywhere but it gives me extra pain
- Pain is bad but I manage journeys over 2 hours
- Pain restricts me to journeys of less than 1 hours
- Pain restricts me to short necessary journeys under 30 minutes
- Pain prevents me from travelling except to receive treatment

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EFFECTS OF PRANAYAMA (YOGA) AND BREATHING EXERCISES ON PULMONARY FUNCTION IN SEDENTARY PEOPLE-AN EXPERIMENTAL STUDY

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ABSTRACT

Background: Pulmonary function test is the most common test to check the function of lungs in normal healthy, sedentary or diseased person. Pulmonary function testing is often considered the basis for diagnosis in many categories of pulmonary disease. Although most of the testing methodologies are well established and widely employed, there are still many questions regarding how tests should be performed, how to ensure that reliable data are produced, what reference values and rules should be used, and how pulmonary tests (PFTs) function should be interpreted to best support clinical decision making. Sedentary behaviour (SB), defined as sitting (no exercising), reclining, and lying down (posture), or by low energy expenditure, is a public health risk independent to physical activity.

Methodology: This study included 30 participants who were of the age group 18-25 and the study was conducted online through ZOOM video calls where everyone was asked to keep their camera on for monitoring them. The participants were divided in 2 groups; Pranayama (yoga) and Breathing Exercise.

Result: Statistically significant improvements were seen in FVC of group pranayama (P=0.0002), FEV1of group pranayama (P=0.0002), FVC of group breathing exercise (P=0.0001), FEV1 of group breathing exercise (P=0.0003); whereas there was no statistical significance in FEV1/FVC% of group pranayama (P=0.2655) and FEV1/FVC% of group breathing exercises (P=0.8839).

Conclusions: The current study strongly support that both pranayama (yoga) improves FEV1 (P=0.0002) whereas breathing exercises improve FVC (P=0.0001) in sedentary people.

Keywords: Pulmonary function test, sedentary people, sedentary lifestyle, pranayama, yoga, spirometry, breathing exercises, physiotherapy

INTRODUCTION

Pulmonary function measures reflect the normal and pathological state of the lungs.[1] Lung function, specifically forced vital capacity (FVC) and forced expiratory volume in 1 second (FEV1), are objectively measurable quantitative parameters of respiratory health. It is an early indicator of respiratory and systematic inflammation, and associated with cardiorespiratory morbidity and mortality. [2]

Pulmonary function test (PFT) is a useful tool for objective assessment of respiratory impairement.[3] PFT results depend on patient efforts. Normal ranges are related to patient's sex, age, race, and body size.[4] It is of great value in early diagnosis, severity classification, disease progression and evaluation of curative effect of respiratory diseases.[5] The most basic and useful PFT is spirometry.[6] Pulmonary function testing (PFT) is a complete evaluation of the respiratory system including patient history, physical examinations, and tests of pulmonary function. [7]

Spirometry includes tests of pulmonary mechanics – measurements of FVC, FEV1, FEF values, forced inspiratory flow rates (FIFs), and MVV. Measuring pulmonary mechanics assesses the ability of the lungs to move huge volumes of air quickly through the airways to identify airway obstruction.[7]

There are four lung volumes and four lung capacities. A lung's capacity consists of two or more lung volumes. The lung volumes are tidal volume (VT), inspiratory reserve volume (IRV), expiratory reserve volume (ERV), and residual volume (RV). The four lung capacities are total lung capacity (TLC), inspiratory capacity (IC), functional residual capacity (FRC) and vital capacity (VC).[8]

PFTs, measure how well the lungs work. For some of the test measurements, the client can breathe normally and quietly. Other tests require forced inhalation or exhalation after a deep breath. Sometimes, they will be asked to inhale a different gas or a medicine to see how it changes test results.[9]

Table 1.1: Pulmonary Function Test

Pulmonary function test	Instrument	Measures	Function
Spirometry	Spirometer	Forced vital capacity (FVC)	Volume of air that is exhaled after maximum inhalation
		Forced expiratory volume (FEV)	Volume of air exhaled in one breath
		Forced expiratory flow, 25–75 percent	Air flow in the middle of exhalation
		Peak expiratory flow (PEF)	Rate of exhalation
		Maximum voluntary ventilation (MVV)	Volume of air that can be inspired and expired in 1 minute
		Slow vital capacity (SVC)	Volume of air that can be slowly exhaled after inhaling past the tidal volume
		Total lung capacity (TLC)	Volume of air in the lungs after maximum inhalation
		Functional residual capacity (FRC)	Volume of air left in the lungs after normal expiration
		Residual volume (RV)	Volume of air in the lungs after maximum exhalation
		Total lung capacity (TLC)	Maximum volume of air that the lungs can hold
		Expiratory reserve volume (ERV)	The volume of air that can be exhaled beyond normal exhalation
Gas diffusion	Blood gas analyzer	Arterial blood gases	Concentration of oxygen and carbon dioxide in the blood

Spirometry Measures the rate of air flow and estimates lung size. For this test, client will breathe multiple times, with regular and maximal effort, through a tube that is connected to a computer. Some people feel lightheaded or tired from the required breathing effort.[10]

If breathing is taken seriously and done with utter care and consciousness it can benefit the body and can increase the efficiency of everyday life and process. Breathing is a workout in itself for the body.[11]

Human life relies on the process of breathing. Breathing is the basic living process on which life depends. It is important to understand the significance of the process of breathing. With breathing, we inhale air and that is circulated throughout the body so it matters, what are we breathing and how are we breathing. Yet with time and lifestyle, people have forgotten how to breathe properly.[12]

When you have healthy lungs, breathing is natural and easy. You breathe in and out with your diaphragm doing about 80 percent of the work to fill your lungs with a mixture of oxygen and other gases, and then to send the waste gas out. Lung Helpline respiratory therapist Mark Courtney compares the process to a screen door with a spring, opening and shutting on its own. "Our lungs are springy, like the door.[13]

Over time, stale air builds up, leaving less room for the diaphragm to contract and bring in fresh oxygen.[14] With the diaphragm not working to full capacity, the body starts to use other muscles in the neck, back and chest for breathing. This translates into lower oxygen levels, and less reserve for exercise and activity. If practiced regularly, breathing exercises can help rid the lungs of accumulated stale air, increase oxygen levels and get the diaphragm to return to its job of helping you breathe.[15]

Breathing exercise (BE) has been an essential part of a comprehensive pulmonary rehabilitation program. Many types of BE such as slow and deep breathing, active expiration, pursed-lip breathing (PLB), relaxation breathing, diaphragmatic breathing (DBE), and ventilatory feedback (VF) training, have been prescribed to decrease lung hyperventilation, enhance respiratory muscle function, exercise tolerance, and QoL.[16] These BEs have been used individually, or in combination of different types of BE.[16]

A person may not be able to change how much oxygen their lungs can hold. However, breathing exercises can help reduce shortness of breath caused by limited lung function.[17]

Some people find it especially beneficial to focus on time, for example by breathing in for 5 seconds and breathing out for 10 seconds. It can help to keep a clock that shows the second's nearby.[18] For people who are not very physically active and may not be exercising their breathing muscles frequently, pursed lip breathing may have particular benefits. Deep breathing exercises may help increase lung capacity. For instance, the British Lung Foundation say that deep breathing can help clear mucus from the lungs after pneumonia, allowing more air to circulate.[17]

Other exercises, such as pursed lip breathing, can help manage breathlessness during respiratory illness. According to the National Institute for Health and Care Excellence, this may help with breathlessness caused by COVID-19.[19]

Although the terms breathing control and diaphragmatic breathing are often used synonymously, unlike breathing control, diaphragmatic breathing exercises encourage abdominal movement and contraction. Levensen (1992) describes diaphragmatic breathing as a breathing exercise which improves diaphragmatic recruitment. Excursion during inspiration and expiration. Although no studies to date have investigated the effect of breathing control on ventilation, it may be appropriate to extrapolate from the findings of research based on diaphragmatic breathing exercises.[20]

Pranayama is the yogic practice of focusing on breath. In Sanskrit, prana means "vital life force", and yama means to gain control.[21] In yoga, breath is associated with the prana, thus, pranayama is a means to elevate the prana shakti, or life energies. Pranayama is described in Hindu texts like the Bhagavad Gita and the Yoga Sutras of Patanjali. Later in Hatha yoga texts, it meant the complete suspension of breathing.[22]

Pranayama, the practice of controlled breathing, can be found as a part of many types of yoga's. This practice is believed to help encourage relaxation and improve breathing.[22, 23, 24] Although limited in nature, research studies on a small group of subjects indicate pranayama to have a positive impact on lung function and lung parameter as an adjunctive treatment. Long term and large-scale studies would be needed in order to validate the research and confirm the effects of pranayama and reach global acceptance pranayama.[24]

Pranayama improves overall performance of the body.[25] The regular practice of pranayama increases chest wall expansion and almost all lung functions. The beneficial effect of different pranayama is well reported and has sound scientific basis. Pranayama makes efficient use of abdominal and diaphragmatic muscles and improves the respiratory apparatus. Yoga strengthens the respiratory musculature due to which chest and lungs inflate and deflate to fullest possible extent and muscles are made to work to maximal extent .[25, 26]

Yoga originated in ancient India and denotes union between the individual self and the transcendental self. Pranayama is an important aspect of yoga that mainly deals with the relationship between breathing pattern and emotional states.[26] It can assume more complex forms of breathing, but the essence of its practice remains slow and fast breathing. Regular practice of pranayama improves cardiovascular and respiratory functions, improves cognitive function, decreases the effect of stress and strain on the body and hence improves the physical and mental health of an individual. The Bhramari Pranayama (Bhr.P), in specific, is one such ancient yogic breathing practice that not only includes a unique breathing technique but also is associated with concurrent generation of a constant humming sound during the phase of expiration thus placing the body in the state of relaxation. Studies done by Jain et al. and Rampalliwar et al. have concluded that regular practice of Bhr.P reduces the cardiovascular reactivity to stress (cold pressor test) by inducing parasympathetic predominance and cortico-hypothalamo medullary inhibition. Immediately after the practice of Bhr.P, there is a reduction in heart rate, blood pressure and improvement in the cognition in healthy subjects.[27]

Pranayama is an ancient yoga technique. The regular practice of Pranayama integrates the mind and the body. It differs from other forms of exercises as it mainly focuses on the sensations in the body.[28] Pranayama thus acts directly on the various functions of the body and affords benefits in a positive way. The following may be the reasons for this:

- Regular, slow and forceful inspiration and expiration for a longer duration during the pranayama practice, leading to strengthening of the respiratory muscles.[28]
- Pranayama training causes improvement in the expiratory power and decreases the resistance to the air flow in the lungs. [28]
- Pranayama training causes an increase in the voluntary breath holding time. This may be due to acclimatization of the chemoreceptors to hypercapnoea. [28]

Pranayama breathing may prevent serious cardio-respiratory complications by emphasizing optimal physical and mental conditioning. It also helps in tranquilizing the mind and as a result patient feel.[29]

REVIEW OF LITERATURE

1. **Breathing exercises and pranayama to decrease perceived exertion during breath-holding while locked-down due to COVID19 online randomized study. Mayank Shukla, et al. (2020)**30

Aim of the study was to compare the anulom vilom pranayama (AVP), kapal bhati pranayama (KBP), diaphragmatic breathing exercise (DBE), and pursed lip breathing (PLB), for breath holding time (BHT) and rate of perceived exertion (RPE). It was concluded that KBP and PLB did not decreased RPE as compared to AVP and DBE (p.0.05). DBE increased BHT more than KBP and PLB interventions (p 0.05). Study concluded that AVP is best among studied interventions for increasing relaxation during breath holding and DBE increases breathe holding time maximally.

2. **Pulmonary function tests. Harpreet Ranu, et al. (2011)**31

The study concluded that pulmonary function tests are an important tool in the assessment of patients with suspected or known respiratory disease. They are also important in the evaluation of patients prior to major surgery. Interpretation of the tests, which requires knowledge of normal values and appearance of flow volume curves, must be combined with the patient's clinical history and presentation.

3. **Pulmonary function tests for the generalist: A brief review. Timothy M. Dempsey, et al. (2018)**32

The study concluded that PFT's are essential to the diagnosis of many lung conditions and help to identify numerous non pulmonary disease processes. Understanding the basic interpretation of the components of this valuable test is crucial for primary care physicians to aid in the diagnosis of patients with respiratory symptoms.

4. **Lung function in obese children and adolescents without respiratory disease: a systematic review. Mariana Simoes Ferreira, et al. (2020)**33

The objective of the study was to perform a systematic review to assess lung function in children and adolescents affected by obesity and to verify the presence of pulmonary changes due to obesity in individuals without previous or current respiratory diseases. Articles from 18 countries were included. Spirometry was the most widely used tool to assess lung function. There was a high variability in lung function values with a trend towards reduced lung function markers (FEV1/FVC, FRC, ERV and RV) in obese children and adolescents.

5. **Effects of Diaphragmatic breathing on health: A narrative review. Hidetaka Hamasaki. (2020)**34

This review consists of a total of 10 systemic reviews and 15 random controlled trials. DB appears to be effective for improving the exercise capacity and respiratory function in patients with chronic obstructive pulmonary disease. Based on this narrative review the exact usefulness of diaphragmatic breathing in clinical practice is unclear due to poor quality of studies. However, it may be feasible and practical treatment method of various disorders.

6. **The short-term effect of pranayama on the lung parameters. Shankarappa V., et al. (2020)**35

An evaluation of a non-controlled study with 50 adult subjects was undertaken to study the effect of 6 weeks of pranayama on the lung parameters. After 6 weeks of pranayama it was noted that pulmonary function parameters FVC, FEV1, PEFR, FEF 25-75% and breath holding time (BHT) increased significantly.

7. **Effect of bhramari pranayama practice on pulmonary function in healthy adolescents: a randomized controlled study. Maheshkumar Kuppusamy, et al. (2017)**36

The study was conducted to find the effects of bhramari pranayama practice on pulmonary function in healthy adolescents. A significant ($P<0.05$) improvement in all pulmonary function parameters; FVC, FEV1, FEV1/FVC ratio, FEF 25% - 75% and PEFR was seen in the bhramari group then the control group adolescents. Slow vital capacity (SVC) and maximum voluntary volume (MVV) also showed significant improvement in the pranayama group.

8. **Exploring the therapeutic benefits of pranayama (yogic breathing): a systematic review. Ranil Jayawardena, et al. (2020)**37

The aim of the study was to perform a systematic review about the beneficial health effects of pranayama. Available evidence on pranayama indicates physiological benefits. Beneficial effects were mostly observed in patients with respiratory diseases such as bronchial asthma. It also helped those with cancer and cardiovascular disease.

9. **The comparison of the pulmonary functions of the individuals having regular exercises and sedentary individuals. Irfan Marangoz, et al. (2016)**38

The objective of the study was to determine the differences between the pulmonary functions of individuals having regular exercises and long-term exercises, and sedentary individuals. When the results of the study were evaluated, it was found out that no difference is present between FEV1 and PEF ($p>0.05$) values of individuals having long term and regular exercises, and sedentary individuals; however, there is a significant difference among MVV, FVC and VC values ($p<0.05$). Therefore, it has been found out that the pulmonary capacities (MVV, FVC, and VC) of individuals having regular exercises have improved better than that of sedentary individuals.

10. **Pulmonary functions in yogic and sedentary population. Shobha Rani Vedala, et al. (2014)**39

Pulmonary functions were compared between the yoga practitioners and sedentary group. Yoga exercise significantly increased chest wall expansion as observed by higher values of pulmonary functions compared with sedentary controls. Regular yoga practice increases the vital capacity, timed vital capacity, maximum voluntary ventilation, breath holding time and maximal inspiratory and expiratory pressures.

11. **A comparative study of the effects of yoga and swimming on pulmonary functions in sedentary subjects. Shilpa S Gupta, et al. (2012)** [40]

The aim of the study was, designed to assess and compare the effects of yogic training and swimming on pulmonary functions in normal healthy young volunteers.100 volunteers were inducted into the study and randomly divided into two groups: One group underwent 12 weeks training for yogic exercises and other for swimming. The training and data acquisition was done in small cohorts of 10 subjects each. The subjects were assessed by studying their anthropometric parameters and pulmonary function parameters (FVC, FEV1/FVC ratio, PEFR, FEF25-75%, FEF 0.2-1.2 l and MVV) both before and after training. All parameters showed statistically significant improvements after both yoga and swimming. Comparison of these improvements for different

parameters statistically analysed by unpaired t test or Mann Whitney U test depicted a statistically better improvement in FVC, FEF25-75% and MVV with swimming as compared to yogic exercises.

12. Effect of short-term yoga practice on pulmonary function tests. Vinayak P Doijad, et al. 2012[41]

This work was done to find effects of short-term Yoga practice on pulmonary function tests. The study was conducted on 60subjects, (40males and 20females) who came voluntarily as subjects for the project with written consent. It was a cohort study on I MBBS students, 60 in number (40 boys and 20 girls). Their age ranged between 18 to 20 years. Various Pulmonary function tests were measured. The instrument used was Medspiror Pneumotachometer (manufactured by MED SYSTEMS PVT. LTD. CHANDIGARH). FVC, FEV 1%, MVV and PEFR were found to be increased in both male and female subjects in result of the study. From this study we conclude that yoga practice can be advocated to improve respiratory efficiency for healthy individuals as well as an alternative therapy or as adjunct to conventional therapy in respiratory diseases.

13. **Effects of slow breathing exercise on cardiovascular functions, pulmonary functions & galvanic skin resistance in healthy human volunteers-a pilot study. AV Turankar, et al. 2013.**42

In this study eleven normal healthy volunteers were randomized into Pranayama group (n= 6) and a non-Pranayama control group (n= 5); the pranayama volunteers were trained in pranayama, the technique being Anuloma-Viloma pranayama with Kumbhak. Pulse, GSR, blood pressure (BP) and pulmonary function tests (PFT) were measured before and after the 7-day programme in all the volunteers.

While no significant changes were observed in BP and PFT, an overall reduction in pulse rate was observed in all the eleven volunteers; this reduction might have resulted from the relaxation and the environment. Statistically significant changes were observed in the Pranayama group volunteers in the GSR values during standing phases indicating that regular practice of Pranayama causes a reduction in the sympathetic tone within a period as short as 7 days. On the basis of results the study concluded that beneficial effects of pranayama started appearing within a week of regular practice, and the first change appeared to be a reduction in sympathetic tone.

14. An Approach to Interpreting Spirometry. Timothy J. Barreiro, et al. 2004.[43]

According to this study spirometry is a powerful tool that can be used to detect, follow, and manage patients with lung disorders. Technology advancements have made spirometry much more reliable and relatively simple to incorporate into a routine office visit. However, interpreting spirometry results can be challenging because the quality of the test is largely dependent on patient effort and cooperation, and the interpreter's knowledge of appropriate reference values. A simplified and stepwise method is key to interpreting spirometry. The first step is determining the validity of the test. Next, the determination of an obstructive or restrictive ventilatory pattern is made. If a ventilatory pattern is identified, its severity is graded.

15. Spirometry in the lung health study. Paul L Enright, et al.1991[44]

In this study Data were obtained from four surveys and included 3,598 subjects aged 4–80 years. The original analyses were sex specific and limited to non-Hispanic white subjects. An extension of the LMS (lambda, mu, and sigma) method, widely used to construct growth reference charts, was applied. The study concluded that the modelling technique provides an elegant solution to a complex and longstanding problem. Furthermore, it provides a biologically plausible and statistically robust means of developing continuous reference ranges from early childhood to old age. These dynamic models provide a platform from which future studies can be developed to continue to improve the accuracy of reference data for pulmonary function tests.

NEED OF STUDY

This study is required to determine the significance of pranayama (yoga) and breathing exercise in increasing or changing the lung volume or its capacity in sedentary people. With increasing popularity and demand of yoga it is important to have the knowledge about its effect on pulmonary function in comparison to breathing exercise, to determine if they both have same effect or if one type is superior to other.

AIM AND OBJECTIVES OF THE STUDY

AIM OF THE RESEARCH:

To see the difference in effects of pranayama (yoga) and breathing exercise on vital capacity in sedentary people.

OBJECTIVE OF THE RESEARCH:

To assess the effectiveness of pranayama (yoga) and breathing exercise on vital capacity in sedentary people.

HYPOTHESIS

NULL HYPOTHESIS:

There will be no significant difference in effects of pranayama (yoga) or breathing exercises on vital capacity in subjects with sedentary lifestyle.

ALTERNATE HYPOTHESIS:

There will be significant difference in effects of pranayama (yoga) or breathing exercises on vital capacity in subjects with sedentary lifestyle.

METHODOLOGY

Study design: Experimental

Study setting: Community

Sampling method: Purposive

Sample size: 30

Inclusion criteria:

a) Age group – 18 to 25 years

b) Subjects with sedentary lifestyle

Exclusion criteria:

a) Age group that does not match the inclusive criteria

b) Subjects who are physically active and not sedentary

c) Subjects having allergic disorders or respiratory disorders

d) Systemic diseases like hypertension, diabetes

Data collection tool:

a) International Physical Activity Questionnaire

b) Pulmonary Function Test

Procedure:

Identification of subjects were done according to the inclusion criteria. Each of them was explained about the study and its benefits and written consent form was obtained from each subject.

Subjects who fulfilled the inclusion and exclusion criteria along with MET scoring were recruited and assigned into one of the two groups: Pranayama (yoga) and Breathing exercise.

Each individual's height, weight and spirometry score were recorded before and after the intervention procedure.

GROUP 1: Pranayama (yoga) group

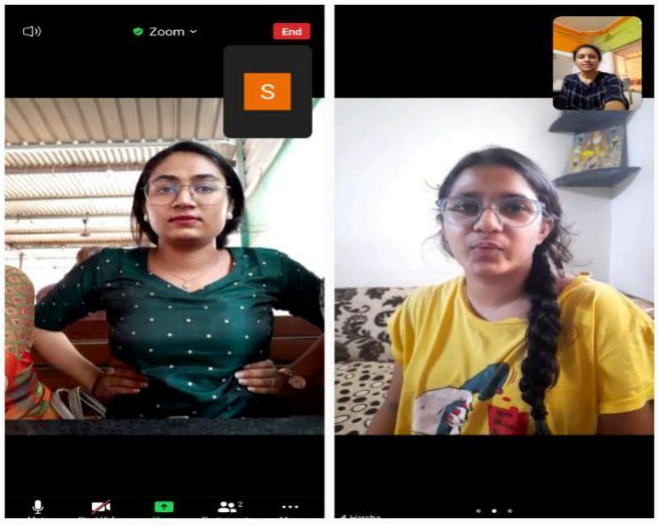
15 subjects were taken in the group who were treated with pranayama (yoga) which included anuloma viloma, kapal bhati, Bhramari.

10 repetition of each exercise was done for 5 sessions per week for 4 weeks.

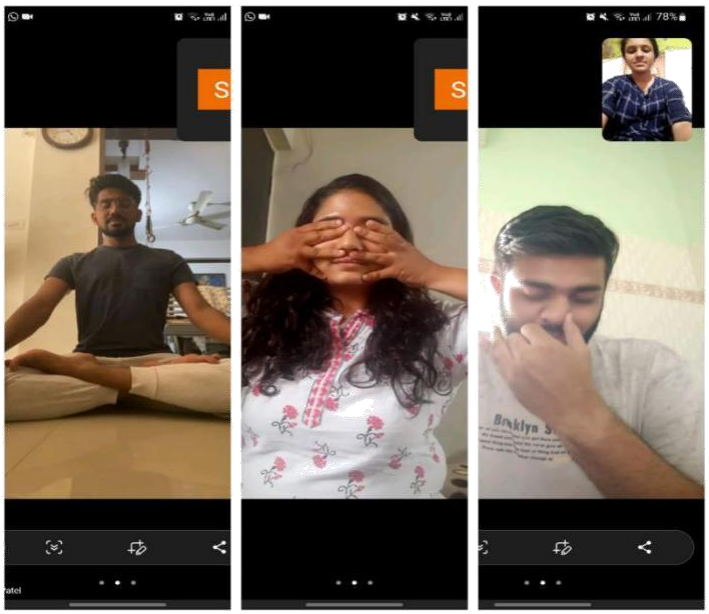
GROUP 2: Breathing exercise group

15 subjects were taken in the group who were treated with breathing exercises which included diaphragmatic breathing, pursed lip breathing, segmental breathing.

10 repetition of each exercise was done for 5 sessions per week for 4 weeks.



Photograph 6.1: Subjects performing Breathing exercises



Photograph 6.2: Subjects performing pranayama (yoga)

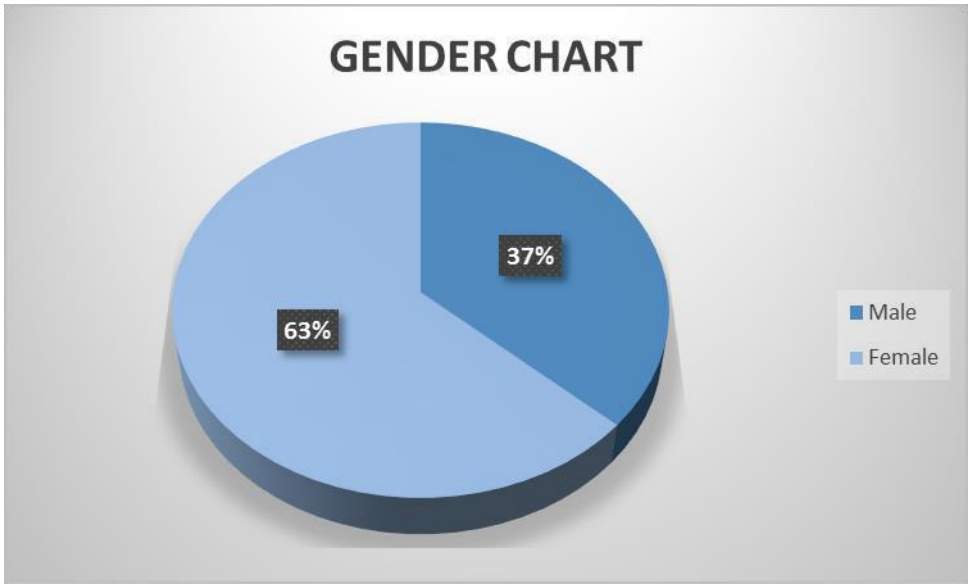
Photograph 6.3: Subjects performing Spirometry

RESULT

Demographic Profile:

1. GENDER DISTRIBUTION:

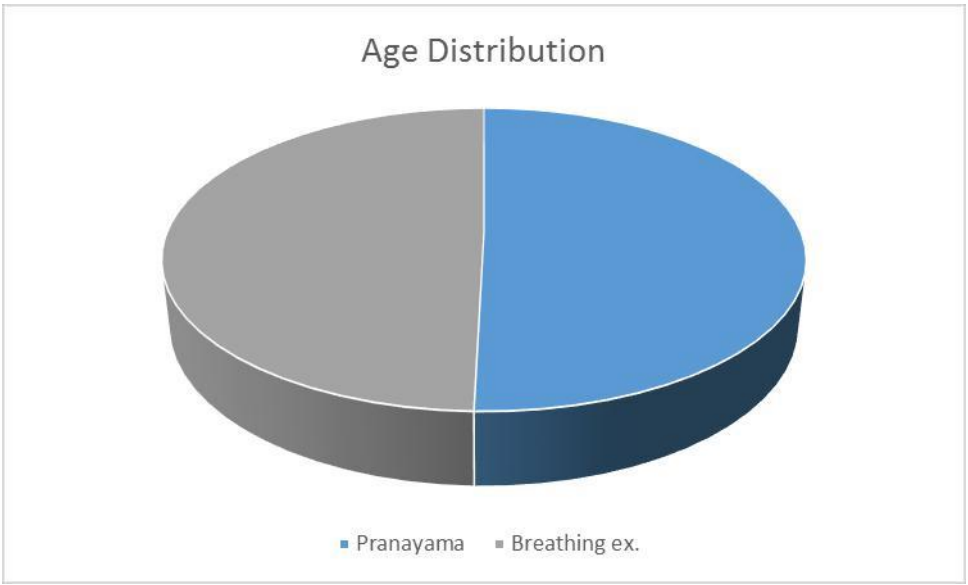
There were total 30 participant taken after matching the inclusion and exclusion criteria in which 19 were Females and 11 were Males.



Graph 7.1: Gender Distribution

2. AGE DISTRIBUTION

The mean age of participants of both groups are 20.8 and 20.46 respectively for group Pranayama (yoga) and Breathing exercise.



Graph 7.2: Age Distribution

Table 7.1: Mean Of Age Distribution

MEASURES	MEAN
PRANAYAMA (YOGA)	20.8
BREATHING EXERCISE	20.46

Clinical Parameters:

The participants in both groups shows significant result in increasing FVC and FEV1 whereas there were no significant changes in FEV1/FVC Ratio.

3. PULMONARY FUNCTION TEST

PFT recordings were done in both groups pre and post intervention for FVC, FEV1 and FEV1/FVC Ratio.

3.1 FVC in Pranayama (yoga) Group and Breathing exercise Group

In Pranayama (yoga) group, the treatment was given for 4 weeks and its pre and post treatment difference is -0.8500.

In Breathing exercise group, the treatment was given for 4 weeks and its pre and post treatment difference is -0.8353.

Table 7.2: FVC Pre And Post

MEASURES	FVC		DIFFERENCE	T VALUE	P VALUE
	PRE	POST			
PRANAYAMA	2.29±0.128	3.14±0.147	-0.85	4.3447	0.0002
BREATHING EX.	2.38±0.116	3.22±0.136	-0.835	4.6424	<0.0001

3.2 FEV1 in Pranayama (yoga) group and Breathing exercise Group

In Pranayama (yoga) group, the treatment was given for 4 weeks and its pre and post treatment difference is -0.7573.
In Breathing exercise group, the treatment was given for 4 weeks and its pre and post treatment difference is -0.7000.

Table 7.3: FEV1 Pre And Post

MEASURES	FEV1		DIFFERENCE	T VALUE	P VALUE
	PRE	POST			
PRANAYAMA	1.948±0.120	2.706±0.128	-0.7573	4.312	0.0002
BREATHING EX.	2.046±0.113	2..746±0.125	-0.7	4.137	0.0003

3.3 FEV1/FVC in Pranayama (yoga) group and Breathing exercise Group

In Pranayama (yoga) group, the treatment was given for 4 weeks and its pre and post treatment difference is -1.4467.

In Breathing exercise group, the treatment was given for 4 weeks and its pre and post treatment difference is 0.2160.

Table 7.4: FEV1/FVC Pre And Post

MEASURES	FEV1/FVC		DIFFERENCE	T VALUE	P VALUE
	PRE	POST			
PRANAYAMA	84.58±0.88	86.03±0.91	-1.446	1.136	0.265
BREATHING EX.	85.43±0.91	85.215±1.14	0.216	0.147	0.8839

DISCUSSION

It is seen in many studies done in past that sedentary lifestyle is one of the causes of reduced lung capacity and volume. It is known that sedentary lifestyle is a risk factor for reduced lung volumes and lung capacity. Reduction in these can cause many obstructive or restrictive lung diseases in healthy as well as sedentary population. Also, current study found out that participant's with lower MET showed comparatively lower lung volume and capacity this indicates that sedentary lifestyle and reduced lung volume are correlated and directly proportional. Many researches have also shown improvement in lung volumes and capacity through pranayama or breathing exercise in diseased individuals but the intervention procedure might take longer duration to show significant results. This research presents an experimental study of Pranayama (yoga) and Breathing exercise in sedentary people.

A study done by Irfan Marangoz, et al. (2016) to determine the differences between the pulmonary functions of individuals having regular exercises and long-term exercises, and sedentary individuals showed that there was a significant difference among MVV, FVC and VC values ($p<0.05$) in individuals doing regular exercise, and sedentary individual. Therefore, it has been found out that the pulmonary capacities (MVV, FVC, and VC) of individuals having regular exercises have improved better than that of sedentary individuals. Similarly, although our study didn't find any statistically significant change in FEV1/FVC but there was statistically significant improvement seen in both FVC and FEV1.

Current findings suggest that participants who were having high more sedentary lifestyle i.e. lower MET value were having comparatively lower lung volume and capacity, this indicates that sedentary lifestyle and reduced lung volume are correlated and directly proportional. We collected 30 samples from which females were 19 and males were 11.

CONCLUSION & SUMMARY

Conclusion

The current study strongly supports that both pranayama (yoga) and breathing exercises improve FVC and FEV1 in sedentary people.

Summary

This study is comparing the effects of pranayama (yoga) and breathing exercise on sedentary people, 30 participants were taken and their MET was calculated using IPAQ. Spirometry was done before and post the intervention procedure. It is seen that both pranayama (yoga) and breathing exercises help increase FVC and FEV1 in sedentary people.

LIMITATIONS

Limitations

Limitations of the study included the conduction of the study which was done online on zoom call because of outrage of cases of COVID-19.
Small sample size (30 participants).
Limited age group of 18-25 years.

Future recommendation

Offline study conduction can help monitor the participants well rather than contacting them online.
Increasing sample size can help in making sure that data obtained is statistically correct.
Increasing age group range.

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The Effect of Progressive Muscle Relaxation on Post Caesarean Section Pain and Functional Activities Limitation - Randomized Controlled Trial

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Abstract

Background:
Pain and Functional activity limitations are the most common complaints of the women after caesarean section. Progressive muscle relaxation has been shown to relieve pain and improve Functional activity in post caesarean section women. We designed this study to examine if PMR reduces Pain and improve Functional activity.

Methodology:
We included 30 participants with the age of 20 to 45 years. Participants were randomly assigned into two groups i.e. PMR in addition with conventional therapy and Conventional Therapy (Control group).

Result:
After the intervention, both groups showed significant improvement ($p<0.05$) in measures of NPRS and Patient Specific Functional Activity scale.

Conclusion:
These data suggest that incorporating PMR in post C-section physical therapy session is effective in reducing pain and improving Functional activity.

Keywords:
C-section, Progressive muscle relaxation technique, Physical activity, Pain.

INTRODUCTION

Lower segment caesarean section is procedure where the making of incision is on the lower abdomen to the deliver the baby.[1]

There are many advantages of the caesarean section i.e. Post-operative comfort is more, Less chances of the wound dehiscence, Less chances of the incisional hernia, Reduced risk of perineal vaginal injury, Obstetric shock, Early postpartum haemorrhage.[2,3,4,5,6,7]

However there are some disadvantages of Caesarean section i.e. neonatal intensive care unit admission, longer hospital stays, Risk of the anaesthesia, Post-operative pain.[4]

Women with C - section surgery has both physical and psychological problems. Physical problems include: incision pain, limitation of the doing activity, gastrointestinal Disturbance, Anaesthesia complication. Psychological problems include: anxiety, depression, loss of the control, disturbed body image .caesarean pain affects the daily activity performance and it contribute to persistent post-operative pain. Caesarean pain characterized as acute and similarly connected the damage caused to the inflammatory reaction derived from traumatic operation.[6]

Progressive muscle relaxation technique was developed by Edmund Jacobson in the literatures science 1938. This technique is used to induce a state of deep relaxation through involving a systemic sequential muscle tension for 5-7 seconds followed by relaxation. During the intervention of the therapy it was instructed to take the deep breath and hold it for 5 to 10 seconds and then exhale the breathe slowly by lips, which will help to get the relaxation state and get the benefits of the deep breathing exercise. Progressive muscle relaxation technique is one of the non-pharmaceutical method used to treat the post-operative pain and increase the physical activity after the caesarean section surgery.[7]

However the few articles Progressive muscle relaxation technique relieve the pain and improve physical activity. Therefore the aim of the study was determine to Progressive muscle relaxation technique can reduce pain and improve physical activity in Post - Caesarean section women.

The purpose of this RCT was to examine the effects of Progressive muscle relaxation technique on Pain and Functional Activity in comparison with conventional therapy.

METHODOLOGY

Study Design: Randomized Controlled Trial

Sampling Method: Randomized Block Technique

Sample Size: 30

Inclusion criteria

- Age: 20 to 45
- Patients who are willingly to participants in study.
- Those who are primary of repeat caesarean section.
- Early post caesarean patients.

Exclusion criteria

- Women who have developed major complication in post caesarean such as severe anaemia ,heart disease, post-partum haemorrhage, severe pregnancy, hypertension, Eclampsia, postpartum psychosis, musculoskeletal problem or urinary infection.
- Multiple births
- Delivery with operative complication.
- Psychiatric disorder such as depression or anxiety.

Each of them was explained about the study and its benefits and written consent was obtained from every Women. Pain and Functional Activity was assessed by using Numeric Pain Rating Scale (NPRS) & Patient Specific Functional Activity Scale (PSFA-S) respectively. The Participants were then randomly divided in 2 groups:

Group A - Progressive Muscle Relaxation

Group B - Conventional therapy

Progressive Muscle Relaxation (Group A):

- Begin with deep breathing exercise. Then slowly exhale out with mouth, the navel pulling in towards the spine. Repeated 3-5 cycles of deep breathing.
- Tense and release muscles.
- Starts with feet clenching toe and press heels towards the ground. Squeeze tightly for 10 seconds and the release it.
- Then flex feet in pointing toes up towards the head, hold it for 10 seconds and then slowly release while counting 1 to 10.
- Work on the right leg squeeze thigh muscle hold it for 10 seconds then slowly release it.
- Repeat on the left leg, after that squeeze the buttocks muscles hold it for 10 seconds and then release it.
- After that squeeze abdomen muscles hold it for 10 seconds and then slowly release it.
- Tensing the chest muscles by taking deep breathing, hold it for 10 seconds and then slowly release it.
- Open mouth widely enough to stretch the hinges of jaw, hold it for 10 seconds, and then release it.
- Clench eyes tightly hold it for 10 seconds and then release it.
- Raise eyebrows and tight the forehead, hold it for 10 seconds then release it.
- End up with few deep breaths.

Technique was used after the effects of anaesthesia are decrease and women on her conscious state of mind. Pre and Post – Therapy NPRS and Patient Specific Functional Activity scale was taken.

Duration: 30 minutes - Thrice a day for 3 days.

In addition with PMR, Conventional therapy were given to Group A.

Conventional therapy (Group B):

- Starts with deep breathing exercise for 3 repetitions.
- After deep breathing 10 repetitions of thoracic expansion, huffing technique and splinted coughing.
- 10 repetition of knee bending and leg bracing.
- End up the session with breathing exercise.

Technique was used after the effects of anaesthesia are decrease and women on her conscious state of mind. Pre and Post – Therapy NPRS and Patient Specific Functional Activity scale was taken.

Duration: 30 minutes - Thrice a day for 3 days.

DATA ANALYSIS

Data were analysed using SPSS statistical software using an intention-to-treat approach. Prior to all hypothesis testing, independent sample t-tests were conducted to examine whether significant mean differences existed in demographic, NPRS and Functional activity variables among the two groups at baseline. We examined whether outcomes changed differentially from baseline to post intervention.

RESULT:

All the patients completed the treatment session without interruption and having no other complication were observed during the treatment session.

Table no.1: The Mean values of Group A and Group B according to pre and post NPRS Scale

Group	Pre/Post NPRS Scale	Mean	Number	Std. Deviation
Group A	Pre	9.53	**15**	**0.61**
	Post	3.86	15	1.14
Group B	Pre	9.4	15	0.61
	Post	6.26	15	1.34

N=number, PRE=Pre NPRS Scale, Post=Post NPRS

Table no.2: The Mean value of Group A and Group B according to Pre and Post patient-Specific Functional Scale.

Group	Pre-Post PSF Scale	Mean	No	Std. Deviation
Group A	Pre	9.13	15	0.95
	Post	4	15	1.15
Group B	Pre	9	15	0.96
	Post	5.8	15	1.46

Table No.3: The Pre and Post values of between group Comparisons: Average improvement in T-Value and P-value.

Group	Pre-Post Comparison	Average Improvement	T-Value	P-Value	Result
Group A	Pre-Post	5.67	8.37	0.00	P<0.05 SIG
Group A	Pre-Post	5.13	3.15	0.1	P<0.05 SIG
Group B	Pre-Post	3.14	1.17	0.00	P<0.05 SIG
Group B	Pre-Post	3.2	2.14	0.1	P<0.05 SIG

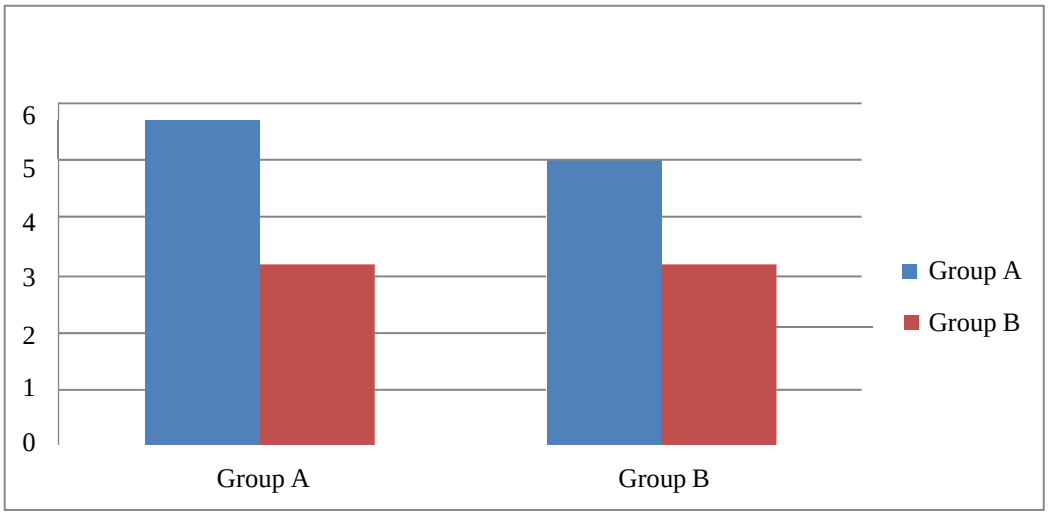

Fig.No.1: Average improvement in T-Value and P-value between groups

However, statistically significant result were noticed in both the groups, clinically it was observed and also observed that PMR technique had greater effects than conventional therapy.

DISCUSSION

The result of the present study is in line with at least four studies. First, Devmurari and Nagrale (2018) who studied "Effectiveness of Jacobson's PMR technique for pain management in post-caesarean women". They found that 100% of experimental group after intervention had pain ranging from 0 to 5 compared to 17.6% of control group. There is significant difference in mean values between pain scores of control and experimental group on VAS score. They further concluded that the pain is more reduced in experimental than control group.[8] Second, Devi et al (2017) who studied " Effect of PMR on post-operative analgesia" among patients with abdominal surgery in India during the first two days post-operative. They reported that PMR was very effective in pain relieve among study group compared to control group. They further added that PMR helped their patients to overcome the distressing feelings during post-operative period and improve their quality of life.[9] Third, Gupta et al (2016) who studied "Effectiveness of PMR technique on physical symptoms among patients receiving chemotherapy". They elaborated that around two thirds (63.3%) among their study participant had only mild pain post intervention compared to non-before it. They further added that none of their study group complained from severe pain post intervention compared to 100% before intervention[10]. Fourth, Paula et al (2002) who studied "the use of PMR technique for pain relief in gynecology and obstetrics". Their subjects were patients with abdominal surgery for obstetrics or gynecologic reason. They concluded that PMR significantly decreased pain perception among study group compared to control group. They further recommended that health care team should prepare their patients to apply PMR during the preoperative period to be used as a pain control method during the post-operative period.[11]

The result of the current study is also in line with relevant literatures. PMR may work to decrease post Cs pain through numerous mechanisms. First, PMR is effective in decreasing stress and consequently stress hormones (cortisol, epinephrine, catecholamines). Second, it can inhibit sympathetic and stimulate the parasympathetic nerves by blocking the feedback pathway from the mind to muscles and consequently prevent the biological response to pain. So, it may lower blood pressure, heart rate and metabolic rate (Avianti et al, 2016 & Topcu and Findik, 2012). Third, PMR may manipulate the hypothalamus by concentration on the positive sensation of deep relaxation state during the intervention so, the stress impulses from the hypothalamus is decreased or even inhibited.[7] Fourth the deep breathing technique during the intervention can increase oxygen

saturation, decrease the oxidative factors and consequently, pain. Fifth, PMR may help the secretion of endogenous endorphins, decrease the secretion of adrenal hormones, and improve blood circulation (Peciuliene et al 2015).[12]

It is expected that all the above mentioned mechanism of PMR over the course of the 3 days post C-section is likely to have resulted in decreasing pain and improving functional gains reported in this study.

CONCLUSION

Based, on the results of the current study, it is concluded that progressive muscle relaxation techniques have significant effects in reducing pain and improving Functional activity of the women who has undergone Caesarean section.

FUTURE RECOMMENDATION

- Based on the findings of the current study Progressive muscle relaxation technique is easy to learn and there is no side effects of therapy , therefore these technique should be involved in the treatment protocol management after caesarean section.
- Patient's education about PMR technique should be implemented with all post caesarean women to help relieve pain.

FUTURE RESEARCHES:

- Replication of the study using a large probability sample from a broad geographical area to allow greater generalization of the results.
- Exploration of the effect of PMR on stress, fatigue, and quality of life during postpartum

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Physical activity and Physical fitness parameter in undergraduate College going students' age group between 18 to 23 years

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Abstract

Introduction: Maximum Oxygen Uptake (VO2max) reflects Physical Fitness of individual. Decreased Cardiorespiratory Fitness due to lack of regular Physical Activity in young adults have forced them to become the victims of Cardiovascular co morbidities in their later stage.

Method: A Total 40 young adult male and female undergraduate College going student age group between 18 to 23 years were recruited by convenient sampling. Data was collected by assessment and International Physical Activity Questionnaire and QCST.

Result: Mean value of VO2max for males was 46.45 $\pm$ 15.9790711 ml/kg/min and for females was 40.780 $\pm$ 4.107005078 ml/kg/min. The Mean and SD values were found to be significantly higher in the males than in females. The VO2max values obtained in males were found to be closer to the normal predicted values than the values obtained in females.

Conclusion: After analyzing the results it is concluded from this study that overall Physical performance of males was higher than the female students.

Keywords: Physical Fitness, Queen's College Step Test, VO2Max, International Physical Activity Questionnaire.

INTRODUCTION

Transition to College is characterized by change, ambiguity, and adjustment compared to the previous lifestyle before entering college. Time spent in university represents a period of transition and may be an appropriate time to promote physical activity among young adults. Transitioning to College life could be stressful due to an increased pressure to focus on academic performance and having a new social life, as well as in some instances moving away from home for the first time. College students are vulnerable to experiencing tension, stress, and anxiety, and exercise could be used as an excellent method to manage these conditions. Moreover, university students are at risk for weight gain 5.5 times more than the general population. They are also at risk of developing high blood pressure and high serum cholesterol. Therefore, exercise is not only helpful in managing psychological stress reactions that students can experience, but it also has a positive effect on mood and self-esteem, physical and mental health, and the student's quality of life.[1]

However, now a day's increasing dependence on mechanical devices in daily life and reduction in work-related and leisure-time physical activities is rendering life style of both males and females sedentary.[2]

PHYSICAL ACTIVITY

Regular physical activity and health related physical fitness are key indicators of health outcomes. Bodies are recognizing that physical activity and exercise are integral to professional practice and core contributors to health along with reducing the risk of developing diabetes, hypertension, osteoporosis and cardiovascular disease, primary and secondary prevention of cancer. Physical activity also improves emotion and stress control. Promoting physical activity in undergraduate college group students is a sensible strategy likely to help reduce physical activity levels. An associated disease in the future generation a decline physical activity levels among young adults so there was a need to evaluate the physical activity level of the students and to determine their physical fitness level.[3]

Physical activity Maintain healthy bone and muscle, reduce obesity, reduce stress and anxiety, depression, enhanced cognitive function, positive mental health and promote Well Being and healthy lifestyle[4]. Young adults are exposed to a number of academic, physical, emotional and social changes which coupled with changes in independence and living situation among some students may influence key health behaviour such as Smoking, alcohol use, poor nutrition and physical activity.[5]

The International Physical Activity Questioner Measure all physical activity for use with individual adult patients aged 15 to 69 years old. The International Physical Activity Questioner can be used clinically and in population research that compare physical activity level between populations internationally[6]. The measure Assess the type of intensity of physical activity and sitting time that people do as part of their daily lives are considered to estimate total physical activity in MET minute per week and time spent sitting.[7]

FACTORS AFFECTING PHYSICAL ACTIVITY

Several Social and Environmental Factors have systematically emerged as determinants of physical activity in adults. In ethnic minorities, the removal of barriers such as unaffordable facilities and unavailable childcare, high crime rates, fear for personal safety and culturally inappropriate activities are of primary importance. Social support from family, peers, communities and healthcare providers has resulted in modest improvements across cultures, ages and genders in selected settings, but the definition of specific interventions and their outcomes deserve additional attention.[8]

PHYSICAL FITNESS

Being physically fit has been defined as the ability to carry out daily tasks with vigour and alertness without undue fatigue and with ample energy to enjoy leisure time pursuit and to meet unforeseen emergencies[9].The health-related components of physical fitness are cardio respiratory endurance, muscular endurance, muscular strength, body composition and flexibility.[10] Physical fitness is a measure of body's ability to function effectively and efficiently or can be defined as state of health and wellbeing of a person fitness can be achieved through proper nutrition, exercise, rest and moderate to vigorous physical activity.[11] Physical fitness is a multidimensional concept that evolves with age and involves muscles, skeleton, heart and mind related activities that enhance physical, intellectual, psychological, emotional and social development. The lifestyle change diminishes level of physical activity as well as increasing various sickness caused by the lack of movement.[12]

PHYSICAL ACTIVITY AND PHYSICAL FITNESS

The Objectives of the Study are to find the level of the physical activity and compare physical fitness parameters in undergraduate college going student's age group between 18-23 years by evaluating Aerobic Capacity and Endurance and body composition in different level of physical activity.[13] There is consensus that regular physical activity (PA) can improve physical fitness (PF) and health and assist in the prevention of disease. Physically active adults are healthier and have a higher PF than inactive adults. Physical activity is therefore promoted as part of a healthy lifestyle. PA can influence fitness and health and that the relationships are also reciprocal.

BMI

Body Mass Index (BMI) is a value derived from the mass (weight) and height of a person. The BMI is defined as the body mass divided by the square of the body height, and is expressed in units of kg/m2, resulting from mass in kilograms and height in meters.

BMI AND PHYSICAL ACTIVITY

Obesity is an excessive fat accumulation in adipose tissues and is defined by a Body Mass Index (BMI) of 30 kg/m2 and above. Individuals in the BMI range of 25 to 30 kg/m2 are categorized as overweight while a BMI of 40 kg/m2 and above is regarded as morbid obesity. Obesity correlates with an individual's increased risk of cancers, stroke, metabolic disease, heart failure, and other cardiovascular conditions, highlighting the need to reduce the incidence and prevalence of obesity[14]. Inactivity or low level of physical activity combined with changes in eating habits are believed to be the main reasons for the increased prevalence of overweight/obesity among adolescents and adult. The genetic differences in weight gain among them also make them vulnerable to overweight. As physical activity is an important component in weight control and also associated with other major health benefits its role in youth health is fundamental. Physical activity measured as number of steps per day was inversely correlated to percentage body fat as well as to Body Mass Index (BMI) in adults. It is therefore difficult to know whether inactivity causes obesity or obesity leads to inactivity. Guidelines for physical activity levels in adolescents and adult recommend at least 60 minutes of accumulated moderate to vigorous physical activity per day. Many other factors besides individual level of daily physical

activity for a healthy lifestyle are cultural, social, and personal. Data on the inter-relationship between BMI and physical activity are limited.[15]

VO2max

VO2max is the maximum amount of oxygen can take in and utilize. Not all air taken in is used by the body. The more cardiovascular conditioned are, the higher VO2max will be, thus the more oxygen will be able to utilize with each breath. Finding VO2max is among the best measures of cardiorespiratory fitness. Each litre of oxygen utilized burns about 5 Kcals so the higher the VO2max, the more energy will require to exercise meaning can burn more calories and get better more intense workouts. Striving for a higher VO2max is one of the best ways to improve all cardiovascular functions in the body which will improve your overall fitness level.[16]

FACTOR AFFECTING VO2MAX

VO2max level depends on body build and composition and is affected by the following factors:

- Sex - Comparatively, the typical female will have a lower VO2max than the typical male.
- Age - Maximal Oxygen Uptake (VO2max) decreases by 10% per decade in men and women regardless of age and exercise activity.
- Size – Maximal Oxygen Uptake is directly proportional to height and body surface area.
- Weight - Maximal Oxygen Uptake is proportional to a weight.
- Lean body mass - VO2max correlates 0.63 with body mass, 0.85 with fat-free body mass, and 0.91 with active muscle tissue.
- Bed rest - Enforced bed rest of 3 weeks reduces maximal oxygen uptake by approximately 17%.[17]

MET

Meta Equivalent represent the amount of energy expended carrying out physical activity. A Meta Equivalent is a multiple of estimated resting energy expenditure. To get a continuous variable score from the International Physical Activity Questioner we will consider walking to be 3.3 METs, moderate physical activity to be 4 METs and vigorous physical activity to be 8 METs.[18] Increasing energy expenditure can help reduce excess adipose tissue and obesity. The current guidelines put out by the American College of Sports Medicine (ACSM) include either aerobic or anaerobic exercise. Aerobic exercise (i.e., running, cycling, rowing, etc.) is an exercise that exhausts the oxygen in the muscles, but oxygen consumption is sufficient to supply the energy demands placed on the muscles and does not need to derive energy from another source. On the other hand, anaerobic exercise (or resistance exercise, i.e., weight lifting) is oxygen consumption that is not sufficient to supply the energy demands placed on the muscles, and muscles must break down other energy supplies, such as sugars, to produce energy and lactic acid.[19]

VO2max and METs

Metabolic Equivalents (METs) refers to the ratio between the energy expended during physical activity and the energy expended while at rest. Finding a person's MET involves measuring how much oxygen their body uses at rest[20]. At rest, oxygen utilization is about 3.5mL · kg-1 · min-1 and is known as a ―Metabolic Equivalent of Tasks‖ or MET. 1 MET is also known as VO2rest. Normal healthy individuals typically have as VO2max of 25-80 or 7.1 to 22.9 METs.

FACTORS AFFECTING HEART RATE DURING EXERCISE

These factors play a role in directly affecting heart rate while running or walking:

- Emotions and anxiety can raise heart rate.
- Body Temperature: If become too hot or too cold body senses a thermal stress load. Blood is sent to skin to enhance heat dissipation to cool or increases blood flow to warm.
- Apparent temperatures (which account for humidity or wind chill) above 70 degrees (F) and below 35 degrees (F) will increase heart rate at least 2-4 beats per minute. Over 90% humidity can equal as much as a10 beats increase in heart rate. 1.0 Walk or run uphill and HR increases - Walk or run downhill and HR decreases.
- Wind - Walking or running with the wind at back is easy, therefore HR decreases. Walking or running into the wind is more difficult: HR increases.
- Dehydration - As become increasingly dehydrated during a long walk, hike, or run blood becomes thicker and waste products build up in bloodstream heart will work harder to maintain constant cardiac output. A fluid loss of 3% of body weight increases pulse rate because of decrease in circulating blood volume.
- Insufficient nutrition - HR increases.
- Insufficient sleep - HR increases.

METHODOLOGY

Study design: Observational study

Source of data: Civil hospital gandhinagar.

Sampling method: convenient sampling method.

Duration: 4 months

Sample size: 40, group a male – 21, group b female - 19

Inclusion criteria

- Age: 18 to 23 years
- Healthy Male and female college going students

Exclusion criteria

- Age: below 18 years
- Above 23 years neurological disorders cardiorespiratory disorders musculoskeletal disorders
- Students who have recently undergone any surgical procedure students making any history of acute or chronic medical illness**.**

Materials and tools required:

- Google form
- Consent form
- Pen , pencil , paper

Data collection tool:

- Borg Rating of Perceived Exertion (RPE)
- Queen's college step test

DATA ANALYSIS

- Descriptive analysis was done for demographic details.
- Correlation between VO2Max values obtained of male and female.
- Correlation between VO2Max values obtained of the students and their HR.

RESULT:

- 40 young Male (n = 21) and Female (n =19) undergraduate college going students aged between 18 to 23 years participated in the study.
- The mean age obtained of the total participants was 19.95 + 1.72388946 years. The mean values obtained for the height and weight of the participants was 164.13 + 8.63486044 cm and 57.1325 + 13.36431121 kg respectively. The max and min values obtained for height and weight were 182.88 cm, 148 cm and 96 kg, 40 kg respectively.
- The mean BMI recorded was 21.115 + 4.511668632 kg/m2 also the max values found was 34.8 kg/m2 and min value found was 13.5 kg/m2. Out of 40 students that had participated for the test 13 students were underweight, 19 were into the normal category, 6 were found to be overweight and 2 were found to be obese class 1 category.
- Mean value of VO2max for males was 46.45 + 15.9790711 ml/kg/min and that for the females was 40.780 + 4.107005078 ml/kg/min. The mean and SD values were found to be significantly higher in males than in females. The VO2max values obtained in males were found to be closer to the normal predicted value than the values obtained in females.

Variables	Mean	SD	Max	Min
Age(years)	19.95	±1.72	23	18
Height(cm)	164.13	±8.63	182.88	148
Weight(kg)	57.1325	±13.36	96	40
BMI (kg/m^2)	21.115	±4.51	34.8	13.5
HR (bpm) (After Ex.)	143.9	±32.41	220	96
RPE	6.05	±1.036	8	4
VO2max(ml/kg/min)	43.755	±12.12	71	18.93
MET (min/week)	1122.9	±957.81	5439	0.0

Table 1. Mean, SD, max and min values of the anthropometrics values as well as the post participation variables of the total participants

Variables	Mean	SD	Max	Min
Male	46.45	15.9790711	71.00	18.93
Female	40.780	4,107006078	48.080	33.300

Table 2. Gender specific mean, SD, max and min values ofVO2max of total participants

Classification	VO2max values obtained
<30	2
30 -36	5
37-41	1
42-46	2
47-51	4
52-60	1
>60	6

Table 3. The given table shows the categorization of the obtained VO2max values for males according to standard VO2max classification

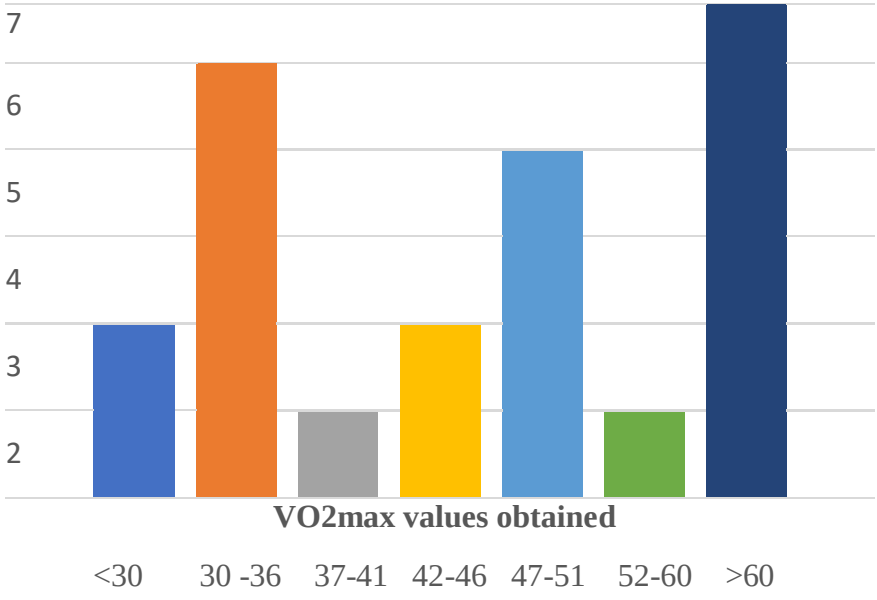


Figure 1. VO2max values for males according to standard VO2max classification

Classification	VO2max values obtained
<28	**0**
28-32	**0**
33-37	**5**
38-41	**6**
42-46	**6**
47-56	**2**
>56	**0**

Table 4. Categorization of the obtained VO2max values for females according to standard VO2max classification

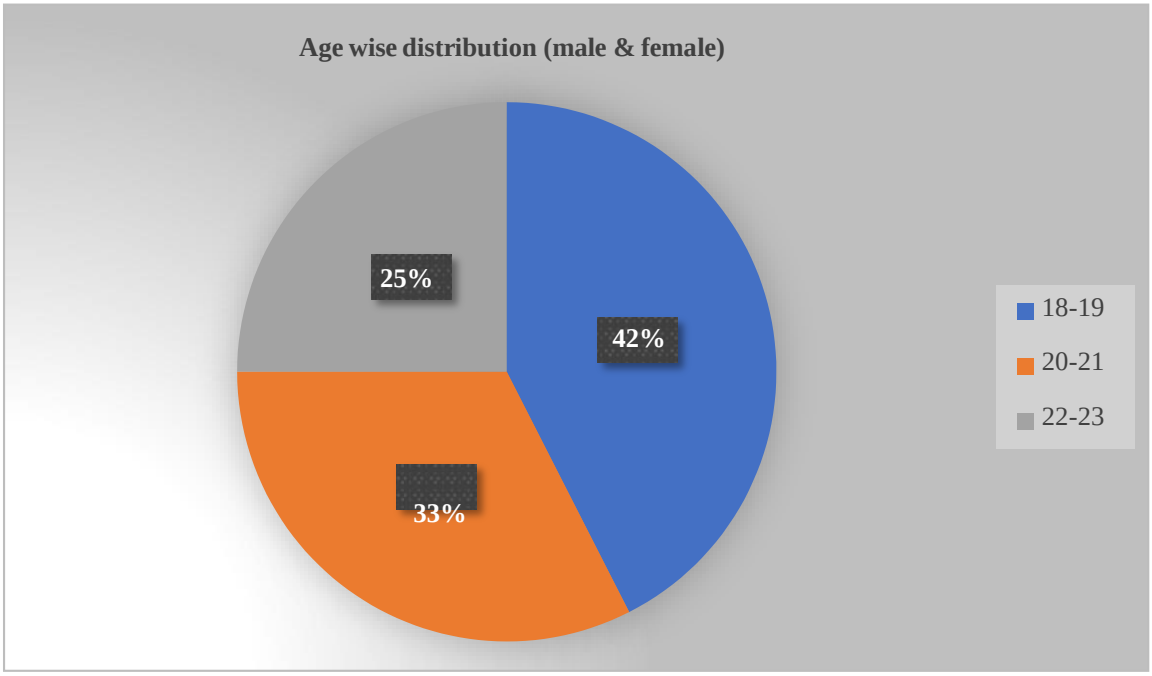
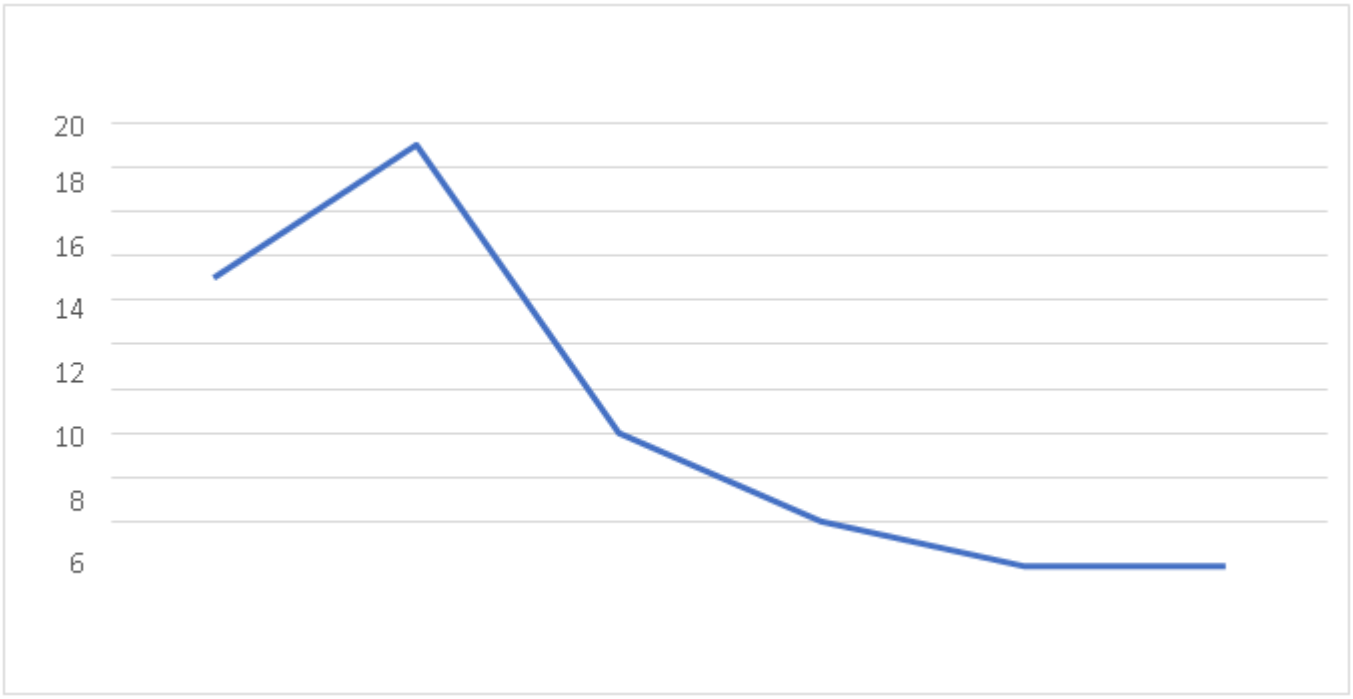


Figure 3. Shows the percentage distribution of participants according to age criteria of 18 to23 years.



Underweight	Normal	Overweight	Obesity class 1	Obesity class 2	Obesity class 3
Below 18.5	18.5 to 24.9	25.0 to 29.9	30.0 to 34.9	35 to 39.9	Above 40

Figure 4. BMI distribution of participants according to the standard classification of BMI

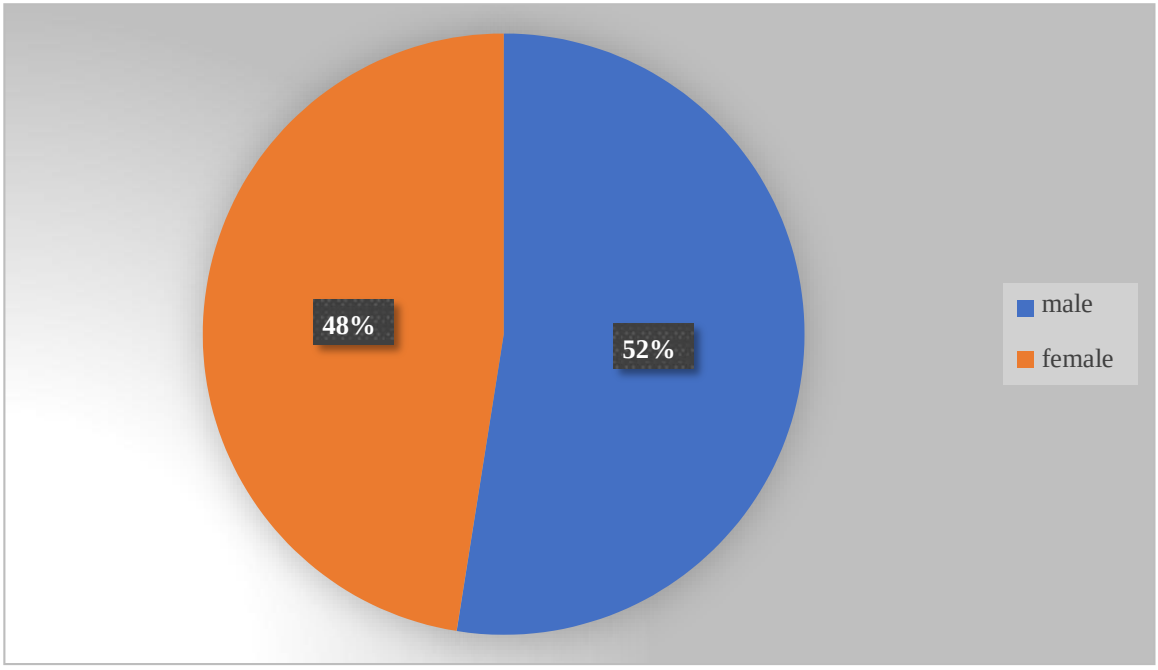


Figure 5. According to gender distribution

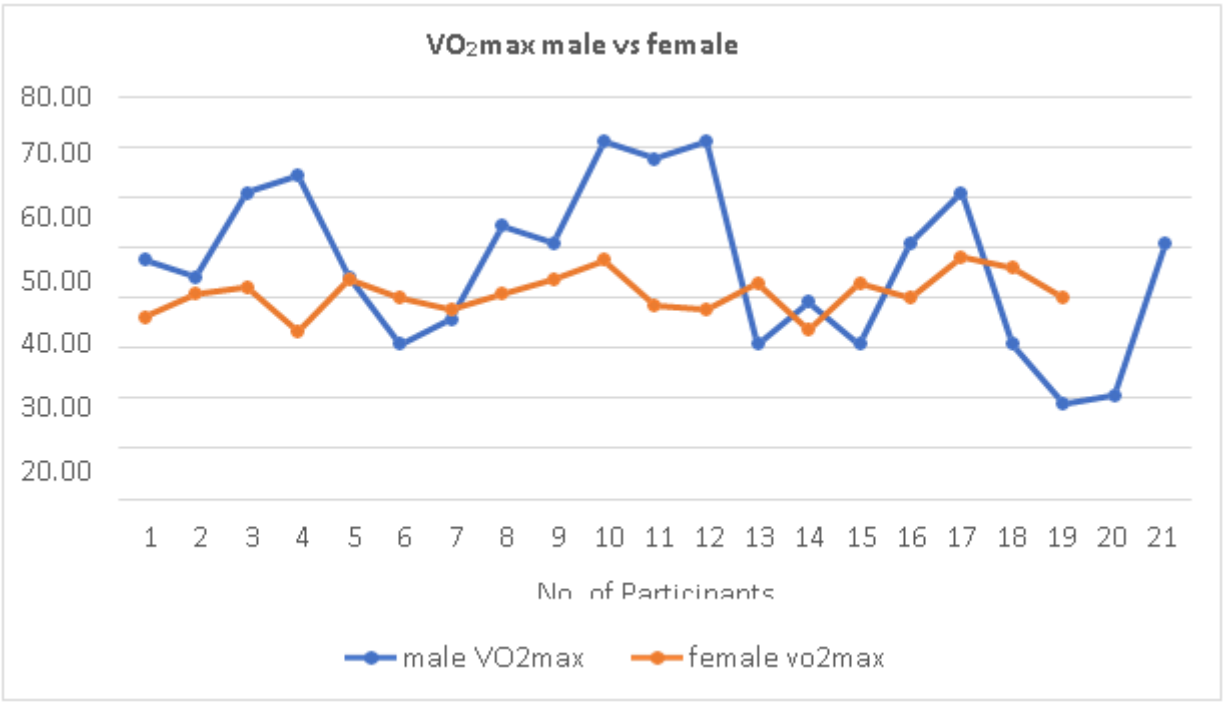


Figure 6. The Correlation between VO2Max values obtained of male and female.

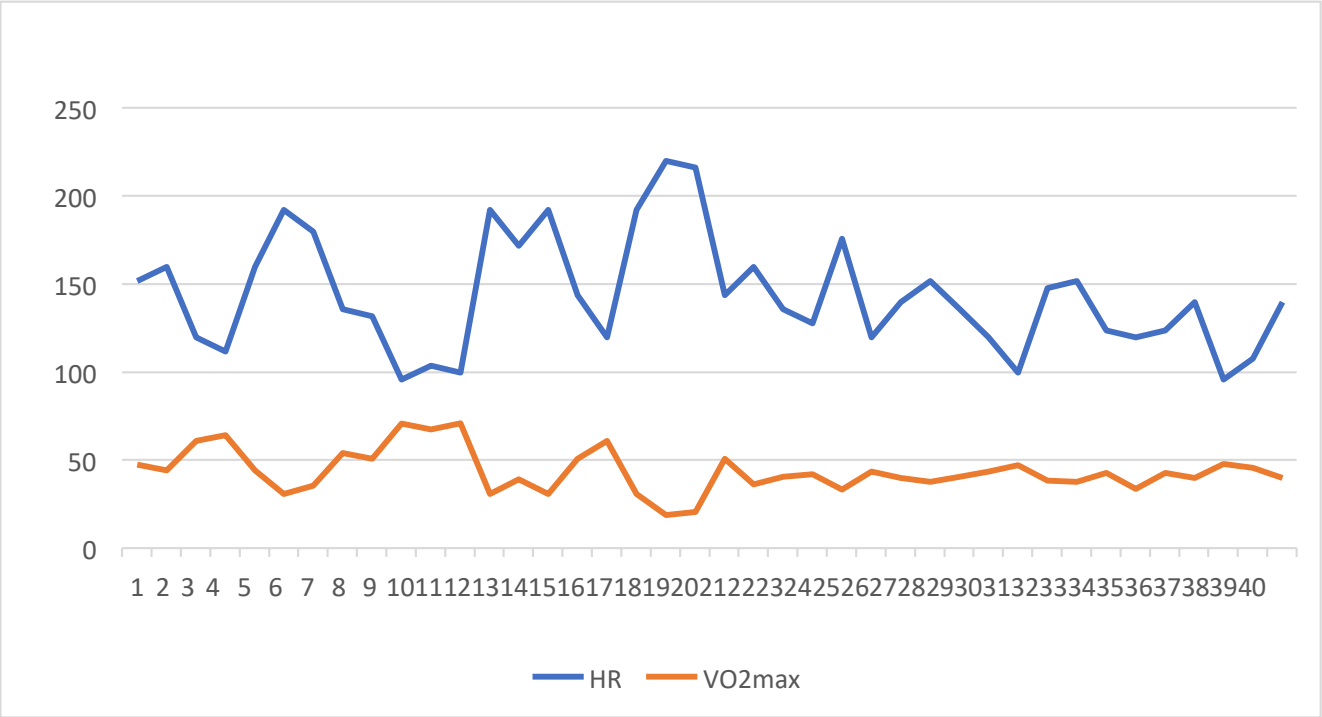


Figure 7. Correlation between VO2Max values of the students and their HR.

DISCUSSION

At present, physical exercise is promoted as an important aspect of general health, and the transition from high school to college will pronounce lifestyle changes that can severely challenge a student's health status[1]. Queen's college step test used to assess the VO2Max of young male and female using heart rate after the participants stepped on a 41.3cm stool at the rate of [female=22 steps/min] and [male=24 steps/min]. Test re-test reliability for recovery heart rate has been measured as r = 0.92. Correlation between recovery heart rate and VO2max has been measured as r = -0.75[21]. 40 young male [n=21] and female [n=19] college going students aged between 18-23 years participated in our study. The result of the present study showed that the mean value of Vo2Max for males was 46.45+15.97 ml/kg/min and that for the females was 40.78+4.1ml/kg/min. On comparing both the mean values it is clearly seen that the aerobic capacity of male students is significantly higher than the female students. It also gives an idea about the level of physical fitness of both the gender. Comparison between the heart rate after exercise and VO2Max values, we found that the students with a high VO2max values were able to gain a lower heart rate and inverse scenario was seen with those who showcased low VO2max. We also found that when compared the BMI and heart rate values of the participants classified according to the standard BMI classification, the students coming under OBESE category had a higher HR and the students coming under the UNDERWEIGHT category also showed and average HR values while some of the students coming under the NORMAL category showed a relatively lower HR somewhere up to the mark. Obesity and Overweight in our participants could also be the reason for a decreased in aerobic capacity. The results of our study also suggested that the female students were into a level of low physical activity when compared with male students. On comparison of the VO2max values of our subjects according to the standard VO2max classifications, the majority numbers of female students n= 6 fitted in the category of AVERAGE and ABOVE AVERAGE, whereas the BELOW AVERAGE and GOOD categories had 5 & 2 females respectively. On the other side maximum numbers of male students n= 6 were found to be falling into the EXCELLENT category. The male students falling into VERY POOR, POOR, BELOW AVERAGE, AVERAGE, ABOVE AVERAGE & GOOD category were 2, 5,1,2,4 & 1 respectively. We also found that out of the total 40 participants who were asked to fill out the physical activity questionnaire, majority students n= 25 were found to be minimally active as they spent 20 to 30 minutes of regular exercise sessions and n= 12 students were found to be inactive and did not spare any time for routine exercise. Lastly 3 students were found to be highly active.

CONCLUSION

This research provides a baseline marker for physical activity levels and sedentary behaviour among college going students, which will be useful for future monitoring and evaluation of interventions. Low to moderate level of physical activity was found among college going students, and there is a difference in aerobic capacity in students who were physically active in their routine life and thus better physical fitness.

FUTURE RECOMMENDATION

- Sample size was small to generalize the result of study.
- IPAQ difficult to provide exact hours and minutes for sitting and walking time.

FUTURE RESEARCHES:

- Further this study can be used to find out the physical fitness index of the individual subjects.
- This study can be extended further by including a detailed measurement of the cardiac function in order to assess whether any cardiac impairment persists or not.

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"EFFECTS OF STRETCHING EXERCISE ON PRIMARY DYSMENORRHOEA IN ADOLESCENT GIRLS"

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ABSTRACT

Background: Primary Dysmenorrhoea is a difficult menstrual flow in the absence of any pelvic pathology where pain is spasmodic in character and felt mainly in the lower abdomen. Women that participated in sports experienced fewer occurrences of symptoms of dysmenorrhea.

Aim: To assess the effect of one term of stretching exercise on primary dysmenorrhea in adolescent girls.

Materials and Methods: 30 girls aged between 18-28 years with mild to severe primary dysmenorrhea were selected; the girls were non-athletes and volunteered for the study. The participants were randomly divided into 2 groups: an exercise group (n=15) and a control group (n=15). In the intervention group, the subjects were requested to complete an active stretching for 12 weeks (4 days per week, 1 time per day, 10 minutes, and post test was examined 12 weeks later.

Results: After the intervention, however, a significant difference was found between the two groups regarding the mean intensity of dysmenorrhea in the first and second menstrual cycles. Also, a significant difference was observed between the stretching group and the control group. However, no such difference was observed in control group.

Conclusions: Stretching exercises are effective in reducing pain intensity, pain duration, and the amount of absenteeism in schools and colleges due to having pain during menstruation.

Key Words: Dysmenorrhoea, Adolescent girls, Stretching, Exercise, Physiotherapy

INTRODUCTION

Dysmenorrhea literally means painful menstruation but more realistic and practical definition includes cases of painful menstruation of sufficient magnitude so as to incapacitate day to day activities. [1]

It is commonly classified into primary dysmenorrhea when there is no co- existent pathology and secondary dysmenorrhea where there is an identifiable pathological condition. About 40-70% of women of reproductive age suffer with dysmenorrhoea. [2]

Primary dysmenorrhea begins when young girls first experience the ovulatory cycles and its prevalence increases during adolescence (15-17) years and decreases progressively then after. In dysmenorrhea pain begins few hours before or after the onset of menstruation and lasts for 24-48 hours. The pain is more in the first day and rarely continues to next day. [3]

Primary dysmenorrhea is commonly seen only in ovulatory cycles, usually developing within 6 to 12 months of menarche and is characterized by lower abdominal sharp pain that may radiate to the back and upper thighs. The pain of primary dysmenorrhea starts with the onset of menstrual flow or a few hours after the onset and may last for a few hours up to 2 days. The pain of secondary dysmenorrhea usually begins few days before the start of menstrual flow and may be present during much of the menstrual cycle. Pain that occurs with the first menses or after the age of 25 or is associated with an ovulatory cycles is more likely to be secondary dysmenorrhea. [4]

It is characterized by lower abdominal pain that potentially could radiate to the back and thigh regions. The pain may be associated with headache, fatigue, nervousness, nausea, vomiting, mood swings.

Primary dysmenorrhea most likely caused by increased prostaglandin production within the uterus and associated uterine hyper- contractility. [5]

In primary dysmenorrhea pain is spasmodic in character and felt mainly in the lower abdomen, but it may radiate to the back and along the thighs. There may be associated systemic symptoms like nausea, vomiting, diarrhea, and headache. [6]

Despite the widespread use of stretch in physical rehabilitation, considerable uncertainty remains surrounding its lasting effects. There is little doubt that stretch induces immediate increases in muscle extensibility due to the viscoelastic nature of soft tissues. [8] However, these effects are transient and quickly dissipate. The lasting effects of stretch are more controversial but arguably of more importance, particularly for individuals with chronic pain.

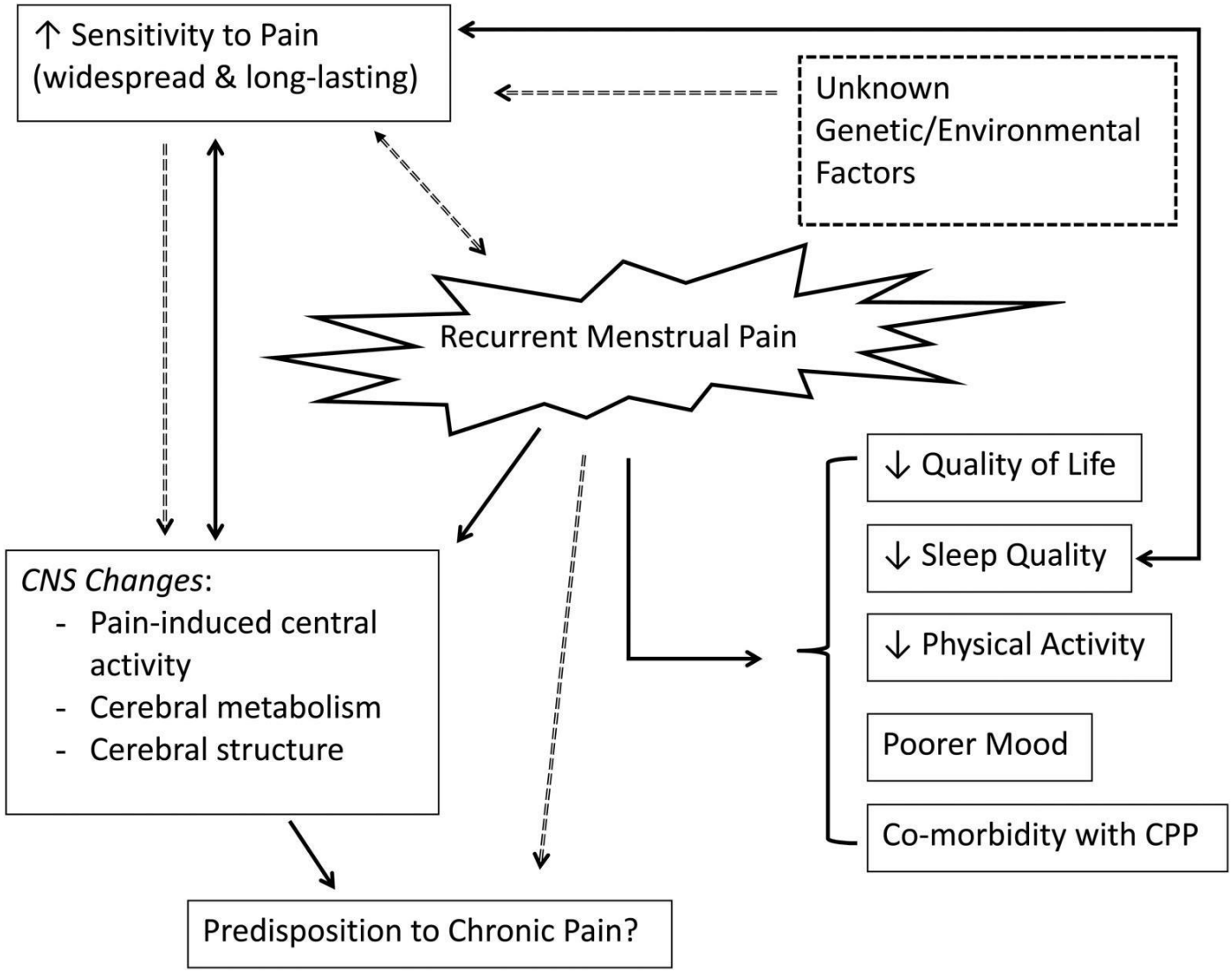


Figure.1 A schematic representation of the proposed (dotted lines) and known (solid lines) effects of recurrent dysmenorrheal pain [7]

The controversy arises from the discrepancy between strong anecdotal evidence and evidence from studies of animals [9] supporting the effectiveness of stretch and high-quality randomized controlled trials indicating otherwise. Studies of animals showed that soft tissues are adaptable and undergo structural remodelling in response to stretch. On the other hand, results of studies of humans are less consistent. In this article, improvements in extensibility refer to an increase in joint ROM when repeat measurements are taken with the same testing torque (torque is the product of applied force and moment arm or the tendency of a force to cause rotation).

Some investigators contend that what appear to be lasting changes in extensibility are in fact changes in people's willingness to tolerate the discomfort associated with stretch over time. For example, following a hamstring muscle stretch program, an individual may touch his or her toes more easily. This patient outcome may not be due to any underlying change in muscle extensibility, but may instead be due to the direct relationship between applied stretch torque and resultant joint ROM. That is, the harder an individual

leans forward (ie, the stretch torque), the further he or she can reach down toward the toes (ie, the joint ROM). The ability to reach further is due to altered perceptions and increased willingness to tolerate the discomfort associated with stretch [10]

The causes of primary dysmenorrhea are still unclear, but one of the most accepted explanations is increased synthesis of prostaglandins, of which types E2 and F2α play a significant role in the development of ischemia and hypoxia, resulting in dysrhythmia uterine contractions and decreased blood flow. [11]

Drug therapies and complementary medicine are often used to treat dysmenorrhea. [12] According to the literature, NSAIDs and OCPs rank among the most frequently used medications. These drugs reduce pain by inhibiting the production and release of prostaglandins. However, long-term use of NSAIDs has been associated with side effects such as headache, dizziness, drowsiness, loss of appetite, nausea, vomiting, gastrointestinal bleeding, increased acute asthma, dysuria, and acne. [13]

OCPs inhibit ovulation, reduce endometrial proliferation, and create an endocrine environment that mimics the early stages of the proliferative phase of the menstrual cycle, in which prostaglandin levels are at theirlowest. Lower prostaglandin levels lead to fewer uterine cramps. In the realm of complementary medicine, methods resorting to herbs, yoga, relaxation, psychotherapy, massage, hypnosis, vitamins (E, B, C), and supplements (calcium and magnesium) as well as acupressure and acupuncture have been used. The herbs used more commonly to treat dysmenorrhea are chamomile, ginger, fennel, cinnamon, and aloe Vera. [14] Common treatments for dysmenorrhea are extensive and in some cases subject to restrictions. For example, NSAIDs are contraindicated for patients with digestive problems, while medicinal plants are not always readily available. This research aimed to investigate the effects of a set of stretching exercises on reducing the pain of dysmenorrhea.

REVIEW OF LITERATURE

1. **An epidemiological study of young women with dysmenorrhoea[15] : B Andersch et al. (1982)**

   The study was conducted in 1982**,** The prevalence of dysmenorrhoea was studied in a random sample of 19 year old women from an Urban-Swedish population, dysmenorrhoea was reported by 72% of the women 15% suffered from dysmenorrhoea which limited daily activity and was unimproved by analgesics.

2. **Prevalence of dysmenorrhea and its effects on quality of life among a group of female university students.[16] : A Unsal et al. (2009)**

   This cross-sectional study was conducted between 15 march and 15 April 2009. The study group included 623 female students. The severity of dysmenorrhea was determined with 10-point visual analog scale. The average age of the study groups was 17-30 years. They concluded that prevalence of dysmenorrhea was found to be 72.7% and it was significantly higher in coffee consumers, females with

menstrual bleeding duration 7 days, and those who had a positive history of dysmenorrhea when compared to the others.

3. **Association of psychologic and nonpsychologic factor with primary dysmenorrhea.[17] : M Faramarzi et al. (2014)**

   This study was conducted in Aug 2014, in this study 180 females with dysmenorrhea and 180 females without dysmenorrhea were enrolled. Psychological risk factors were evaluated in four domains including affects, social support, personality, and alexithymia. The data was collected by using questionnaires and they concluded and high caffeine diet are important risk factors risk factors for women with primary dysmenorrhea.

4. **Comparing the effects of aerobic and stretching exercises on the intensity of primary dysmenorrhea in the students of universities of busher[18]: F Vaziri et al. (2015)**

   The study was conducted in March, 2015. This randomized clinical trial was conducted on 105 females who were suffering from primary dysmenorrhea. The participants were divided into aerobic, stretching and control groups. The 2 groups performed exercise three times a week for 8 weeks. Then after the intensity of dysmenorrhea was determined using several modified questionnaires that assessed several symptoms of dysmenorrhea. After all, the data was compared between and within groups through analysis of variance. They concluded the aerobic and stretching exercises are effective in reducing Severity of dysmenorrhea.

5. **Primary dysmenorrhea and its effects on quality of life in young girls.[19]: T Joshi et al. (2015)**

   The study was conducted in March 2015, A cross sectional study and data were collected among 310 young girls on presence and absence of dysmenorrhea, premenstrual symptoms, dietary habits using questionnaire and they concluded that concluded that dysmenorrhea is a leading causes of a absenteeism in colleges and has an adverse effects on the quality of young girls.

6. **Effects of different exercise techniques on primary dysmenorrhea among higher secondary school girls. [20]: D Khare et al. (2016)**

   The study was conducted in 2016, to study the effectiveness of isometric exercises and variousstretching techniques used as a treatment protocol for primary dysmenorrhea. The students were divided into control and experimental groups, both groups performed set protocol from fourth day of menstrual cycle. They concluded that isometric and stretching both exercise has a positive effects on treatments of primary dysmenorrhea in school girls.

7. **Effects of exercises on primary dysmenorrhea in young females.[21]S Shah et al. (2016)**

This study was conducted in year 2016, A convenient sample was taken of 40 participants, randomly and equally divided into 2 groups. Groups A received stretching exercises and group B was control groups. Participants in group A completed an active stretching exercise program for 6 active stretching exercises in the abdominal, pelvic and groin regions for 8 weeks, group B was control group. All the participants were examined for pain intensity with VAS and VMSS. After the research they concluded that stretching exercises are effective in reducing pain in young females with primary dysmenorrhea.

8. **Effects of selected muscle stretching exercise on primary dysmenorrhea among studentnurses.[22]: B Gomathi et al. (2017)**

This study was conducted in July 2017, To assess the effectiveness of selected muscle stretching exercise on primary dysmenorrhea. 67 student nurses with primary dysmenorrhea were selected from college by using non probability purposive sampling technique and they were randomly assigned into experimental group and control group. Muscle stretching exercise taught to the experimental group and practiced for 8 weeks. Pain intensity was assisted by using numerical pain rating scale and they concluded that selective muscle stretching exercise are effective in reducing pain in dysmenorrhea.

9. **What we know about primary dysmenorrhea today: a critical review[23]S Lacovides et al. (2015)**

Comprehensive literature searches on primary dysmenorrhea were performed using the electronic databases PubMed, Google Scholar and the Cochrane Library. Full-text manuscripts published between the years 1944 and 2015 were reviewed for relevancy and reference lists were cross-checked for additional relevant studies. In combination with the word „dysmenorrhea" one or more of the following search terms were used to obtain articles published in peer-reviewed journals only: pain, risk factors, etiology, experimental pain, clinical pain, adenomyosis, chronic pain, women, menstrual cycle, hyperalgesia, pain threshold, pain tolerance, pain sensitivity, pain reactivity, pain perception, central sensitization, quality of life, sleep, treatment, non-steroidal anti-inflammatory drugs.

NEED OF STUDY

Dysmenorrhea pain is associated with restriction of activities and it is considered as the leading cause of absenteeism from work place and colleges in young girls. Dysmenorrhea is the most commonly relieved by medication ranging for commercially available formulas to contraceptive. The side effects from such medication are well known (nausea, breast tenderness, and drowsiness, hearing and visual disturbances).
Despite the widespread belief that exercise can reduce dysmenorrhea, evidence based studies are limited. Several observational studies reported that physical exercise was associated with reduce prevalence of dysmenorrhea, although numerous other studies found no significant association between outcomesevidence

from controlled trials suggests that exercises can reduce dysmenorrhea and associated symptoms. Hence this study is designed to determine the value of stretching exercise weather it is helpful in reducingthe symptoms of primary dysmenorrhea or not.

OBJECTIVE OF THE STUDY

1) **Aims:** To check the effects of stretching exercises on reducing the symptoms of primary dysmenorrhea in adolescent girls.
2) **Objectives of the studies:** To find out effects of stretching exercise on primary dysmenorrhea in adolescent girls.

HYPOTHESIS

1) **NULL HYPOTHESIS**

   There will be no significant effects of stretching exercise on reducing the symptoms of primary dysmenorrhea in adolescent girls.

2) **EXPERIMENTAL HYPOTHESIS**

   There will be significant effects of stretching exercise on reducing the symptoms of primary dysmenorrhea in adolescent girls

METHODOLOGY

Materials and Methods:

- **Study design:** Randomized control trial
- **Source of data:** Nearby colleges and working girls through online question forms
- **Population:** All subjects are adolescent girls that are having symptoms of primary dysmenorrhea
- **Sampling method:** Purposive sampling
- **Sample size:** 30 subjects
- **Duration of study:** 3 months

All the data were collected by general assessment form, questionnaires regarding menstrual characteristics and dysmenorrhea, Numerical rating scale and verbal rating were used for assessment of intensity of pain. The general assessment form and questionnaires were distributed to all the girls who agreed to participatein

the study.

Then participants were explained the procedure and purpose of the study and consent was taken in an understandable language.

Then after participants was randomly divided into 2 groups, Group A: Stretching exercise group, Group B: Control group. Severity of the pain was measured by using Numerical rating scale and Verbal pain rating scale for pretreatment and post treatment.

Group A participants was asked to perform 5 self- stretching exercises in the back, thigh and pelvic regions for 8 weeks (4 days per week). Also they were asked to avoid performing stretching exercise during the menstrual cycle and group B participants were asked not to perform any kind of exercise on daily basis.

The exercises are as follows:

1. **Double Knee Chest**

First you have to lie down on a mat then bring one knee towards the chest then the other one, clasp the hands around the thighs and pull them to the chest, elevating the lower back part off the mat, you should not grasp over the knee part but end area of the thigh. Do it for 20 seconds and 5 times.[This exercise will stretch the lumbar spine muscle and tissues posterior to the spine]

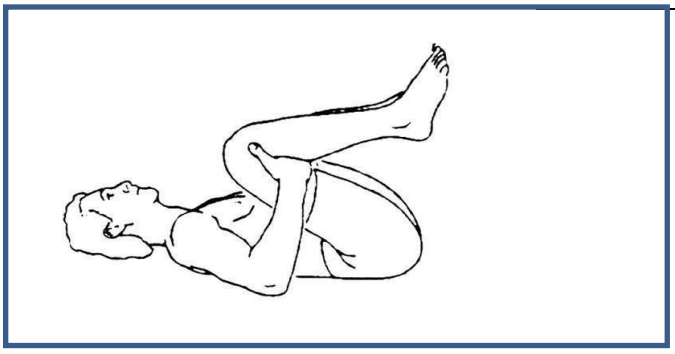


Figure.2 Double knee chest

2. **Gluteal Muscle Stretch**

Knee to chest: Pull your left knee towards your chest while lying on the ground , focus on placing your lower back flat on the ground while breathing long and deep, hold the stretch for 20 seconds and 5 times. Then perform this same on the right side of knee for 20 seconds 5 times.[This exercise will stretch the gluteal muscles , hamstrings and lower back muscles]

Figure.3 Gluteal muscle stretch

3. Child's Pose

Go on all 4 limbs and with both arms reach as far as possible with your elbows locked and your arms straight. Then lean back with your shoulders relaxed.

The stretch should be felt in the lower back and shoulders. Focus on breathing deeply with your long breaths (20 seconds 5 times) [This exercise will stretch the lumbar spine muscle , gluteal Maximus , quadriceps femoris and shoulderextensor muscle].

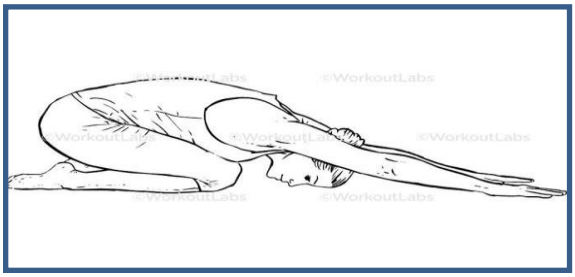


Figure.4 Childs pose

4. Cobra Pose

Lay down on your stomach then place your hands by your sides at chest level and push up while leaving your waist on the floor. Try to relax your back and waist and allow the stretch in your stomach and lower back. Focus on breathing deeply and increase movement in the spine.(20 seconds 5 times) [This exercise will stretch the soft tissues anterior to the lumbar spine and hip joints].

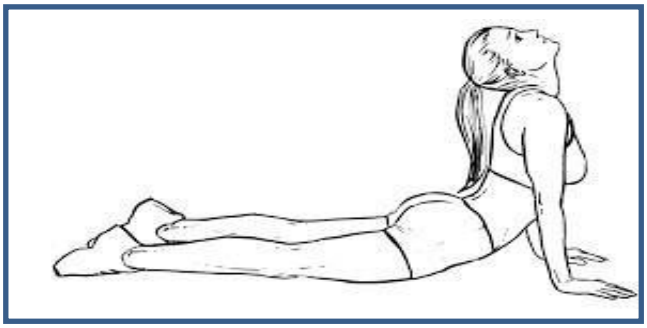


Figure.5 Cobra pose

5. Quadratus Lumborum Stretch

Lay down the ground and pull the left leg over the right side, try to leave the same side of shoulder on thefloor while you are holding the stretch. To increase the intensity of stretch extend your leg and pull the leg closer to your chest, keep inmind that do not stretch beyond your limits. (20 seconds 5times) [This exercise will stretch the quadratus lumborum muscle]

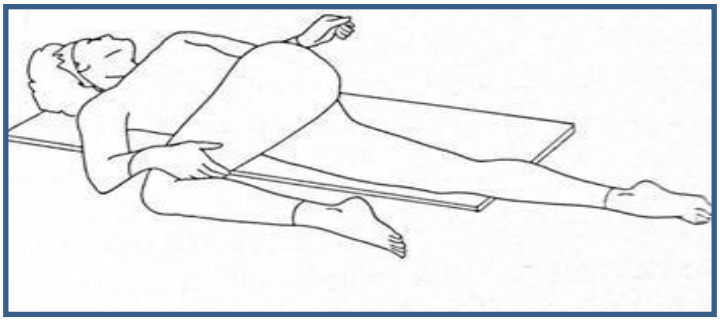


Figure.6 QL stretch

- Then same perform to the right side (20 seconds 5 times)
- Group B will be Control Group and will be asked not to perform any type of exercise during this time of study. Again data will be collected, that includes their menstrual pain before study and menstrual pain after 8 weeks, from both the group. Data will be compared and conclusion will be made on results

- Scales that were used for pain assessment of girls are as follow

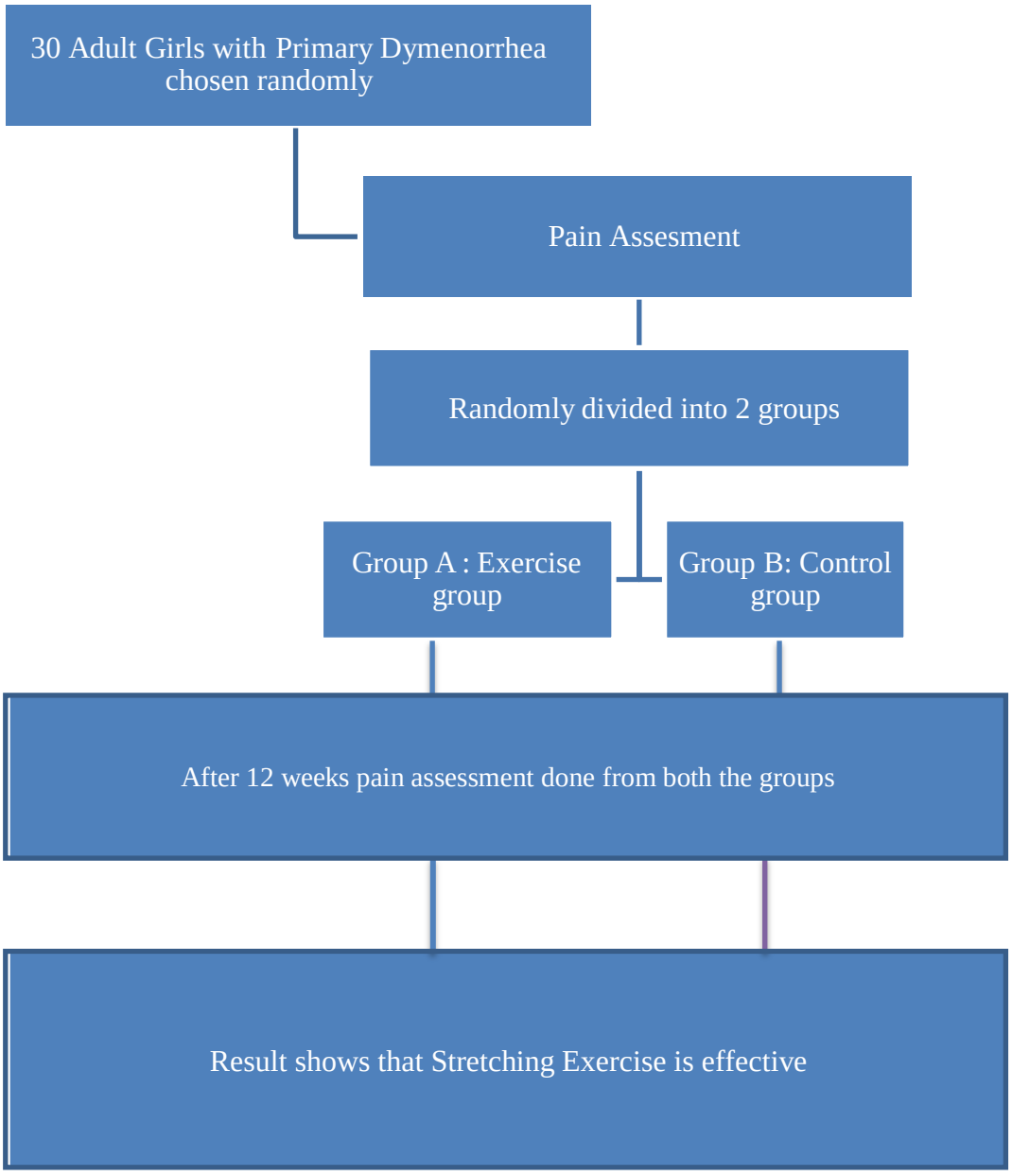
1) Numerical pain rating scale
2) Verbal pain rating scale

. Numerical pain rating scale

0 1 2 3 4 5 6 7 8 9 10

. Verbal pain rating scale

- None
- Mild
- Moderate
- Severe



RESULT

In present study 30 subjects with the age of 18-28 years were selected and divided into two groups:

- Group A – Exercise group
- Group B - Control group

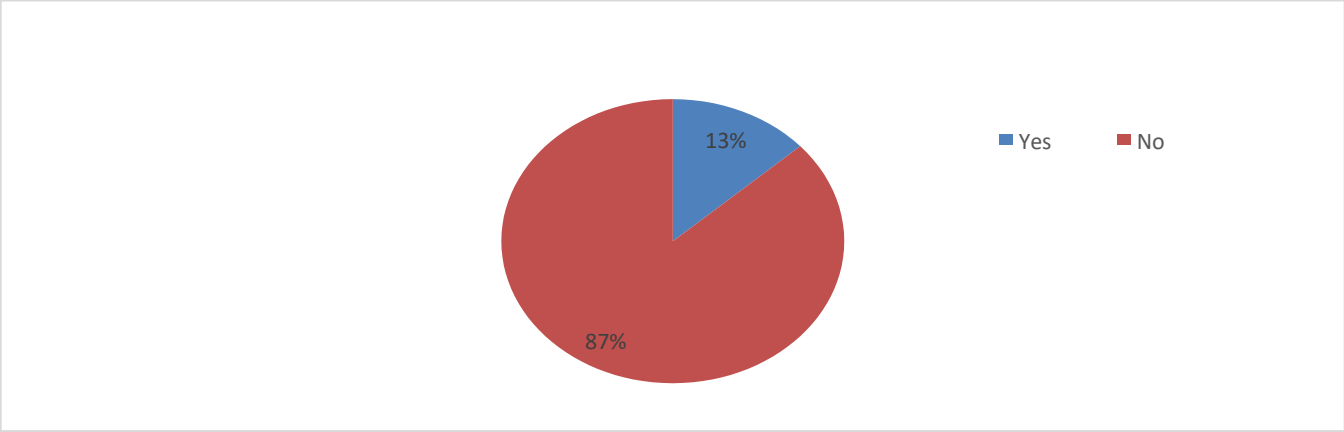
30 individuals completed the study program without any complications. The data obtained in both the groups are as follows.

Table 1 Medication taken by patients

Medicines (pain relief)	NO. of Patients
YES	4
NO	26
Total	30

Interpretation: The above table shows the no. of patients that took medication for pain relief in both the groups

Graph.1



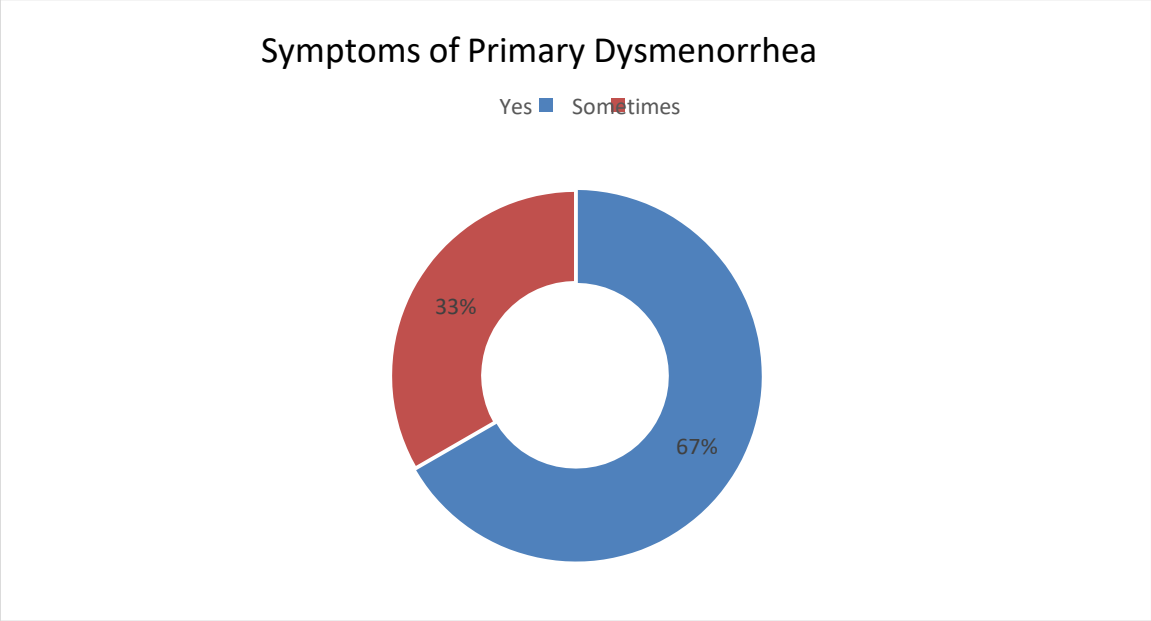
Interpretation: Above graph shows no. of patients who respond yes and no to the medication

Table 2: Pain and any other symptoms

Pain and symptoms	No. of patients
Yes	20
Sometimes	10
Total	30

Interpretation: The above table shows the no. of patients having pain or any other symptoms

Graph.2



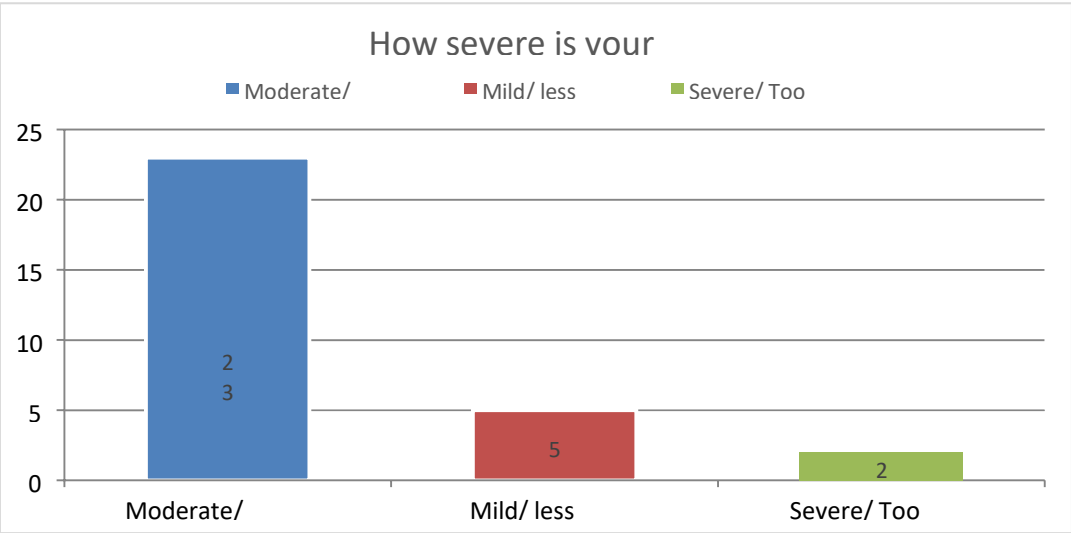
Interpretation: Above graph gives information about having pain and other symptoms in both the groups

Table 3: Severity of Pain

Severity	No. of patients
MILD	5
MODERATE	23
SEVERE	2
Total	30

Interpretation: The above table shows the severity of pain in both the groups before treatment.

Graph.3



Interpretation: Majority of girls were having Moderate pain and few girls were having severe pain during menstruation

Table 4: Mean and SD of Pain Intensity Group A

	Mean	N	Std. Deviation	d. Error Mean
VRS PRE	3.40	15	.632	.163
VRS PRE	.60	15	.737	.190
NPRS PRE	7.40	15	1.242	.321
NPRS POST	1.33	15	1.113	.287

Table.5 Paired Sample T Test of Pain Intensity of Group A

	N	Correlation	Sig.
VRS PRE & VRS POST	15	.368	.177
NPRSPRE &NPRS POST	15	-.775	.001

Paired Sample T Test

		Paired Differences							
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig.(2-tailed)
Pair 1	VRS PRE-VRS POST	2.800	.775	.200	2.371	3.229	14.000	14	.000
Pair 2	NPRS PRE NPRS POST	6.067	2.219	.573	4.838	7.295	10.589	14	.000

Table 6: Mean and SD of Pain Intensity of Group B

	Mean	N	Std. Deviation	d. Error Mean
VRS PRE	3.13	15	.743	.192
VRS PRE	2.80	15	.676	.175
NPRS PRE	7.13	15	1.767	.456
NPRS POST	6.60	15	1.639	.423

Table 7: Paired Sample T Test of Pain Intensity of Group B

	N	Correlation	Sig.
VRS PRE & VRS POST	15	.768	.001
NPRS PRE &NPRS POST	15	.932	.000

Paired Sample Test									
				Paired Difference					
					95% Confidence interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig(2-tailed)
Pair 1	VRSPRE-VRSPOST	333	.488	126	.063	.604	2.646	14	.019
Pair 2	NPRSPRE-NPRSPOST	533	.640	165	.179	.888	3.228	14	.006

Table 8: Unpaired t test between group A and group B of pain measurement scale

Group Statistics					
	GROUP	N	Mean	Std. Deviation	Std. Error Mean
NPRS	A	15	1.33	1.113	287
	B	15	6.60	1.639	423

Independent Samples Test										
		Levene"s test for Equality of vanances								
							or Equality ofMeans		95 % Confidence interval of the Difference	
		F	Sig.	T	df	Sig(2-tailed)	Mean Differences	Std. Error Difference	Lower	Upper
NPRS	Equal variances assumed	5.009	0.33	-10.297	28	000	-5.267	.511	-5.314	-4.219
	Equal variances not assumed			-10.297	24.645	000	-5.267	.511	-6.321	-4.213

DISCUSSION

The present study was conducted to see the effect of stretching exercises on the pain intensity of primary dysmenorrhea. In present study, pain has reduced in primary dysmenorrhea more in stretching exercise group than in control group.

This improvement may be due to the increase in the blood flow and metabolism of the uterus during exercise which may be effective in the reduction of dysmenorrheal symptoms. A study done by Izzo and Labriola (1991) [26] has shown that improved metabolism is a factor in the reduction of symptoms. It is also suggested that increased menstrual pain by uterine muscle contraction is derived from a nervous system that is innervated by the sympathetic nerve hence; stress through hyperactivity of sympathetic nerve system via the increase contractibility of uterine muscles may lead to menstruation symptoms. A study done by Dawood MY (2006) [27] has shown that therapeutic exercise can increase the secretion of endorphins from the brain, and these materials in turn raise the pain threshold of the body. Daley AJ (2009) [28] believed that contracted ligamentous bands in the abdominal region were the causative factor for physical compression of nerve pathways and their irritation, so the proposed series of stretching exercise was considered very effective.

Pain in general has disabling nature and makes dysmenorrhea stressful and it can become important irritating factor in the life of lots of women, particularly who are self-financing. Some women are completely prostrated and cramped to bed, whereas others are able to remain in the works with the support of analgesics. So, many studies were done to replace medication by physical exercises in management of primary. The present study was conducted to see effect of stretching exercises in relieving pain of primary dysmenorrhea. In this study, treated females reported a significant reduction in menstrual pain within an average of 8 weeks of exercises (Group A).

Since time ago, Israel et al. [29] found that after 12 weeks of aerobic training, the intensity of symptoms decreased and Golub et al. [30]expressed that dysmenorrhea in high school girls who were involved in sports and physical activities were less than non-exercise group. In present study, pain of primary dysmenorrhea has reduced in exercise group than in control group as regard intensity and duration. These findings are similar to those of lots of authors who studied the effects of exercises on primary dysmenorrhea. Abbaspour et al. [31] and Shahr-jerdy et al. [32] proved that stretching exercises are effective in reducing pain intensity, pain duration, and the amount of painkillers used by girls with primary dysmenorrhea. Onur et al. [33] studied the impact of home-based exercise on quality of life of women with primary dysmenorrhea and concluded that there is evidence that exercise has a positive effect in the treatment of dysmenorrhea.This improvement may be due to the increase in the blood flow and metabolism of the uterus during exercise which may be effective in the reduction of dysmenorrheal symptoms. Stress tends to enhance sympathetic activity and may increase menstrual pain by exacerbating uterine contraction. Exercise may decrease this sympathetic activity and relief the stress through release of endorphins, substances produced by the brain that raise the pain threshold, so reducing symptoms. [34] Dawood [35] has shown that therapeutic exercise can increase the secretion of endorphins from the

brain, and these materials in turn raise the pain threshold of the body. Daley [36] believed that contracted ligamentous bands in the abdominal region were the causative factor for physical compression of nerve pathways and their irritation, so the proposed series of stretching exercise was considered very effective. Golomb et al. [37] concluded that exercise is widely accepted as a mean of moderating stress and biochemical changes in the immune system. A mechanism by which exercise may improve the symptoms of dysmenorrhea (reducing stress) has been articulated so, findings of different studies have shown that therapeutic exercise and physical activity was related with reduced incidence of dysmenorrhea**.**

CONCLUSION:

Stretching exercises are effective in reducing pain intensity and improve the quality of life and also it helps in reducing the amount of pain killers taken by young girls which might have bad long term effects on their health and it is also shown that the productivity has also increased for those days as having less pain among the girls with primary dysmenorrhea.

SUMMARY:

The study was conducted to find out the effects of stretching exercise in reducing pain symptoms among the adult girls that were having primary dysmenorrhea. 30 girls are voluntarily participated in the study, after that pain assessment and data was collected through assessment form and girls were randomly divided into two groups (A: exercise group, B: control group). After that exercise groups was given a set of exercises to practice for 12 weeks (4 days per week) meanwhile control group was asked not to perform any exercise on daily basis. After the study duration pain assessment was taken from both the groups and compared to find out the effects. Results are seen that stretching exercises are effective in reducing pain in the girls of group A while girls of group B did not felt any change in their pain after 12 weeks.

LIMITATIONS:

There are some drawbacks of this study, such as

This study was conducted through online modes so there are some chances of faulty postures of candidates while doing the exercises which can affect the final results of the exercises.

FUTURE RECOMMENDATIONS;

- Study can be done among various other types of exercise forms which could be effective in reducingthe pain intensity of primary dysmenorrhea.

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"PREVALENCE OF IRREGULAR MENSTRUATION INFEMALES OF AHMEDABAD CITY- A CROSS- SECTIONAL STUDY."

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ABSTRACT

BACKGROUND: A natural process in which the blood is discharged through the vagina from the uterus, mainly occurs monthly at regular intervals in every women is known as menstruation. Menstrual abnormalities have the potential to have an impact on women's health and can be an indication. Therefore, awareness about this diseases can make the precautionary measurements a lot more easier.

AIM: To find the prevalence of Irregular menstruation in females of Ahmedabad city.

MATERIAL AND METHODS: This cross-sectional study was carried out within period of six months to study various menstrual problems experienced by the females. A questionnaire was designed and 500 females were asked to partake by answering questions regarding their menses. After that, their data as collected for analysis.

RESULTS: Result shows that most of the population had regular menstruation cycle. Under closure analysis, it was found that 59 percent of females had medium bleeding flow and 64 percent had a painful menstrual cycle. However, 18 percent of which are taking treatment for the same.

CONCLUSIONS: This study's findings depicts about how the population is unaware of menstrual disorders and its impact on a women's life as only fewer subjects had intended to take treatment. Therefore, proper education must be gained by the females to maintain their health and thereby prevent these disorders. Moreover, attention

should be drawn towards it.
KEYWORDS: Prevalence, Irregular menstruation, Menstrual disorders

INTRODUCTION

Menstruation is the visible manifestation of cyclic physiologic uterine bleeding due to shedding of the endometrium. The period extending from the beginning of a period (mens) to the beginning of the next one is called menstrual cycle.[1]

Menstrual cycle starts at the age of 12 to 15 years, which marks the onset of puberty. The commencement of menstrual cycle is called menarche. Menstrual cycle ceases at the age of 45 to 50 years. Permanent cessation of menstrual cycle in old age is called menopause.[2]

The four basic stages of the menstrual cycle are: Menstruation, the follicular stage, ovulation, theluteal stage. During menstruation, the thickened outside layer of the uterus is disposed of fromthe body through vagina. Blood cells from the coating of the uterus and bodily liquid form the menstrual fluid. During the initial stages of cycle, the level of estrogen begins to rise, coating of the uterus grows and thickens due to the rise in the levels of estrogen.[3]

Normal menstrual cycle in females represents the complex interplay of hormones such as estrogen and progesterone. Regular menstrual cycle occurs every 28-35 days ± 2-3 days in whichthe menstrual flow lasts for 3-5 days with an average loss of 30-80 ml of blood.[4]

Menstrual cycle pattern changes with age. Overall cycle variations are common at menarche and perimenopause. A menstrual disorder is an abnormal condition in women's menstrual cycle.

Menstrual disorder may present as abnormal uterine bleeding, dysmenorrhea, premenstrual syndrome and premenstrual dysphoric disorder.[5]

Normal menstrual cycle is the indication of functioning of hormones in a proper manner, whichis significant of a healthy hypothalamo-pituitary axis with a normal uterus. Nevertheless, a number of conditions such sudden over-exercising, weight loss, medical conditions such as Polycystic ovarian disease, and even stress can have unpleasant effects on a woman's ability to experience a normal menstrual cycle. From most of the existing literature, it is evident that both longer duration of menstrual bleeding and irregular cycles are associated with major depression.[6]Life of adolescents is majorly affected by menstrual disorders. Among these are women who are affected by dysmenorrhea and heavy menstruation. The WHO reports that 18 million women aged 30 - 55 years identify their menstrual bleeding to be extreme.[3]

Menstrual patterns can be affected by a number of factors, including age, ethnicity, family history, smoking, physical activity, and dietary habits. Stress can be a major contributor to, or cause of menstrual irregularities. In addition, a high incidence of menstrual problems has been observed in students studying medicine and health sciences.[7]

Irregular menstruation can have various health implications, and is an indicator of health in women. The prevalence of irregular menstruation varies from 5% to 35.6% depending on age, occupation, and the country of residence.[8]

Abnormal menstrual cycle is any deviation from the normal cycle. Menstrual disorders prevailing in adolescent girls, including dysmenorrhea, amenorrhea, menorrhagia, hypomenorrhea, polymenorrhea, oligomenorrhea, and premenstrual syndrome.[4]

Menstrual irregularity results from various causes such as endometriosis, PCOS, type-2 diabetes mellitus, depression, hormonal imbalances, stress, underweight or obesity, smoking habit, etc.[8] The menstrual problems are not always problems but bodily reactions to various changes inside.Most of the women have some symptoms or a combination of a few or all of them, which may beeither physical or emotional. Insomnia or change in appetite is also a part of menstrual cycle.[4] There is a lack of information about the awareness and behaviors of adolescents

towardsmenstruation. Mostly girls have little knowledge about regular menstruation and about theirirregularities. Their only source of information is from their mothers or peers. Girls are interestedin knowing more about normal and abnormal menstruation. Having knowledge of thesedisorders, helped them to get medical advice as and when required.[3]

Some women experience backache, headache, or abdominal pain during their menstrual cycle.Pain around the breasts, swelling, soreness, or heaviness also occurs during menstruation.

Abdominal cramps are the worst among the menstrual pains that really bother all activities. These are caused by the involuntary contraction of the uterine muscles. Knowledge of the complications that are caused by these menstrual disorders in the general population may help to inform women when they should consult primary care and aid the appropriate referral of women for investigation of malignancy.[9]

REVIEW OF LITERATURE

1. Pattern and prevalence of menstrual disorders in adolescents.[3] Zafar M et al (2018):

This study was conducted in the year 2018, that depicts about adolescent menstrual disorders which are exceptionally not unusual, study reported higher than predicted incidence of menstrual issues. Expertise regarding the factors influencing menstrual symptoms is critical as a way to manage it correctly and assist the girls to make up the days less troublesome and tolerable. A selection of factors is recognized to affect menstrual behaviors, the most influential ones being economic popularity. Absenteeism from the school changed into the impact of menstruation related problems on their each day recurring. Dysmenorrhea and premenstrual symptoms had been perceived as maximum distressing symptoms leading to school absenteeism and of days off work. Women with premenstrual signs and symptoms have suggested a greater number of days with impairment in recurring work, school and household activities.

2. Prevalence of Menstrual Disorders and Their Association with Physical Activity in Adolescent Girls of Aligarh City. [4] Kulshrestha S. et al (2019):

This cross-sectional descriptive study was conducted in 2019 to assess the prevalence of menstrual disorders and their association with physical activity among 320 adolescent girls aged between 14 to17 years in Aligarh city. Data regarding age of menarche, menstrual cycle interval, menstrual flow length and period pain was contained. Physical activity was assessed by the Physical activity questionnaire scale (PAQ-A). The overall prevalence of menstrual disorders was reported by 76.9%. Dysmenorrhea and PMS were found to be highly prevalent among girls in Aligarh. It was found that PMS was the commonest menstrual disorder that interfered with the daily routine of the school girls.

3. Prevalence of Menstrual Disorders in Woman of Reproductive AgeGroup. [5] Farhan I. et al (2020):

This study was conducted in 2020 which showed that menstrual disorders are prevalent in Pakistan. Management of these disorders should be paid more attention within the available reproductive health care programs. Further research into prevalence of and risk factors for menstrual disorders and their morbidity is endorsed. Appropriate health education measures should be promoted to influence females to seek medical management leading to early diagnosis and precautionary treatment.

4. Association of Menstrual Patterns with Perceived Stress Score in College Going Female Students of a South Indian Town.[6] Periasamy P. et al (2021):

This study was conducted in 2021, stated an association between high stress levels in students (PSS >20) and menstrual pattern could not be established notably. However, there was association established between high stress levels (PSS >20) and menorrhagia (heavy menstrual bleeds). Consequently, despite high levels of stress in

undergraduate students, other factors can also play a significant role in maintaining their menstrual cycle. Therefore, other causes must also be looked for among the young females complaining of menstrual problems before concluding them because of stress.

5. Prevalence of menstrual problems and their association with psychological stress in young female students studying health sciences.[7] Rafique N. et al (2018):

This study conducted in 2018 concluded that the prevalence of menstrual problems and stress is quite high in young, Saudi, female health sciences students. In addition, a strong positive association between psychological stress and amenorrhea, dysmenorrhea, and premenstrual symptoms was identified. It is recommended that all health sciences students should be provided with short courses on stress management techniques as part of their curriculum. Moreover, allhealth sciences colleges should make arrangements for early identification of students with menstrual problems, as these conditions can not only affect the academic performance of the students, but can also have negative effects on their psychological and reproductive health. The students identified should be provided with timely psychological and gynecological counselling, as well as instructions and strategies for preventing future complications.

6. Prevalence of irregular menstruation according to socioeconomic status: A population-based nationwide cross-sectional study.[8] Kwak Y. et al (2019):

This cross-sectional study conducted in the year 2019, observed a higher prevalence of irregular menstruation among women with higher incomes and lowereducational levels. Public health professionals should recognize the need for early education, detection, and intervention for at-risk populations and stress the importance of building a multidimensional understanding of irregularmenstruation.

7. Prevalence of irregular menstruation among homemakers and workingwomen.[9] Sharon V. et al (2019):

This study was conducted in 2019 which described about the development of the symptoms of menstrual loss among women in the community is common, in contrast to the rarity of gynecological malignancy. That raised concern about the usefulness of the current guidelines, based on symptoms, advising women when to consult, and for the early awareness of gynecological malignancy in the community and primary care.

8. Pattern of menstrual irregularities amongst women presenting to gynaecological outpatient department. Journal of Islamabad Medical & Dental College (JIMDC). [10] Mahmood M. et al (2013):

This study conducted in the year 2013 depicted about how most of thepatients are unaware about what represents normal menstrual pattern. Therefore, it is important to educate patients regarding range of normal cycle length. It isequally important for the clinicians to have an understanding of bleeding patterns and ability to differentiate between normal and abnormal conditions. Menstrual cycle as an additional vital sign adds a powerful tool for the assessment of normal development and exclusion of pathological conditions.

9. Prevalence and pattern of menstrual disorders among Lebanese nursing students.[11] Karout N. et al (2012):

This study conducted in 2012 found a higher percentage of different menstrual disorders among young female students in Lebanon. These disorders are not only likely to affect the quality of life and future productivity of women but may also be indicators of underlying problems that can become serious in thefuture and this is an important concern for reproductive health policy-makers. Health education on menstrual problems targeting female students

and their parents, and including education on reproductive health in the school curriculum may assist in early diagnosis of these disorders.

10. Factors associated with menstrual cycle irregularity and menopause.[12]Bae J. et al (2018):

This study conducted in the year 2018, results showed the importance of healthier behavioral practices to maintain menstrual cycle regularity, especially when considering that smoking may be associated with the occurrence of early menopause. Given the association between early menopause or irregular menstruation and women's health, improvements in health behaviors should be emphasized inview of public health.

NEED OF STUDY

Irregular menstruation is an important indicator and mediator of various health problems among women. The study focuses on women experiencing irregular menstruation cycle are somehow not aware about the future health issues. Therefore, the study is necessary to measure the awareness level and prevalence of

the irregular menstruation among women. The results obtained will be helpful increating strategies for improving psychological and reproductive health.

OBJECTIVE OF THE STUDY

1) AIMS: To find the prevalence of Irregular menstruation in females ofAhmedabad city.

2) OBJECTIVE OF THE STUDY: To assess the menstrual health in females of18-30 age groups in Ahmedabad city using a questionnaire.

To measure the awareness level of the causes of irregular menstruation inAhmedabad city.

METHODOLOGY

This was a cross-sectional study of six month duration (2021), in which 500 females (aged between 18 and 30 years) of Ahmedabad city were invited toparticipate.

The questionnaire was designed by the author, based on some previous similar studies and was regarding menstrual characteristics, and multiple choice questions were used for assessment of intensity of pain.

The subjects were asked to complete a menstrual problem identification questionnaire anonymously. The questionnaire included items relating to the participants' demographic details, and concerned their menstrual pattern (menarcheage, cycle length in days, duration of flowing days, menstrual regularity).

Furthermore, all the data were collected by sending the questionnaire form to the females who agreed to participate in the survey.

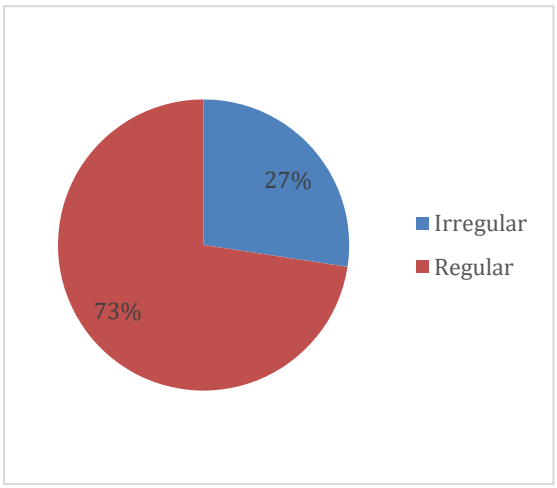
In addition to that, the participants were given brief about the procedure and purpose of the study and thereby the consent was contained in an understandable language and all the participants were assured that their personal informationwould be kept confidential.

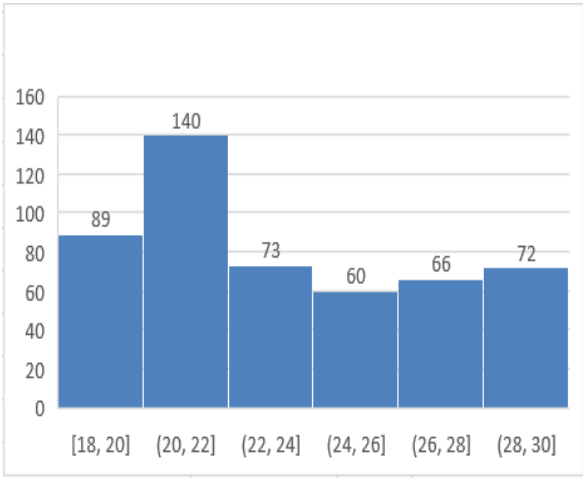
After that, the result was shown with statistical analysis which included proper graphs and charts that provided detailed information of the numbered characteristics.

RESULT

In this cross-sectional study of 500 subjects among females aged between 18 to 30 years, irregular menstrual cycle was noticeably lesser than the regular menstrual cycle. Under thorough observation, plethora of questions were asked and analyzed accordingly [Graph 2].

Irregular menstruation was observed to be about 27% while the regular menstruation stated about 73% overall [Graph 1].



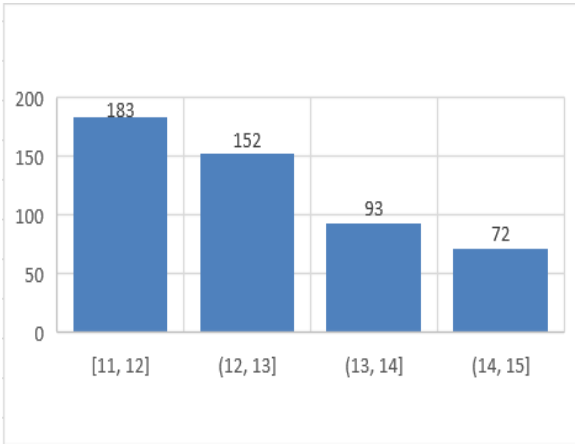


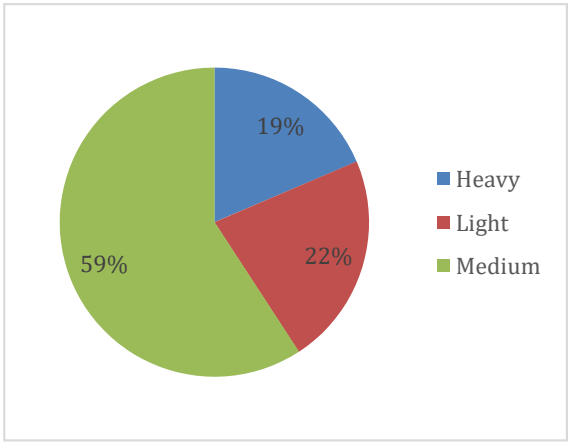
Graph 1: Menstrual period

Graph 2: Age

The females who participated in the study had their menarche age from 11 to 15 years. Moreover, the average value suspected was 13 years of age [Graph 3].

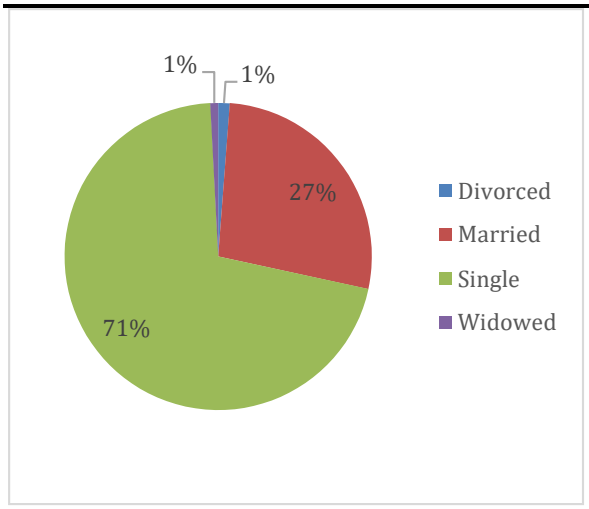
When the females were asked about the bleeding, around 59% of the females were observed medium flow, and the heavy flow was observed in nearly 19% of females. While 22% observed light flow [Graph 4].



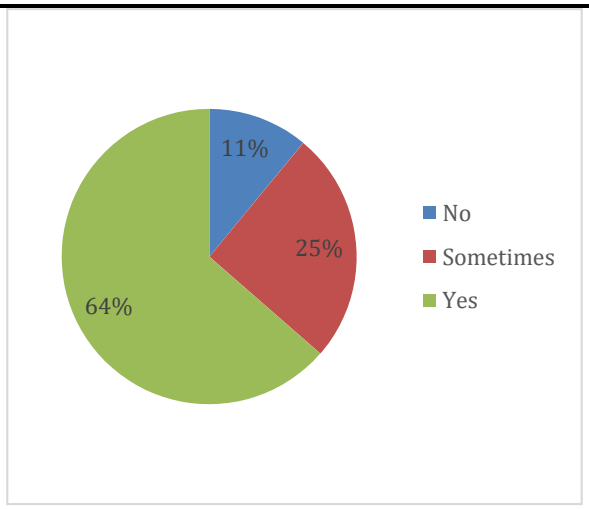


Graph 3: Age of menarche

Graph 4: Bleeding

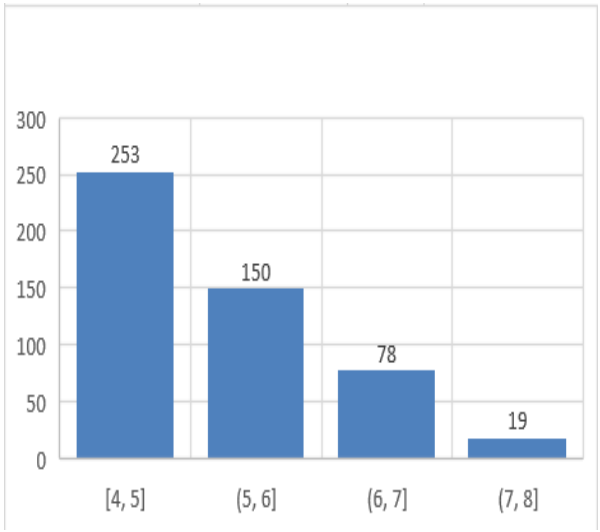


Graph 5: Marital status

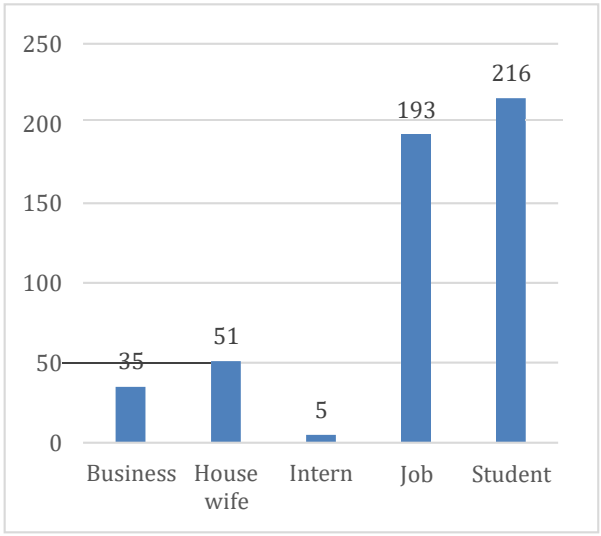


Graph 6: Pain during menstrual period

Besides that, the highest subjected females were single as amounted to 71% , and 27% married women being the second highest. Whereas, the other two categories had remarkably as low as 1% individually [Graph 5].
Menstrual cramp or pain is the most common remark presented as well as observedin the population. 64% of the women had experienced pain during their mensesand 25% of which had experienced it sometimes. The women who did not go through menstrual cramps were around 11% [Graph 6].

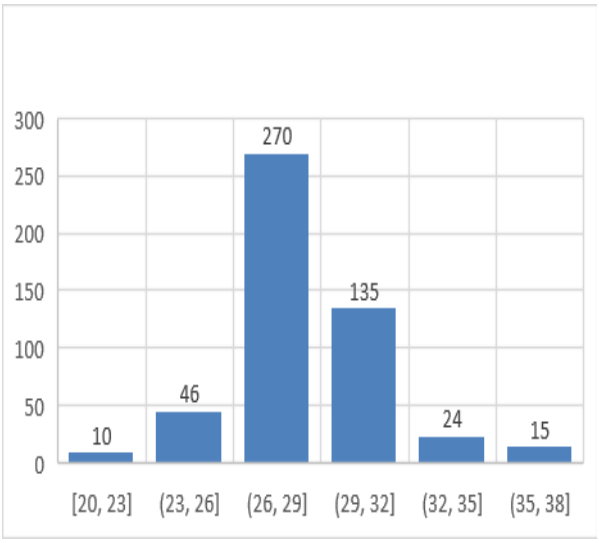


Graph 7: Menses period

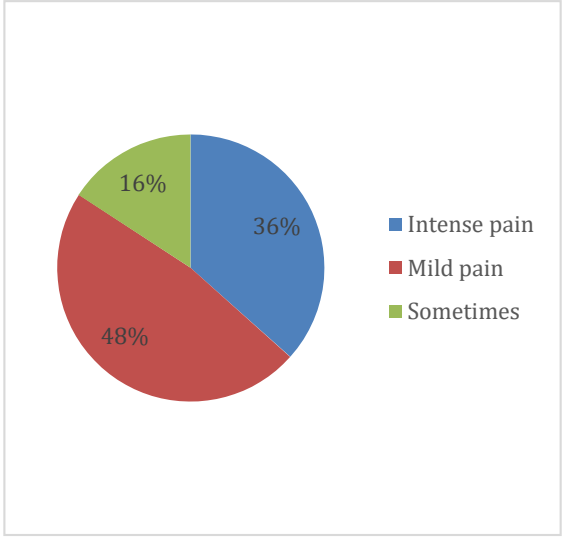


Graph 8: Occupation

Most of the females, that is about 253 females had their menses for about four to five days, and the least score was 19 females who had their period for seven to eight days. The other 228 subjected females were experiencing 5 to 7 days of menstrual cycle [Graph 7].
In this study, the subjected females were from various sectors such as student, job, housewife, business, intern. All of this details are kept in descending order according to the outcome [Graph 8].



Graph 9: Days of menstrual cycle



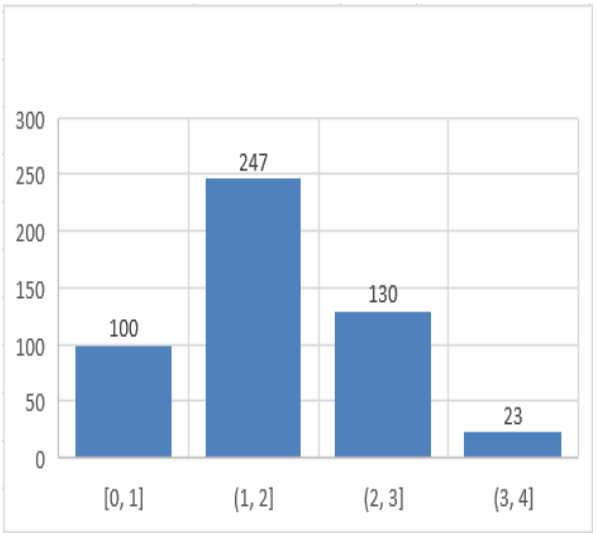
Graph 10: Stomach pain

When asked about their days of menstrual cycle, however, the range was from 20 days to 38 days, but 270 females had nearly 26 to 29 days during their menstrual cycle which states that huge amount of females had normal menstrual cycle [Graph9].

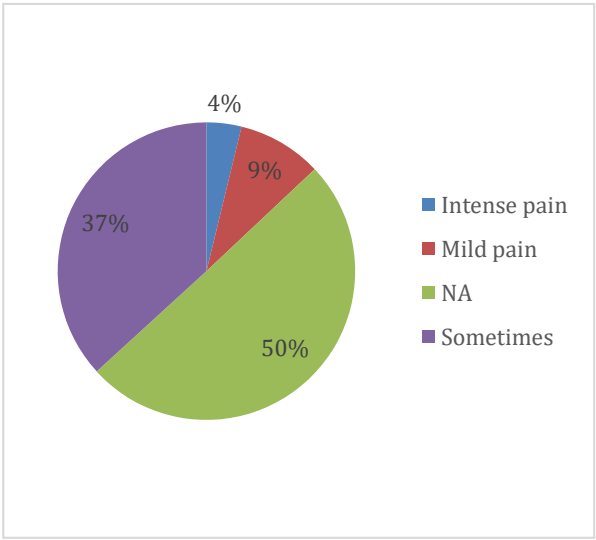
In addition to this, menstrual pain can be seen in various parts of the body, stomachpain has relatively higher remarks in that. 48% of women were having mild pain symptom. Whereas, the other women had experienced sometimes and intense pain amounting to 16% and 36% respectively [Graph 10].

Other than that, the severity of pain was experienced highest on the first two days as claimed by 247 females. While the intensity of pain on 3rd and 4th day wasquite low [Graph 11].

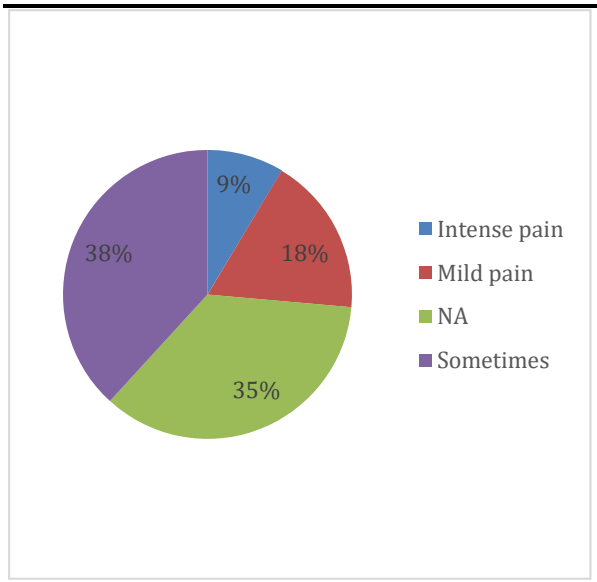
When asked about chest pain, 50% of the females had no experience as such while the other 50 percent of women had experienced mild pain (9%), intense pain (4%), sometimes (37%) [Graph 12].



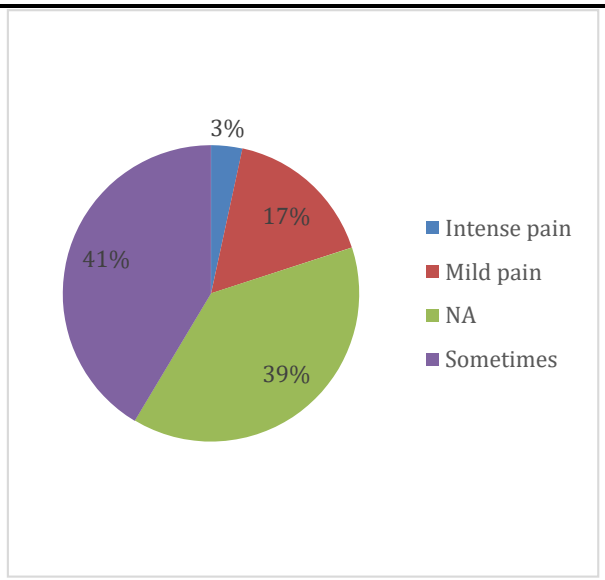
Graph 11: Days of severe pain



Graph 12: Chest pain

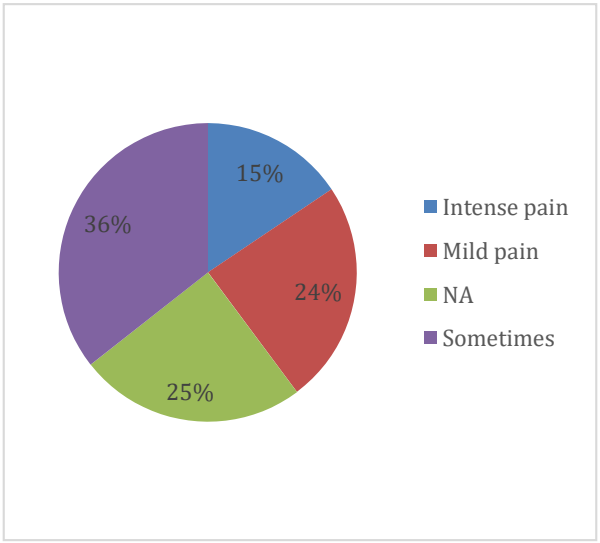


Graph 13: Pain in the hip

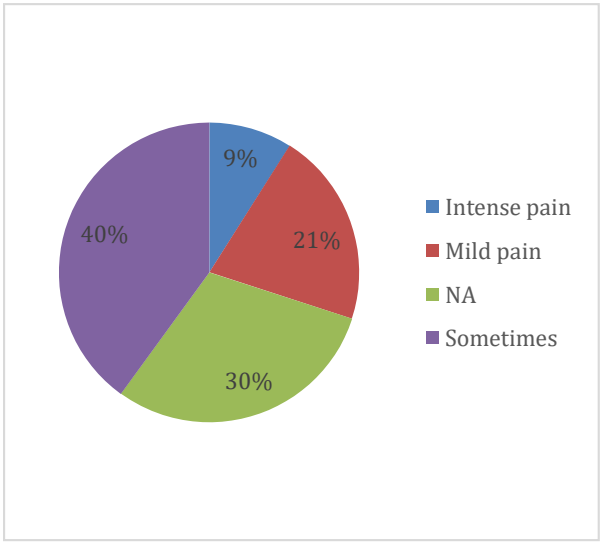


Graph 14: Pain in the arms

Further when questioned about pain in the hip, 38 percent of females had pain sometimes, and 35 percent of them had responded to no, whereas, 18 and 9 percenthad experienced mild and intense pain respectively [Graph 13].
Next question was about pain in the arms, as low as 3% of which had experienced intense pain and 17% females had experienced mild pain. On the other hand, 41% females had responded sometimes [Graph 14].

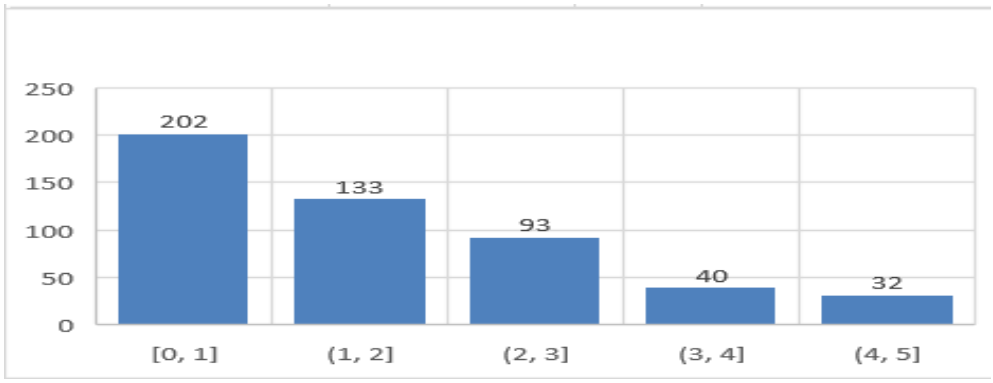


Graph 15: Pain in the legs



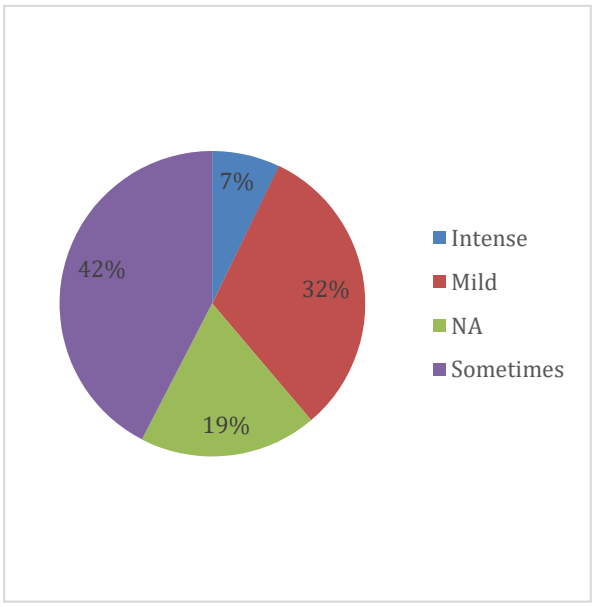
Graph 16: Pain in the joints

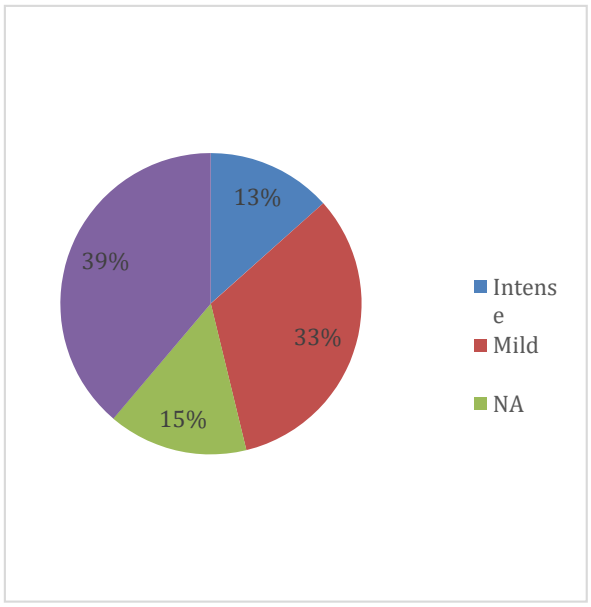
When asked about pain in the legs, 15 percent of females had intense pain and 36 percent of which had experienced pain sometimes. The females had responded to no pain as well as mild pain of about 25% and 24% respectively [Graph 15].
After that, a question about pain in joints was observed to have responded sometimes (40%), no pain (30%), mild pain (21%), intense pain (9%) in the same manner [Graph 16].



Graph 17: Number of irregularities in a year

The majority of the population, that is, 202 females experienced to 0 to 1 irregularities in a year. While 133 females claimed it to have extended up to 1 to 2 irregularities. On the other hand, some females around 32 of them had respondedto have 4 to 5 menstrual irregularities in a year [Graph 17].





Graph 18: Headache

Graph 19: Fatigue

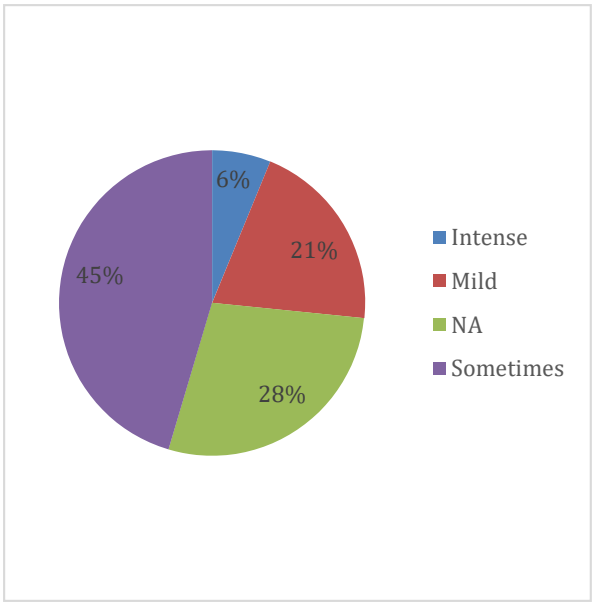
Headache was observed to be at peak about 42% with sometimes response, whereas, mild headache was noted to be around 32%, and significant aching in 7%of females [Graph 18].

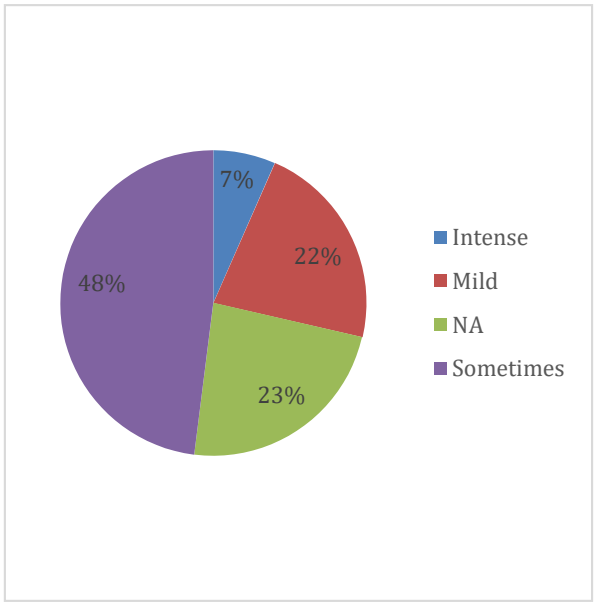
Among 39% of females, fatigue or tiredness was experienced sometimes. Whilethe mild and intense tiredness along with no response was observed to be 33%,13% and 15% respectively in females [Graph19].

Nausea was experienced sometimes for about 45% of females, while mild (21%) and intense (6%) nausea was

answered by females. Of which, 28% had no response at all [Graph 20].

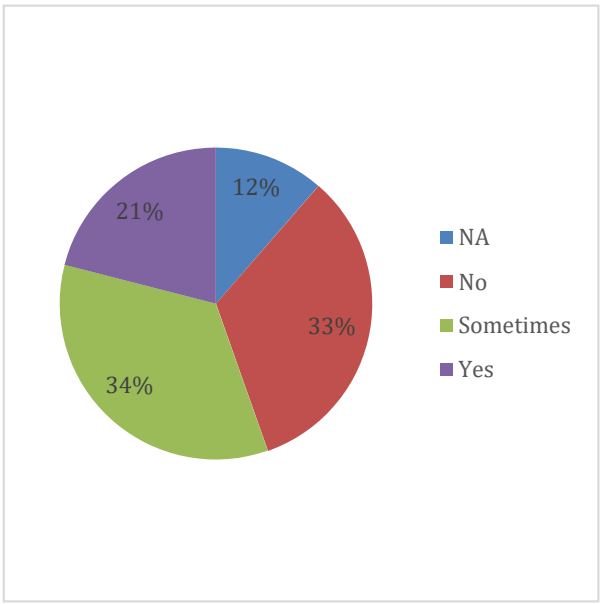
Almost around 48 percent of females answered sometimes when asked aboutdizziness. Whereas, the mild and intense response was noted to be around 22 and 7percent individually [Graph 21].

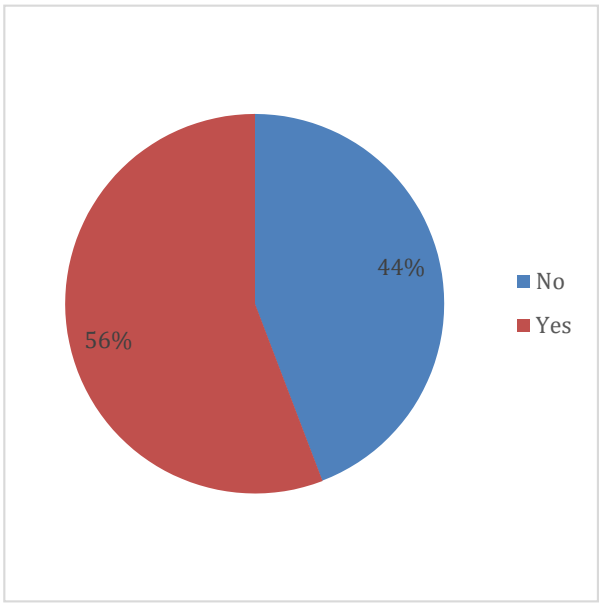




Graph 20: Nausea

Graph 21: Dizziness





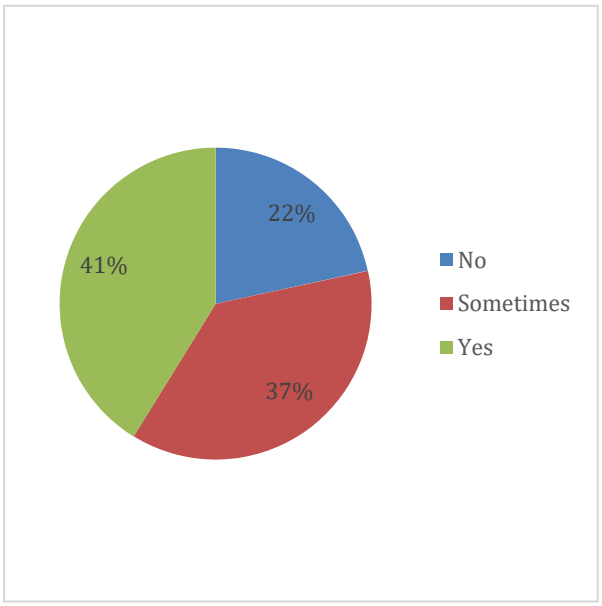
Graph 22: Anxiety

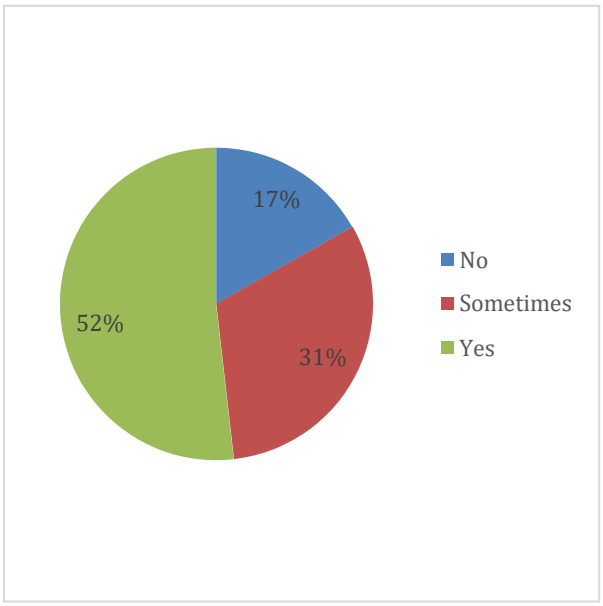
Graph 23: Increased appetite

When enquired about the anxiety level during their menstrual period, 34 % of themhad answered sometimes, while 21% answered yes , 33% answered no and 12% had no response as such during their menses [Graph 22].

Among 56% of females felt that their appetite had increased during their menses while the other 44% of them had

felt the literal opposite of it [Graph 23].





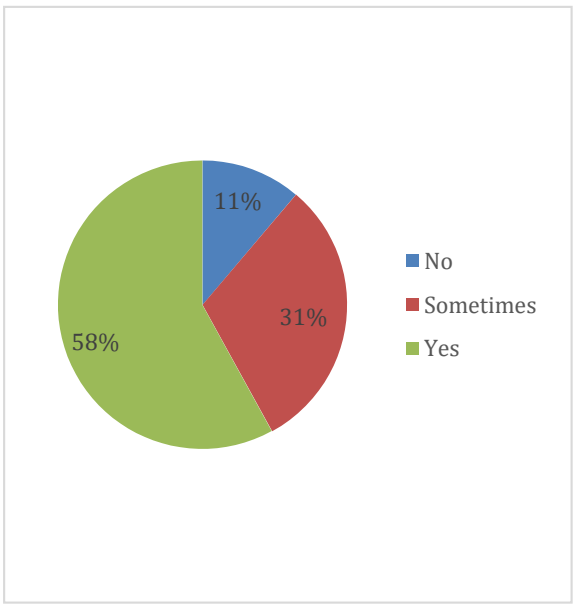
Graph 24: Difficulty in concentrating **Graph 25:** Irritability

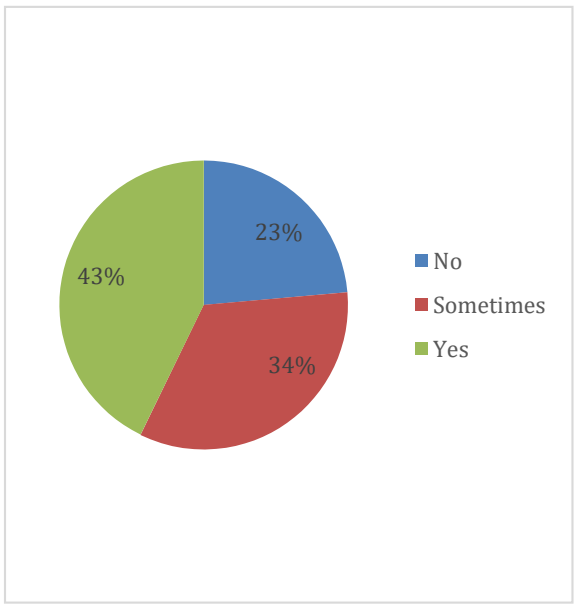
Almost 41% of the females had faced lack of concentration during their menstrual period while 22% of which had no difficulty in concentrating. Whereas, 37% of them had experienced it sometimes [Graph 24].

Irritability during the menses was noticeable as 52% of females answered yes, the other 31% of them answered sometimes, and 17% of females answered no [Graph 25].

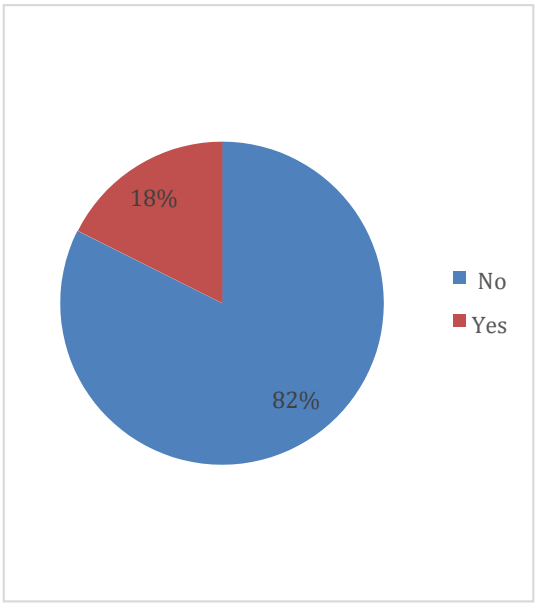
Among 58% of females had experienced mood swings, whereas, some females answered no (11%) along with sometimes (31%) during their menstrual cycle [Graph 26].

Anger issues were observed in 43% of females, 23% of them had no such feelings while the other 34% of females were experiencing anger problems sometimes during their menstrual period [Graph 27].

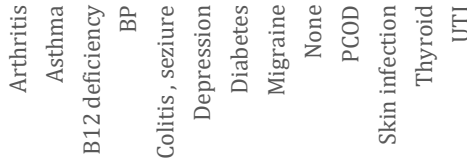




Graph 26: Mood swings **Graph 27:** Anger



Graph 28: Taking treatment



Graph 29: Any other major diseases

When questioned about taking any precautionary treatment, only 18% of femalesagreed to it while the other 82% of females answered no [Graph 28].
Majorly diabetes (7 females), asthma (6 females), arthritis (6 females) and PCOD

(6 females) were listed when question was raised regarding diseases. Other diseases listed had a very miniscule amount as 459 females in particular werecompletely healthy [Graph 29].

DISCUSSION

Menstrual cycle being irregular mainly affects women health as they are not aware of it causes. The present study shows that most of the population had regular menstruation cycle. Under closure analysis, it was found out that 59 percent of females had medium bleeding flow and 64 percent had a painful menstrual cycle. However, 18 percent of which are taking treatment for the same.

Sharon V et al. in their survey reported that 33.4% of homemakers had experiencedhip pain sometimes, 46.6% responded to yes, and 20% responded to no.[6]

This study depicts that around 270 respondents had a normal length cycle, and 10 respondents had a shorter cycle. These variations in cycle length and duration are consistent with other finding from Rafique and Alshiekh, where they found 13% of their participants had a short cycle with only 5% reporting long menstrual periods.[11]

According to the World Health Organization International and Multicenter study of3073 girls, the median length of the first cycle after menarche was 34 days with 38% of cycle lengths exceeding 40 days. Hence, the irregular menstrual cycle in young girls may not be taken in account since they vary from 34 days.[13]

The survey in Tiruchirappalli district shows that 68.6% of women experience pain during their cycle, intense stomach pain (23.8%), intense hip pain (25.7%), and intense leg pain (23.3%). 80% of respondents have no headache, 94.8% have no chest pain, and 84.3% have no pain in joints.

Pitts et al. have reported high rates of pelvic pain in Australian women. Among 4366 women, 15% of them reported severe pain with dysmenorrheal, 7.3% women with dyspareunia, and 20% of women with chronic pelvic pain.[14]

Agarwal and Agarwal reported in their survey that dysmenorrhea is a very commonproblem among adolescent girls and they experience a number of physical and emotional symptoms associated with increased intensity of pain.[15]

CONCLUSION

This study's findings depicts about how the population is unaware of menstrual disorders and its impact on a women's life as only fewer subjects had intended to take treatment. Therefore, proper education must be gained by the females to maintain their health and thereby prevent these disorders. Moreover, attentionshould be drawn towards it.

SUMMARY

A cross-sectional study was contained among 500 females of Ahmedabad city regarding their menstrual cycle. To assess, the subjected females were asked to answer different questions about their menstrual period. After that their data was collected to analyze and find out the prevalence of irregular menstruation among these women. The end result showed that only fewer population are experiencing

irregular menses but somehow only half of these females are taking proper carewhich briefs out about their lack of knowledge towards it.

LIMITATIONS:

The sample size was limited due to study conducted in Ahmedabad cityonly.

FUTURE RECOMMENDATIONS:

The future study can involve effects of various exercises on irregularmenstruation.

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EFFECTS OF SUJOK THERAPY IN KNEE PAIN: AN EXPERIMENTAL STUDY

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Abstract : Sujok is a simple, easy and effective way to heal oneself. In Sujok therapy, the palms and feet represent all of the organs and meridians in the body. Sujok can be done in addition to other therapies and it has no side effects. By stimulating points on the hands and feet, this therapy can help cure various ailments throughout the body. Physiotherapists help people with injuries, illnesses or disabilities by providing movement and exercise, manual therapy, education and advice. They provide health care for people of all ages, helping patients manage pain and prevent disease. Physiotherapy is a science-based profession that takes a holistic approach to health and wellbeing, including considering a patient's overall lifestyle. An experimental study was conducted using convenient sampling from the physiotherapy clinics situated in the area of Gandhinagar and Ahmedabad of Gujarat state among 90 adult patients of knee OA aged between 18 to 60 years. Data was collected in the period of April and May 2022. There is a significant difference before and after physiotherapy, Sujok and Sujok + Physiotherapy sessions on all 7 consecutive days. There was a significant decrease in the pains of the patients after 3rd day, irrespective of treatment taken by patient. Significant difference was found between physiotherapy and Sujok treatments after day 5. Physiotherapy and Sujok treatments do differ significantly. But there is no benefit

I. INTRODUCTION

Pain disrupts people's lives, and the ability to recognize and understand pain is an early sign of disease states (1), illness, bodily injury (2), and serious or minor health problems (3). One definition of pain is: An unpleasant sensory and emotional experience associated with, or resembling that associated with, actual or potential tissue damage (4). Several literature reviews indicate that there are two types of pain management strategies: multimodal or multidisciplinary (5) and non-multidisciplinary. Multimodal strategies are commonly referred to as "programs". The non-multidisciplinary program is his second strategy for pain relief. This method includes medical treatment and alternative therapy, usually applied in one treatment. Several studies have shown that Su Jok can be used to treat fatigue and weakness (6), elbow eczema (7), migraines (8), asthma (9), and stroke rehabilitation (10). Su Jok for pain relief can also be used for heel spur pain (11). Su Jok Therapy is a complementary and alternative therapy developed in 1987 by his Professor Park Jae Woo in South Korea. Su Jok can provide fast and meaningful results (12). The term Su Jok is of Korean origin. Su means hand, Jok means foot, and Su Jok functions as a therapeutic group for managing health (12). The Su Jok method of treatment is done by stimulating the hands and feet (13). Because they have many similarities with the human body (12). Stimulate the limbs by massaging, applying paint to the skin, moxibustion, placing seeds, magnets, needles, etc. in specific locations. Su-Jok therapy is considered an easier and cheaper treatment than most alternative therapies, and results are generally quicker.

Su Jok Therapy's view of the healing process is based on the concept that the human body is a living organism subject to various factors and has causal relationships with all the energies of the universe. All changes in the human body must obey universal laws of interaction, so that a person's health is determined not only by individual characteristics, but also by environmental forces (14). The aim of this current study was to assess the effects of Sujok therapy, physiotherapy and Sujok + physiotherapy on patients with knee OA.

II. MATERIALS AND METHODOLOGY

An experimental study was conducted using convenient sampling from the physiotherapy clinics situated in the area of Gandhinagar and Ahmedabad of Gujarat state among 90 adult patients of knee OA aged between 18 to 60years. Data was collected in the period of April and May 2022.

Data was collected for the pain and its intensity. Then the patients were divided in to 3 groups -Group A: Patients will be treated by physiotherapy treatment and Sujok therapy. Group B: Patients will be only treated by Sujok therapy. Group C: Patients will be only treated by physiotherapy. In Sujok therapy patients will be diagnosed by probe and then after finding point on hand. Using Su Jok theory, the first thing to do is to find the corresponding areas of the knee on the hand, and then stimulate those points. The most painful points were found on one or several of the areas on Middle or on ring finger and then massaging those areas. Next stage is to massage areas on the fingers (phalanxes of fingers) corresponding to your knee using a Sujok ring or massage ring. The next step

is heating up these areas with Moxa. After that we will apply seeds to the area corresponding to the knee either on the left or right hand. Patients will be examined by VAS (Visual Analog Scale). The visual analog scale (VAS) is a validated, subjective measure for acute and chronic pain. Scores are recorded by making a handwritten mark on a 10-cm line that represents a continuum between "no pain" and "worst pain." for checking the effect of Sujok therapy. Physiotherapy treatment will include the following: - 1. Quadriceps setting, 2. Quadriceps Strengthening, 3. Hamstring Stretch.

The Study was approved by Institutional Ethical Committee, on 25th February 2021 with the outward number VIP/2021/EC/95.

III. RESULTS AND DISCUSSION

Table I: Descriptive Statistics

		Frequency	Percentage
Gender	**Female**	44	48.9%
	Male	46	51.1%
Treatment Given	**Physiotherapy**	30	33.3%
	Sujok + Physiotherapy	30	33.3%
	Sujok Therapy	30	33.3%

In this study, a total of 90 respondents in this study comprised of 46 males and 44 females. All the 90 respondents were divided equally among all the three treatments. The type of therapy can be seen from Table I.

Table II: Statistical Significant difference between pains in patients before and after physiotherapy sessions

Paired Samples Test							
		Paired Differences			t statistic	df	P-Value
		Mean	Std. Deviation	Std. Error Mean			
Pair 1	**b_day 1 - a_day 1**	0.567	0.568	0.104	5.461	29	0.000
Pair 2	**b_day 2 - a_day 2**	0.567	0.568	0.104	5.461	29	0.000
Pair 3	**b_day 3 - a_day 3**	0.667	0.547	0.100	6.679	29	0.000
Pair 4	**b_day 4 - a_day 4**	0.833	0.461	0.084	9.898	29	0.000
Pair 5	**b_day 5 - a_day 5**	0.833	0.379	0.069	12.042	29	0.000
Pair 6	**b_day 6 - a_day 6**	0.900	0.403	0.074	12.245	29	0.000
Pair 7	**b_day 7 - a_day 7**	0.833	0.379	0.069	12.042	29	0.000

Significant differences before and after Physiotherapy, Sujok and Sujok + Physiotherapy sessions were calculated using t-test on SPSS 20.0 software at 5% level of significance. From the table II it can be concluded that there is a significant difference before and after physiotherapy treatment on day 1, 2, 3, 4, 5, 6, 7 as p-value was found to be 0.000 < 0.05 at 5 % level of significance.

Table III: Statistical Significant difference between pains in patients before and after Sujok sessions + Physiotherapy

Paired Samples Test							
		Paired Differences			t statistic	df	P-value
		Mean	Std. Deviation	Std. Error Mean			
Pair 1	b_day 1 - a_day 1	0.933	0.691	0.126	7.393	29	0.000
Pair 2	b_day 2 - a_day 2	0.867	0.434	0.079	10.933	29	0.000
Pair 3	b_day 3 - a_day 3	0.833	0.379	0.069	12.042	29	0.000
Pair 4	b_day 4 - a_day 4	0.833	0.648	0.118	7.047	29	0.000
Pair 5	b_day 5 - a_day 5	0.767	0.568	0.104	7.389	29	0.000
Pair 6	b_day 6 - a_day 6	0.900	0.548	0.100	9.000	29	0.000
Pair 7	b_day 7 - a_day 7	0.833	0.531	0.097	8.601	29	0.000

From the table III it can be concluded that there is a significant difference before and after Sujok + physiotherapy treatment on day 1, 2, 3, 4, 5, 6, 7 as p-value was found to be 0.000 < 0.05 at 5 % level of significance.

Table IV: Statistical Significant difference between pains in patients before and after Sujok sessions

Paired Samples Test							
		Paired Differences			t statistic	Df	P-Value
		Mean	Std. Deviation	Std. Error Mean			
Pair 1	b_day 1 - a_day 1	1.033	0.183	0.033	31.000	29	0.000
Pair 2	b_day 2 - a_day 2	1.067	0.583	0.106	10.016	29	0.000
Pair 3	b_day 3 - a_day 3	1.100	0.712	0.130	8.462	29	0.000
Pair 4	b_day 4 - a_day 4	1.067	0.691	0.126	8.449	29	0.000
Pair 5	b_day 5 - a_day 5	1.233	0.504	0.092	13.403	29	0.000
Pair 6	b_day 6 - a_day 6	1.067	0.521	0.095	11.217	29	0.000
Pair 7	b_day 7 - a_day 7	0.933	0.450	0.082	11.366	29	0.000

From the table IV it can be concluded that there is a significant difference before and after Sujok treatment on day 1, 2, 3, 4, 5, 6, 7 as p-value was found to be 0.000 < 0.05 at 5 % level of significance in Table IV.

Table V: Significant difference between the pains of patients after physiotherapy session, Sujok session and Sujok + physiotherapy session.

		N	Mean	Std. Deviation	F Statistic	P-Value
Pain after _day 1	Physiotherapy	30	5.43	1.073	0.385	0.682
	Sujok	30	5.27	0.868		
	Sujok + Physiotherapy	30	5.20	1.215		
	Total	90	5.30	1.054		
Pain after _day 2	Physiotherapy	30	5.43	1.073	1.123	0.33
	Sujok	30	5.13	0.860		
	Sujok + Physiotherapy	30	5.07	1.081		
	Total	90	5.21	1.011		
Pain after _day 3	Physiotherapy	30	5.30	1.149	2.239	0.003
	Sujok	30	4.73	0.944		
	Sujok + Physiotherapy	30	4.90	1.094		
	Total	90	4.98	1.081		
Pain after _day 4	Physiotherapy	30	4.97	1.066	2.453	0.092
	Sujok	30	4.43	0.858		
	Sujok + Physiotherapy	30	4.50	1.106		
	Total	90	4.63	1.033		
Pain after _day 5	Physiotherapy	30	4.70	1.119	4.2	0.018
	Sujok	30	3.90	0.803		
	Sujok + Physiotherapy	30	4.33	1.241		
	Total	90	4.31	1.108		
Pain after _day 6	Physiotherapy	30	4.47	1.042	4.698	0.012
	Sujok	30	3.67	0.758		
	Sujok + Physiotherapy	30	4.03	1.189		
	Total	90	4.06	1.053		
Pain after_day 7	Physiotherapy	30	4.37	1.033	5.676	0.005
	Sujok	30	3.57	0.774		
	Sujok + Physiotherapy	30	3.77	1.040		
	Total	90	3.90	1.006		

To test the significant difference between the pains pertaining to patients after giving physiotherapy session, Sujok session and Sujok + physiotherapy session, ANOVA test was applied at 5% level of significance using SPSS 20.0 software. Following results were concluded from Table V:

After applying all the sessions to respective patients, the significant difference between the after therapy, pain of all the three groups on day 1 and day 2, was not found significant, with P-value > 0.05 at 5% level of significance. In other words, there is no significant difference in therapies after day 1 and day 2.

The significant difference between the after therapy, pain of all the three groups on day 3 was found significant, with P-value 0.003 > 0.05 at 5% level of significance. In other words, there is a significant difference in therapies after day 3. Physiotherapy was found least effective with average VAS for pain (5.30), Sujok + Physiotherapy was found second highest with average VAS for pain (4.90) after Sujok and Sujok was highest effective among all the three with average VAS for pain (4.73).

The significant difference between the after therapy pain of all the three groups on day 4 was not found significant, with P-value 0.092 > 0.05 at 5% level of significance. In other words, there is no significant difference in therapies after day 4, though the effectiveness of the therapies remained same as that on day 3 i.e. Physiotherapy was least effective with average VAS for pain (4.97), Sujok + Physiotherapy less than only Sujok with average VAS for pain (4.50) and Sujok was found highest effective with average VAS for pain (4.43).

The significant difference between the after therapy pain of all the three groups on day 5 was found significant, with P-value 0.018 < 0.05 at 5% level of significance. In other words, there is a significant difference in therapies after day 5. Physiotherapy was found least effective with average VAS for pain (4.70), Sujok + Physiotherapy was found second highest with with average VAS for pain (4.33) after Sujok and Sujok was highest effective among all the three with with average VAS for pain (3.90).

The significant difference between the after therapy pain of all the three groups on day 6 was found significant, with P-value 0.012 < 0.05 at 5% level of significance. In other words, there is a significant difference in therapies after day 6. Physiotherapy was found least effective with average VAS for pain (4.47), Sujok + Physiotherapy was found second highest with average VAS for pain (4.03) after Sujok and Sujok was highest effective among all the three with with average VAS for pain (3.67).

The significant difference between the after therapy pain of all the three groups on day 7 was found significant, with P-value 0.005 < 0.05 at 5% level of significance. In other words, there is a significant difference in therapies after day 7.

In two pooled studies (15), (16), the reduction in the VAS pain score from treatment with physiotherapeutic modalities in combination with stretching exercises was statistically superior to treatment with physiotherapeutic modalities alone. (WMD 0.56; 95% CI 0.20 to 0.92; $I^2 = 0\%$; $P < 0.05$; n = 102 pooled sample size). A similar result was obtained from studies (17), (15), using the KOOS pain scale. (WMD 7.52; 95% CI 4.05 to 10.98; $I^2 = 0\%$; $P < 0.05$; n = 76 pooled sample size).

Fitzgerald et al. (18) evaluated these techniques separately, and found no significant evidence that these exercises improve pain and muscle strength in OA patients. This finding does not corroborate the study by Diracoglu et al., (19) who compared kinesthesia and balance exercises or only strengthening exercises in women with knee OA, obtaining positive outcomes on muscle strength, quality of life, and the physical function scale, according to the WOMAC questionnaire.

In the Chen, HL. Et. al (2022)'s study, functional status was primarily assessed using the WOMAC scale, and significant improvements with the implementation of IFC were observed in short-term assessment but not in long-term follow-up. We also discovered that the results for walk tests (short- and long-term) and stiffness scores (short-term) did not favor IFC use over control treatment. The WOMAC scale evaluates activities of daily living, functional mobility, gait, general health, and quality of life in knee osteoarthritis patients (21). It consists of 24 questions that can be divided into the subscales of pain, physical function, and stiffness. The outlier data of one study were removed in sensitivity testing because we observed high heterogeneity, which could be attributed to the study's inadequate blinding of participants and its small sample size (22). The significance of our meta-analysis findings persisted after sensitivity testing, indicating that the outcomes were reliable.

We found many studies pertaining to knee pain treatments, but no study came to our knowledge in regard to Sujok therapy on knee osteoarthritis patients. In our study overall, Physiotherapy was found least effective with average VAS for pain (4.37), Sujok + Physiotherapy was found second highest with average VAS for pain (3.77) after Sujok and Sujok was highest effective (pain relieving technique) among all the three with average VAS for pain (3.57).

IV. CONCLUSION

There are many ways to manage pain, including traditional and unconventional treatments. The development of pain management research continues, and easier, less expensive therapeutic approaches that produce quicker pain relief are still being sought after. In this retrospective study, Su Jok is one of the complementary therapies for pain, offers a successful method of pain relief and highest effective when compared to that of physiotherapy for patients with Knee osteoarthritis. However, future studies must be conducted using stricter procedures, large sample and with more precise standards for pain management.

V. LIMITATIONS OF THE STUDY

Due to low sample size, Su Jok treatment in combination with Physiotherapy doesn't show more effectiveness compared to solely Physiotherapy treatment. So, further research must be conducted using large sample size.

VI. DECLARATION OF COMPETING INTEREST

There is no conflict of interest in this publication.

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"PREVALENCE OF SMS THUMB AMONG TEENAGERS WHO USE SMARTPHONES: A CROSS-SECTIONAL STUDY

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ABSTRACT

Background:

Physical exposure during mobile phone use results repetitive movement of thumb and hand causes multiple symptoms. The term SMS Thumb is most common among them. Aim is to find out the prevalence rate of SMS Thumb among smartphone users in school going students

Methodology:

A cross sectional study was conducted by convenient sampling technique. A total 300 participants who is school going students both boys and girls at age group of 13-18 years using a smartphone minimum 1 hourper day. Participants were asked to fill a Proforma containing Cornell Hand Discomfort Questionnaire (CHDQ) & Numerical Pain Rating Scale (NPRS).

Result:

It is shown that there is 28% prevalence of SMS thumb pain is shown among teenagers who use smartphones.

Conclusion:

The prevalence rate of SMS thumb among smartphone users in teenagers has been established in this study. Musculoskeletal problems may be short term initially but can develop into long term disabilities if proper caution is not taken.

Keywords:

Pain, Smartphone, SMS Thumb

INTRODUCTION

A Smartphone is the most popular gadget among the adolescent population nowadays foe sharing information, using the internet, watching videos, using social media, gaming and many other daily activities. (1)

There is a relation between mobile design and anthropometry of the user in causing discomfort and fatigue in hand, elbow and shoulder while using the hand-held device (HHD).(2) Type of Posture(sitting or standing) and the type of mobile phone task (holding the phone versus texting)have an effect on muscles activity and thumb positions. The thumb is placed in abductionand flexion during texting compared to adduction and extension when making phone calls with its range of moment differing according to the size of the phone and orientation of the keys. Females compared to males had higher muscle activity in extensor digitorium muscle and the abductor policies longus muscle when entering SMS messages and tended to have greater thumb abduction, higher thumb movement velocities and fewer pauses in thumb movements. (3) Long-term repetitive movements of the thumb and fingers are the main identified risk factor for disorder of thumb and its musculature. (1)

This has led to coining of various phrasesto describe musculoskeletal disorders due to use of mobile phones such as "SMS Thumb", "iPod finger", "blackberry thumb" etc. [4][5]

Continuous repetitive movements with the thumb and fingers may lead to disorders of the thumb and its musculature like tendinosis of the extensor pollicislongus or myofacial pain syndrome in the hand. [6]

The term "Text neck syndrome" was first coined by Dr. Dean L. Fishman as an overuse injury.The injury may be due to poor posture because, during smartphone use, the neck goes into forward flexion and the normal curvature of the cervical spine is flattened and stretched on theneck musculature. The poor posture of the head and neck has been correlated with chronic musculoskeletal pain of the cervical spine and upper back, tightness, and spasm in the upper extremity muscles.

Several studies have reported a significant increase in the number of adolescent smartphones. Users and its association with musculoskeletal discomfort in recent years, which is becoming agrowing problem and has large impact globally.

NEED OF STUDY

SMS Thumb is associated with restricted movement of thumb and fingers most commonly seen in teenagers who uses smart phones for very long time. This study is to find out the prevalence of SMS thumb among teenage students who use smart phones.

AIM

- Aim of study was to find out the prevalence rate of SMS Thumb among smartphone users incollege going students.

OBJECTIVE

- To assess Pain and Discomfort using NPRS scale in teenagers who use smart phones.
- To assess Pain and Discomfort using Cornell Hand Discomfort Questionnairein teenagers who usesmart phones.

HYPOTHESIS

1) NULL HYPOTHESIS

There will be no significant relation of SMS Thumb among teenagers who usesmartphone very long time.

2) EXPERIMENTAL HYPOTHESIS

There will be significant relation of SMS Thumb among teenagers who use smartphonevery long time.

METHODOLOGY

- Study Design: Cross Sectional Study
- Source of Data: Schools of Ahmedabad
- Population - students of Age 13-18 years
- Sampling Method - Convenient Sampling
- Sample Size - 300 subjects
- Duration of the Study - 1 years

Materials and Tools Used:

- Numerical Pain Rating Scale
- Cornell Hand Discomfort Questionnaire
- Pen

- Pencil
- Rubber
- Scale

Inclusion Criteria:

- School - going students
- Age 13 - 18 years
- Using smart phone for a period minimum 1 year
- Minimum duration of smart phone use of ≥1 hour per day
- Able to understand and fill in the questionnaire in English
- Willing to participate in the study.

Exclusion Criteria:

- Any known condition which could lead to pain in the upper limb
- Any traumatic injury to the upper limb.
- History of hand surgery
- Neurological problems of upper limb

Outcome Measures:

1.Numerical Pain Rating Seale (NPRS): The NPRS is an 11- point scale consisting of integers from 0 through10; 0 representing "NoPain" and 10 representing "Worst imaginable pain". Respondents select the single number that best represents their pain intensity.

2.Cornell hand discomfort questionnaire (CHDQ): It is a 6-item questionnaire containing a hand map diagram showing 6 shaded areas of thehand and questions about

1. Prevalence of Musculoskeletal pain,
2. Discomfort,
3. Interference with work, during the previous week.

Total discomfort score will be calculated by using the following formula: Frequency x discomfort x interference, where higher the score indicated more discomfort. Maximumscoring for each are is 90, and the total scoring for 6 areas is 560.

Procedure:

- Participants were recruited from various schools in Ahmedabad, Gujarat.
- Study participates will be recruited according to their academic year (8th - 12th), andan equal percentage will be obtained from each class, Boys and girls will be divided equality among the academic year groups.
- The nature and purpose the study will be explained by the researcher and informedconsent will be taken from the participants.
- A structured questionnaire containing Demographics (Name, Age, Gender, Height, Weight & duration of smartphone use), Numerical Pain Rating Scales(NPRS), Cornell Hand Discomfort Questionnaires (CHDQ) will be used to collect thedata.

RESULT

In present Study 300 participants with 13 -18 years were selected and divided in five groups.300individuals have been filled a proforma digitally.

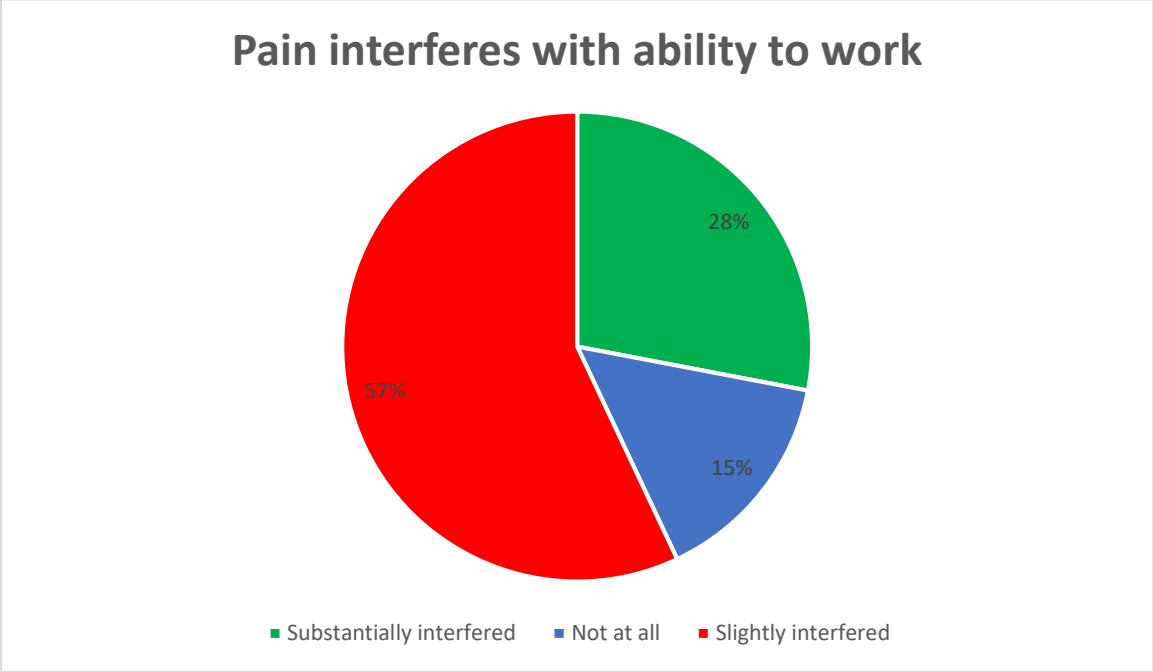

Figure 1: Pain interferes with ability to work

As per the figure 1, 15% subjects have no pain that interferes with their ability to work. 57% were slightly interference and 28% have substantially interference with ability to wok. Among them 57% have slight discomfortness, 27% have moderately uncomfortnesss and 15% have very uncomfortnessdue to pain while using smartphone. This shows that 85% subjects have some affection due to use ofsmartphones.

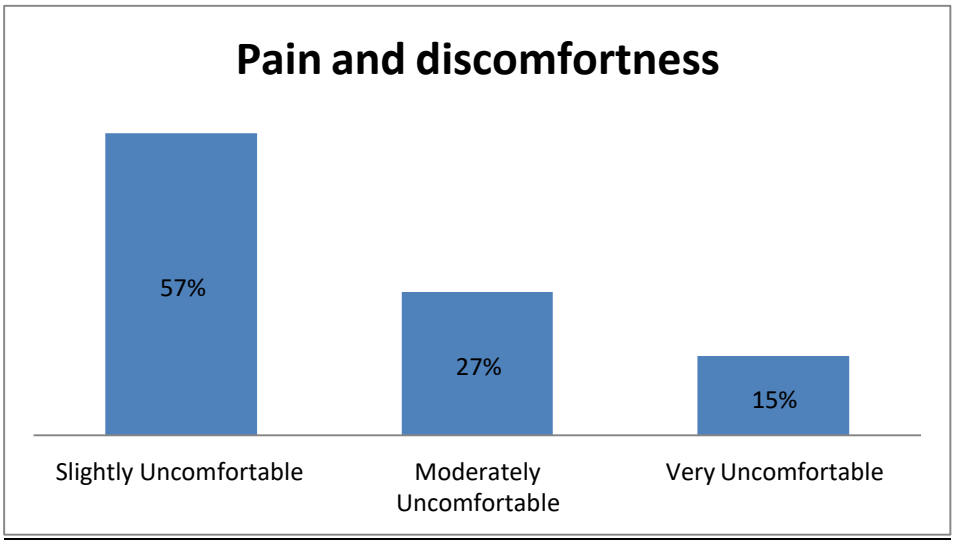

Figure 2: Pain and discomfortness

Among the population affected 5% have pain experienced several times per day, 11% have affection onceevery day, 21% have 3-4 times per week , 54% have 1-2 times per day and 9% have experienced no pain.

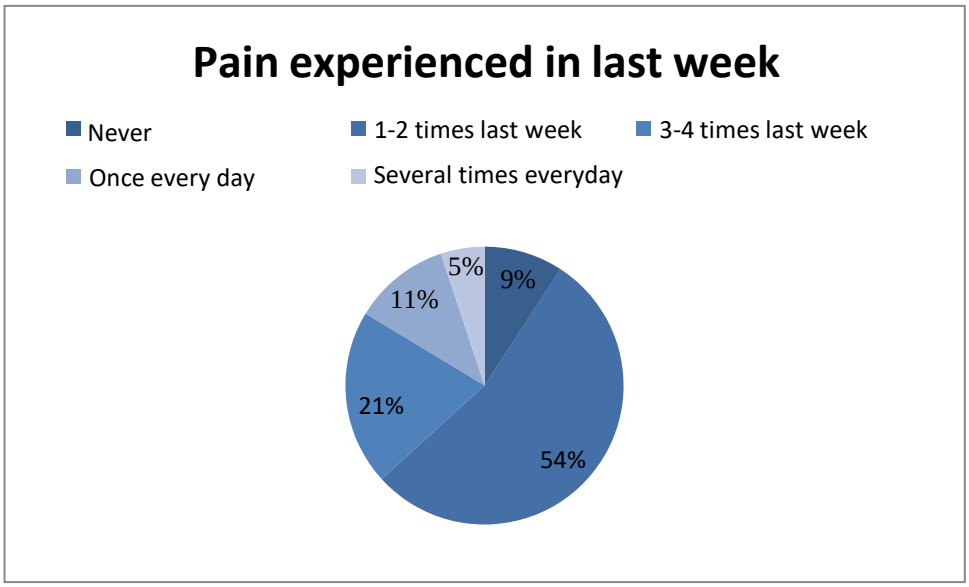

Figure 3: Pain experienced in last week

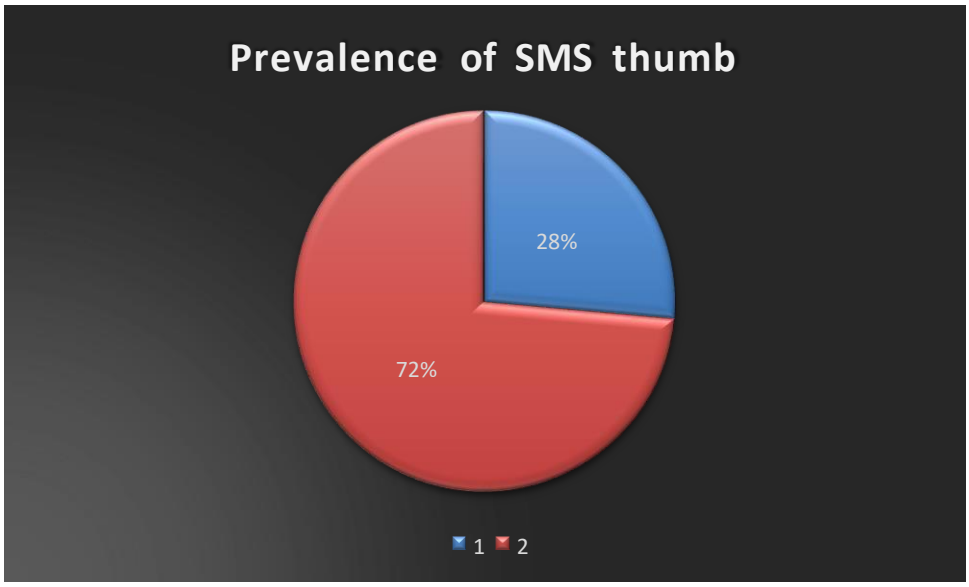

Figure 4: Prevalence of SMS Thumb

So, it is concluded that 28% population is affected by SMS thumb and it is shown in figure 6. 72%population is remained unaffected.

DISCUSSION

In this study, the prevalence of SMS Thumb among teenagers who use smartphone was reported. During message typing, the thumb and palm muscles are used extensively. Sustained gripping and repetitive movements of the fingers and thumb are main key factor that might lead to the associated syndrome.

For texting, the thumb is adducted on the key pad of mobile device and high force is used to type. Studies reported that tendonitis in extensor pollicis longus, adductor pollicis, wrist tendonitis, and deQuervain's syndrome are associated with text messaging. Excessive texting might also lead to carpometacarpal joint arthritis.

Various factor affect the cause of SMS thumb. The contributing factors might be the small spacing on keyboard, mobile size, phone keypad, posture of thumb, etc. the static loading during text messaging on a hand-held device for a long duration can be hazardous for the body posture and overuse of the hand muscle, which might lead to pain in the hand, forearm, neck and upper back muscles.

Long durations of use of mobile phones could adversely affect the musculoskeletal system of hand. Long durations off computer use might increase the risk of neck and shoulder pain.

Text neck syndrome and SMS thumb are repetitive stress injuries that could be prevented by taking some preventive measures and controlling the use of smart phones. Simple life style changes like maintaining correct posture during smart phone use and avoiding long-term use of smart phones could prevent the development of neck pain and SMS thumb.

This study would be helpful to inform smart phone users about the alarming rise of negative consequences of smart phone addiction and long-term smart phone use.

The various biases of this cross-sectional survey, such as selection bias, non-response bias and ascertainment bias, were eliminated by using some strategies as follows. By using pre-fixed inclusion and exclusion criteria, the ascertainment bias was eliminated. Selection bias and non-response bias were eliminated by using a random sampling method. The sample size used in this study was small.

CONCLUSION

The prevalence rate of SMS thumb among smartphone users in teenagers has been established in this study. It is shown that there is 28% prevalence of SMS thumb pain is shown among teenagers who use smartphones. The musculoskeletal problems may be short term initially but can develop into long term disabilities if proper caution is not taken.

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Reliability and Validity of Gujarati Version of Tinetti Assessment Tool: Validation Study

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Abstract:

Background: The Tinetti Assessment Tool is a valid and reliable self-reporting Tool evaluating the patient's problems toward the effect of their activities of daily living (ADLs) and works on their balance and gait disorder. Till the date it was translated into various languages but is not available in Gujarati language. This study aimed to translate Tinetti Assessment Tool into Gujarati and to study reliability and validity of Gujarati version**.**

Methodology: Translation and cross culture adaptation were performed according to the guidelines. Content validation was executed by the panel of 6 members who were experts in using Gujarati and English. They were completed the content validity .The psychometric properties were tested by administering the tool to 60 samples (40 to 70 years) was recruited by Purposive sampling. For test-retest reliability, people with Balance Gait disorder were tested after a week by Intra-class correlation coefficient (ICC) and internal consistency was assessed by Cronbach's alpha (α).

Result : The content validity of Gujarati translated Tinetti Assessment Tool by a panel of 6 experts were found to be, I-CVI of individual items of Gujarati version of Tinetti Assessment Tool ≥ 0.93 and the overall S-CVI for idiomatic equivalence (S-CVI =0.89) semantic equivalence (S-CVI=0.91) and content relevance(S-CVI=0.92). The test-retest reliability of Gujarati version Tinetti Assessment Tool was good (ICC (2,1) = 0.986 and 0.977). Internal consistency was found to be good (Cronbach's alpha = 0.993 and0.988).

Conclusion : The Gujarati version of Tinetti Assessment Tool was cross-culturally adapted and validated can be use patient with balance and gait disorder in the Gujarati-speaking populations.

Keywords : Cross cultural adaption, Tinetti Assessment Tool, Reliability, Validity , Balance and Gait disorder

INTRODUCTION

Balance and gait disorders are among the most common causes of falls in older adults.[1] more than one third of persons 65 years of age or older fall each year, and in half of such cases the falls are recurrent. Approximately 1 in 10 falls results in a serious injury, such as hip fracture, other fracture, ,subdural hematoma, other serious soft-tissue injury, or head injury.[2] Chronic diseases and aging can affect the balance ability of older people; therefore, an assessment of balance ability is valuable predicting and preventing falls and a reduction in independent living in older people. [3]

Balance is required for maintaining static posture, stabilizing dynamic movements, performing daily activities and moving around the community.[3] The loss of balance response and increased incidence of falls is of concern to physical therapists. Improvement of the balance may be a desired functional outcome for many patients. Balance function has been reported to decline with age, as evidenced by increased postural sway and decreased stability.[4]

Balance difficulties are reported by 13% of patients at age 65,35%at age 75, and 46% at age 85. Gait impairment has been estimated to occur in 8% to 19% of elderly individual living in the community.[5]

Balance can be affected in various ways which include joint motion limitation, weakness, altered muscular tone, sensory deficits, anomalous postural reactions and cognitive problems.[6] Most of changes in gait that occur in older are related to underlying medical conditions, particularly as condition increase in severity, and should not be viewed as merely an inevitable consequence of aging.[1]

Other causes of balance is the dizziness, vertigo, neurological disorder, vestibular migraine and vestibular neuritis. Balance disorders are recognized risk factors for falls. especially in the elderly with high associated morbidity, mortality, and economic cost.[7] Only few studies describe the distribution of gait disorders. Obviously, the spectrum of underlying illnesses will depend on the population under consideration and the assessment technique. Within a relatively healthy subgroup of 153 community residents aged 88 years and older, about 61% reported distinct diseases as a cause of gait impairment.[0] Non-neurological disorders were the leading causes of gait impairment, in particular joint pain (52 of 87 people), whereas many others had multiple causes for their gait impairment.[8]

Non-neurological disorders were the leading causes of gait impairment, in particular joint pain (52 of 87 people), whereas many others had multiple causes for their gait impairment. Stroke was the most common neurological cause. In another study of 120 elderly outpatients seen in a neurological reference practice, the most common causes for gait disorders were sensory ataxia (18%), myelopathy (17%), multiple strokes (15%), and parkinsonism (12%).2 Largely the same causes dominated in a series of 493 neurological inpatients, 60% of whom had a gait disorder.[8]

Determining that a gait is abnormal can be challenging, because there are no clearly accepted standards to define a normal gait in an older adult.10 Studies comparing healthy persons in their 70s with healthy persons in their 20s demonstrate a 10 to 20 percent reduction in gait velocity and stride length in the older population.18,19 Other characteristics of gait that commonly change with aging include an increased stance width, increased time spent in the double support phase, bent posture, and less vigorous force development at the moment of push off. These changes may represent adaptations to alterations in sensory or motor systems to produce a safer and more stable gait pattern.[1]

They may contribute to gait and balance disorders for a variety of reasons, such as causing pain, dyspnea, imbalance, diminished strength, limited range of motion, poor posture, decreased sensory perception, fatigue, deformity, and decreased awareness of and ability to adapt to and traverse through possibly hazardous surroundings.[1]

In addition, recent surgery or hospitalization and other acute medical illnesses may lead to gait and balance disorders. The use of multiple medications, as well as specific classes of medications, can lead to gait disorders and an increased rate of falls.[00] Although data are limited, surgery may improve gait for patients with cervical spondylotic myelopathy,51 lumbar spinal stenosis,52 normal-pressure hydrocephalus,53 or arthritis of the knee or hip.[1]

In many studies ,risk factor for falls have been determined. These are classified as intrinsic and extrinsic factors. Muscular weakness of the Lower extremities ,decreased grip force, impaired postural balance, Functional and cognitive disorders, and visual problems constitute Intrinsic factors ,while extrinsic factors include environmental factors Such as inadequate illumination, slippery floors and lack of safety equipments in bathrooms. Besides, a decrease in the ability to perform daily living activities and usage of walking aids contribute to the frequency of falls.[9,10]

Tests and functional scales used in proportion to variation in risk factors for falls, and excess number of components of postural control are also numerous.[9] One of these scale tinetti balance was developed by mary tinneti 1986 so as determine as risk falls.[9]

One of the most widely used version of the Tinetti Assessment of Balance and Gait scale. It is composed of two separate categories as balance and gait tests. Balance and gait are evaluated with nine and eight items, respectively. Total score of balance category consists of sitting balance, balance on arising to stand, immediate standing balance (within first 5s), standing balance, maintenance of balance when the subject turns 360 degree around him /herself, and tries to sit down from standing position is 16 points. Total score of the gait category which evaluates initiation of gait, step length and height , step symmetry and continuity deviation from a specified path, sways of patient's trunk and the position of heels while walking is 28 points. As a result, the total score of the amounts to 28 points. The highest score indicates the best performance.[9]

REVIEW OF LITERATURE

1. **Jinse Park. Seong-Beom Koh, Hee Jin Kim, Eungseok Oh, Joong-Seok Kim, Ji Young Yun, Do-Young Kwon, Younsoo Kim, Ji Seon Kim, Kyum-Yil Kwon, Jeong-Ho Park, Jinyoung Youn, and Wooyoung Jang. (2018)[10] :-** ·Validity and Reliability Study of the Korean Tineti Mobility Test for Parkinson's Disease**.:-** Twenty-four patients diagnosed with PD were enrolled in this study. For the interrater reliability test, thirteen clinicians scored the TMT after watching a video clip. We also used the test-retest method to determine intrarater reliability. The interrater reliability and intrarater reliability of the Korean Tinetti balance scale were 0.97 and 0.98, respectively. The interrater reliability and intra-rater reliability of the Korean Tinetti gait scale were 0.94 and 0.96, respectively. The Korean TMT scores were significantly correlated with the other clinical scales and three-dimensional motion capture. The cutoff values for predicting falling were 14 points (balance subscale) and 10 points (gait subscale).
2.
3. **Seung-Heon An, Dong-Geon Lee, PT, Yun-Bok Lee, Gyu-Chang. (2014)[11]**. Inter –rater ? absolute Reliability and Concurrent Validity of Tinetti – gait Scale (Korean version) in stroke patients**. :-** The purpose of this study was to investigate the inter-rater absolute reliability and the concurrent validity of the Tinetti-gait scale that was translated into Korean for chronic stroke patients. Fifty-two with post-stroke participated in this study. Results was The inter-rater reliability of the Tinetti-gait scale was high; ICC(3,1)=.91 ICC(3,1)=.91 (95% CI=.85~.95) (very reliable), the range of Kappa coefficient were .73~.92 (substantial~good). The inter-rater agreement of the each item in Tinetti-gait scale ranged from .74 to .92 (95 % CI=.59~.95) (reliable~very reliable). The SEM and MDC were .56 and 1.55, respectively. In the results of concurrent validity, there were moderate positive correlation between Tinetti-gait scale and DGI (r=.78), 10WT (r=.74), OLST (r=.65~.73), FM-LE (r=67). And there was moderate negative

correlation between Tinetti-gait scale and STS (r=-79) (p<.01). The Tinetti-gait scale(Korean version) was a reliable and valid tool to measure gait ability in stroke patient.

4. **Serap D. Yücel & Füsun Şahin & Beril Doğu & Tülay Şahin, Banu Kuran & Sevda Gürsakal.(2012)[9].** Reliability and Validity of the Turkish version of the Performance- Oriented Mobility Assessment 1. **:-** The aim of this study was translate POMA-l to Turkish and to assess its reliability and validity people with amputated lower extremities. Eighty participants enrolled in the study with a mean age of 76.5 ± 6.75 years.The turkih version of POMA were ICC(0.70)and cronbach's alpha(0.72,0.83,0.88). In the reliability evaluation of the scale in validation study POMA total score had a strong positive correlation with BBS total score ($r = 0.86, p < 0.0001$), and also a negative correlation with TUG ($r = - 0.75, p < 0.0001$). According to the results of this study, the Turkish version of the POMA-l scale has been found to be a reliable and a valid scale for elderly Turkish peopl

5. **Camila Rodriez Guevara. Luz Helena Lugo. (2012)[12] .** Validity and reliability of Tinetti Scale for Colombian people :- A validity study was conducted in 2012 to a validate the Tinetti Scale for its use in Colombian populations. The Spanish version of Tinetti scale was applied by two evaluators to elderly persons with different degress of gait and balance functionally. Results of this study was the The content validity suggests the re-structuring of the items in the domain of equilibrium with a Cronbach's alpha of 0.948 and a variance of 13,894, in the construct validity, 46 of the 48 responses of the scale differences statistically significant in the ability to detect changes in a group without alterations in gait and balance (healthy) and a group with these conditions (sick); the concurrent validity had a high correlation r = -0.82 with Timed up and go. The inter and intra- rater reliability was between 0.4 to 0.6 and 0.6 to 0.8, respectively. The Cronbach's alpha was 0.91 so the scale was valid and reliable.

6. **Huma Parveen. Majumi M. Noohu.(2016)[13].** Evaluation of Psychometric properties of Tinetti Performance-Oriented Mobility Assessment Scale In Subjects with Knee Osteoarthritis :- The objective of this study was to determine the psychometric properties of the (POMA) scale to measure balance and gait impairments in individuals with (OA).A convenient sample of 25 individuals with bilateral OA knee were recruited. The Results Score of BBS was significantly correlated with POMA-B scores, $r_s = 0.63$, $p = 0.001$, whereas TUGT showed a negative correlation with POMA-G, $r_s = -0.481$, $p = 0.020$, showing moderate convergent validity. ICC results of the total POMA scale (POMA-T), POMA-B, and POMA-G were 0.96, 0.93, and 0.96, respectively, indicating high test retest reliability. SEM, for POMA-T, POMA-B, and POMA-G was 0.35, 0.27, and 0.35, respectively; MDC values were 0.97 for POMA-T, 0.75 for POMA-B, and 0.63 for POMA-G. The findings indicate that the POMA is a valid and reliable tool to assess balance and gait impairments in people with OA knee.

7. **Anne D Kloos, Deb A. Kegelmeyer ,Gregory S. Young, Sandra K Kostyk.(2010)[14].**Fall risk assessment using the Tinetti mobility test in individuals with Huntington's disease. :- The Tinetti Mobility Test (TMT) is a clinical balance and gait test that predicts fall risk in the elderly. This study examined the concurrent validity, usefulness of the TMT as a fall risk screening tool, and the potential ability of the TMT to predict falls in individuals with Huntington's disease (HD). Data from a retrospective review of 94 patient records were used. TMT scores were correlated with Unified Huntington Disease Rating Scale motor scores. The ability of the TMT to accurately assess fall risk was determined using validity index measures. Logistic regression was used to assess the ability of the TMT to predict falls. TMT scores correlated with motor scores ($r_s = -0.751$, $P < 0.0001$). Using a cutoff value of 21, the TMT had a sensitivity of 74% and a specificity of 60% to identify fallers. Lower TMT scores and younger age were significant predictors of falls. The TMT is a for assessing balance and gait status and fall risk of individual with HD.

8. **Anne D. Kloos.Nora E. Fritz, Sandra K. Kostyk, Gregory S, Deb A. Kegelmeye Young. (2014)[15].**Clinimetric properties of the Tinetti Mobility Test, Four Square Step Test , Activities-Specific Balance Confidence Scale, and spatiotemporal gait measures in individuals with Huntington's disease:- This study examined the reliability and concurrent validity of spatiotemporal gait measures, the TMT, FSST and ABC scale in individuals with HD. Results of this study was participants Spatiotemporal gait measures, the TMT total and the FSST showed good to excellent test–retest reliability (ICC > 0.75). MDC values were 0.30 m/s and 0.17 m/s for velocity in forward and backward walking respectively, four points for the TMT, and 3 s for the FSST. The TMT and FSST were highly correlated with most spatiotemporal measures. The ABC Scale demonstrated lower reliability and less concurrent validity than other measures. The high test–retest reliability over a six week period and concurrent validity between the TMT, FSST, and spatiotemporal gait measures suggest that the TMT and FSST may be useful outcome measures for future intervention studies in ambulatory individuals with HD.

9. **Lorenzo Panella, Tinelli Carmine, Buizza Angelo, Lombardi Remo, Gandolfi Roberto.(2008)[16].** Towards objective evaluation of balance in the elderly: validityand reliability of measurement instrument applied to the tinetti test **:-** The aim of present study was the validation of an instrument for evaluating balance, applied Tinetti test. Trunk inclination was measured by inclinometers during thr Tinetti test in 163 healthy participants. Reliability was evaluated by cronbach;s alpha and its validity by itemscale correlation, discriminant validity and concurrent validity. Influence of age and gender was assessed by regression model. Repeatable and distribution consistent measurement were obtained (cronbach;s alpha=0.88). parameter distribution was significantly different in control and patients ($p<0.001$). optimal threshold fpr discriminating between normal and abnormal performance (153.9/200) corresponded to sensitivity of 84.7% and area under the receiver operating characteristics curve of 93.

10. **Cipriany-Dacko LM, Dana Innerst, Joann Johannsen, Vicki Rude.(1997)[17].** Interrater reliability of the tinetti balance scores in novice and experienced physical therapy clinicians:- A reliability design was used to assess the interrater agreement and consistency of the BPOMA scores in an elderly population. Twenty-six residents of a skilled nursing home, ranging in age from 66 to 90yrs ($\bar{x}$ = 80.4, SD = 6.8), participated in Phase 1. Twenty-four hospital inpatients and five residents of a skilled nursing home, ranging in age from 60 to 92yrs ($\bar{x}$ = 74.7, SD = 7.9), participated in Phase 2.Phase 1 demonstrated fair to excellent κ coefficients (.40–1.00) in all maneuvers across all raters. The ORs had higher agreement compared with the AR, ranging from good to excellent (.75–1.00). Phase 2 demonstrated fair to good κ coefficients (.40–.75) in 5 of 8 maneuvers across all nine raters. When comparing proportion of observed agreement to evaluate the years of experience on rater agreement, there was no significant difference between clinician groups.Fair to good reliability of BPOMA scores occurred across many raters of varied experience with a small amount of BPOMA scores occurred across many raters of varied experience with a small amount of training..

11. **Bahman Moulodi., Akram Azad, Ghorban Taghizadeh, Mahtab Roohi-Azizi, Parvaneh Mohammadi.(2020)[18].**Reliability and Validity of Persian Version of Performance Oriented Mobility Assessment (POMA) in Community- dwelling Iranian older adults:- This study aimed at investigating the construct validity, factor analysis, internal consistency, test-retest and inter-rater reliability, and ceiling/floor effects of the Persian version of Performance-oriented Mobility Assessment (POMA) in community-dwelling elderly**.** One hundred and forty-five older adults aged 65 years and older were recruited from daily care centers of Tehran by convenience sampling method. Timed Up and Go (TUG) test and Berg Balance Scale (BBS) were used to investigate the construct validity of the POMA. Test-retest (7-14 days with interval) and inter-rater reliability of the gait and balance subscales and the total score of the POMA were moderate to very high correlation ($r= 0.67-0.9$, $P\leq 0.05$) was found between the total score of the POMA and BBS, Fullerton Advanced Balance Scale, step test (right and left), TUG, Dynamic Gait index, and walking speed, whereas the correlation between the total score of the POMA and step length was poor ($r= 0.39$, $P\leq 0.05$). The results of confirmatory factor analysis showed a poor goodness-of-fit of POMA with the two-factor

model (balance and gait) in community-dwelling elderly. Internal consistency (Cronbach's alpha= 0.94), test-retest reliability (ICC = 0.97), as well as inter-rater reliability (ICC = 0.92) of the POMA were excellent. The results revealed no floor effect for the total score of the POMA; however, its ceiling effect was 3.44%.The Persian version of POMA showed excellent psychometric properties for evaluating different aspects of balance in community-dwelling

NEED OF STUDY

Tinetti Assessment Tool is one of the most common Tool that has been used by physiotherapist all over the world. Also it is already translated in many language like Turkish,[9] Korean[10], Spanish[12], persian[18] etc. I want to translate this scale in my mother language i.e. Gujarati because it will be more beneficial for patients to understand the scale in Gujarati and it will be helpful to physiotherapists also who are from Gujarat.

OBJECTIVE OF THE STUDY

- To translate Tinetti Assessment Tool in to Gujarati language.
- To find out test-retest reliability and internal consistency of Gujarati version
- Tinetti Assessment Tool.
- To find out face and contact validity of the Gujarati version Tinetti Assessment Tool.

HYPOTHESIS

- NULL HYPOTHESIS : Tinetti Assessment Tool for balance and gait will be not reliable and valid on Gujarati population.
- RESEARCH HYPOTHESIS : Tinetti Assessment Tool for balance and gait will be reliable and valid on Gujarati population.

METHODOLOGY

The study was carried out on elderly people aged 40 to 70 years in Gujarat, India. Those peoples who have balance and gait disorder.

INCLUSION CRITERIA

1) Patients who can write , reading and understand Gujarati language
2) Age group 40 – 70 years
3) Patient who is having problems with balance and gait

EXCLUSION CRITERIA

1) Subjects who don't know Gujarati
2) Subjects who had fracture within 6 months
3) Patient with neurological and psychological problem

The Tineeti Balance Scale had been cross-culturally adapted into Gujarati version of Tinetti Assessment Tool in following eight steps:

1. Initial translation to Gujarati language/ forward translation: The translation of Tinetti Assessment Tool in Gujarati language was performed by two individuals whose native language is Gujarati.

2. Synthesis: After discussion, the 2 translators produced a consensus version of the Tinetti Assessment Tool

3. Back translation: Back translation of preliminary Tinetti Assessment Tool into English was conducted by two native English speakers who were fluent in both English and Gujarati. The two translators were neither aware nor be informed of the concepts explored, and they had no medical background.

4. Reviewer's committee: An expert committee comprising of panel of 6 members performed cross-cultural adaption and validation. After back translation, the Scale were forwarded to back translators. They reviewed all translation and developed the
Pre-final version of Tinetti Assessment Tool with emphasis on semantic, idiomatic, experimental and conceptual equivalence in relation to original back- translated Tinetti Balance Scale versions. Then the Scale was content validation by the expert committee.

5. Content validation: Content validation was excuted by the panel of 6 pre-identified members who experts in using Gujarati and English. They were provided with five options, "agree", "strongly agree", "neutral", "disagree", and "strongly disagree". For providing their valuable opinion regarding Gujarati version of Tinetti Assessment Tool.. Eighty percent consensus of agreement among the experts were required to validate the translated version of Tinetti Assessment Tool .Eighty percent of agreement between the experts were fixed in recommendation by Lynn to yield the item-level content validation index (I-CVI) of 0.93. According to Lynn's (1986) criteria a minimum I-CVI of 0.78 for 6 to 10 experts is required to validate each item in a scale.[19] Hence, we have used an expert panel with 6 members to validate the Gujarati translated content of Tinetti Assessment Tool .They were provided with options, agree, strongly agree, neutral, disagree and strongly disagree in a five point likert scale with Gujarati translated content of Tinetti Balance Scale Neural, disagree and strongly disagree were considered as negative response while agree and strongly agree was considered as positive. Content validation of Tinetti Assessment Tool was performed until the overall scale-level content validation index (S-CVI) reaches SCVI/Ave $\geq$ 0.90.[19]

6. Pretesting: According to inclusion and exclusion criteria, the pre-final Scale was administered to 10 balance and gait disorder patients. The interviewer reported on each respondents understanding the Scale items and making decision on them. As no further adaptation is indicated, the pre-final and final Tinetti Assessment Tool is identical. The objective was to assess whether the translated Scale was understandable, the vocabulary was appropriate and also the expression was relevant for Gujarati culture

7. Validation study: Face validity and Content validity was obtained by the Experts and the translators.

i. Test-retest reliability: The recruited patients with balance and gait disorder were asked to fill Gujarati version of Tinetti Assessment Tool by themselves twice with minimum gap of one week duration. So that person may not copy the same data as well as he/she will not forgot.[19] The readings were recorded to report test-retest reliability.

ii. Internal consistency: Internal consistency was measured with Cronbach's alpha (α), a statistic which was calculated from the pair wise correlations measured between paired readings of Gujarati version of Tinetti Assessment Tool.

Fig: 6.1 (a)

Patient performing Tinetti Assessment Tool

Fig: 6.1 (b)

Patient performing Tinetti Assessment Tool

Process Discussion Result

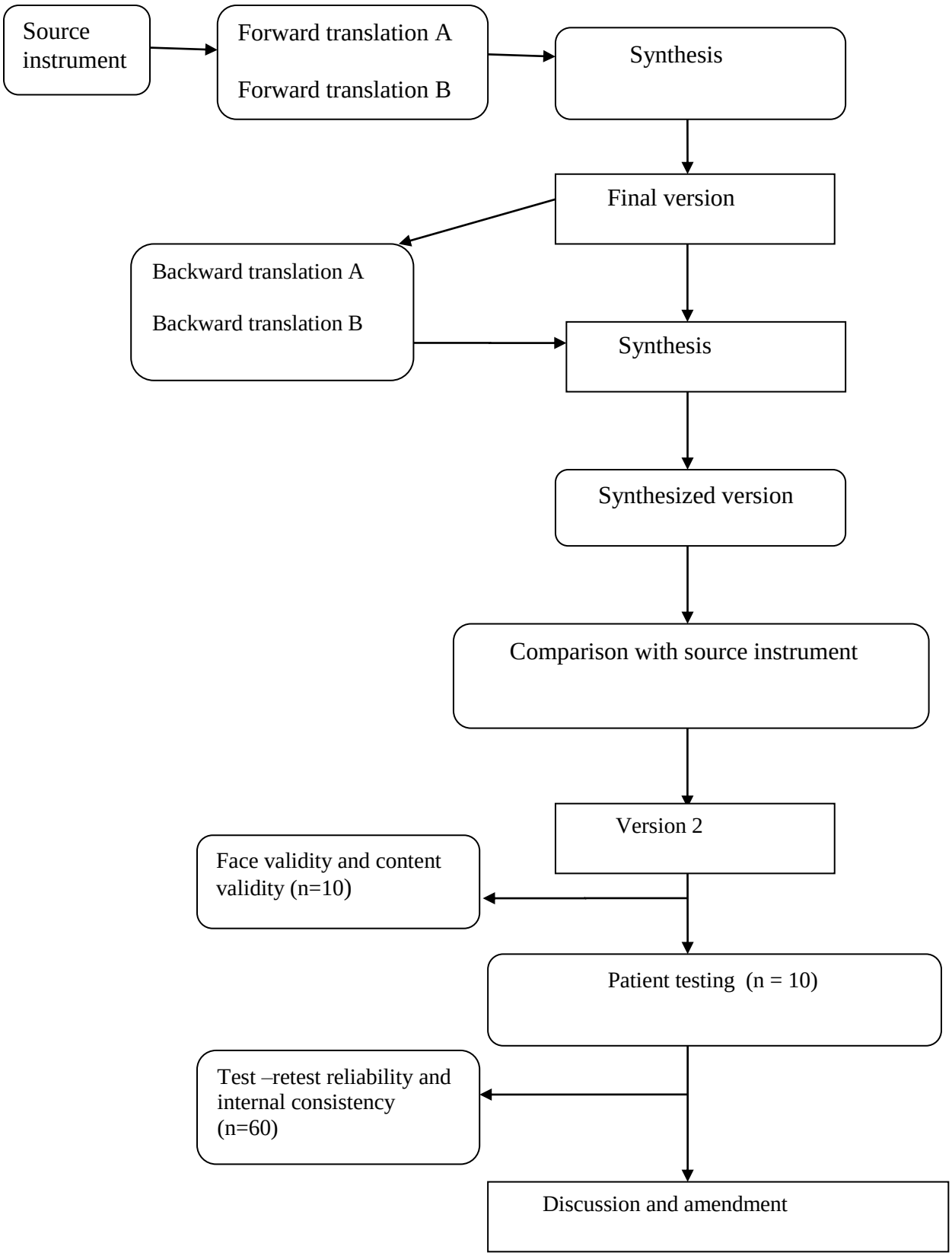
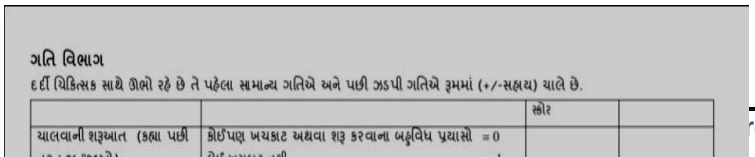
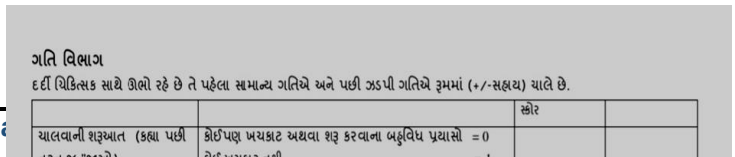


CHART 6.1 CROSS CULTURAL ADAPTION


ગતિ વિભાગ
દર્દી ચિકિત્સક સાથે ઊભો રહે છે તે પહેલા સામાન્ય ગતિએ અને પછી ઝડપી ગતિએ રૂમમાં (+/-સહાય) ચાલે છે.

		સ્કોર	
ચાલવાની શરૂઆત (કહ્યા પછી	કોઈપણ ખચકાટ અથવા શરૂ કરવાના બહુવિધ પ્રયાસો = 0		


ગતિ વિભાગ
દર્દી ચિકિત્સક સાથે ઊભો રહે છે તે પહેલા સામાન્ય ગતિએ અને પછી ઝડપી ગતિએ રૂમમાં (+/-સહાય) ચાલે છે.

		સ્કોર	
ચાલવાની શરૂઆત (કહ્યા પછી	કોઈપણ ખચકાટ અથવા શરૂ કરવાના બહુવિધ પ્રયાસો = 0		

Fig: 6.2

TRANSLATED TINETTI BALANCE SECTION

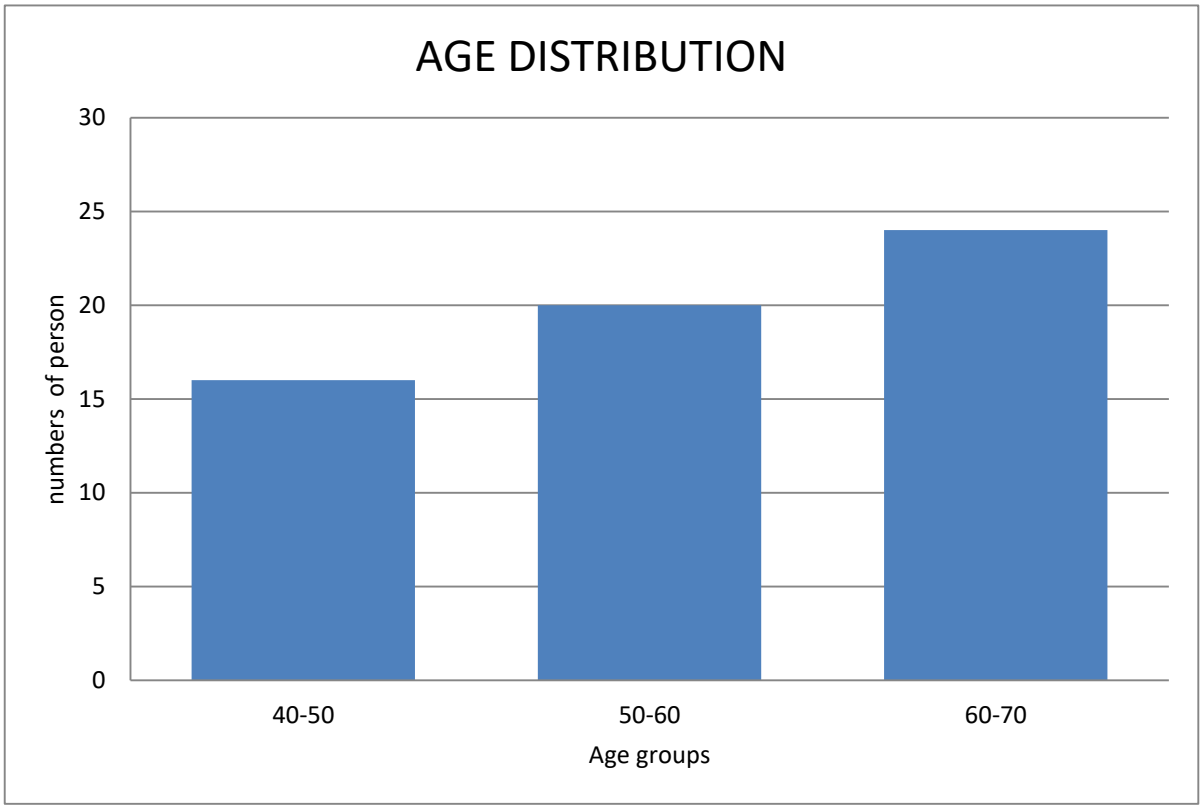
Fig: 6.3

TRANSLATED TINETTI GAIT SECTION

RESULT

1. Age distribution

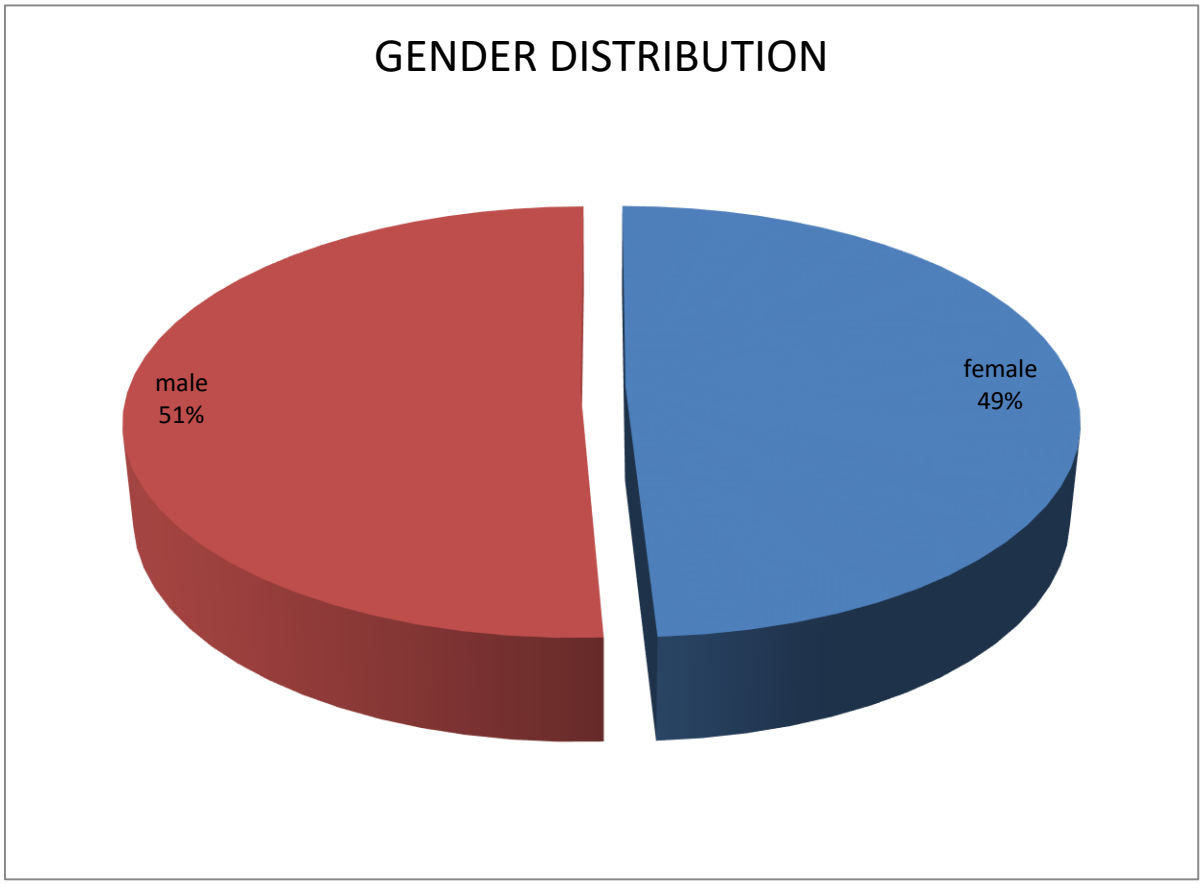
The research was performed on 60 patient with Balance and Gait disorder between the age of 40-70. There were 14 patients between the ages of 40 to 50, 20 patients between the ages 50 to 60, and 24 patients between the ages of 60 to 70. The Mean of age was 20.



GRAPH 7.1 :- AGE DISTRIBUTION CHART

2. Gender distribution

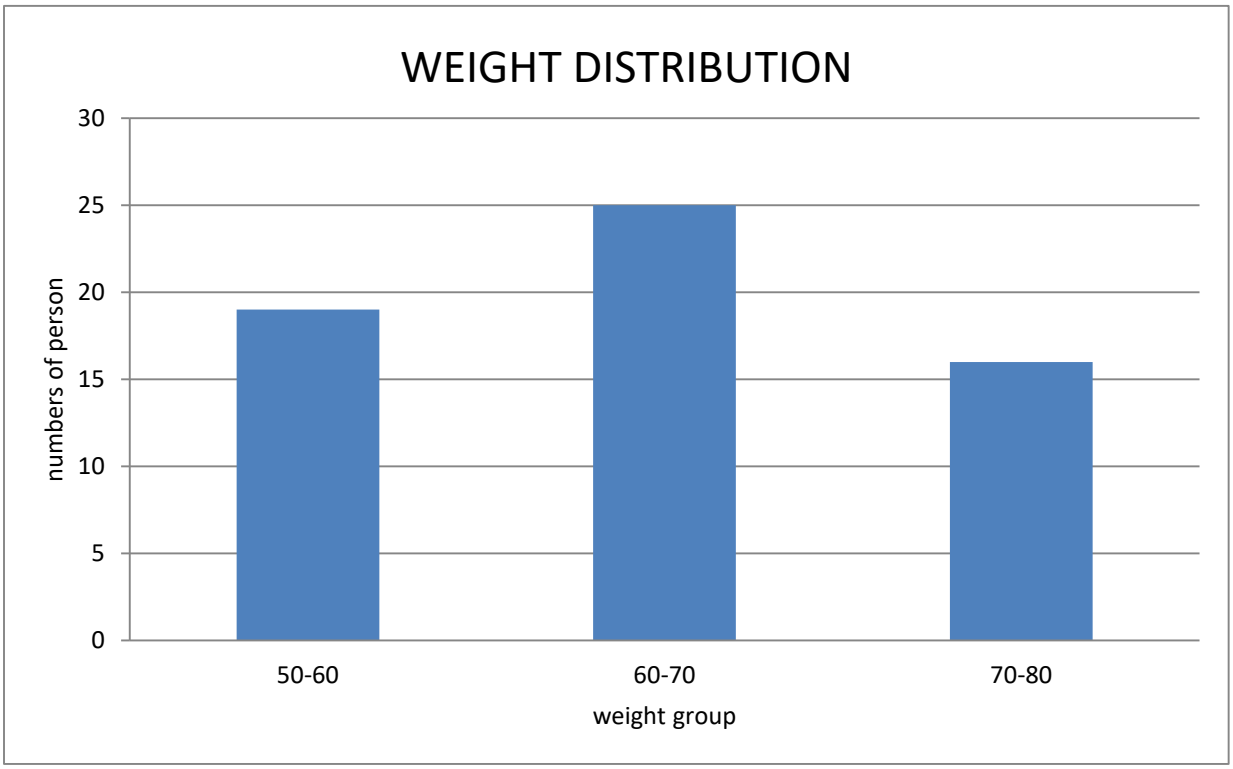
The research was performed on 60 patient with Balance and Gait disorder. In which 30 are Females and 31 are Males. The Mean of gender was 30.5



GRAPH 7.2 :- WEIGHT DISTRIBUTION CHART

3. Weight Distribution

The research was performed on 60 patient with Balance and Gait disorder There were 19 patients between the weight of 50 to 60, 25 patients between the weight of 60 to 70 and 16 patients between the weight 60 to 70 . The Mean of weight was 20.



GRAPH 7.3 :- WEIGHT DISTRIBUTION CHART

The content validity of Gujarati translated Tinetti Assessment Tool by a 6 experts were found to be, I-CVI of individual items Tinetti Assessment Tool of ≥ 0.93 and overall S-CVI for idiomatic equivalence, semantic equivalence and content relevance ≥ 0.90. For content validity equivalence all 6 experts answers were located between mostly agree and strongly agree of Gujarati version of Tinetti Assessment Tool for idiomatic equivalence (average= 0.89) semantic equivalence(average = 0.91) and content relevance (average= 0.92). Test-retest reliability (n=60) was tested by using the intraclass correlation coefficient, ICC (2,1) and Internal consistency (n=60) was reported in terms of cronbach's α measured in two session after 1 week is reported in Table 2.

Tinetti Balance Scale	Session 1	session 2	Cronbach's alpha	ICC	P- value
BALANCE SECTION	10.71±6.34	10.88±6.20	.993	.986	0.980
GAIT SECTION	8.60±3.29	8.41±3.40	.988	.977	0.959

TABLE 7.1 :- TEST-RETEST RELIABILITY OF TINETTI TOO

DISCUSSION

Many elderly people has Balance and Gait disorder caused by neurological disorder, Parkinson, stroke, poor posture, ataxia , myelopathy. They causing pain, dyspnea, imbalance, diminished strength, limited range of motion, poor posture, fatigue. In our study first report of the reliability and validity of the Tinetti Assessment Tool for evaluating patient with Balance and Gait disorder.

In this study 60 patients participated. Gujarati version of Tinetti Assessment Tool was given twice with 1-week interval to measure the test- retest reliability and to validity. The results of the study showed good

correlation Balance scale and Gait scale(ICC= .986,and .977) (P<0.01) and internal consistency (cronbach's alpha = . 993 and .986).

For content validity equivalence all 6 experts answer were located between mostly agree and strongly agree of Gujarati version of Tinetti Assement Tool for idiomatic equivalence (average= 0.89) semantic equivalence (average = 0.91) and content relevance (average= 0.92). Thus, Gujarati version of Tinetti Balance Scale was content validated for idiomatic equivalence, semantic equivalence , content relevance.

In previous studies, interrater reliability and intrarater reliability of the Korean Tinetti balance scale were(ICC =(0.97 and 0.98) respectively. The interrater reliability and intrarater reliability of the Korean Tinetti balance scale were(ICC =0.94 and 0.96). reliability and validity for gait and balance had high sensitivity and specificity for predicting falls among the patient with PD.[10] In Spanish version the concurrent validity had a high correlation (r = 0.74- 0.93). and inter and intra- rater reliability was between 0.4 to 0.6 and 0.6 to 0.8 The tinetti scale is valid and reliable for Colombian population.[12]

Turkish version of the scale was applied on the participants at 2 week intervals. Test-retest shown good reliability (ICC= 0.94) . interrater and intrarater reliability (ICC=0.86 And 0.90).[9] Turkish version of the POMA-1 scale has been found be a reliable and valid.In Persian version of POMA was applied 7-14 days intervals. Internal consistency (cronbach's alpha= 0.94). test-retest reliability (ICC=0.97). inter-rater reliability (ICC=0.92). Persian shown excellent psychometric properties

It was found Gujarati version of Tinetti Assessment Tool items equivalent to those in original version which is intended by translators involve in this study. The results showed that it was translate this scale into other languags without losing psychometric properties of the original English version

CONCLUSION

The Gujarati version of Tinetti Assessment Tool was cross-culturally adapted and validated for use among the Gujarati-speaking populations. The translated version has acceptable reliability and internal consistency.

SUMMARY

The study is find out the reliability and validity of the Tinetti Assessment Tool in Gujarati language on the elderly people with Balance and Gait disorder in Gujarat. 40 people were chosen with the 40-70 age group participated in the study and they were given Tinetti Assessment Tool was given twice with 1 week interval to measure test-retest reliability and to measure validity. The results showed good correlation and internal consistency and content validity

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CHRONIC NECK PAIN AMONG COLLEGE STUDENTS A CROSS-SECTIONAL STUDY

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ABSTRACT :

Chronic neck pain is most common problem in people nowadays. Chronic neck pain can have causes such as working for hours over computer and mobile phones which eventually causes muscle strains.

BACKGROUND:

To find prevelance, determinants and consequences of chronic neck pain among college going students.

METHODOLOGY:

STEP 1: Selection of suitable participants.

STEP 2: Sending the consent form through e-mail.

STEP 3: Sending the link of questionnaire through e-mail.

STEP 4: Collection of data.

STEP 5: Analysis of the survey.

STEP 6: Statistical Analysis

STEP 7: Result

RESULT: Most of the patient did not had any pain or had miled pain during personel care, lifting heavy weights, reading, headaches, Concentration inactivities, work, driving, Sleeping and Recreational activities.

CONCLUSIONS: From the results it can be concluded that more than half of the population had no pain or mild pain and they didn't feel any issues in dealing with personal care lifting heavy weights reading headaches concentration work driving sleeping and Recreation

KEYWORDS: Chronic neck pain, VAS scale, NDI scale, college students

I. INTRODUCTION

Chronic neck pain is most common problem in people nowadays.1,2The chronic neck pain seems to a have large impact on people's health and hinders with an Individual's day to day activity and work.2

Symptoms

- Pain that's often worsened by holding your head in one place for long periods, such as when driving or working at a computer.
- Muscle tightness and spasms.
- Decreased ability to move your head.
- Headache.
- Neck pain is typically classified as chronic when it persists or regularly recurs for at least 3 months.

Causes of neck pain and problems may include:

- Injury (damage to the muscles, tendons, or ligaments) Herniated disk in the neck.
- Arthritis (such as osteoarthritis, rheumatoid arthritis) Cervical (neck) disk degeneration.
- Congenital (present at birth) abnormalities of the vertebrae and bones.
- Tumors.

Your neck is flexible and supports the weight of your head, so it can be vulnerable to injuries and conditions that cause pain and restrict motion. Neck pain causes include:

- Muscle strain : Overuse, such as too many hours hunched over your computer or smartphone, often triggers muscle strains. Even minor things, such as reading in bed or gritting your teeth, can strain neck muscles.
- Worn joints : Just like the other joints in your body, your neck joints tend to wear down with age. Osteoarthritis causes the cushions (cartilage) between your bones (vertebrae) to deteriorate. Your body then forms bone spurs that affect joint motion and cause pain.

- Nerve compression : Herniated disks or bone spurs in the vertebrae of your neck can press on the nerves branching out from the spinal cord.
- Injuries : Rear-end auto collisions often result in whiplash injury, which occurs when the head is jerked backward and then forward, straining the soft tissues of the neck.
- Diseases : Certain diseases, such as rheumatoid arthritis, meningitis or cancer, can cause neck pain.

Neck pain can cause reduced range of motion due to movement restriction muscles of the neck can become strained due to bad posture habits such as spending excessive time on computer and mobile phones where the neck remains continuously in the same position for a prolonged period of time. Pain in the neck most of the time goes away within a few weeks that being said pain that persist for months could be a sign of underlying problem that needs Observation.4 Chronic Neck pain can have causes such as working for hours over computer and mobile phones which eventually causes muscle strains. Whiplash injuries where the head is forced backward and forward and diseases like cancer.4

REVIEW OF LITERATURE

1. Prevalence , determinants and consequences of chronic neck pain in Finland, By Matti Makela, Markku Heliovaara, Kai Sievers, Olli Impivaara, Paul Knekt, Arpo Aromaa , in 1991.

The distribution, determinants, and consequences of chronic neck pain have hitherto been described inadequately. In the Mini-Finland Health Survey, a representative population sample of 8,000 Finns aged ≥30 years was invited to participate in a comprehensive health examination comprising an interview and a clinical examination; 90.2% complied. Predetermined criteria were used to diagnose major cardiovascular, musculoskeletal, respiratory, mental, and other disorders, regardless of other simultaneous disorders. Chronic neck syndrome was diagnosed in 9.5% of the men and 13.5% of the women. When adjusted for age and sex, the prevalence of the neck syndrome was associated with a history of injury to the back, neck, or shoulder and with mental and physical stress at work. Among those aged 30 to 64 years, overweight and parity were also significant determinants. Other musculoskeletal and mental disorders were associated with neck syndrome, and the association persisted after working conditions, injuries, overweight, and parity were adjusted for. There was some independent association between neck syndrome and disabilities, use of physician services, and use of pain killers.

2. Neck pain among undergraduate medical students in a premier institute of central India: A cross-sectional study of prevalence and associated factors,By Prateek Behera, Anindo Majumdar, G Revadi, John Ashutosh Santoshi, Vivek Nagar, Nitu Mishra in 2020 .

This study aimed to evaluate the prevalence of neck pain and the associated factors including gadget use among undergraduate medical students of a premier medical college in central India.

3. Prevalence of neck pain among under graduate student of Lahore, By Ayesha Malik , M.Umer Pasha , Sadia khalid , Ashfaq ahmad , Syed Amir Gilani , 2017 .

The main intent of this study was to find out the prevalence of neck pain in undergraduates Students. A cross sectional study was conducted which was not derived from experiments. A survey was conducted from the undergraduate students of main universities in lahore city named as Punjab university of Lahore and University of Lahore descriptive statistics focused on bar charts histograms and pie charts were Used. Results concluded that out of 402 respondents (56.7%) were suffering with neck pain while (43.3%) respondents were not having neck pain. No association was found between gender and neck pain (p-value 0.351) additionally, there was weaker relation between age and neck pain (p-value 0.785).Neck pain occurring. In students was mainly sudden in onset & intensity was mild to moderate of the neck pain. Mostly students were taking medications & physiotherapy treatment for reducing the neck pain.

4. Improving knowledge of Text Neck and Neck Pain Using Interactive Smartphone Application for Undergraduate Students in Universiti Sains Malaysia, By Jasni Dolah, Joey Loh Jo Yie, Lilian Lee Shiau Gee , In 2020.

The objective of this study is to determine the level of knowledge and awareness of the text neck among undergraduate students of University Sains Malaysia (USM) and to create an interactive mobile application to reduce the prevalence. The app is ARbased neck exercise gamification that alerts incorrect posture using a smartphone front camera and a built-in sensor. The proposed study will enable people who are suffering from, or at risk of, text neck to have more pleasant and engaging neck exercise experience with a better exercise impact, and may promote regular breakaway from the wrong posture.

5. Effects of neck exercise on sitting posture in patients with chronic neck pain , By Deborah Falla, Gwendolen Jull, Trevor Russell, Bill Vicenzino,Paul Hodges , 2007

This study had 2 purposes: (1) to compare change in cervical and thoracic posture during a distracting task between subjects with chronic neck pain and control subjects and (2) to comparethe effects of 2 different neck exercise regimens on the ability of people with neck pain to maintain an upright cervical and thoracic posture during this task. Fifty-eight subjects with chronic, nonsevere neck pain and 10 control subjects participated in the study.

6. Responses to Vignettes about Students with Chronic Pain in K-12 Public Schools Provide by Current Principals and Assistant Principal BY Kimberly S Payne , In 2020.

This dissertation study addresses a gap in the literature in K-12 public education regarding students who experience chronic pain (CP). While awareness and understanding about the plight of children and adolescents with CP are prevalent in the healthcare and medical realms, evidence of how public schools respond to students' pain

complications as they apply to their education, both in the K-12 setting andbeyond, is scant. Despite this, consequences of ignoring or misunderstanding CP instudents by K-12 schools could be significant: Studies from the healthcare realm indicate that students with CP often become caught in a "downward spiral" of chronic pain-invoked absenteeism resulting in falling behind in academics and low school functioning, thus placing them at risk of poorer eventual outcomes in life. Likewise, family members and school personnel become frustrated by lack of information, communication problems, and the inability to attend to students' needs. Additionally, matters are complicated when K-12 school administrators are required to work within fixed legal frameworks that are not necessarily sensitive to CP issues.

7. Active neck muscle training in the treatment of chronic neck pain in women a Randomized Controlled trial, by Jari Ylinen , Esa-Pekka Takala , Matti Nykänen , in 2003

Patients were randomly assigned to either 2 training groups or to a control group, with 60 patients in each group. The endurance training group performed dynamic neck exercises,which included lifting the head up from the supine and prone positions. The strength training group performed high-intensity isometric neck strengthening and stabilization exercises with an elastic band. Both training groups performed dynamic exercises for the shoulders and upper extremities with dumbbells. All groups were advised to do aerobic and stretching exercises regularly 3 times a week

8. A systematic review of the impact of chronic pain on adolescents' school functioning School personnel responses to managing pain in the schools By Fatimah Alsaggaf, Imelda Coyne , In 2020.

To critically synthesize empirical studies on the impact of chronic pain on adolescents' school functioning and school personnel responses to managing pain in schools.

9. Physical exercises and functional rehabilitation for the management of chronic neck Pain , By Jari Ylinen , in 2007

The aim of this review was to reassess the effectiveness of different exercise methods in relieving pain and improving disability in patients with chronic nonspecific neck pain. Ten andomized controlled or comparative high-quality trials were included in a more detailed analysis using patient oriented primary outcome measures (e.g., patient's rated pain and Disability) as well as pressure pain threshold and functional outcomes (neck strength and range of motion). Findings revealed moderate evidence supporting the effectiveness of both long-term dynamic as well as isometric resistance exercises of the neck and shoulder musculature for chronic or frequent neck disorders. Findings revealed no evidence supporting the long-term effectiveness of postural and proprioceptive exercises or other very low intensity exercises. Clinicians are encouraged to consider these findings and incorporate them into their practice when planning the treatment of patients with chronic neck disorders.

NEED OF STUDY

Currently there are many studies done on chronic neck pain but there is limited research on prevalence ,determinants and consequences of chronic neck pain among college going students. Need for study arises to understand the determinants and prevalence of chronic neck pain in college going students as their neck remains in the same position continuously for longer time while studying and using mobile phones as well as laptops.

OBJECTIVE OF THE STUDY

- To find out whether Myofacial Release (MFR) Technique or Active Release Technique is more effective in treating chronic low back pain.
- To find out whether Myofacial Release (MFR) Technique is superior for treating chronic low back pain.
- To find out whether Active Release Technique is superior for treating chronic low back pain.

HYPOTHESIS

H0 : There is no association between pain and personal care, lifting heavy weights, reading, headaches, concentration in activities, work, driving, sleeping, recreational activities.

H1: There is association between pain and personal care, lifting heavy weights, reading, headaches, concentration in activities, work, driving, sleeping, recreational activities.

METHODOLOGY

STEP 1: Selection of suitable participants.

STEP 2: Sending the consent form through e-mail.

STEP 3: Sending the link of questionnaire through e-mail.

STEP 4: Collection of data.

STEP 5: Analysis of the survey.

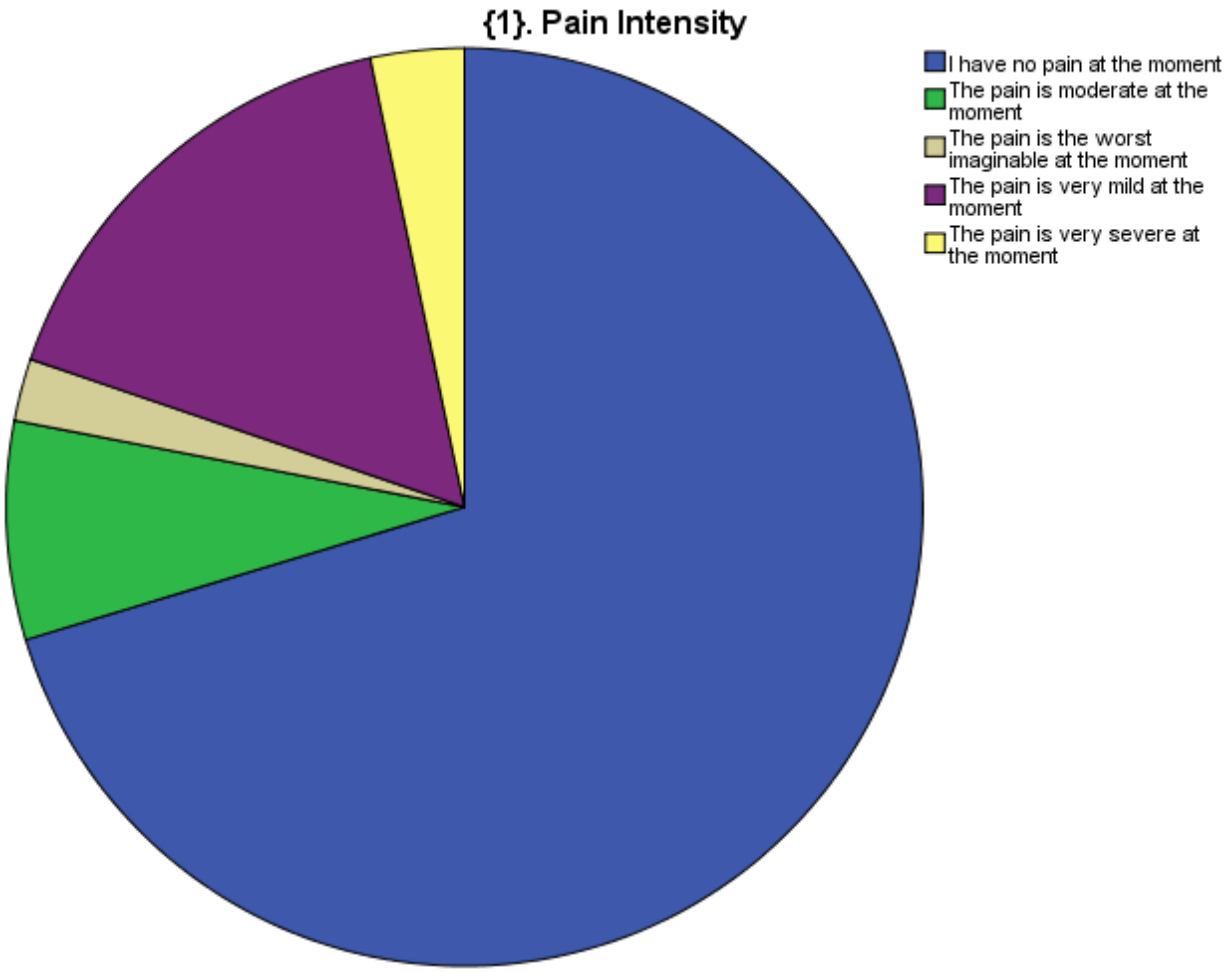
STEP 6: Statistical Analysis

STEP 7: Results

Result

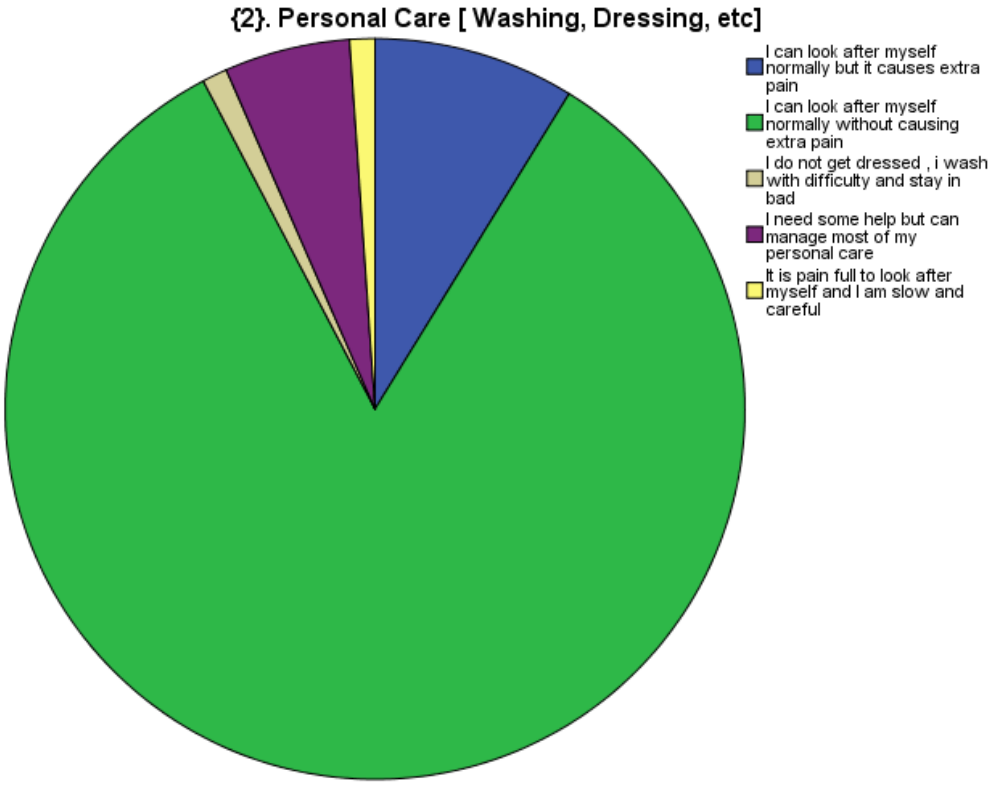
{1}. Pain Intensity

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	I have no pain at the moment	64	70.3	70.3	70.3
	The pain is moderate at the moment	7	7.7	7.7	78.0
	The pain is the worst imaginable at the moment	2	2.2	2.2	80.2
	The pain is very mild at the moment	15	16.5	16.5	96.7
	The pain is very severe at the moment	3	3.3	3.3	100.0
	Total	91	100.0	100.0	

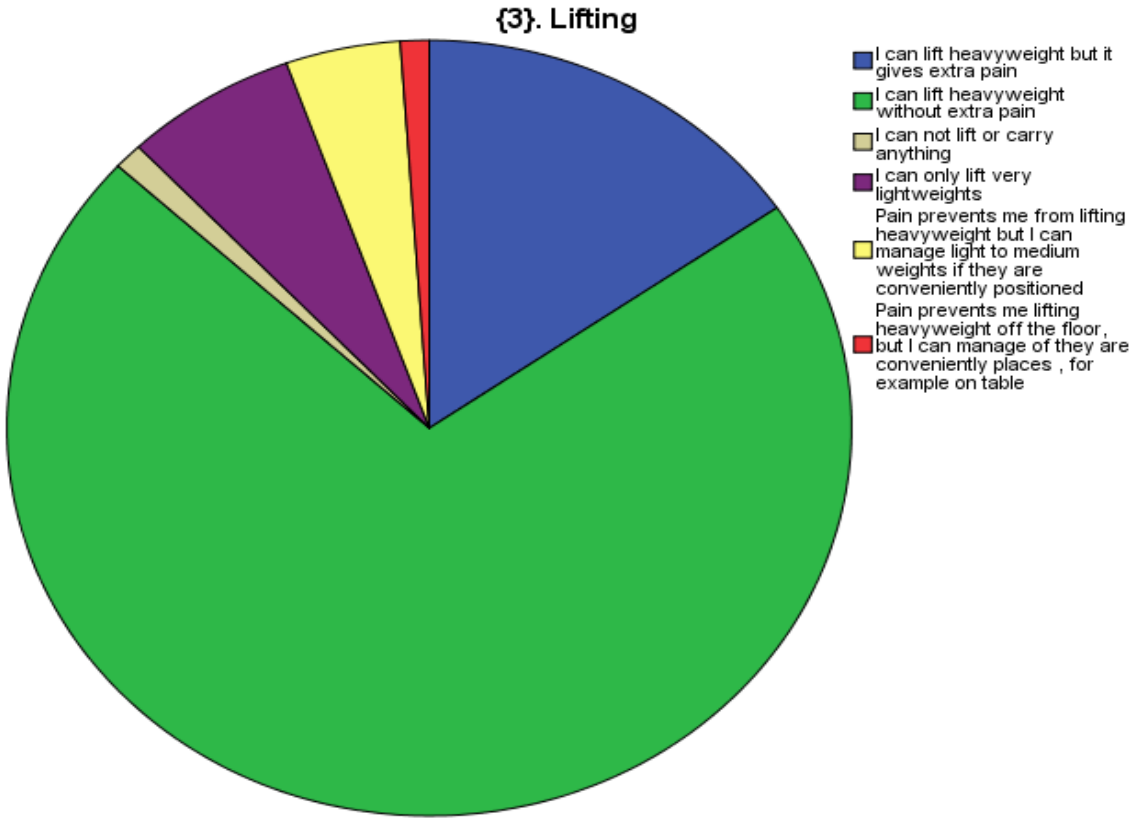


{2}. Personal Care [Washing, Dressing, etc]

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	I can look after myself normally but it causes extra pain	8	8.8	8.8	8.8
	I can look after myself normally without causing extra pain	76	83.5	83.5	92.3
	I do not get dressed , i wash with difficulty and stay in bad	1	1.1	1.1	93.4
	I need some help but can manage most of my personal care	5	5.5	5.5	98.9
	It is pain full to look after myself and I am slow and careful	1	1.1	1.1	100.0
	Total	91	100.0	100.0	

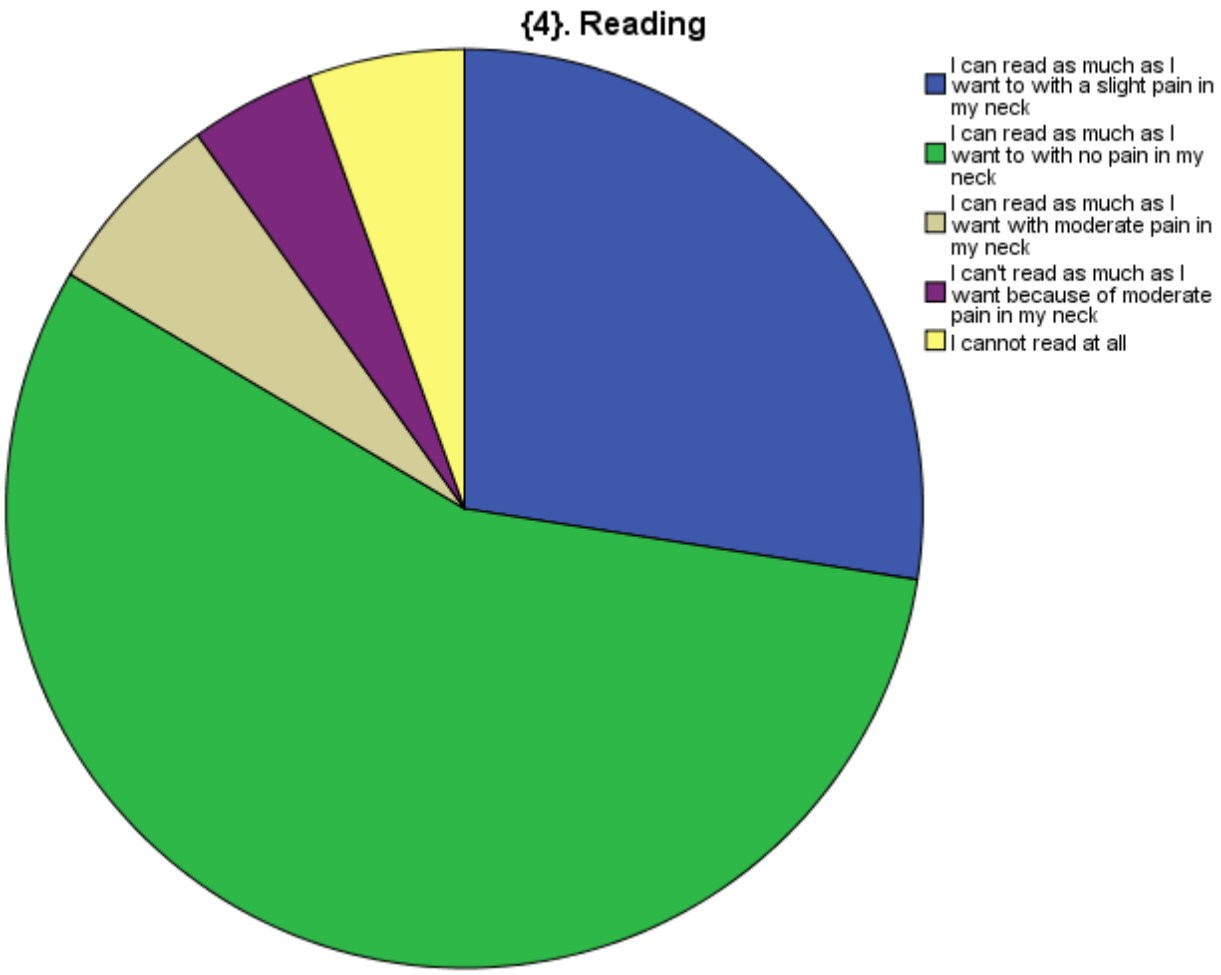


		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	I can lift heavyweight but it gives extra pain	14	15.4	15.4	15.4
	I can lift heavyweight without extra pain	65	71.4	71.4	86.8
	I can not lift or carry anything	1	1.1	1.1	87.9
	I can only lift very lightweights	6	6.6	6.6	94.5
	Pain prevents me from lifting heavyweight but I can manage light to medium weights if they are conveniently positioned	4	4.4	4.4	98.9
	Pain prevents me lifting heavyweight off the floor, but I can manage of they are conveniently places , for example on table	1	1.1	1.1	100.0
	Total	91	100.0	100.0	



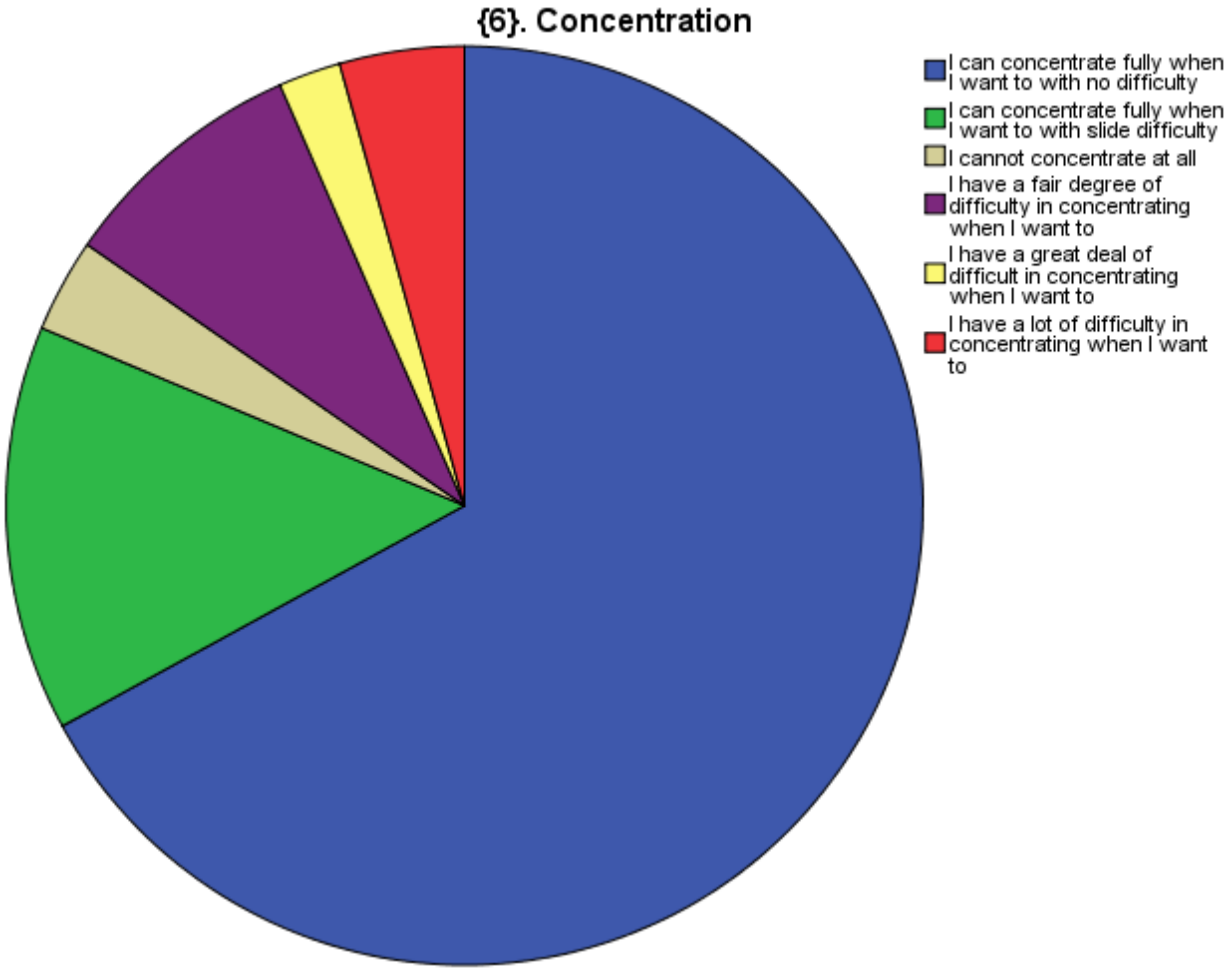
{4}. Reading

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	I can read as much as I want to with a slight pain in my neck	25	27.5	27.5	27.5
	I can read as much as I want to with no pain in my neck	51	56.0	56.0	83.5
	I can read as much as I want with moderate pain in my neck	6	6.6	6.6	90.1
	I can't read as much as I want because of moderate pain in my neck	4	4.4	4.4	94.5
	I cannot read at all	5	5.5	5.5	100.0
	Total	91	100.0	100.0	



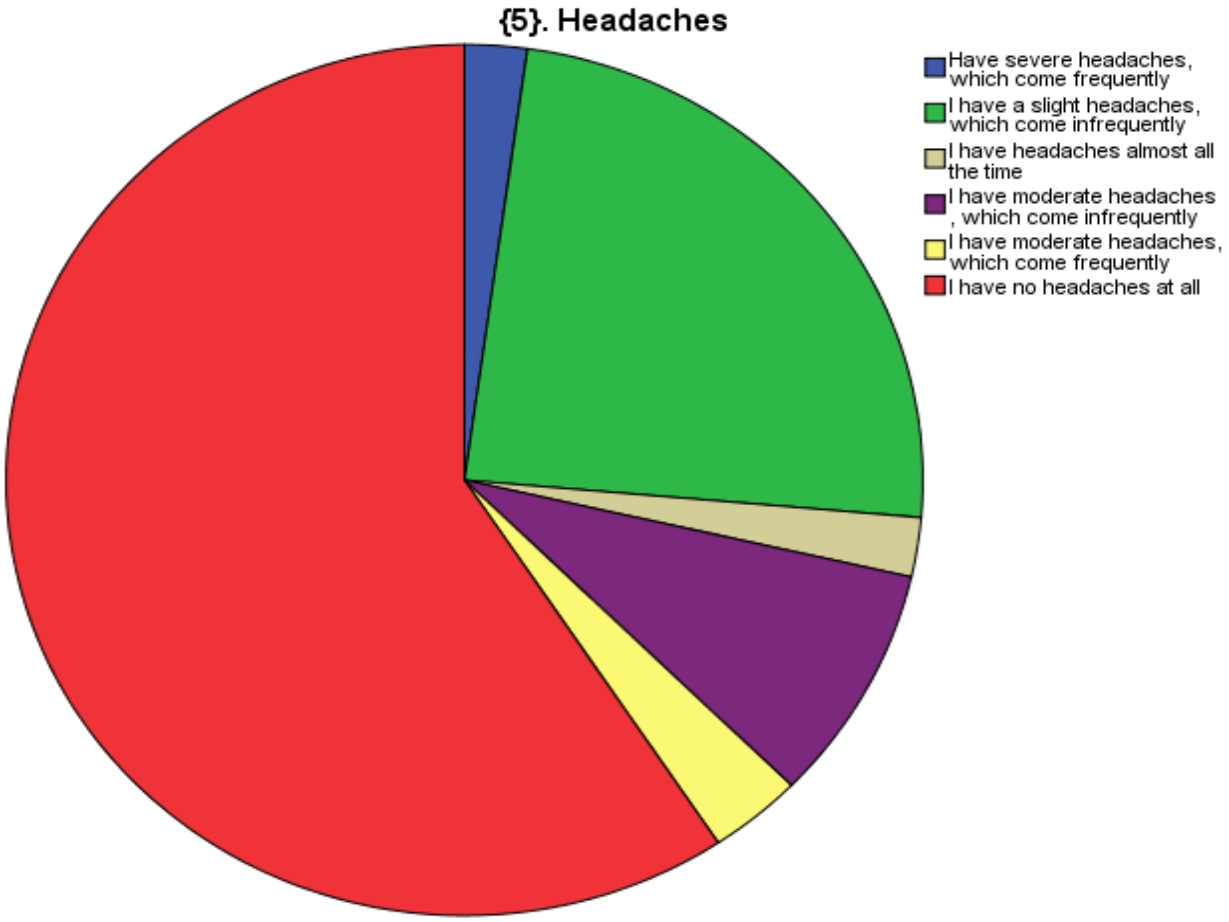
{5}. Headaches

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Have severe headaches, which come frequently	2	2.2	2.2	2.2
	I have a slight headaches, which come infrequently	22	24.2	24.2	26.4
	I have headaches almost all the time	2	2.2	2.2	28.6
	I have moderate headaches , which come infrequently	8	8.8	8.8	37.4
	I have moderate headaches, which come frequently	3	3.3	3.3	40.7
	I have no headaches at all	54	59.3	59.3	100.0
	Total	91	100.0	100.0	



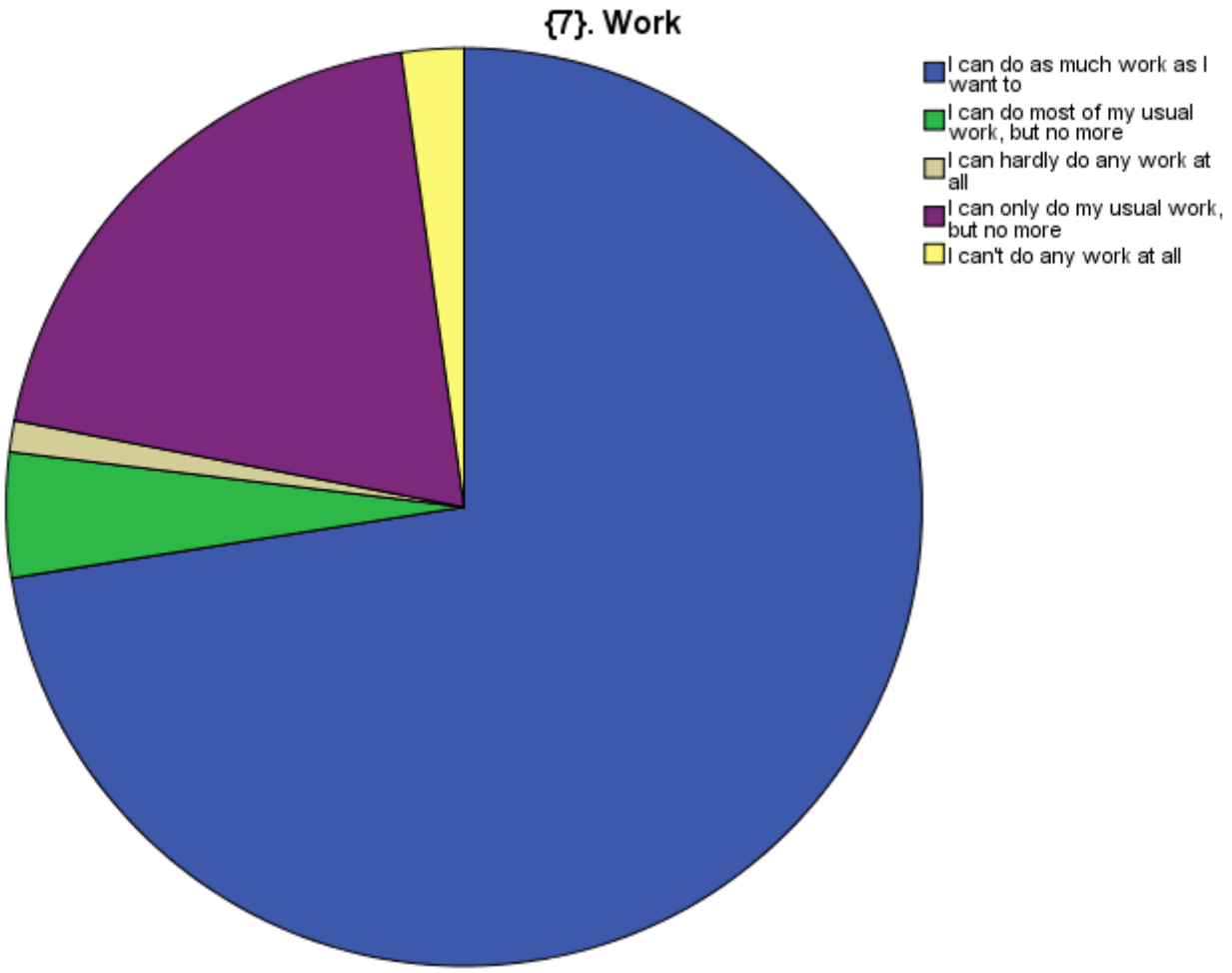
{6}. Concentration

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	I can concentrate fully when I want to with no difficulty	61	67.0	67.0	67.0
	I can concentrate fully when I want to with slide difficulty	13	14.3	14.3	81.3
	I cannot concentrate at all	3	3.3	3.3	84.6
	I have a fair degree of difficulty in concentrating when I want to	8	8.8	8.8	93.4
	I have a great deal of difficult in concentrating when I want to	2	2.2	2.2	95.6
	I have a lot of difficulty in concentrating when I want to	4	4.4	4.4	100.0
	Total	91	100.0	100.0	



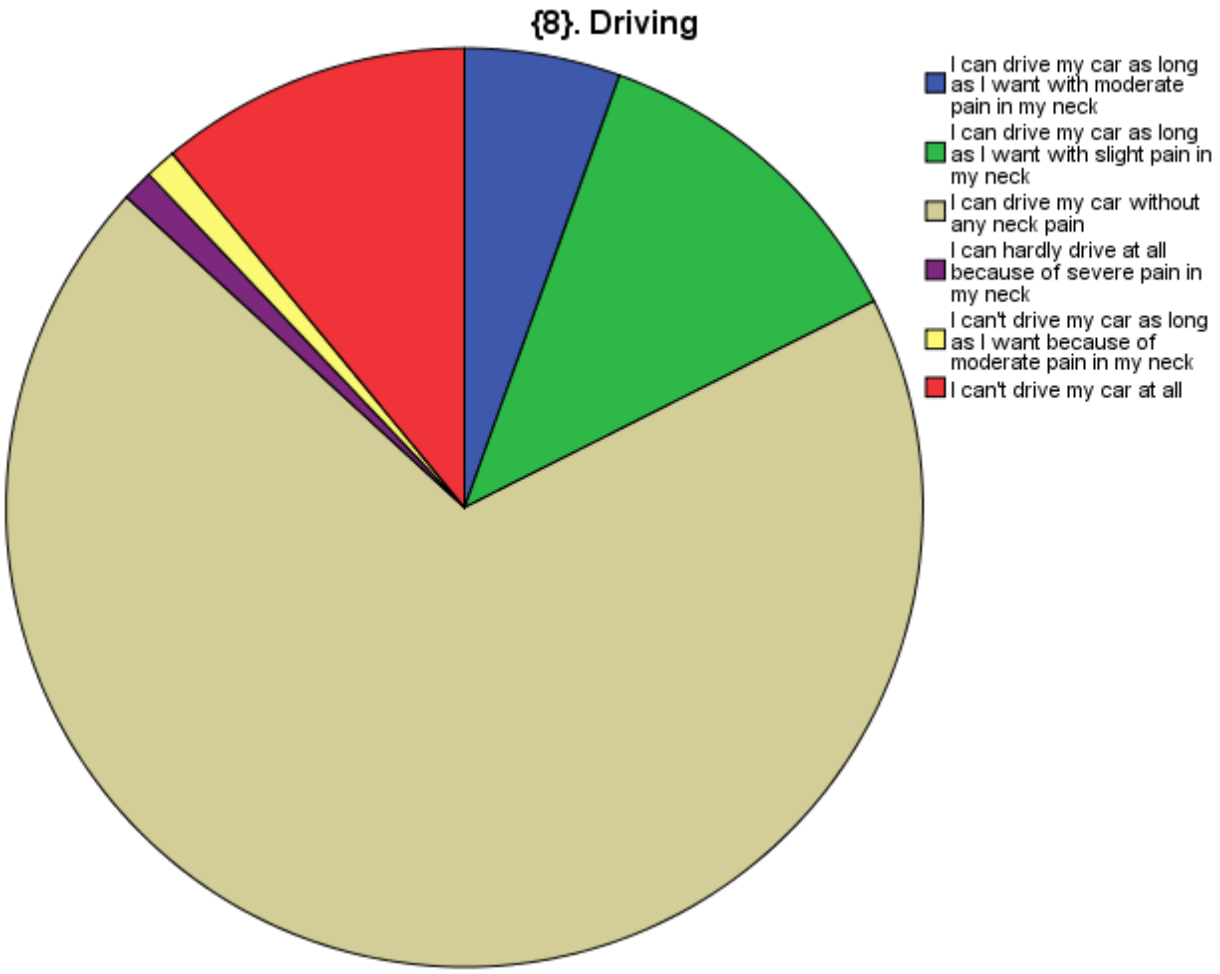
{7}. Work

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	I can do as much work as I want to	66	72.5	72.5	72.5
	I can do most of my usual work, but no more	4	4.4	4.4	76.9
	I can hardly do any work at all	1	1.1	1.1	78.0
	I can only do my usual work, but no more	18	19.8	19.8	97.8
	I can't do any work at all	2	2.2	2.2	100.0
	Total	91	100.0	100.0	



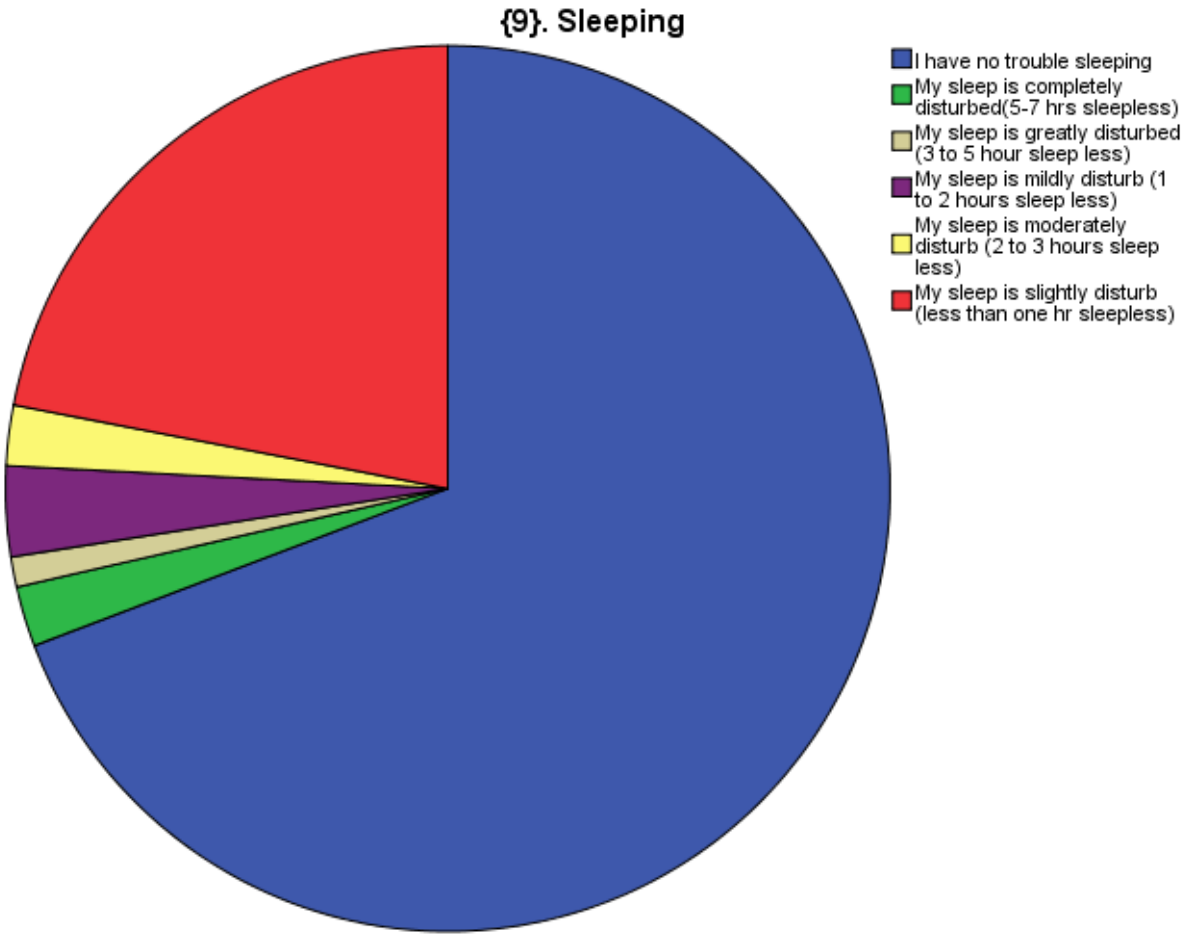
{8}. Driving

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	I can drive my car as long as I want with moderate pain in my neck	5	5.5	5.5	5.5
	I can drive my car as long as I want with slight pain in my neck	11	12.1	12.1	17.6
	I can drive my car without any neck pain	63	69.2	69.2	86.8
	I can hardly drive at all because of severe pain in my neck	1	1.1	1.1	87.9
	I can't drive my car as long as I want because of moderate pain in my neck	1	1.1	1.1	89.0
	I can't drive my car at all	10	11.0	11.0	100.0
	Total	91	100.0	100.0	



{9}. Sleeping

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	I have no trouble sleeping	63	69.2	69.2	69.2
	My sleep is completely disturbed(5-7 hrs sleepless)	2	2.2	2.2	71.4
	My sleep is greatly disturbed (3 to 5 hour sleep less)	1	1.1	1.1	72.5
	My sleep is mildly disturb (1 to 2 hours sleep less)	3	3.3	3.3	75.8
	My sleep is moderately disturb (2 to 3 hours sleep less)	2	2.2	2.2	78.0
	My sleep is slightly disturb (less than one hr sleepless)	20	22.0	22.0	100.0
	Total	91	100.0	100.0	



{10}. Recreation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	I am able to engage in all my recreation activities with no neck pain at all	68	74.7	74.7	74.7
	I am able to engage in all my recreation activities, with some ne pain in my neck	17	18.7	18.7	93.4
	I am able to engage in most common but not all of my usual recreation activities because of pain in my neck	2	2.2	2.2	95.6
	I can't do any recreation activities at all	4	4.4	4.4	100.0
	Total	91	100.0	100.0	

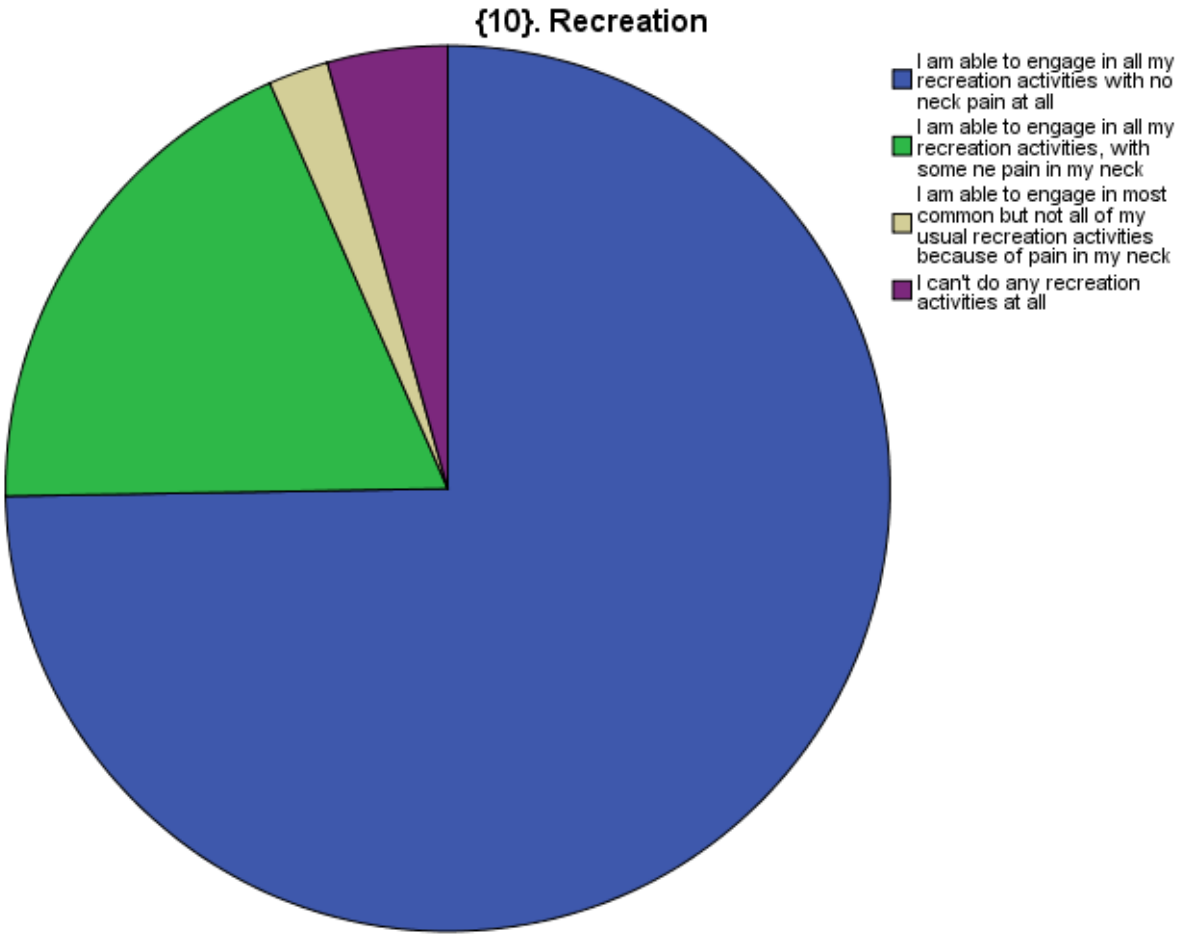
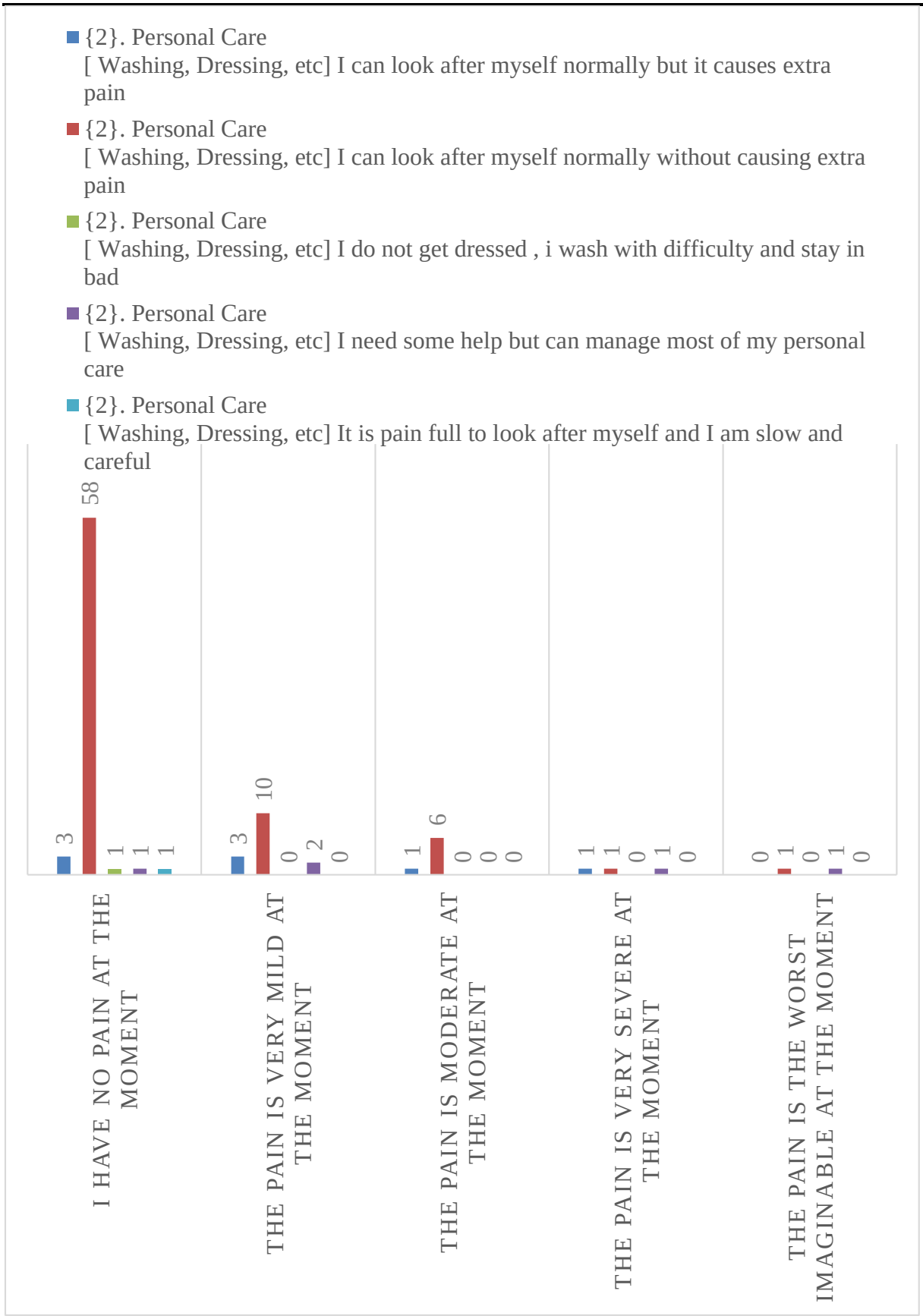


Table 1 : Pain Intensity v/s Personal Care (Washing, Dressing etc.)

Pain Intensity		I have no pain at the moment	The pain is very mild at the moment	The pain is moderate at the moment	The pain is very severe at the moment	The pain is the worst imaginable at the moment
{2}. Personal Care [Washing, Dressing, etc]	I can look after myself normally but it causes extra pain	3	3	1	1	0
	I can look after myself normally without causing extra pain	58	10	6	1	1
	I do not get dressed , i wash with difficulty and stay in bad	1	0	0	0	0
	I need some help but can manage most of my personal care	1	2	0	1	1
	It is pain full to look after myself and I am slow and careful	1	0	0	0	0


{2}. Personal Care [Washing, Dressing, etc] I can look after myself normally but it causes extra pain
{2}. Personal Care [Washing, Dressing, etc] I can look after myself normally without causing extra pain
{2}. Personal Care [Washing, Dressing, etc] I do not get dressed , i wash with difficulty and stay in bad
{2}. Personal Care [Washing, Dressing, etc] I need some help but can manage most of my personal care
{2}. Personal Care [Washing, Dressing, etc] It is pain full to look after myself and I am slow and careful
3
58
1
1
1
3
10
0
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I HAVE NO PAIN AT THE MOMENT
THE PAIN IS VERY MILD AT THE MOMENT
THE PAIN IS MODERATE AT THE MOMENT
THE PAIN IS VERY SEVERE AT THE MOMENT
THE PAIN IS THE WORST IMAGINABLE AT THE MOMENT

Table 2 : Lifting Weights v/s Pain Intensity

Pain Intensity		I have no pain at the moment	The pain is very mild at the moment	The pain is moderate at the moment	The pain is very severe at the moment	The pain is the worst imaginable at the moment
{3}. Lifting	I can lift heavyweight but it gives extra pain	2	4	6	2	0
	I can lift heavyweight without extra pain	53	9	1	1	1
	I can not lift or carry anything	1	0	0	0	0
	I can only lift very lightweights	6	0	0	0	0
	Pain prevents me from lifting heavyweight but I can manage light to medium weights if they are conveniently positioned	2	1	0	0	1
	Pain prevents me lifting heavyweight off the floor, but I can manage of they are conveniently places , for example on table	0	1	0	0	0

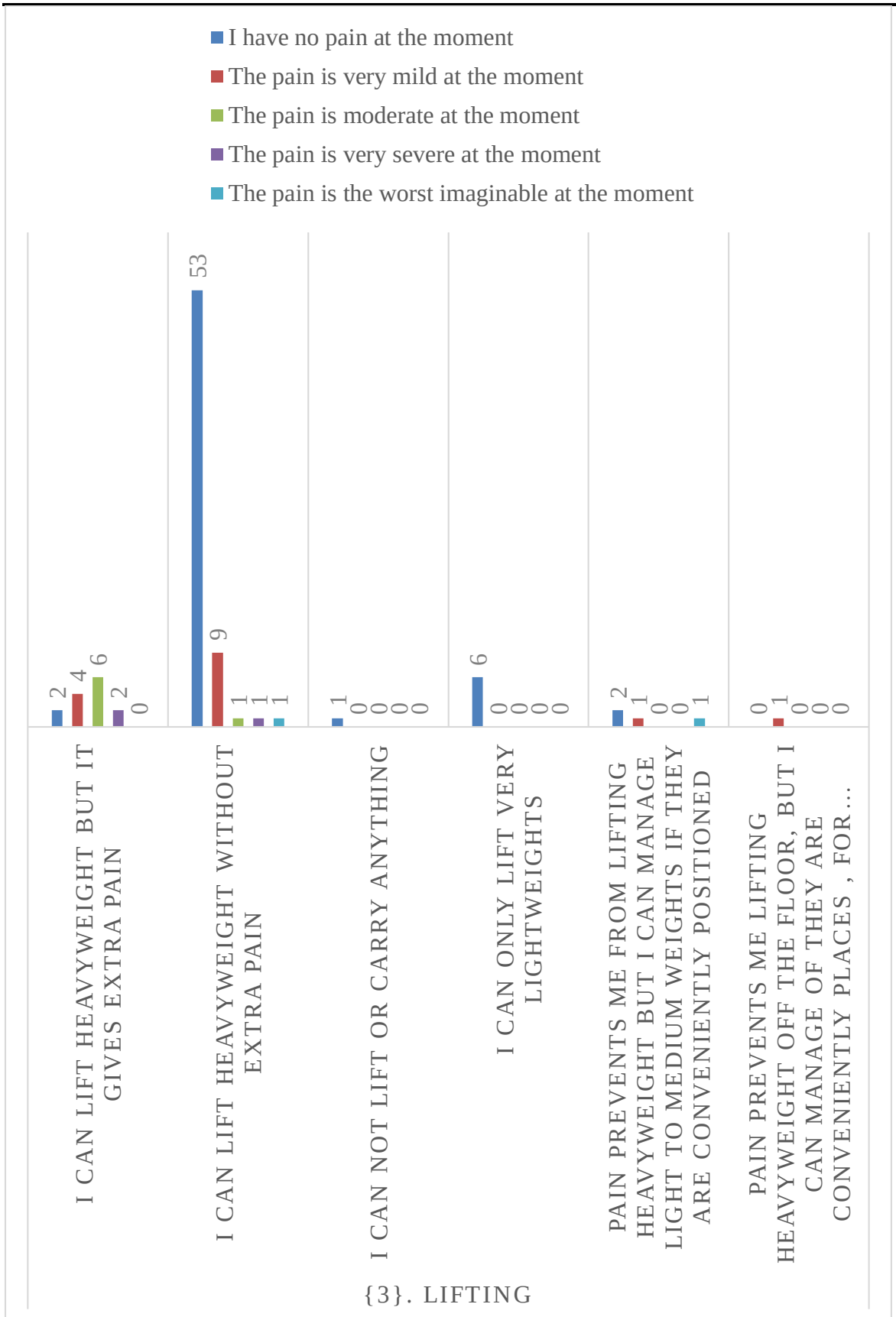

I have no pain at the moment
The pain is very mild at the moment
The pain is moderate at the moment
The pain is very severe at the moment
The pain is the worst imaginable at the moment
2 4 6 2 0
53 9 1 1 1
1 0 0 0 0
6 0 0 0 0
2 1 0 0 1
0 1 0 0 0
I CAN LIFT HEAVYWEIGHT BUT IT GIVES EXTRA PAIN
I CAN LIFT HEAVYWEIGHT WITHOUT EXTRA PAIN
I CAN NOT LIFT OR CARRY ANYTHING
I CAN ONLY LIFT VERY LIGHTWEIGHTS
PAIN PREVENTS ME FROM LIFTING HEAVYWEIGHT BUT I CAN MANAGE LIGHT TO MEDIUM WEIGHTS IF THEY ARE CONVENIENTLY POSITIONED
PAIN PREVENTS ME LIFTING HEAVYWEIGHT OFF THE FLOOR, BUT I CAN MANAGE OF THEY ARE CONVENIENTLY PLACES , FOR...
{3}. LIFTING

Table 3 : Reading v/s Pain Intensity

Pain Intensity		I have no pain at the moment	The pain is very mild at the moment	The pain is moderate at the moment	The pain is very severe at the moment	The pain is the worst imaginable at the moment
{4}. Reading	I can read as much as I want to with a slight pain in my neck	16	6	2	1	0
	I can read as much as I want to with no pain in my neck	44	5	1	1	0
	I can read as much as I want with moderate pain in my neck	1	4	1	0	0
	I can't read as much as I want because of moderate pain in my neck	0	0	2	1	1
	I cannot read at all	3	0	1	0	1

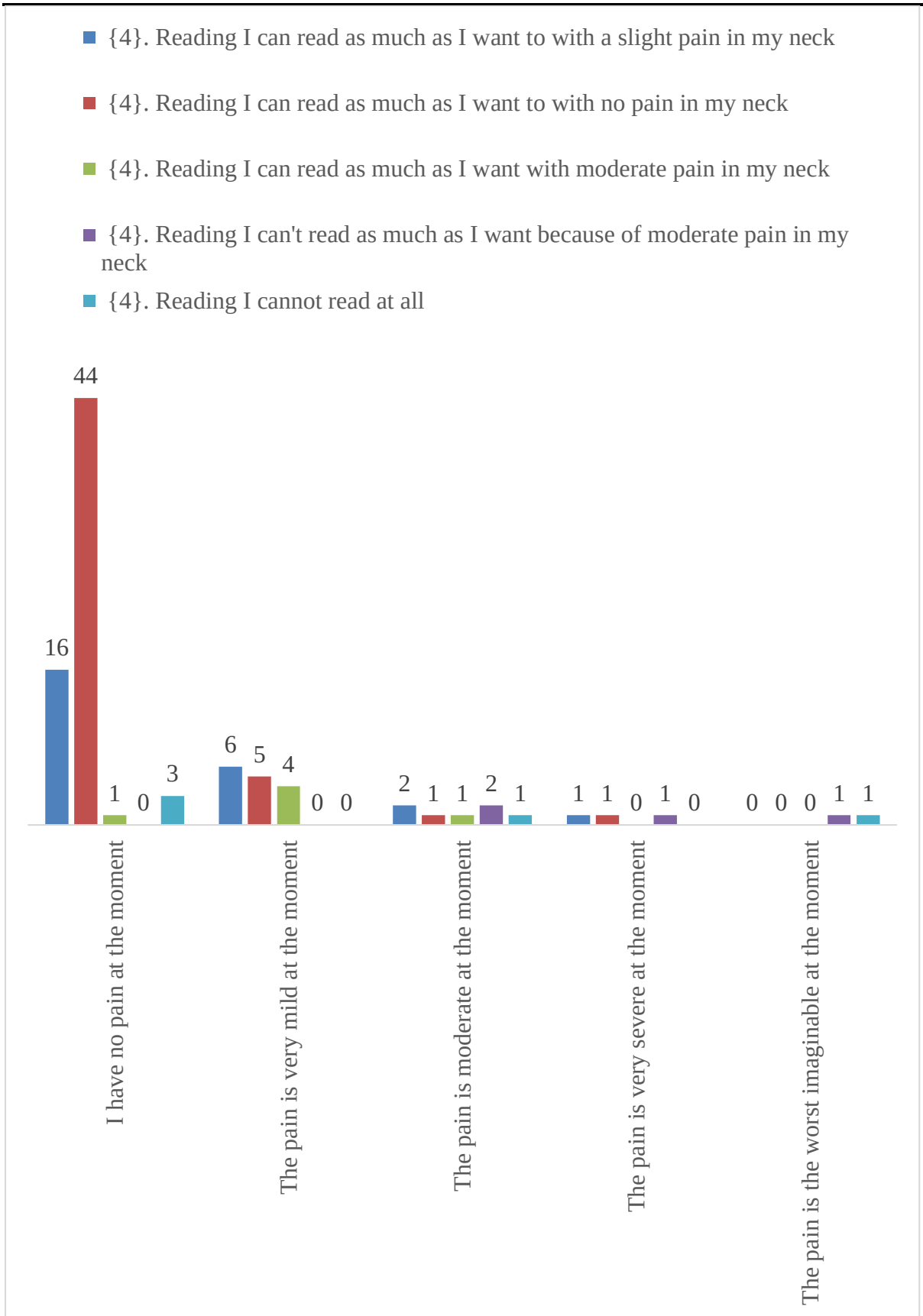

{4}. Reading I can read as much as I want to with a slight pain in my neck
{4}. Reading I can read as much as I want to with no pain in my neck
{4}. Reading I can read as much as I want with moderate pain in my neck
{4}. Reading I can't read as much as I want because of moderate pain in my neck
{4}. Reading I cannot read at all
16 44 1 0 3
6 5 4 0 0
2 1 1 2 1
1 1 0 1 0
0 0 0 1 1
I have no pain at the moment
The pain is very mild at the moment
The pain is moderate at the moment
The pain is very severe at the moment
The pain is the worst imaginable at the moment

Table 4 : Headaches v/s Pain Intensity

Pain Intensity		I have no pain at the moment	The pain is very mild at the moment	The pain is moderate at the moment	The pain is very severe at the moment	The pain is the worst imaginable at the moment
{5}. Headaches	Have severe headaches, which come frequently	0	0	2	0	0
	I have a slight headaches, which come infrequently	14	7	0	0	1
	I have headaches almost all the time	1	0	1	0	0
	I have moderate headaches , which come infrequently	3	3	1	1	0
	I have moderate headaches, which come frequently	2	0	1	0	0
	I have no headaches at all	44	5	2	2	1

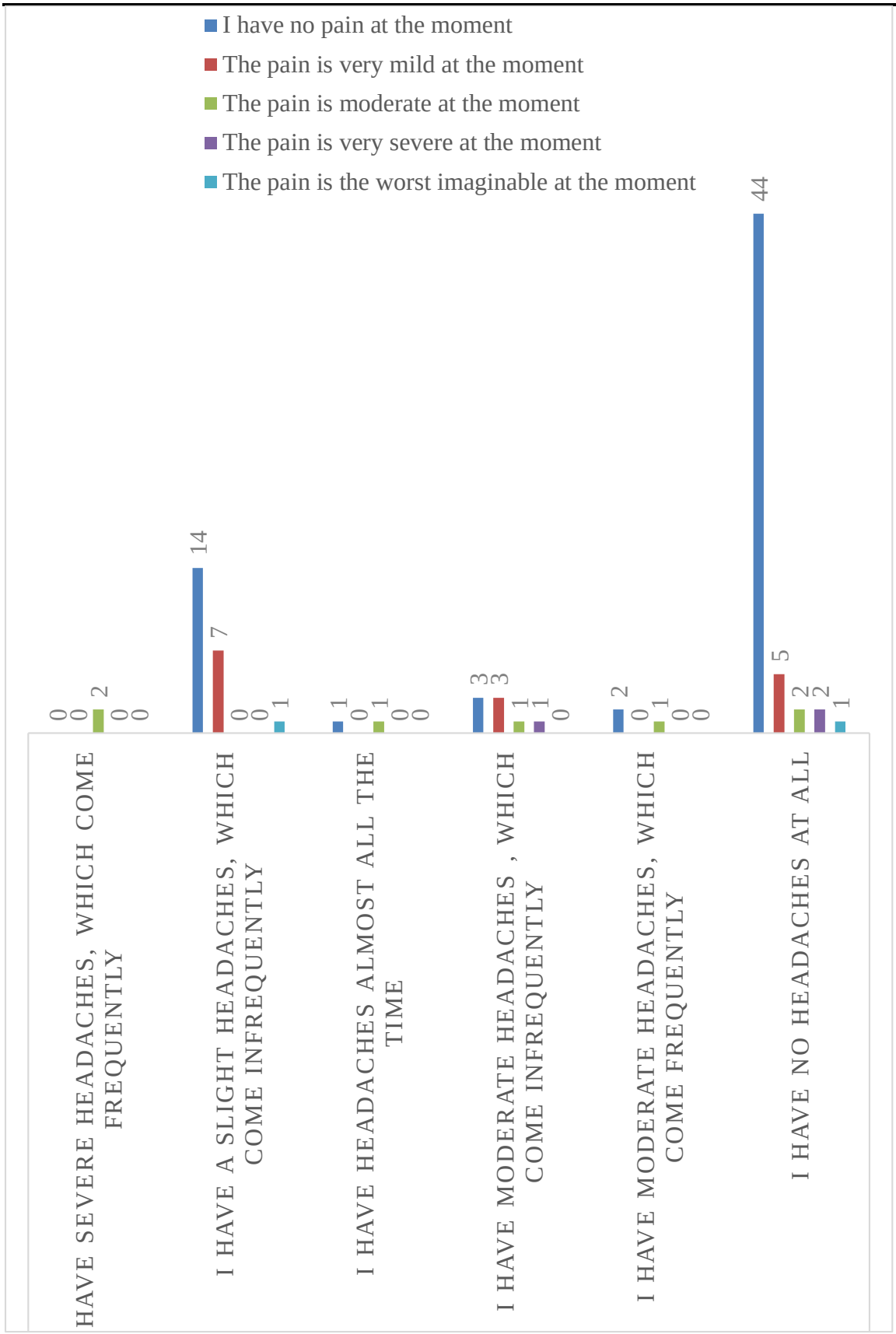

I have no pain at the moment
The pain is very mild at the moment
The pain is moderate at the moment
The pain is very severe at the moment
The pain is the worst imaginable at the moment
HAVE SEVERE HEADACHES, WHICH COME FREQUENTLY
0 0 2 0 0
I HAVE A SLIGHT HEADACHES, WHICH COME INFREQUENTLY
14 7 0 0 1
I HAVE HEADACHES ALMOST ALL THE TIME
1 0 1 0 0
I HAVE MODERATE HEADACHES , WHICH COME INFREQUENTLY
3 3 1 1 0
I HAVE MODERATE HEADACHES, WHICH COME FREQUENTLY
2 0 1 0 0
I HAVE NO HEADACHES AT ALL
44 5 2 2 1

Table 5 : Concentration v/s Pain Intensity

Pain Intensity		I have no pain at the moment	The pain is very mild at the moment	The pain is moderate at the moment	The pain is very severe at the moment	The pain is the worst imaginable at the moment
{6}. Concentration	I can concentrate fully when I want to with no difficulty	52	6	1	1	1
	I can concentrate fully when I want to with slide difficulty	5	6	1	1	0
	I cannot concentrate at all	2	0	1	0	0
	I have a fair degree of difficulty in concentrating when I want to	3	3	2	0	0
	I have a great deal of difficult in concentrating when I want to	1	0	1	0	0
	I have a lot of difficulty in concentrating when I want to	1	0	1	1	1

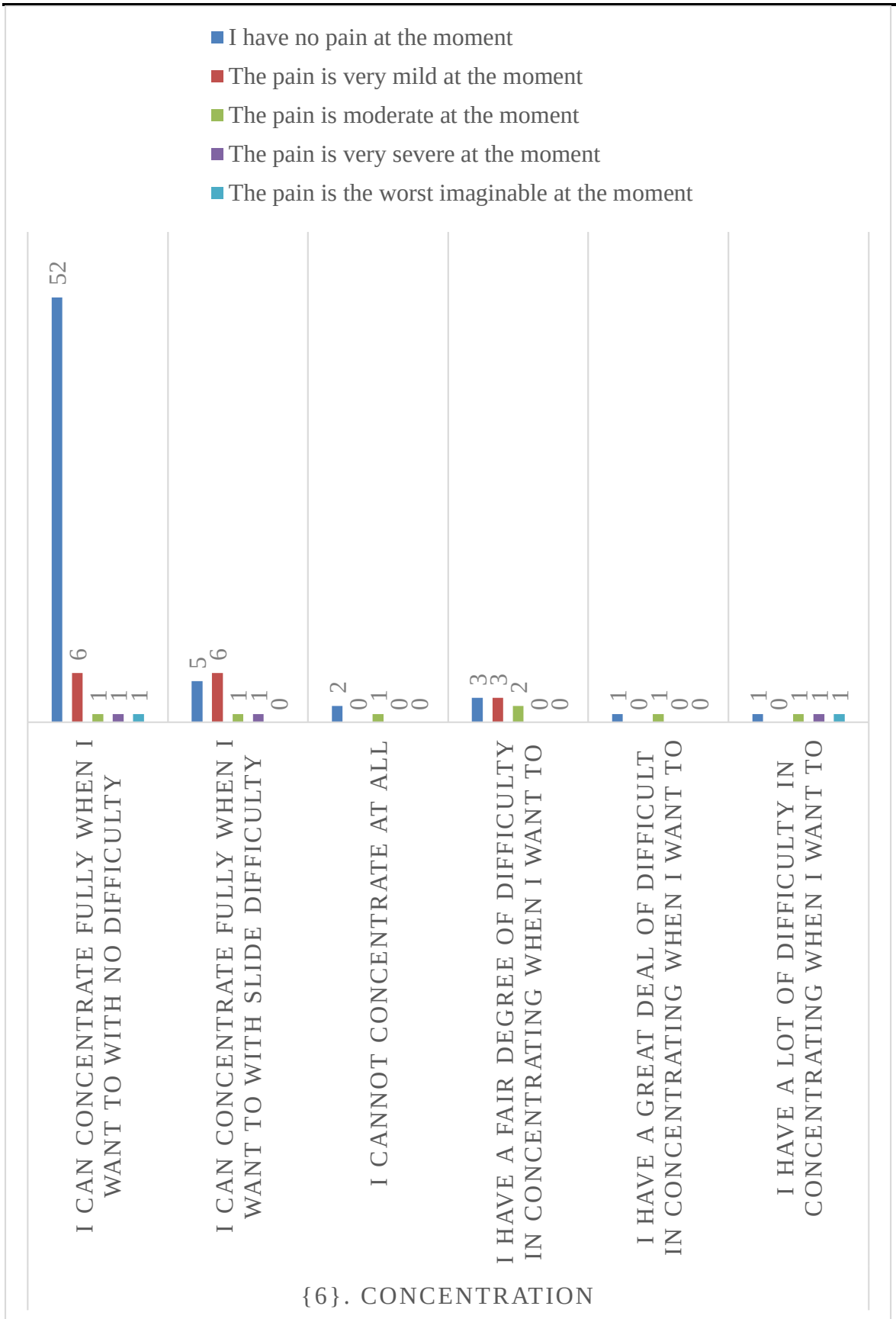

I have no pain at the moment
The pain is very mild at the moment
The pain is moderate at the moment
The pain is very severe at the moment
The pain is the worst imaginable at the moment
52
6
1
1
1
5
6
1
1
0
2
0
1
0
0
3
3
2
0
0
1
0
1
0
0
1
0
1
1
1
I CAN CONCENTRATE FULLY WHEN I WANT TO WITH NO DIFFICULTY
I CAN CONCENTRATE FULLY WHEN I WANT TO WITH SLIDE DIFFICULTY
I CANNOT CONCENTRATE AT ALL
I HAVE A FAIR DEGREE OF DIFFICULTY IN CONCENTRATING WHEN I WANT TO
I HAVE A GREAT DEAL OF DIFFICULT IN CONCENTRATING WHEN I WANT TO
I HAVE A LOT OF DIFFICULTY IN CONCENTRATING WHEN I WANT TO
{6}. CONCENTRATION

Table 6 : Work v/s Pain Intensity

Pain Intensity		I have no pain at the moment	The pain is very mild at the moment	The pain is moderate at the moment	The pain is very severe at the moment	The pain is the worst imaginable at the moment
{7}. Work	I can do as much work as I want to	53	8	3	1	1
	I can do most of my usual work, but no more	0	0	2	2	0
	I can hardly do any work at all	1	0	0	0	0
	I can only do my usual work, but no more	9	7	2	0	0
	I can't do any work at all	1	0	0	0	1

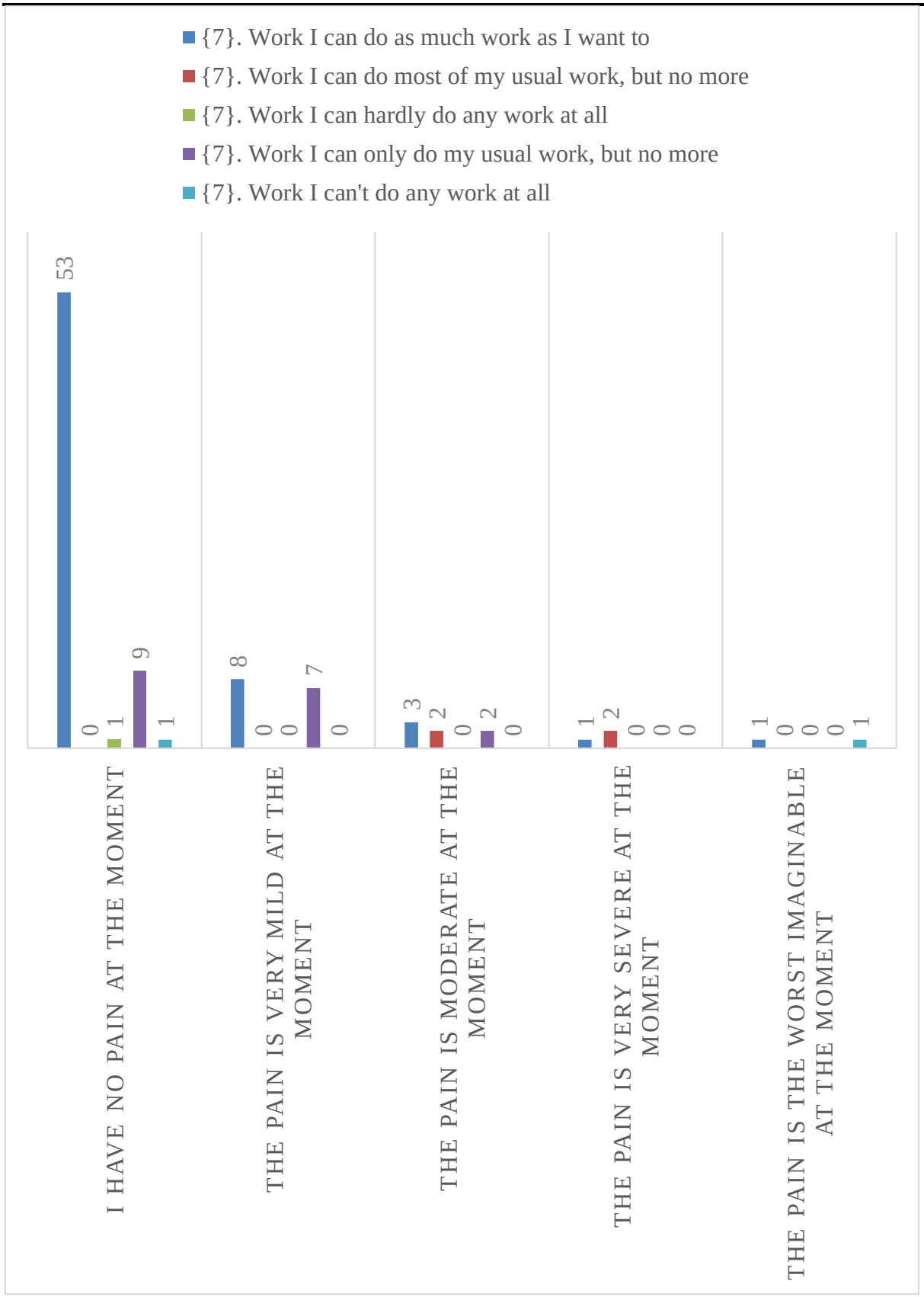
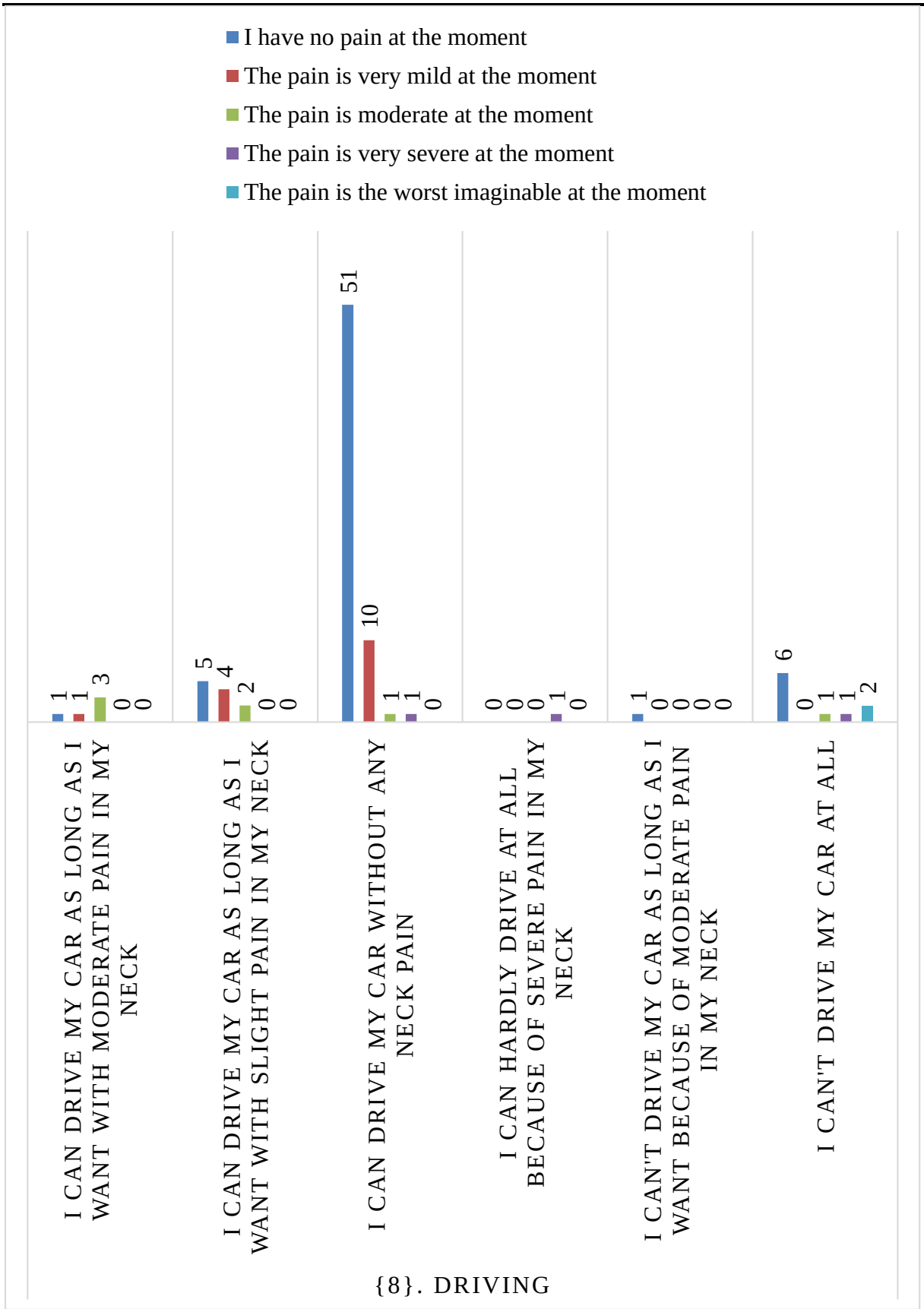

{7}. Work I can do as much work as I want to
{7}. Work I can do most of my usual work, but no more
{7}. Work I can hardly do any work at all
{7}. Work I can only do my usual work, but no more
{7}. Work I can't do any work at all
53
0
1
9
1
8
0
0
7
0
3
2
0
2
0
1
2
0
0
0
1
0
0
0
1
I HAVE NO PAIN AT THE MOMENT
THE PAIN IS VERY MILD AT THE MOMENT
THE PAIN IS MODERATE AT THE MOMENT
THE PAIN IS VERY SEVERE AT THE MOMENT
THE PAIN IS THE WORST IMAGINABLE AT THE MOMENT

Table 7 : Driving v/s Pain Intensity

Pain Intensity		I have no pain at the moment	The pain is very mild at the moment	The pain is moderate at the moment	The pain is very severe at the moment	The pain is the worst imaginable at the moment
{8}. Driving	I can drive my car as long as I want with moderate pain in my neck	1	1	3	0	0
	I can drive my car as long as I want with slight pain in my neck	5	4	2	0	0
	I can drive my car without any neck pain	51	10	1	1	0
	I can hardly drive at all because of severe pain in my neck	0	0	0	1	0
	I can't drive my car as long as I want because of moderate pain in my neck	1	0	0	0	0
	I can't drive my car at all	6	0	1	1	2


I have no pain at the moment
The pain is very mild at the moment
The pain is moderate at the moment
The pain is very severe at the moment
The pain is the worst imaginable at the moment
1 1 3 0 0
5 4 2 0 0
51 10 1 1 0
0 0 0 1 0
1 0 0 0 0
6 0 1 1 2
I CAN DRIVE MY CAR AS LONG AS I WANT WITH MODERATE PAIN IN MY NECK
I CAN DRIVE MY CAR AS LONG AS I WANT WITH SLIGHT PAIN IN MY NECK
I CAN DRIVE MY CAR WITHOUT ANY NECK PAIN
I CAN HARDLY DRIVE AT ALL BECAUSE OF SEVERE PAIN IN MY NECK
I CAN'T DRIVE MY CAR AS LONG AS I WANT BECAUSE OF MODERATE PAIN IN MY NECK
I CAN'T DRIVE MY CAR AT ALL

{8}. DRIVING

Table 8 : Sleeping v/s Pain Intensity

Pain Intensity		I have no pain at the moment	The pain is very mild at the moment	The pain is moderate at the moment	The pain is very severe at the moment	The pain is the worst imaginable at the moment
{9}. Sleeping	I have no trouble sleeping	49	9	1	2	2
	My sleep is completely disturbed(5-7 hrs sleepless)	1	0	1	0	0
	My sleep is greatly disturbed (3 to 5 hour sleep less)	0	0	1	0	0
	My sleep is mildly disturb (1 to 2 hours sleep less)	1	1	1	0	0
	My sleep is moderately disturb (2 to 3 hours sleep less)	1	0	1	0	0
	My sleep is slightly disturb (less than one hr sleepless)	12	5	2	1	0

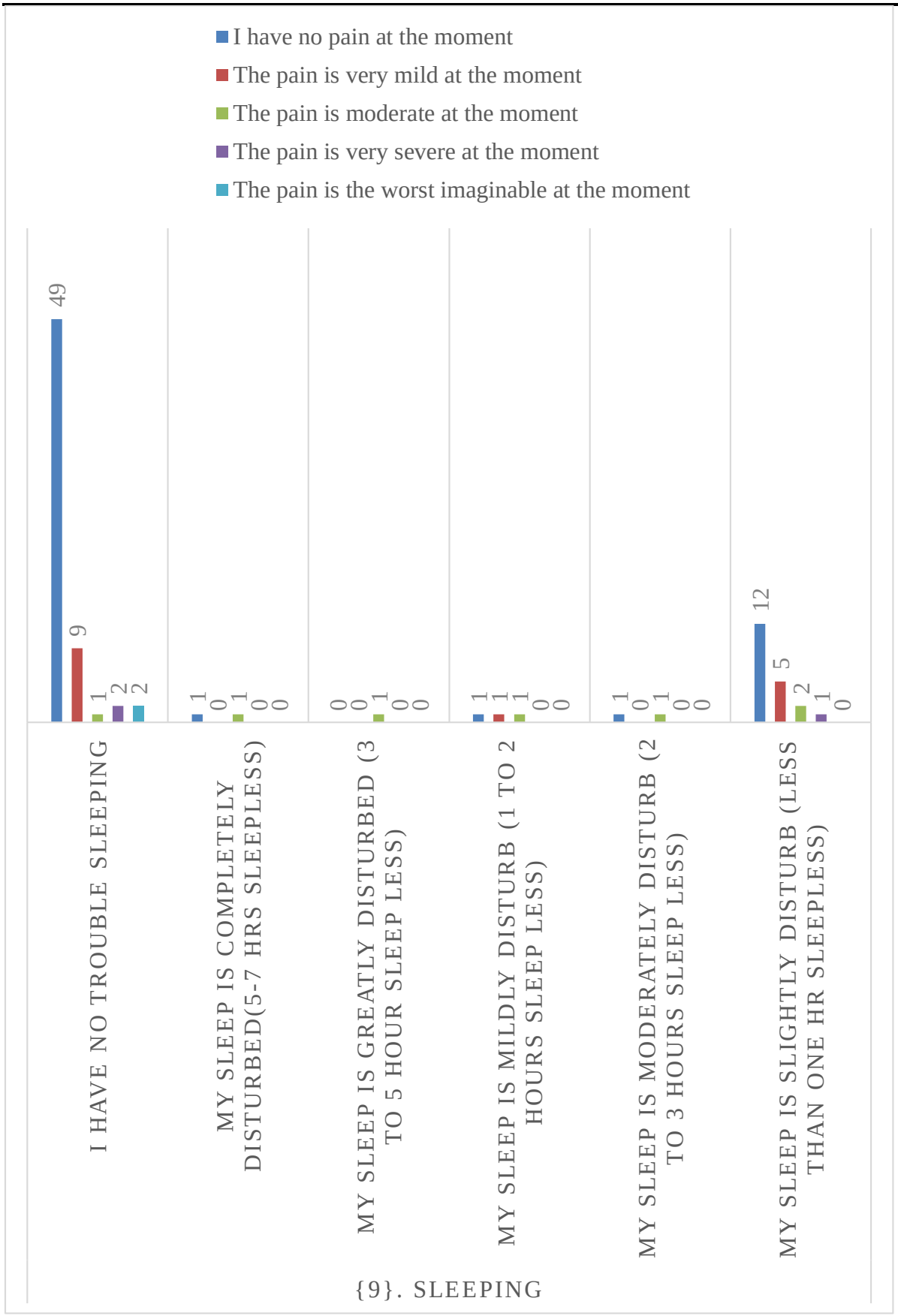
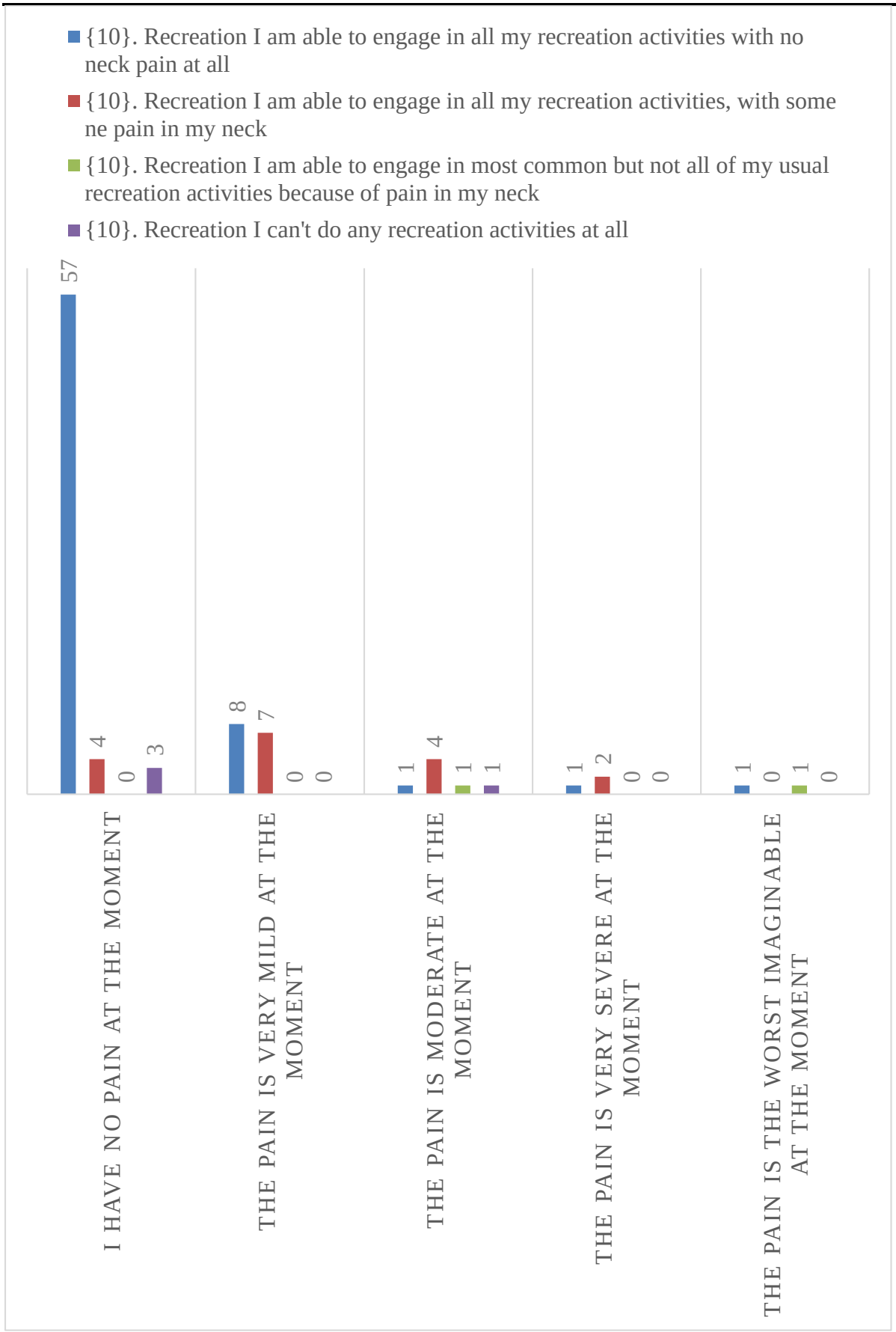

I have no pain at the moment
The pain is very mild at the moment
The pain is moderate at the moment
The pain is very severe at the moment
The pain is the worst imaginable at the moment
49
9
1
2
2
1
0
1
0
0
0
0
1
0
0
1
1
1
0
0
1
0
1
0
0
12
5
2
1
0
I HAVE NO TROUBLE SLEEPING
MY SLEEP IS COMPLETELY DISTURBED(5-7 HRS SLEEPLESS)
MY SLEEP IS GREATLY DISTURBED (3 TO 5 HOUR SLEEP LESS)
MY SLEEP IS MILDLY DISTURB (1 TO 2 HOURS SLEEP LESS)
MY SLEEP IS MODERATELY DISTURB (2 TO 3 HOURS SLEEP LESS)
MY SLEEP IS SLIGHTLY DISTURB (LESS THAN ONE HR SLEEPLESS)
{9}. SLEEPING

Table 9 : Recreation v/s Pain Intensity

Pain Intensity		I have no pain at the moment	The pain is very mild at the moment	The pain is moderate at the moment	The pain is very severe at the moment	The pain is the worst imaginable at the moment
{10}. Recreation	I am able to engage in all my recreation activities with no neck pain at all	57	8	1	1	1
	I am able to engage in all my recreation activities, with some ne pain in my neck	4	7	4	2	0
	I am able to engage in most common but not all of my usual recreation activities because of pain in my neck	0	0	1	0	1
	I can't do any recreation activities at all	3	0	1	0	0


{10}. Recreation I am able to engage in all my recreation activities with no neck pain at all
{10}. Recreation I am able to engage in all my recreation activities, with some ne pain in my neck
{10}. Recreation I am able to engage in most common but not all of my usual recreation activities because of pain in my neck
{10}. Recreation I can't do any recreation activities at all
57
4
0
3
8
7
0
0
1
4
1
1
1
2
0
0
1
0
1
0
I HAVE NO PAIN AT THE MOMENT
THE PAIN IS VERY MILD AT THE MOMENT
THE PAIN IS MODERATE AT THE MOMENT
THE PAIN IS VERY SEVERE AT THE MOMENT
THE PAIN IS THE WORST IMAGINABLE AT THE MOMENT

Results

Using the graphs the following results were obtained:

1. Most of the patients did not had any pain or had mild pain during personal care (washing, dressing, etc).
2. Most of the patients did not had any pain or had mild pain during Lifting heavy weights.
3. Most of the patients did not had any pain or had mild pain during Reading.
4. Most of the patients did not had any pain or had mild pain during slight headaches, which come infrequently.
5. Most of the patients did not had any pain or had mild pain and so they can concentrate in their day to day activities with no/less difficulty.
6. Most of the patients did not had any pain or had mild pain while doing work.
7. Most of the patients did not had any pain or had mild pain while driving.
8. Most of the patients did not had any pain or had mild pain while sleeping or had no trouble sleeping.
9. Most of the patients did not had any pain or had mild pain and so they were able to engage in all their recreational activities with no/mild neck pain.

DISCUSSION

Neck pain can have causes that aren't due to underlying disease. Examples include prolonged straining (looking up or down), sleeping in an uncomfortable position, stress, chiropractic manipulation or wearing heavy necklaces. Chronic neck pain can range from an achy annoyance to shock-like pain that goes into the arm and becomes debilitating. Neck pain is typically classified as chronic when it persists or regularly recurs for at least 3 months.

Drs Ylinen and Häkkinen,Dr Takala ,Dr Nykänen,Dr Mälkiä,Dr Pohjolainen and Ms Karppi,Dr Airaksinen did research in Active neck muscle training in the treatment of chronic neck pain in women: a randomized controlled trial , the results show that the Both strength and endurance training for 12 months were effective methods for decreasing pain and disability in women with chronic, nonspecific neck pain. Stretching and fitness training are commonly advised for patients with chronic neck pain, but stretching and aerobic exercising alone proved to be a much less effective form of training than strength training. [6]

Author Deborah Falla, Gwendolen Jull, Trevor Russell, Bill Vicenzino, Paul Hodges did research in Effect of neck exercise on sitting posture in patients with chronic neck pain, the results show that the This study showed that people with chronic neck pain demonstrate a reduced ability to maintain an upright posture when distracted. Following intervention with an exercise program targeted at training the craniocervical flexor muscles, subjects with neck pain demonstrated an improved ability to maintain a neutral cervical posture during prolonged sitting. [4]

When Jari Ylinen did research in Physical exercises and functional rehabilitation for the management of chronic neck pain ,the results show that Specific moderate and highintensity neck muscle training can reduce neck pain. A decrease in neck pain is associated with reduced pressure pain sensitivity in neck muscles. Intensive regular training will increase neck muscle strength and range of motion, leading to improved function and less disability in patients with chronic neck pain. Training for a few months is commonly recommended, but it has beenshown to produce only transitory improvements. Long-term progressive resistance training for neck and shoulder muscles is therefore recommended. Moreover, effective training can be performed at home with low-cost training equipment.[8]

In this cross - sectional research chronic neck pain among college going students on 90 students from age 18-24 . In this research NDI scale and VAS scale were used to measure pain and disability of students. My research concluded that the there is no disability among college going students.

I did this research because I observed that college going students have to keep their neck constantly in one position whether it was for attending lectures or working on their desk so I wanted to know if they were experiencing any kind of chronic neck pain in their day to day life.

CONCLUSION

From the results it can be concluded that more than half of the population had no pain or mild pain and they didn't feel any issues in dealing with personal care lifting heavy weights reading headaches concentration work driving sleeping and recreation.

SUMMARY

From the results it can be concluded that more than half of the population had no pain or mild pain and they didn't feel any issues in dealing with personal care lifting heavy weights reading headaches concentration work driving sleeping and recreation.

Limitations

- Smallsamplesize.
- Limitedagegroupof18-24years.
- Neckpainprolongedmorethan12weeks.

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ROLE OF YOGA IN PCOD [POLYCYSTIC OVARIAN DISEASE]-A QUASI-EXPERIMENTAL ONE-WAY STUDY

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[1]Swarrnim Startup & Innovation University, Gandhinagar

ABSTRACT

BACKGROUND : Polycystic means many cysts. Polycystic ovarian Disease is a complex disorder of chronic oligoanovulation or oligomenorrhoea and clinical or biochemical hyperandrogegism. Genetic and environmental factors may contribute to this disorder and may affect 14-44 year age of women . This is one of the main reason for infertility. Women affected with this syndrome often have ovulatory dysfunction hormonal disbalance, hyperandrogenemia, obesity and hyper insulinemia.

METHODOLOGY: They were subjected to Yoga therapy for 30-45 mins /day for 3 months with a break after every 6 days. Treatment duration was 3 months. Pre and post outcome measures were taken.

RESULT: . Data was considered statistically significant with $P<0.05$ and highly significant at $p<0.01$. Pre and post mean difference of BMI shows 33.28 ± 26.64 in pre date collection and 28.36 ± 21.77 in post data collection. As $p<0.05$ there is significant difference between groups. Pre and post mean difference values of VMSS shows 2.33 ± 14.67 and 0.93 ± 23.87. This shows a significant difference between two groups.

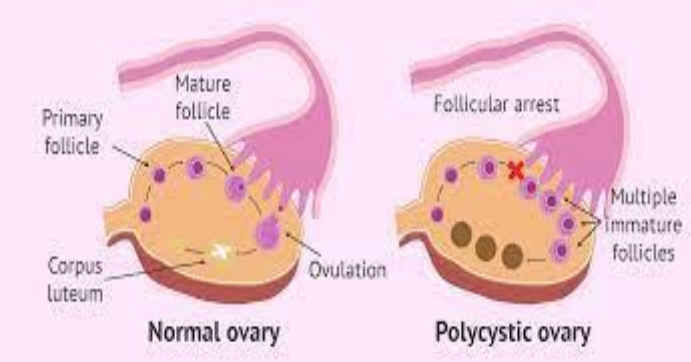
CONCLUSIONS: Daily yoga for 30 minutes with 5 Asanas along with meditation and Shavasana helps in weight reduction and stress management which ultimately stabilize the normal function of hypothalmo-pituitary–ovarian axis and cure PCOD.

KEYWORDS: polycystic ovarian disease, yoga, obesity, Body Mass Index , infertility.

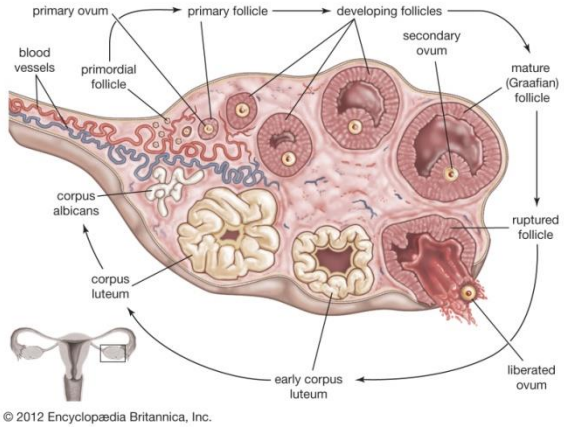
INTRODUCTION

Polycystic means many cysts. Polycystic ovarian Disease is a complex disorder of chronic oligoanovula-tion or oligomenorrhoea and clinical or biochemical hyperandrogegism. Genetic and environ-mental fac-tors may contribute to this disorder and may affect 14-34 age of women .This is one of the main reason for infertility. Women affected with this syndrome often have ovulatory dysfunction hormonal disbalan-ce, hyperandrogenemia, obesity and hyper insulinemia. PCOD has life-long implications with in-creased risk for infertility, metabolic syndrome, type 2 diabetes mellitus, cardiovascular disease and endometrial carcinoma. [1]

Polycystic ovary Disease (PCOD) is a very common endocrine disorder, of uncertain aetiology, that affects an estimated 5–10% of women of reproductive age. PCOD typically presents during adolescence and is a heterogeneous syndrome that classically is characterized by features of an ovulation (amenorrh-ea, oligomenorrhoea) combined with symptoms of androgen excess (Hirsutism, acne, alopecia). [2]



PHOTOGRAPH: 1 NORMAL OVARIES VS PCOD OVARI



PHOTOGRAPH: 2 OVULATION

Polycystic ovary disease (PCOD) is an endocrine disorder associated with metabolic change in women of reproductive age. It is the most common cause of infertility with physical, mental and hormonal imbalances. The prevalence rate of polycystic ovary disease (PCOD) in India is 9.13%.[3]

It is characterized by irregular, short menstruation, depression, obesity, acne, hair fall, cystic ovary, blood sugar imbalance, etc. Various factors responsible for polycystic ovary disease, but also stress and lack of exercise are the most important factor for exaggerating polycystic ovary disease. [3]

Clinical signs of PCOD include elevated luteinizing hormone (LH) and gonadotropin–releasing hormone (GnRH) levels, whereas follicular-stimulating hormone (FSH) levels are muted or unchanged. As a result of the increase in GnRH, stimulation of the ovarian thecal cells, in turn, produces more androgens.[4]

The word yoga is derived from the Sanskrit root yuj, which means to join or yoke. Philosophically, yoga refers to the connection of the individual self with the universal self. Yoga is one of the six branches of classical Indian philosophy and has been practiced for thousands of years.[5]

Yoga is an ancient discipline designed to bring balance and health to the physical, mental, emotional, and spiri- tual dimensions of the individual. Yoga is often depicted metaphorically as a tree and comprises eight aspects, or ‘‘limbs:’’ yama (universal ethics), niyama (individual ethics), asana (physical postures), pranayama (breath control), pratya- hara (control of the senses), dharana (concentration), dyana (meditation), and samadhi (bliss). Long a popular practice in India, yoga has become increasingly more common in Wes- tern society. In a national, population-based telephone survey (n 1⁄4 2055), 3.8% of respondents reported using yoga in the previous year and cited wellness (64%) and specific health conditions (48%) as the motivation for doing yoga.[6]

Yoga is the union of individual self, jeevatma, with the universal self, paramatma. It is the communion of the human soul with the divinity. Simple meaning of Yoga is union. Yoga is the integration and harmony between thoughts, words, and deeds or integration between head, heart and hands. [7]

NEED *OF STUDY*

Many researchers have studied the individual effect of Suryanamaskar and pelvic opening yoga among with diet and life style mordification but there is no research done without a combination of these two and any diet and lifestyle changes. Thus, it is necessary to conduct the study on Effect of Yoga on PCOD.

AIM AND OBJECTIVES OF THE STUDY

AIM OF STUDY:

To evaluate effect of yoga in PCOD.

OBJECTIVES OF STUDY:

1. To assess and compare the changes in BMI in PCOD before & after 3 months of Yoga.
2. To assess and compare the Oligomenorrhea (irregular menstruation) in PCOD. Before and after 3 months of yoga
3. To assess and compare yoga therapy in PCOD before and after 3 months of Yoga therapy.

HYPOTHESIS

1. **Null hypothesis:**
   There will be no significant impact of yoga in management of symptoms of PCOD.

2. **Research hypothesis:**
   There will be significant impact of yoga in management of symptoms of PCOD.

MATERIALS AND METHODS

STUDY DESIGN - A Quasi- experimental one- way study
SOURCE OF DATA - Hospitals (Ahmedabad)
POPULATION - 18-30 adolescent girls
SAMPLING METHOD- convenient sampling
SAMPLE SIZE - 30
DURATION OF THE STUDY - 3 months
TRETMENT DURETION - 6 session per week for 3 months

METHOD OF COLLECTION OF DATA

1.Inclusion criteria:

- Age limitation 18 to 30
- Menstrual irregular symptoms with PCOD
- Dysmenorrhea
- Obesity with symptoms with PCOD

2.Exclusion criteria :

- PCOS
- Infertility
- Patient takes any treatment or therapy

MATERIALS AND TOOLS USED

- Yoga Mats
- Pillow
- Blocks
- Mobile phones

OUTCOME MEASURES

BMI (Body Mass Index)

- It is a measure of body fat based on your weight in relation to your height. It is more of an indicator than a direct measurement of a person's total body fat. As the BMI score increases, so does the
- person's total body fat increases.
- Formula to check BMI is BMI= weight/ [height (m2)
- BMI weight ranges: Less than 18.5 = Underweight , Between 18.5 - 24.9 = Healthy Weight, Between 25 - 29.9 = Overweight, Over 30 = Obese.

VMSS (verbal multimensiona scoring system) [8]

- The Verbal Multidimensional Scoring System (VMDS) measures both pain and related systemic signs and symptoms, while the Visual Analogue Scale measures only pain. Hence, primary dysmenorrhea was measured in different degrees of severity in different studies. Dysmenorrhea or pain during menstruation is commonly seen in young women and largely impacts their quality of life. Pain medications are largely used to tackle this situation; however, they have side effects with regular use.

METHODOLOGY

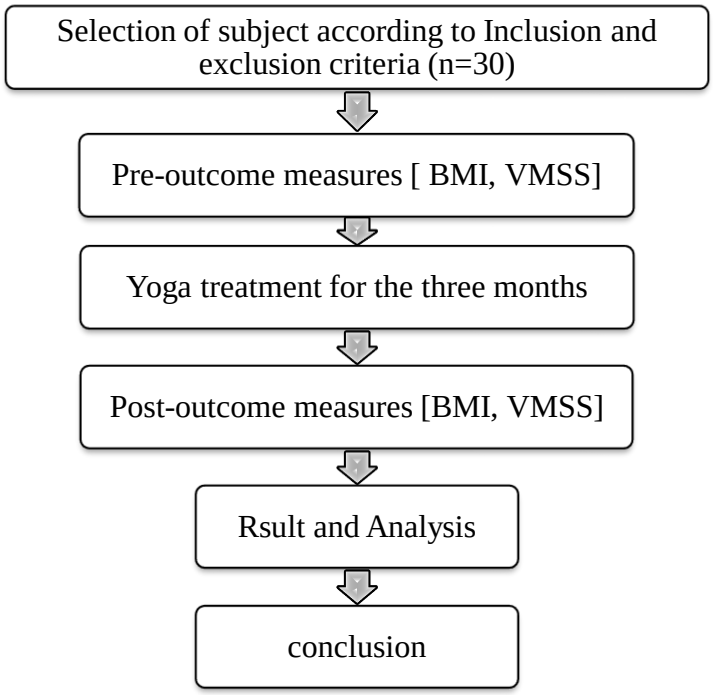


CHART 1: CHART OF STUDY PROCEDURE

The study a quasi -experimental one way study was undertaken by collecting data by convenient sampling of 18-30 age adolescent girls. First of all 30 patients will be selected according to the inclusion and exclusion criteria from the hospitals. Newly diagnosed and a case of PCOD but not under treatment. The patients have already diagnosed dysmenorrhoea severity. All of that patients presenting with complaints of weight gain, irregular periods from several years, lethargy, increased appetite and heaviness in the body.

At the second stage Informed consent was obtained from all the participants. Following which the study was initiated a thorough history was collected using questionnaire in favor of pre outcome measurement.

From all the participants including personal details such as name, age, address and phone number, medical history of any menstrual irregularities (Amenorrhoeal Oligmenorrhoea /menorrhagia) Hyperandrogenism features like (Hirsutism, Acne, Alopecia), history of other exclusion features were collected in detail. As well the Physical examination must be taken in this General examination was done

Height in inch's and weight in kilograms were measured and Body Mass Index (BMI) was calculated as weight/height in meter square; additionally VMSS (verbal multidimensional scoring sysrem) to assessment as concerns to dysmenorrhoea severity. All of that patients presenting with complaints of weight gain, irregular periods from several years , lethargy, increased appetite and heaviness in the body .

After the second stage, all participants will be asked to sign a consent with clear information about the research which will provide a clear understanding of the research project , procedure or treatment and clinical trial. It also includes information of possible risks and benefits, including what the researcher is doing in the field. If a person chooses to take part in the treatment, procedure, trial, or testing, she needs to signs the form to give official consent.

Next stage would be yoga therapy (yoga specific for PCOD along with weight loss) .Therefore for the management of obesity physical exercise, fat reducing medicine and diet is necessary. In this case only Yogasanas were advised without any medicinal treatment and diet management.

Patient prescribes Surya Namaskar, along with pelvic opening asanas. In these yoga package these asanas will include: Suryanamaskar (start with 5 rounds and then slowly increasing the number), Baddhakonasana, Supta baddhakonasana, Ustrasana, Shalabhasana (with 7 repetition) .

These Asanas practiced early in the morning with empty stomach for 45 mins to one hour per day for 3 months. Prior to therapy 6 days of training was given to participant. Participant didn't had any previous experience of yoga practice. Total duration of each asanas during six days training period for three months. While doing these asanas abdomen, thighs and spine are stretched. Stretching helps to reduce extra fat which is accumulated over abdomen, thighs. That's why these Asanas were selected for the study.

PHOTOGRAPH: 3 PATIENTS PERFORMING YOGASANAS

PHOTOGRAPH: 4 PATIENTS PERFORMING YOGASANAS

When patient start practicing yoga, patient was made to perform for 35 mins for seven days of training according to the schedule given in table number 1.

After 7 days yogasana training, duration of asanas was increased. This was followed for 1 hour 15min daily in the morning with empty stomach. Schedule of Yoga therapy practiced for three months by patient as shown in table number 2.

Sr.No.	Yogasanas	Duration	repetition	Rest	Total duration
1	Suryanamaskar	10 min	5	-	10 min
2	Baddhakonasana	30 sec	5	30 sec	3 min
3	Suptabaddhakonasana	30 sec	5	30 sec	3 min
4	Ustrasana	30 sec	5	30 sec	3 min
5	Shalabhasana	30 sec	5	30 sec	3 min

TABLE: 1 YOGA TERAPY FOR SEVEN DAYS

Sr.No.	Yogasanas	Duration	repetition	Rest	Total duration
1	Suryanamaskar	10 min	7	-	10 min
2	Baddhakonasana	30 sec	7	1min	7 min
3	Suptabaddhakonasana	30 sec	7	1min	7 min
4	Ustrasana	30 sec	7	1min	7 min
5	Shalabhasana	30 sec	7	1min	7 min

TABLE: 2 YOGA TERAPY FOR THREE MONTH

In last stage After three months of regular yoga practice history was collected using questionnaire in favor of post outcome measurement from all the participants including personal details such as medical history of any menstrual irregularities (Amenorrhoeal Oligmenorrhoea /menorrhagia). Hyperandrogenism features like (Hirsutism, Acne, Alopecia), history of other exclusion features were collected in detail. In General examination, height and weight were measured in inches and kilograms respectively. In addition physical examination should must be taken and Body Mass Index (BMI) was calculated as weight/height in meter square; additionally VMSS (verbal multidimensional scoring system) to assessment as concerns to dysmenorrheal severity .

RESULT

Study variables were done before starting physiotherapy sessions on group and at the end of the study, study variables include BMI and VMSS.

Data analysis:

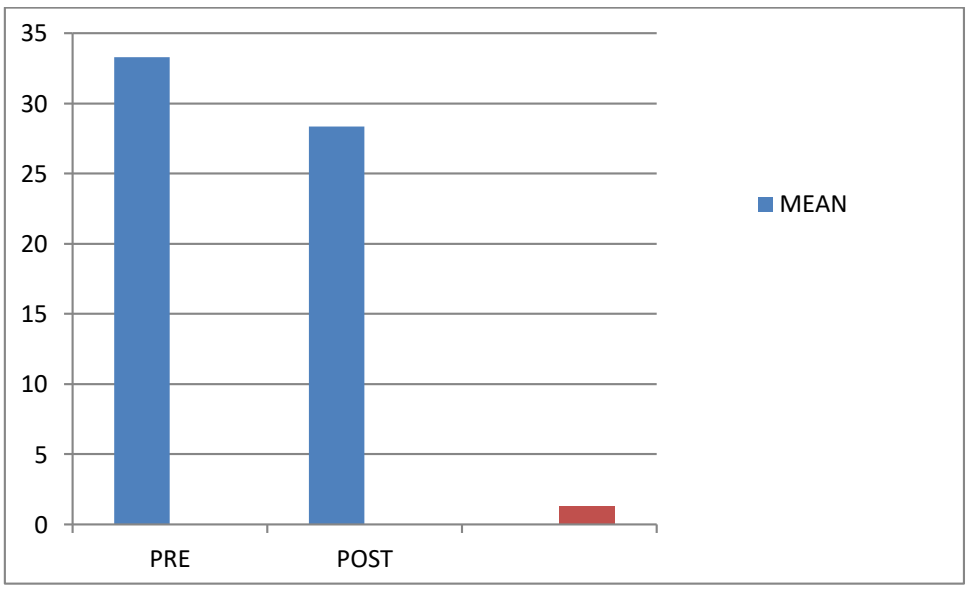
Statistical analysis was performed on the data obtained from 30 patients. Data was analyzed using Social Science statistics. It was a website which working with statistics. Descriptive statistics for all outcome measures were expressed as mean, standard deviations and test of significance such as paired‘t’ test used for comparing within group and comparing between the groups. Data was considered statistically significant with $P<0.05$ and highly significant at $p<0.01$. Pre and post mean difference of BMI shows 33.28 ± 26.64 in pre date collection and 28.36 ± 21.77 in post data collection. As $p<0.05$ there is significant difference between group. Pre and post mean difference values of VMSS shows 2.33 ± 14.67 and 0.93 ± 23.87. This shows a significant difference between two groups.

Group	Mean	Mean Difference	Standard Deviation	"t" Value	"p" Value
Pre Test	33.28	4.29	26.64	4.29812	P<0.05
Post Test	28.36	4.29	21.77		P<0.05

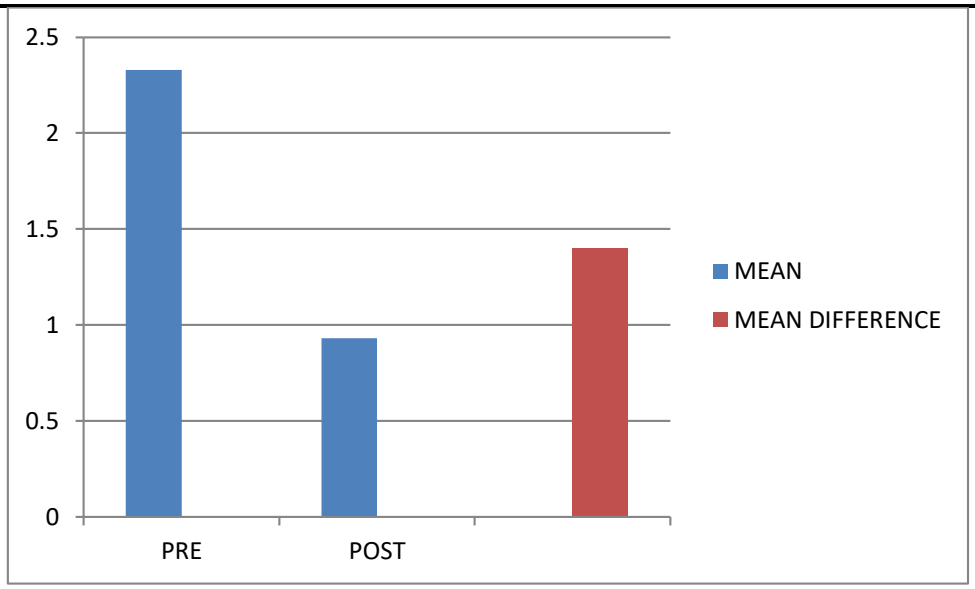
TABLE 3: PAIRED "T" TEST VALUES FOR BMI

Group	Mean	Mean Difference	Standard Deviation	"t" Value	"p" Value
Pre Test	2.33	1.4	14.67	-6.65226	P<0.05
Post Test	0.93	1.4	23.87		P<0.05

TABLE 4: PAIRED "T" TEST VALUES FOR VMSS



GRAPH 1: MEAN VALEUE FOR BMI



GRAPH 2: MEAN VALUE OF VMSS

Outcome Measures	"t" Value	"p" Value
BMI	4.29812	P<0.05
VMSS	-6.65226	P>0.05

TABLE 5: INDEPENDENT "T" TEST VALUES

DISCUSSION

Obesity, hormonal imbalance, mental health problems such as depression, anxiety, stress, etc are among the most common reasons for individuals to seek treatment with Yoga, Asanas and Pranayama. Yoga encourages one to relax, ease the breath and focus on the present,shifting the balance from the sympathetic nervous system and the flight-or-fight response to the parasympathetic system and the relaxation response. It effects are mainly calming and restorative; it lowers breathing and heart rate, decreases blood pressure, lowers cortisol levels, and increases blood flow to the intestines and vital organs.[9]

Yoga calmness of the mind and create a sense of well-being, feelings of relaxation, improved self-confidence, improved efficiency, increased attentiveness, lowered irritability, and an optimistic outlook on life, it also help us treating the symptoms of PCOD such as obesity, stress and hormonal imbalance. It optimizes the body's sympathetic responses to stressful stimuli and restores autonomic regulatory reflex mechanisms associated with stress. The regular practice of Yoga results in lower anxiety, heart rate, respiratory rate, blood pressure, and cardiac output in students practicing yoga and meditation. Consistent yoga practice improves depression and can lead to significant increases in serotonin levels coupled with decreases in the levels of monamine oxidase, an enzyme that breaks down neurotransmitters and cortisol.[9]

Yoga increases blood flow and levels of hemoglobin and red blood cells which allows for more oxygen to reach the body cells, enhancing their function and reducing stress and improving metabolism.Many yoga asanas and postures lowers the resting heart rate, increases endurance, and can improve the maximum uptake and utilization of oxygen during exercise.[9]

The significant positive effects of yoga in reducing stress, anxiety, and depression have been confirmed.

CONCLUSION

Daily yoga for 30 minutes with 5 Asanas along with meditation and Shavasana helps in weight reduction and stress management which ultimately stabilize the normal function of hypothalmo-pituitary–ovarian axis and cure PCOD.

SUMMARY

A study was conducted to evaluate the effect of Yoga therapy on autonomic function and adrenal fatigue in patients with polycystic ovarian disease. 30 PCOD patients were participated in the study & they were given Yoga therapy for 45mins to one hour per day for 3months with 6 days for week. Before and after the therapy, subjects underwent pre and post outcome measurement. The results showed not only a significant reduction in BMI but also regular period cycle per month.

LIMITATION

- Small sample size
- Age group is limited in 18-30 years

FUTURE RECOMMENDATION

Further research can replicate these findings in other variation such as large group or large age group. In addition, comparison between two groups as well as comparison between exercises and yoga. Lastly, yoga therapy with diet plan.

ABBREVIATIONS

- **PCOD:** polycystic ovarian dieses
- **PCOS:** polycystic ovarian syndrom
- **VMSS:** verbal multimensiona scoring system
- **FSH:** follicle Stimulating Hormone
- **LH:** Luteinizing Hormone
- **GnRH:** Gonadotrepin-releasing hormone
- **BIM:** Body Mass Index

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"EFFECTS OF YOGA THERAPY ON PHYSICAL AND PSYCHOLOGICAL QUALITIES OF LIFE IN PERIMENOPAUSAL WOMENS- AN EXPERIMENTAL STUDY"

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ABSTRACT

Background: Perimenopausal period is characterized by a continuous decline in ovarian function due to which women are vulnerable to various physical and psychological symptoms affecting quality of life. Currently these symptoms are managed by hormone replacement therapy. However, hormonal therapy can cause complications including malignancy which has resulted in search for various alternative therapies to improve the quality of life (QOL). Yoga is one such alternative therapy shown to enhance the QOL at all stages of human life associated with the chronic illness. There are very few scientific studies regarding the effect of yoga on perimenopause and in this study, we investigated the effects of yoga therapy on physical and psychological symptoms using the standardized questionnaire.

Objective: To study the effect of yoga therapy on physical and psychological symptoms of perimenopause.

Materials and Methods: It is a prospective non-randomized control study of 56 perimenopausal women with 12 weeks of intervention. The subjects were divided in two groups with either yoga therapy [n = 28] or exercise [n = 28] as the interventional tool. The symptoms control and QOL before and after intervention in both the groups were assessed by using the MENQOL which is standardized questionnaire.

Results: The perimenopausal symptoms in all domains were improved by yoga therapy, thus significantly improving the overall QOL compared to the control group.

Conclusion: This study clearly demonstrates the effectiveness of yoga therapy in managing the distressing perimenopausal symptoms. It is easy, safe, non-expensive alternative therapy helping the well-being of perimenopausal women and must be encouraged in the regular management of perimenopausal symptoms.

Key Words: MENQOL questionnaire, perimenopausal QOL, yoga therapy.

INTRODUCTION

Menopause is an important event in the life of a women when reproductive capacity ceases. During this transitional phase, woman exhibits severe and multiple symptoms. Frequently reported symptoms fall into several categories, including physical disturbances such as hot flushes, psychological complaints such as mood swings, and other changes that may impair personal or social interactions and diminish the overall quality of life.[1] It was seen that in 1990, there were an

estimated 467 million women in this state and this number is expected to increase to 1,200 million by the year 2030. [2]

According to the Indian Menopause Society [3] there will be a large increase in the perimenopausal women in India also. Most women in India over the age of 45 years do not understand the changes taking place in their bodies and spend their valuable years of life battling problems and diseases associated with perimenopause. Hence it becomes very important to develop methods and treatment plans to control perimenopausal symptoms and thereby to improve the quality of life of this large group of women.

DIFFERENCE BETWEEN PERIMENOPAUSE AND MENOPAUSE: Perimenopause is the period of a woman's life shortly before the occurrence of menopause. A women's body will begging the process of menopause meaning the hormone production from the ovaries is beginning to decline.

SYMPTOMS: The common symptoms include

- Irregular menses - As ova production in ovary reduces oestrogen production becomes erratic leading to Irregular menses
- Hot Flashes - Due to blood vessels dilation near the skin as a result of reduced estrogen
- Night sweats - Due to hot flashes
- Weight gain - oestrogen deficiency leads to weight gain
- Mood swings - Perimenopause has increased risk of depression
- Breast tenderness - Due to oestrogen induced water retention
- Alteration of blood cholesterol - Elevated oestrogen favours high density lipoprotein which reduces blood cholesterol
- Low bone density - oestrogen is involved in maintaining equilibrium of calcium in bone

BENEFITS OF YOGA IN PERIMENOPAUSAL WOMEN:

1. It relieves stress: yoga can also help women better manage and support Overall mood
2. A consistent practice may reduce blood pressure: Some research shows blood pressure may increase after menopause due in great part to the hormonal changes that take place in the body. Fortunately, yoga is a traditionally utilized antidote. A consistent practice may help promote better oxygenation and blood circulation throughout the body.
3. Yoga promotes good joint health: Research shows a frequent, and consistent yoga practice may help relieve joint pain Not all menopausal women have arthritis, but the condition does increase with age.
4. Yoga may help lead to fewer hot flashes.

NEED OF STUDY

Yoga, the traditional Indian body-mind science has been used effectively in various health disorders affecting almost all the major organ system including cardiovascular, respiratory, neuroendocrine, gastrointestinal and musculoskeletal system. [12-15] Since perimenopause also affects several organ systems, this study is conducted to evaluate the effects of yoga therapy on menopausal symptoms.

AIM

- To study the effects of Yoga Therapy on Physical and Psychological Quality of Perimenopausal Women

OBJECTIVE

- To study the effects of Yoga Therapy on Physical Quality of Perimenopausal Women
- To study the effects of Yoga Therapy on Psychological Quality of Perimenopausal Women

HYPOTHESIS

1) NULL HYPOTHESIS

There are no significant effects of Yoga Therapy on Physical and Psychological Quality of life Perimenopausal Women.

2) EXPERIMENTAL HYPOTHESIS

There are significant effects of Yoga Therapy on Physical and Psychological Quality of life Perimenopausal Women.

METHODOLOGY

Study Design: An Experimental Study
Source Of Data: Near Ahmedabad
Population: Perimenopausal Women
Sampling Method: Random Sampling
Duration Of Study: 3 Months
Sample Size: 56

Materials and Tools Used:

1. Consent form
2. Pen,
3. Pencil
4. Paper
5. Plinth and
6. Pillow
7. Assessment form

Inclusion Criteria:

1. Aged between 40-50 years,
2. Subjects willing to participate,
3. Subjects able to practice yoga or exercise protocols and,
4. Subjects who are having perimenopausal symptoms.

Exclusion Criteria:

1. Women who were already practicing yoga for a month or more,
2. Women with surgical menopause and receiving any kind of hormone therapy and
3. Active psychological disorders or any other medical disorders.

Outcome Measures:

MENOPAUSE-SPECIFIC QUALITY OF LIFE QUESTIONNAIRE (MENQOL) [13]

The self-administered questionnaire utilized in this study included socio-demographic information with menstrual history and the menopause-specific quality of life questionnaire (MENQOL). MENQOL is a self-administered, 'scaled' 29-item survey questionnaire, designed to measure quality of life in menopausal women and also to measure the extent to which an individual is affected by menopausal symptoms. It comprises the four domains, Vasomotor, Psychosocial, Physical and Sexual, which are graded separately.

Procedure:

This interventional study included 56 perimenopausal women divided into two groups. One group practiced yoga therapy (test group, n = 28) and the other practiced a set of physical exercise (control group, n = 28).

The subjects were from local community and recruited through personal contacts with various women's organizations, clubs and self-help groups. The informed oral consent was obtained from the subjects before starting the intervention.

After taking informed consent patients were divided into 2 groups by simple random sampling method and treatment was given for 3 months.

Group A: Subjects of these group received Yoga therapy.

Group B: Subjects of these group received conventional treatment (Exercise Program).

The intervention program in both groups were started by collecting the baseline data, teaching and practicing the respective protocols for 45 minutes every day, follow-ups and collection of post-interventional data after 12 weeks of practice.

FLOW CHART OF THE STUDY PROCEDURE

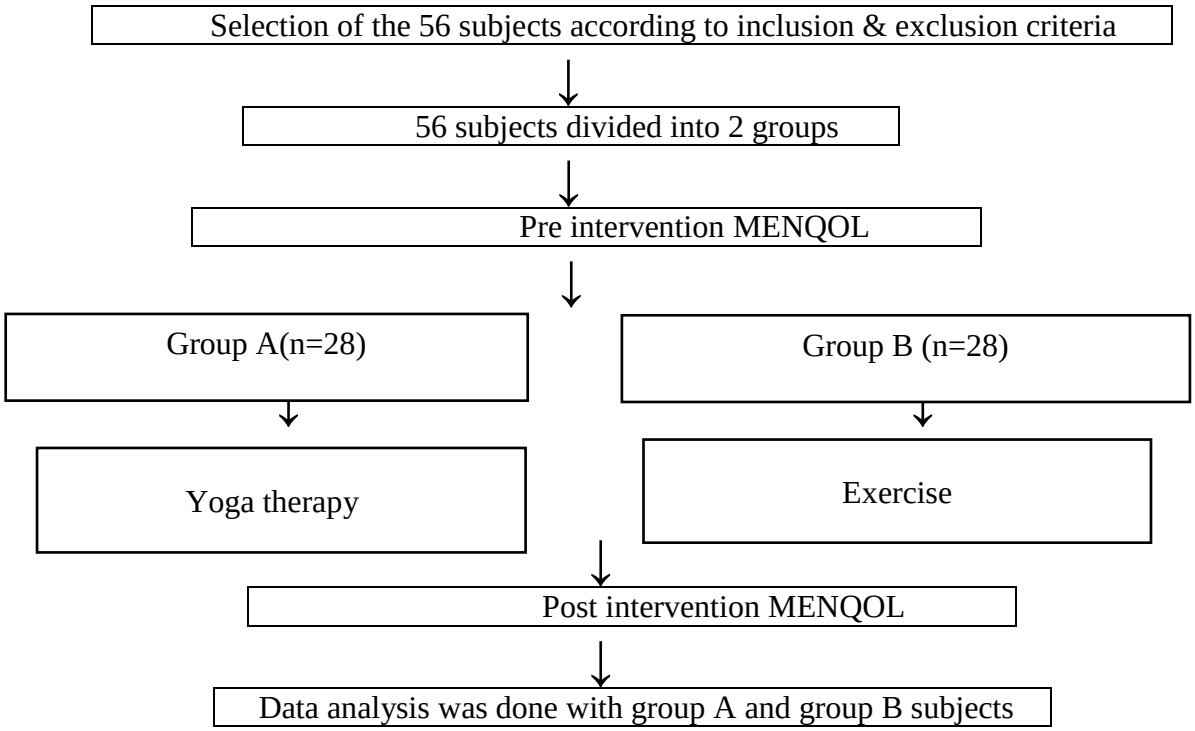

Figure 1: Flow chart of study Procedure

The yoga therapy module used was developed on the basis of Patanjali yoga [16] and Hatha yoga [17] to address the physical, psychological and emotional symptoms with suitable practice of asanas, pranayama and dhyana to result in improvement of overall quality of life. The control group practiced a set of exercise program.[18]

GROUP A: YOGA THERAPY (TEST GROUP)

1. ASANAS (Body postures)

- Sitting: Vajrasana, supta vajrasana Pascimottanasana, Poorvatanasana, Janusirsasana, Upavistakonasana, Baddhakonasana, Vakrasana, Ashvinimudra.
- Standing: Tadasana, Trikonasana, Parshvakonasana.
- Lying on the back (supine): Pavanamuktasana, Padottanasana.
- Lying on the stomach (Prone): Bhujangasana, Shalabhasana, Dhanurasana, Paryankasana.

Figure 2: Asanas

2. PRANAYAMA (Breathing practices)
    - Anuloma-viloma (alternative nostril),
    - Surya bhedana (right nostril),
    - Chandrabhedana (left nostril),
    - Sheetali (through tongue) and
    - Bhramari (honey bee sound during exhalation).

3. Relaxation: Deep relaxation in shavasana (corpse pose).

4. Meditation: 'So Ham' dhyana sitting in meditative postures like swastikasana

GROUP B: EXERCISE INTERVENTION (CONTROL GROUP)

1. Loosening exercises:
    - Sitting: Passive rotation of toes, Toe bending, Ankle bending, Ankle rotation, Knee bending, Knee rotation, Knee cap tightening, Half butterfly, Full butterfly, Neck bending, Neck rotation.
    - Standing: Waist rotation, Wrist rotation, Shoulder rotation.
    - Each one repeated for 10 rounds or 10 rotations.
2. Strengthening exercises (While standing/ Sitting).
    - Wrist — Stretching arms straight in front, make the tight fist, palm facing down, move the fist up and down vigorously from the wrist-10 times.
    - Palms — Holding near the chest bending at the elbow, spread the fingers, and move palms up and down vigorously from the wrist.
    - Fingers — Throwing out the arms in front, give the fingers of both the arms the shape of the hood of cobra, stiffen the entire length of the arms from the shoulder joints to the finger tips till they start trembling-5 times.
    - Elbows — Stretch the arms straight down beside the body, make the tight fist of the palms, and raise the fists forward up to the level of the shoulder with a jerk-10 times.
    - Arms — Make the fists of hands with thumb tucked in, bend the elbow and raise the forearms till they parallel to the ground, push both the arms forward forcefully and vigorously to the level of the shoulder-10 times.

Figure 3: Strengthening Exercise of wrist

- Back — Spreading the legs apart as far as possible, place the hands on the hips bend backward from the waist as far as possible and then forward without bending the knees till head reaches the ground-5 times.
- Thighs — Stretch out the arms facing down straight in front at the shoulder heights, inhaling bend the knees till thighs come parallel to the ground, and then come up exhaling-5 times.
- Calves — Stretch out the arms facing down straight in front at the shoulder heights, inhaling squat and go down as far as possible-5 times. Supine rest 5 to 10 minutes.

RESULT

Statistical analysis

All pre and post data were analyzed by using SPSS Version 16. The individual variables were evaluated to determine the changes in two groups after 12 weeks. The pre and post data of MENQOL questionnaire was analyzed.

The effectiveness was calculated as 'within the group' (yoga and control group), 'between the groups' (yoga vs. control).

Sr. No.	Variables	Yoga	Control
1	Age	47.03 ± 2.56	47.54 ± 2.17
2	BMI	26.08 ± 3.07	26.89 ± 3.45
3	Menstruation regular	6	8
4	Menstruation irregular	13	11
5	No Menstruation	9	9

Table 1: Demographic Data

The largest categories of women were between 46 and 50 years of age. No significant difference was observed between the groups regarding body mass index and menstrual history is shown in Table 1. There was no significant difference between the groups ($P > 0.05$). In the psychosocial domain, large number of women from both the groups (72% to 79%) complained experiencing poor memory as the most prevalent symptom followed by feeling of anxiety, loneliness, depression and impatience. Two of the questions in this domain that is being dissatisfied with personal life and accomplishing less what I used to do were recorded more significantly by control group compared to the yoga group ($P < 0.05$) while other attributes from this domain were all comparable ($P > 0.05$). All the symptoms in the physical domain except for flatulence and muscles and joint pains were comparable in both groups without any significant difference.

Groups	Within group analysis	Mean Difference	Standard Deviation	"t" Value	"p" Value
Group A	Pre-Test Post Test	-1.59	0.64	-8.9	P<0.05
Group B	Pre-Test Post Test	-0.68	0.18	-7.09	P<0.05

Table 2: Paired "t" test values for MENQOL

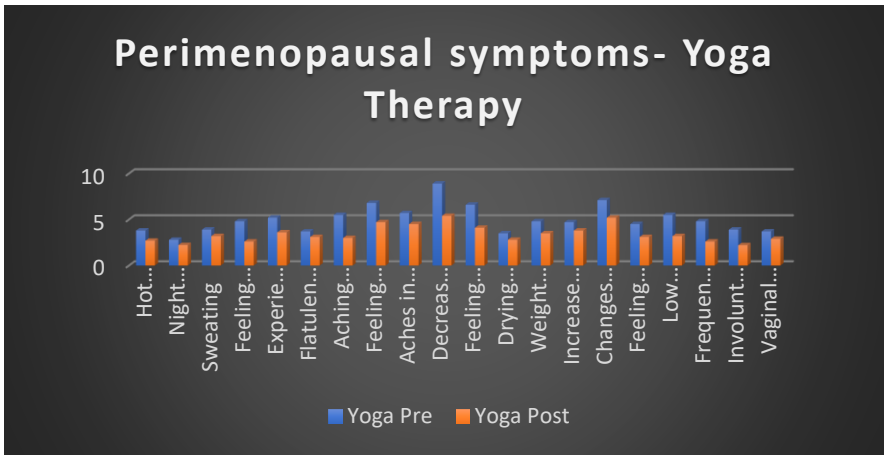

Figure 4: Yoga therapy and effect on Perimenopausal symptoms

The results of effect of yoga therapy (test group) and exercise (control group) on the symptoms of all the two domains are presented in Table 2. In the psychosocial domain, yoga therapy resulted in the significant difference in all the symptoms while exercise therapy resulted in the improvement of four symptoms but failed to provide relief for the remaining symptoms. All the symptoms in the physical domain were significantly improved in yoga group. In control group, highly significant ($P < 0.05$) decrease was observed only in one symptom and moderate in other six symptoms. The symptom of aching in muscles and joints was relieved somewhat after physical exercise and no significant change was observed in the remaining symptoms.

Outcome Measures	"t" Value	"p" Value
MENQOL	-3.48	P<0.05

Table 3: Independent "t" test values

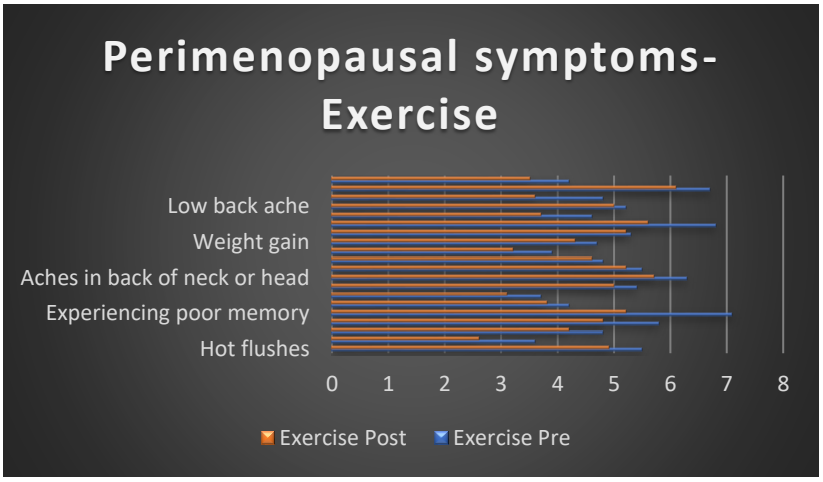

Figure 5: Exercise and effect on Perimenopausal symptoms

The effect size' was greater in yoga therapy group in all domains compared to the control group. 'Between the group effect', there was significant difference between the groups in all domain ($P = 0.53$) [Table 3]. The overall quality of life is measured by the mean of overall scores of each domain and yoga therapy group showed a very significant improvement ($P < 0.05$) compared to control group.

DISCUSSION

The present study thus clearly documents the significant presence of various perimenopausal symptoms in the local population severely affecting the quality of life. Many of these women expressed their distress and helplessness regarding these symptoms, which were seriously interfering in their day-to-day living. Thus, there is a need to search and develop a cost-effective, simple, community-based therapeutic tool to provide symptom relief and to improve health status, and in this perspective yoga has emerged as the appropriate system to deal effectively with issues related to perimenopause.

The present study clearly demonstrates the clinical utility of yoga in significantly reducing the perimenopausal symptom in all domains and thereby improves the overall quality of life. Asanas, pranayama and dhyana, the components of yoga therapy, seem to improve the symptom profile in the all domains through several physiological and biochemical mechanisms. The improvement in physical strength and fitness caused by yoga seems to be related to several factors like muscular strength and endurance, flexibility, cardiorespiratory fitness, body composition and pulmonary function.[19] The intense stretching and muscle conditioning associated with attaining and holding yoga postures increases the skeletal muscle oxidative capacity and decrease glycogen utilization, possibly caused by increased vascularization, increased intramuscular oxygen and glycogen stores or by increased numbers of mitochondria.[20] Yoga practice also may increase the absorption of the calcium from the intestine, stimulate bone remodeling and maintain the load bearing capacity of the bone; reduces the pain in the back of the head, neck, lower back and headache by influencing limbic system modulation of endogenous pain control system.[21]

This impact of yoga seems to be due to its effect on the functioning of nervous system leading to increase in alpha rhythm, intra hemispheric coherence and homogeneity in the brain [22,23] and increase in P 300 phase amplitude [19] all of which seems to enhance the cognitive processes. Menopausal anxiety can be a very difficult symptom to manage, but yoga therapy showed significant improvement compared to physical exercise. Several mechanisms like altered neurotransmitters, changed brain blood flow and brain metabolism and sympathetic activation seems to be responsible for this improvement brought by yoga practice. [24]

Compared to physical exercise group, yoga showed most significant effect in managing the symptoms of vasomotor domain. All the three symptoms in this domain, that is, hot flushes, night sweats and sweating were significantly reduced in the yoga group while no improvement was observed in any of the symptoms in control group. Especially, the improvement in hot flushes through yoga was very rewarding, since this is most difficult symptom to manage and affects the overall quality of life. The vasomotor symptom improvement brought about by yoga intervention seems to be due to its effect in modulating autonomous nervous system with special attention to decreased sympathetic nervous system activation [25] which in turn seems to affect the thermoregulation resulting in vasodilatation and sweating.[26]

The yoga postures used in this study are known to improve the tone of the muscles of pelvic region and enhance the blood circulation to the urogenital area.[27] Thus, yoga improved most of the symptom profile thus contributing significantly in the improvement of overall quality of life. Yoga is relatively simple to learn and is economical, non-invasive with multiple collateral lifestyle benefits. Group and individual practice may also help to improve lifestyle choices and health-related attitudes in part, by enhancing psychological well-being and thereby contributing significantly to chronic disease protection and health promotion.

Though most of the clinical effects of yoga are probably brought about by vagal stimulation and parasympathetic activation, the complete mechanisms underlying the reported benefits remain poorly understood. Clearly, additional high-quality research is warranted to confirm and further explore the putative beneficial effects of yoga in perimenopausal women.

CONCLUSION

This study clearly demonstrates the effectiveness of yoga therapy in managing the distressing perimenopausal symptoms. It is easy, safe, non-expensive alternative therapy helping the well-being of perimenopausal women and must be encouraged in the regular management of perimenopausal symptoms.

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"THE EFFECTS OF ZUMBA DANCE AND LOW-IMPACT AEROBIC EXERCISE ON BODY FAT PERCENTAGE IN PATIENTS WITH OBESITY -A COMPARATIVE STUDY."

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ABSTRACT

BACKGROUND: Obesity is a complex disease involving an excessive amount of body fat. Obesity isn't just a cosmetic concern. An obese patient is at risk of developing diseases such as: Coronary heart disease , High blood pressure, Heart failure, Diabetes mellitus, Stroke, Body fat abnormalities, Metabolic syndrome, Menstrual issues, leading to infertility, osteoarthritis, and hypoxemia. Zumba is a fitness program that involves cardio and Latin-inspired dance. Zumba choreography is composed using all or some of sixteen core steps. There are four basic rhythms: salsa, reggaeton, merengue, and cumbia each basic rhythm has four core steps. Aerobic exercise is any type of cardiovascular conditioning. It can include activities like brisk walking, swimming, running, or cycling. Your breathing and heart rate will increase during aerobic activities.

METHODOLOGY: It is a comparative study with pre-test and post-test design. 30 subjects in between the age of 25 to 40 years with obesity were allocated into two different groups. The body mass index (BMI) was

evaluated before and after the test. All the participants performed low-impact aerobic exercise and zumba dance for 4 weeks.

RESULT: At the end of the study, the BMI mean and SD of group1 is 19.512 and 1.839 respectively, whereas the mean BMI and SD of group 2 is 21.158 and 1.727 respectively, and their difference mean BMI and SD is 2.006 and 0.112 respectively.

CONCLUSIONS: At the end of the study, it has been concluded that low-impact aerobic exercise is more effective than Zumba dance on body fat percentage in patients with obesity.

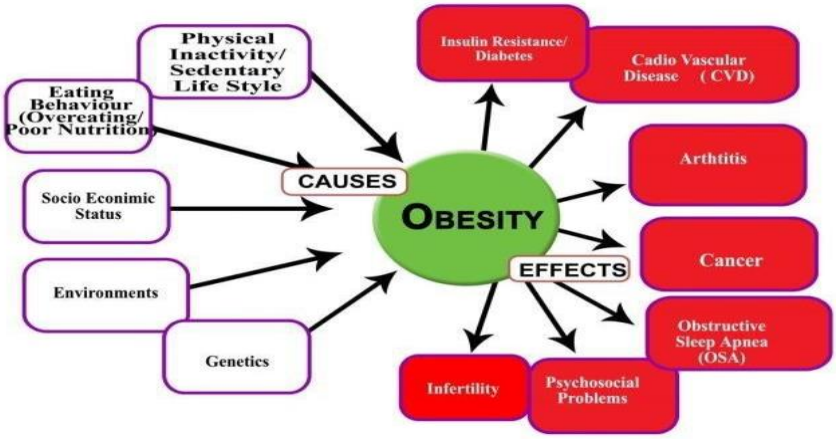
INTRODUCTION

INTRODUCTION

Obesity is a problem affecting many countries of the world irrespective of their levels of development. And it is the major public health condition with comorbidities leading to reduction in life expectancy. Therefore, obesity should not only be seen as a condition that develops through an unhealthy lifestyle but one which creates significant risk to health [1].

Approximately 1.2 billion people in the world are over-weight and at least 300 million people of them are obese. This is a major threat to public health because it increases the risk of chronic diseases. Thus, it is one of the problems that need serious attention .Unhealthy food intake such as those with low nutrient density, sweet drinks and the likes, leading to the condition while changes in the eating and snacking at home, improved sedentary lifestyles and the likes are some of the things that can get rid of it within the population [1].

Besides physical discomfort, an obese individual is at risk of developing diseases such as: Coronary heart



disease, High blood pressure, Heart failure, Diabetes mellitus, Stroke, Body fat abnormalities, Metabolic syndrome, Menstrual issues, leading to infertility, osteoarthritis, and hypoxemia [2].

Fig 1: Effects and causes of obesity

Obesity has, in the recent years become a global phenomenon. This has serious implications, particularly in countries like India, where one-fourth of the population is diabetic. Factors such as age, sex, ethnicity, and muscle mass can influence the relationship between BMI and body fat. Also, BMI doesn't distinguish between excess fat, muscle, or bone mass, nor does it provide any indication of the distribution of fat among individuals [2].

Common specific causes of obesity include: genetics, which can affect how your body processes food into energy and how fat is stored, growing older, which can lead to less muscle mass and a slower metabolic rate, making it easier to gain weight, not sleeping enough, which can lead to hormonal changes that make you feel hungrier and crave certain high-calorie foods, pregnancy, as weight gained during pregnancy may be difficult to lose and might eventually lead to obesity [3].

Certain health conditions can also lead to weight gain, which may lead to obesity. These include:

polycystic ovary syndrome (PCOS), a condition that causes an imbalance of female reproductive hormones, Prader-Willi syndrome, a rare condition present at birth that causes excessive hunger, Cushing syndrome, a condition caused by having high cortisol levels (the stress hormone) in your system, hypothyroidism (underactive thyroid), a condition in which the thyroid gland doesn't produce enough of certain important hormones, osteoarthritis (OA) and other conditions that cause pain that may lead to reduced activity [4].

Depression can sometimes lead to weight gain, as some people may turn to food for emotional comfort. Certain antidepressants can also increase the risk of weight gain. Quitting smoking is always a good thing, but quitting may lead to weight gain too. In some people, it may lead to excessive trusted source weight gain. For that reason, it's important to focus on diet and exercise while you're quitting, at least after the initial withdrawal period. Medications, such as steroids or birth control pills, can also raise your risk for weight gain [5].

Obesity prevention requires a complex approach, including interventions at community, family, and

individual levels.

Obesity can lead to more than simple weight gain. Having a high ratio of body fat to muscle puts strain on your bones as well as your internal organs. It also increases inflammation in the body, which is thought to be a risk factor for cancer. Obesity is also a major risk factor for type 2 diabetes [5].

Obesity has been linked to a number of health complications, some of which can be life threatening if not treated: type 2 diabetes, heart disease, high blood pressure, certain cancers (breast, colon, and endometrial), stroke, gallbladder disease, fatty liver disease, high cholesterol, sleep apnea and other breathing problems, arthritis, infertility.

A sedentary lifestyle plays a significant role in obesity. Worldwide there has been a large shift towards less physically demanding work, and currently at least 30% of the world's population gets insufficient exercise. This is primarily due to increasing use of mechanized transportation and a greater prevalence of labor-saving technology in the home. In children, there appear to be declines in levels of physical activity), likely due to safety concerns, changes in social, and inadequate urban design. World trends in active leisure time physical activity are less clear [5].

The main treatment for obesity consists of weight loss via lifestyle interventions, including prescribed diets and physical exercise. Although it is unclear what diets might support long-term weight loss, and although the effectiveness of low-calorie diets is debated, lifestyle changes that reduce calorie consumption or increase physical exercise over the long term also tend to produce some sustained weight loss, despite slow weight regain over time[6] .

Although 87% of participants in the National Weight Control Registry were able to maintain 10% body weight loss for 10 years, the most appropriate dietary approach for long term weight loss maintenance is still unknown. In the USA, intensive behavioral interventions combining both dietary changes and exercise are recommended. Intermittent fasting has no additional benefit of weight loss compared to continuous energy restriction. Adherence is a more important factor in weight loss success than whatever kind of diet an individual undertakes.

Several hypo-caloric diets are effective. In the short-term low carbohydrate diets appear better than low fat diets for weight loss. In the long term, however, all types of low-carbohydrate and low-fat diets appear

equally beneficial [6].

Exercise is also like a medicine in that it has an appropriate dosage, indications, contraindications, and adverse effects associated with its use. The importance of proper technique in strength training and flexibility exercise, the appropriate guidance in aerobic activity progression, the role of kinetic chain and movement pattern analysis are all essential to an accurate and safe exercise prescription for obese people[7].

Looking at the state of sport development today, it is an advanced state, especially the aerobic dance that is common among young generation. Other benefits this gives the body include increasing the work rate of the heart increasing muscle strength, burning fat, etc. aerobic dance is one of the most common exercise practices in the world. This is because there have been many gymnastic club have been established and now almost every agency or office also organizes aerobic dance exercises.

The fact that low-impact aerobic dance exercise has been well adapted to keep and improve health in a wide range of the population. And that regular aerobic dance exercise can prevent obesity and build muscles [8].

Zumba is a dance-based activity based on a variety of Latin dance styles :salsa, reggaeton, cumbia, etc, and including steps in multiple directions. Also, it is an alternative activity that helps the body in burning excessive fats and a systematic review has shown that zumba has beneficial effects on reducing body weight. Therefore, both exercises help in reducing the body fat percentage [9].

The WHO recommended the body mass index (BMI) as a simpler marker to reflect total body fat and is used as a measure of over-weight and obesity [10]. This can also be used to determine the ideal body weight.

The relationship between BMI, BF%, and body fat distribution were different between populations.Hence, the subjects in this study were grouped based on those that have mild or severe obesity by calculating the BMI of each participant [11]..

REVIEW OF LITERATURE

REVIEW OF LITERATURE:

1.Comparison of the effects of Yoga, Zumba, Aerobic exercises in controlling blood pressure in Indian population. Jerusha Santa Packyanathan and S.Preetha Et Al(2009)[12].

This study is designed to analyze the effects of Yoga, Zumba, and Aerobic exercises in controlling blood pressure and to determine which of these three is better to treat hypertension without using hypertensive drugs. It is concluded that comparing the three activities, it is found that the drop in the blood pressure was greatest among participants who practiced yoga, followed by participants who performed Zumba dance and finally among participants of aerobics.

2. The effectiveness of an 8 weeks Zumba program for weight reduction in a group of over-weight and obese patients. Charles Miscallef Et Al(2014)[13].

The study investigated the before–after effects of a Zumba program on the weight and body mass index (BMI) of 36 females, mean age 34.25 ± 8.50 years and mean BMI 32.98 ± 5.32 kg/m2. Methods: The intervention involved 16 hourly Zumba sessions held twice weekly over 8 weeks. The exercises comprised a mixture of merengue, salsa, reggaeton and bachata with warm-up and cool-down activities. They were of low-impact style, but were maintained at vigorous intensity that was still bearable for the obese subjects.

3 .An 8 weeks exercise intervention based on Zumba improves Aerobic fitness. Anne A Delextrat, Sarah Warner Et Al(2014)[14]. The objective of this study was to investigate the effects of Zumba on physiological and psychological outcomes in healthy women. Zumba provided significant positive changes in maximal aerobic fitness (+3.6%), self-perception of physical strength (+16.3%) and muscular development (+18.6%), greater autonomy (+8.0%), and purpose in life (+4.4%). No significant changes were observed in the control group. These results highlight that Zumba is beneficial to improve fitness and well-being in healthy women, but does not change body composition.

4. Effects of Pilates and Aerobic exercises on blood pressure, heart rates, and serum lipids in sedentary females . SemraSetin, CumaEce, Murat Sen Et Al(2019)[15].

The aim of this study was to determinate the effects of 12 weeks pilates and aerobic exercise on blood pressure, heart rates, and blood serum lipids in sedentary females. 18 sedentary women with an average age of 45.52 years, height of 161.14 cm and weight of 72.5 kg have been selected and put through a plates and aerobic exercise programmer one hour a day for three days a week. In this study, together Pilates and aerobic exercise was effective in sedentary women with initially high total cholesterol, triglyceride, and Low density lipoprotein levels. At end of the cycles of 12 weeks Pilates and aerobic exercises, has a positive effect of waist to hip ratio, blood pressure, and heart beats in sedentary females. Risk of heart and vascular disease is reduced. Pilates and aerobic exercises are recommended for decrease risk.

5. Effects of Zumba fitness program on body composition of women. Adriana Ljubojevic Et Al (2014)[16].

The aim of this research was to determine the effects of zumba fitness program on changes of women body composition. 12 women aged 25-35 participated in the conducted research. The zumba fitness program was estimated after eight weeks of exercise, total of 24 training sessions. Body weight, fat percentage, fat mass, fat free mass and total body water were measured at the beginning and at the end of the research.

6. Zumba dancing and Aerobic exercise can improve working memory, motor function, and depressive symptoms in female patients with Fibromyalgia. Ebrahim Norouzi Et Al(2019)[17].

This study compares the impact of two different interventions, aerobic exercise training and Zumba dancing, on working memory, motor function and depressive symptoms among female patients with FM. The design also included a control condition. Method: A total of sixty middle-aged female patients with

FM (mean age: 35.76 years) and undergoing standard care took part in the study. Participants were randomly assigned to one of the following three conditions: aerobic exercise training, Zumba dancing, or control.

7. Effects of the Aerobic Exercise Program with music on the body composition and subcutaneous fat of young women: A Systematic Review. Milijan Hadzovic Et Al (2020)[18].

The aim of this research was to determine the effects of aerobic exercise to music on body composition and

subcutaneous fat among young women. The research results confirm the positive influence of aerobic exercise to music on the parameters of body composition and subcutaneous fat among young women, irrespective of the overall duration of the exercise programs, with the conclusion that programs lasting up to 12 weeks are more effective when it comes to the decrease and maintenance of body weight, fat reduction, increase in muscle tissue, and lead to an improvement in aerobic abilities.

8. Benefits of Zumba Fitness among sedentary adults with components of the metabolic syndrome: A pilot study. Araneta MR, Tanori D Et Al (2014)[19].

The aim of this study was to assess the feasibility of a 12 week Zumba Fitness® pilot study and temporal changes in components of the metabolic syndrome (MetS) among sedentary, obese women with at least two MetS components. This twelve week Zumba Fitness® intervention showed good feasibility and adherence, with significant reductions in blood pressure and triglyceride levels, despite minimal weight loss.

NEED OF THE STUDY

NEED OF THE STUDY

NEED OF THE STUDY

This study is required to determine the significant effects of Zumba dance and low-impact Aerobic exercises on body fat percentage in patients with obesity. With the increasing demand of Zumba dance, it is important to have knowledge about its effects on body fat percentage in obese patients in comparison to aerobic exercise.

AIM AND OBJECTIVES OF THE STUDY

AIM AND OBJECTIVES OF THE STUDY

AIM OF THE STUDY:

To determine the effect of low-impact aerobic exercise and Zumba dance on body fat percentage in

patients with obesity.

OBJECTIVE OF THE STUDY:

- To determine the effect of low-impact aerobic exercise on body fat percentage in patients with obesity.
- To determine the effect of Zumba dance on body fat percentage in patients with obesity.
- To compare the effect of both of the exercises on body fat percentage in patients with obesity and to determine which of these two is better for obese patients.

HYPOTHESIS

HYPOTHESIS

HYPOTHESIS

NULL HYPOTHESIS:

There will be no significant difference between the effects of low-impact aerobic exercise and zumba dance on body fat percentage in patients with obesity.

ALTERNATE HYPOTHESIS:

There will be significant difference between the effects of low-impact aerobic exercise and zumba dance on body fat percentage in patients with obesity.

METHODOLOGY

METHODOLOGY

STUDY DESIGN: A Comparative Study

SOURCE OF STUDY: Classes conducting Zumba and Aerobics

POPULATION: Subjects with obesity of age group 25 to 40 years

SAMPLING METHOD: Convenient sampling

DURATION OF STUDY: 1 Month

TREATMENT DURATION: 3 sessions per week for 4 weeks

SAMPLE SIZE: 30

A) GROUP 1: 15

B) GROUP 2: 15

METHOD OF SELECTION OF SUBJECTS:

INCLUSION CRITERIA:

- Age group-25 to 40 years
- Subjects with obesity

EXCLUSION CRITERIA:

- Patients suffering from back pain
- Patients having any previous spinal cord injury
- Patients with joint pain
- Patients with any neuromuscular disorder
- Patients with any cardiovascular disorder

MATERIALS AND TOOLS USED:

1. Pen, pencil, paper
2. Consent form
3. Eraser
4. Measuring tape
5. Weighing machine

Fig :2

Fig :3

OUTCOME MEASURES:

BMI (BODY MASS INDEX)

Body mass index (**BMI**) is a value derived from the mass (weight) and height of a person. The BMI is defined as the body mass divided by the square of the body height, and is expressed in units of kg/m^2, resulting from mass in kilograms and height in meters. The BMI is a convenient rule of thumb used to broadly categorize a person as underweight, normal weight, overweight, or obese based on tissue mass (muscle, fat, and bone) and height. Major adult BMI classifications are underweight (under 18.5 kg/m^2), normal weight (18.5 to 24.9), overweight (25 to 29.9), and obese (30 or more).When used to predict an individual's health, rather than as a statistical measurement for groups, the BMI has limitations that can make it less useful than some of the alternatives, especially when applied to individuals with abdominal obesity, short stature, or unusually high muscle mass.

Classification	BMI (kg/m^2)	Risk of associated illness
Underweight	< 18.5	Low (but greater risk of other clinical problems)
Normal range	18.5–24.9	
Overweight	> 25.0	Average
Pre-obese	25.0–29.9	Increased
Obese class I	30.0–34.9	Moderate
Obese class II	35.0–39.9	Severe
Obese class III	> 40.0	Very severe

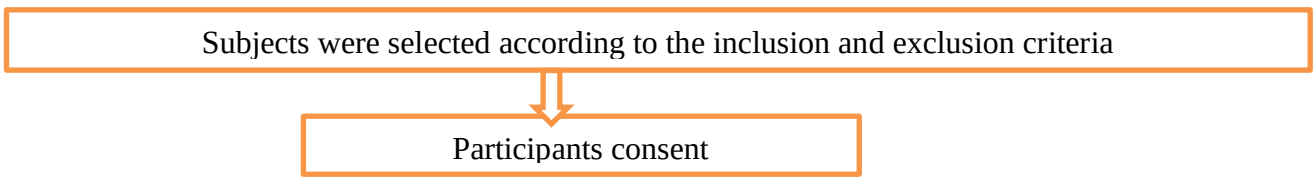
Table no.1: Classification of obesity

The clinical limitations of BMI should be considered. BMI is a surrogate measure of body fatness because it is a measure of excess weight rather than excess body fat. Factors such as age, sex, ethnicity, and muscle mass can influence the relationship between BMI and body fat. Also, BMI does not distinguish between excess fat, muscle, or bone mass, nor does it provide any indication of the distribution of fat among individuals. The following are some examples of how certain variables can influence the interpretation of BMI:

- On average, older adults tend to have more body fat than younger adults for an equivalent BMI.
- On average, women have greater amounts of total body fat than men with an equivalent BMI.
- Muscular individuals, or highly-trained athletes, may have a high BMI because of increased muscle mass

PROCEDURE:

All the subjects for the study were selected according to the inclusion criteria. Research objectives, procedure, and benefits are fully explained to the patients. Before the experiment, subject's measurements such as height, and weight were carried out. Mechanical scales and measuring tape were used in order to measure weight and height respectively. After that, the subjects were parted into two groups.



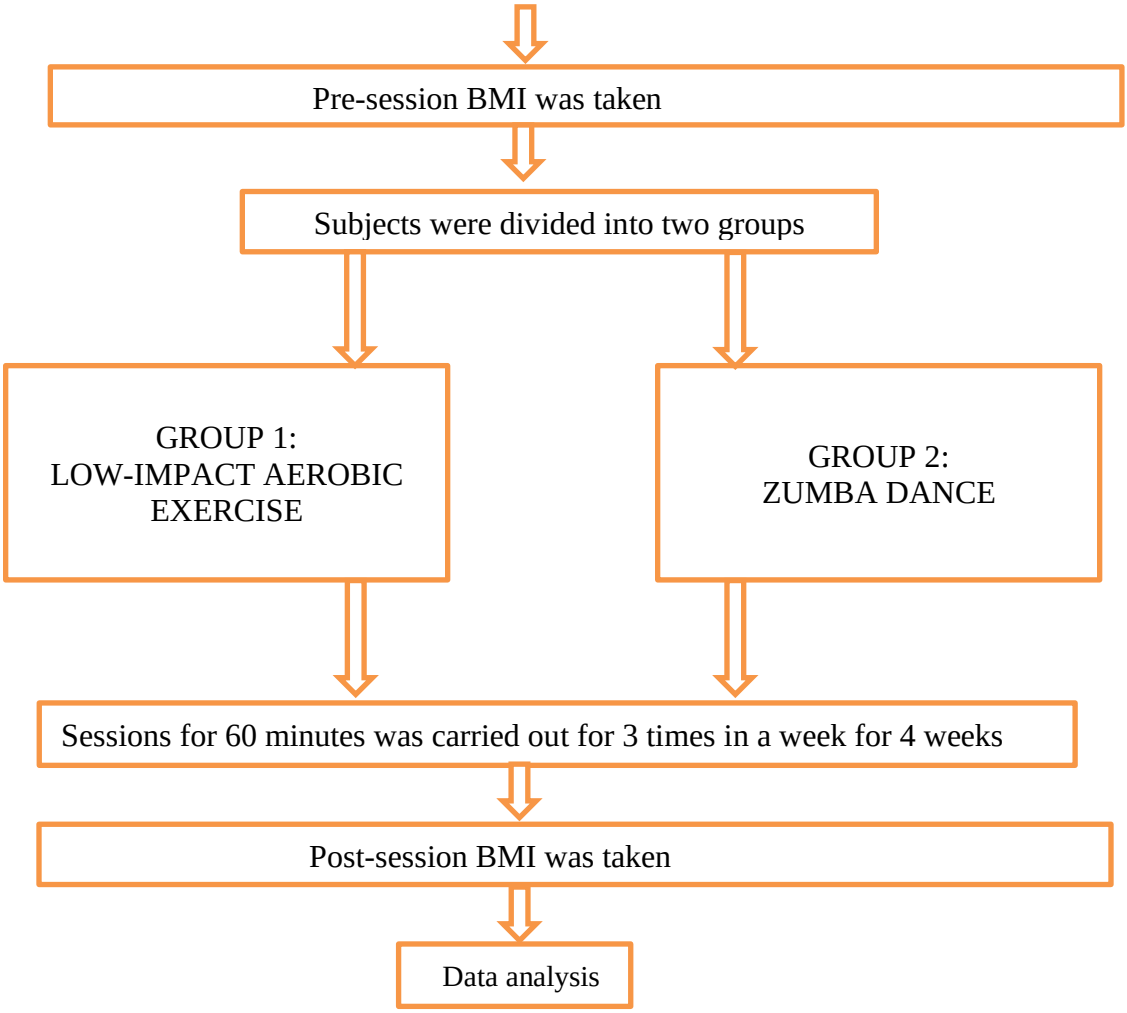


Fig no. 4: flowchart of study procedure

GROUP 1: Low-impact aerobic exercise:

The exercise was choreographed by an experienced Aerobic instructor. The participants were explained the procedures for implementing this treatment after which consent form was filled. The treatment period was made up of 3 sessions in a week for 4 weeks and each session lasted for 1 hour including 10 – 15 minutes warm-up phase, 30 – 35 minutes low-impact aerobic exercise and ended up with a 5 – 10 minutes cooling phase.

The aerobic exercises includes :

>Walking

>Jogging

>Cycling

>Stair climbing

>Skipping

GROUP 2: Zumba dance:

The exercise program was led by a Zumba instructor and just like what was done in the low-impact aerobic dance exercise, the participants were given the explanation regarding the procedures for implementing the treatment, its duration and location. The treatment period was made up of 3 sessions in a week for 4 weeks and each session includes three dance steps along with 15 minutes of rest period during the session.

The zumba dance includes the main three dance steps:

>Salsa steps: Dance with an 8 beat pattern:

Beat 1: step forward with your left foot
Beat 2: shift your weight to your right foot
Beat 3: step back to your starting position with your foot
Beat 4: pause
Beat 5: step back with right foot
Beat 6: shift your weight to your left foot
Beat 7: step your right foot back to your starting position
Beat 8: pause.
This dance step was performed for 15 minutes continuously followed by 5 minutes rest.

>Merengue steps: Dance with stepping on each beat:

Beat 1: shift your hips to the right and stomp with your left foot
Beat 2: shift your hips to the left and stomp with your right foot
This dance step was performed for 15 minutes continuously followed by 5 minutes rest.

>**Reggaeton steps:** Dance with stepping on each beat:

Beat 1: take a wide step with your left foot

Beat 2: tap your right foot next to your left foot while leaning to the right

Beat 3: take a wide step with your right foot

Beat 4: tap your left foot next to your right foot

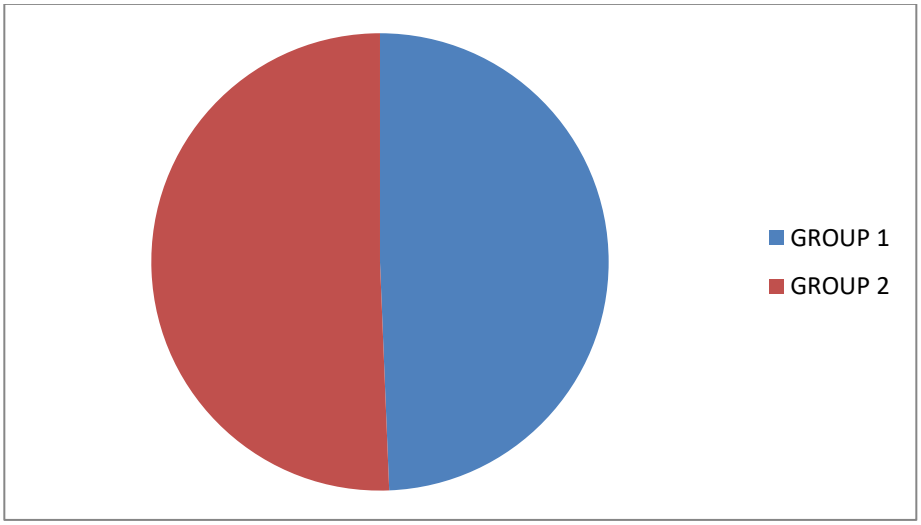
This dance step was performed for 15 minutes continuously followed by 5 minutes rest.

RESULTS

RESULTS

Table 2: Age distribution of both groups

	NO OF PATIENTS	MEAN AGE	SD
GROUP 1	15	50.033	3.058
GROUP 2	15	51.333	3.498

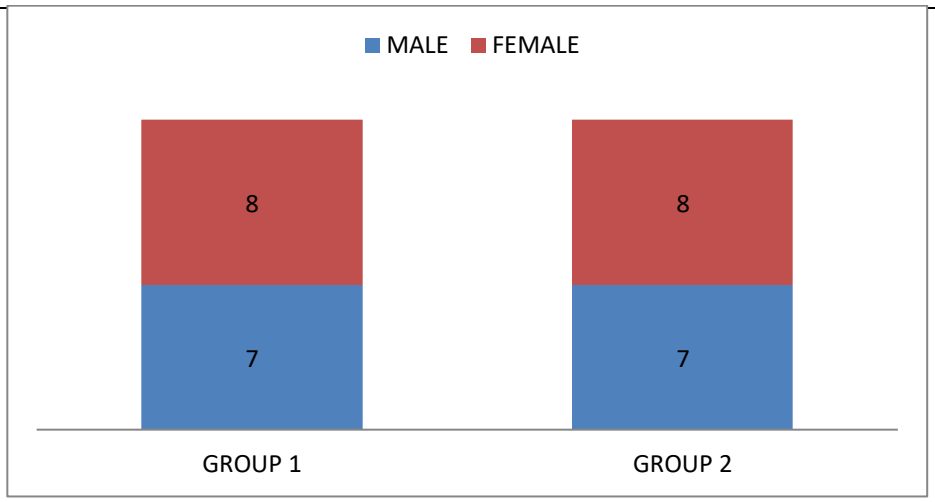


(Graph1: Age distribution in both groups)

The above pie chart represents the mean age of group 1 and group 2. It depicts that the mean age of group 1 and group 2 are 50.033 and 51.333 respectively.

Table 3: Gender distribution in both groups

	MALE	FEMALE	TOTAL
GROUP 1	7	8	15
GROUP 2	7	8	15

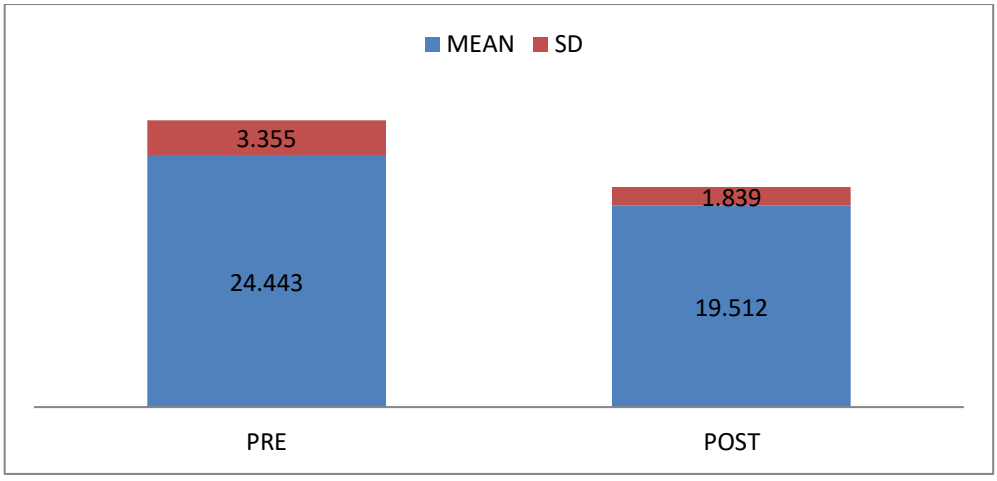


(Graph 2: Gender distribution in both groups)

The above bar graph represents the gender distribution in group1 and group 2. It shows that the number of male and female in group 1 and group 2 are 7 and 8 respectively.

Table 4: Comparison of pre and post BMI mean in group 1

GROUP 1 BMI				
	MEAN	**SD**	**DF**	**T-value**
PRE	**24.443**	**3.355**	**14**	**4.985**
POST	**19.512**	**1.839**		

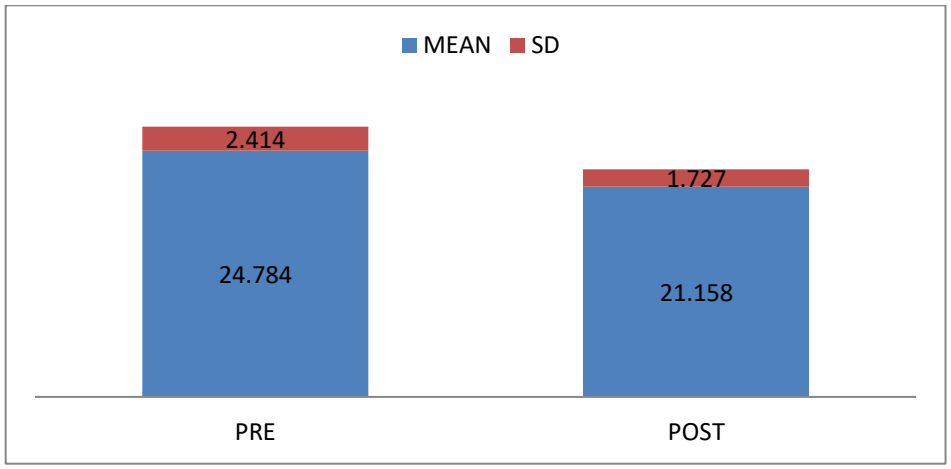


(Graph 3: comparison of pre and post-test BMI mean in group1)

The graph 3 represents the comparison of pre-test and post-test BMI mean in group 1. It shows that the pre-test BMI mean and standard deviation are 24.443 and 3.355 respectively .Whereas, the post-test BMI mean and standard deviation are 19.512 and 1.839 respectively.

Table 5: Comparison of pre and post BMI mean of group 2

GROUP 2 BMI				
	MEAN	**SD**	**DF**	**T-value**
PRE	**24.784**	**2.414**	**14**	**4.749**
POST	**21.158**	**1.727**		

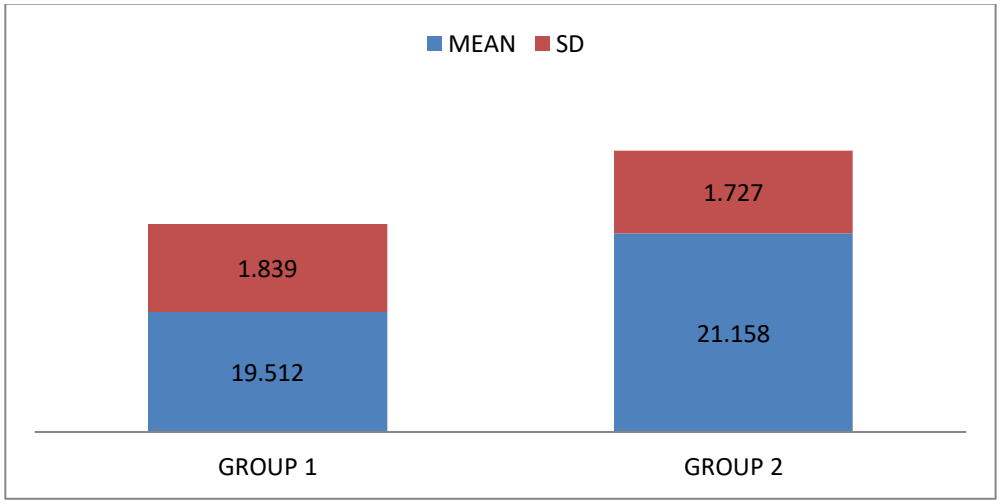


(Graph 4: Comparison of pre and post-test BMI mean in group 2)

The above graph represents the comparison of pre-test and post-test BMI mean in group 2. It shows that the pre-test BMI mean and standard deviation are 24.784 and 2.414 respectively .Whereas, the post-test BMI mean and standard deviation are 21.158 and 1.727 respectively.

Table 6: Comparison of post-test BMI mean in group 1 and group 2

POST BMI OF BOTH GROUPS					
	MEAN	**SD**	**DF**	**T-value**	**SIG**
GROUP 1	**19.512**	**1.839**	**28**	**2.540**	**0.01**
GROUP 2	**21.158**	**1.727**			



(Graph 5: Comparison of post-test BMI mean in group 1 and group 2)

The above bar graph depicts the comparison of post-test BMI mean in group 1 and group 2. It shows that the BMI mean and standard deviation in group 1 are 19.512 and 1.839. And in group 2, the mean and standard deviation are 21.158 and 1.727 respectively. It clearly represents that the subjects in group 1 showed a significant reduction in BMI in comparison to the subjects in group 2.

DISCUSSION

DISCUSSION

The result of the study conclude that the use of low-impact aerobic exercise and zumba dance are both effective for reducing the BMI of patients with obesity. The study rejects the null hypothesis:- There is no significant difference between the effect low-impact aerobic exercise and zumba dance on BMI of patients with obesity, and accepts the experimental hypothesis:- There is significant difference between the effect of low-impact aerobic exercise and zumba dance on BMI of patients with obesity [20].

According to the study done by Jerusha Packyanathan and S.Pretha in 2020, it was concluded that, hypertension can be controlled without drug intervention. Exercises like Aerobics, Zumba dance and yoga are other interventions that can bring about a fall in hypertension. They help reduce the morbidity and mortality from cardiovascular diseases which are now on top of the lists. Comparing the three activities, it is found that the drop in the blood pressure was greatest among participants who practiced yoga, followed by participants who performed Zumba dance and finally among participants of aerobics. However, it should be noted that all the three activities produce no side effects which is evident while using drug interventions for prolonged periods. Obesity and HBP are almost risk associated with coronary artery disease and the same result is shown in thus study [21].

According to the study done by Charles Miscallef in 2014, it was investigated the before–after effects of a Zumba program on the weight and body mass index (BMI) of 36 females, mean age 34.25 ± 8.50 years and mean BMI 32.98 ± 5.32 kg/m2. Methods: The intervention involved 16 hourly Zumba sessions held twice weekly over 8 weeks. The subjects had statistically significant decreases and large effects for weight and BMI: 2.13 kg, t(35) = 13.77, P\0.0005, d = 2.30, and 0.83 kg/m2, t(35) = 13.02,

P\0.0005, d = 2.17, respectively [22].

According to a study done by Anne A Delextrat and Sarah Warner in 2014, it was concluded that Zumba provided significant positive changes in maximal aerobic fitness (+3.6%), self-perception of physical strength (+16.3%) and muscular development (+18.6%), greater autonomy (+8.0%), and purpose in life (+4.4%). No significant changes were observed in the control group. In addition, some psychological changes were significantly correlated to body fat at baseline, and changes in fitness. These results highlight that Zumba is beneficial to improve fitness and well-being in healthy women, but does not change body composition [23].

CONCLUSION AND SUMMARY

CONCLUSION:

The result of the study conclude that the use of low-impact aerobic exercise and zumba dance are both effective for reducing the BMI of patients with obesity. But the result says that the low-impact aerobic exercise is much more effective as compared to zumba dance.

SUMMARY:

During the course of the study, it has been concluded that low-impact aerobic exercise and zumba dance are both helpful in reducing BMI of obese patients. But it is seen that the group performing low-impact aerobic shown a significant reduction in BMI of patients with obesity than the group performing zumba dance.

LIMITATIONS

Limitations:

- Limited sample size
- Specified age group of 25 to 40 years
- No follow ups

Future recommendation:

- Study can be done on large population
- Study can give long term effects
- Study can be done on older people

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ANNEXURE A

CONSENT FORM

Study title**: THE EFFECT OF LOW-IMPACT AEROBIC EXERCISE AND ZUMAB DANCE ON BODY FAT PERCENTAGE IN PATIENTS WITH OBESITY: A COMPARATIVE STUDY.**

I Mr / Mrs_____exercising my free power of choice ; hereby giving my consent to include myself as a subject. I have been explained everything about the research in details and about the therapy which was given to me. I understand that my participation is voluntary in the study and that I am free to withdraw at any time, without giving any reason, without my medical care or legal rights being affected.

I understand that the data obtained through the study may be used for research paper publication and I also understand that my identity will not be revealed in any information released into third parties or published.

Patient's name: Date:
Sign:
Physiotherapist name:
Sign:

ANNEXURE B

सहमति फॉर्म

अध्ययन शीर्षक: **मोटापे के साथ रोगियों में शरीर में वसा प्रतिशत पर कम प्रभाव वाले एरोबिक व्यायाम और ज़ूमाब नृत्य का प्रभाव: एक तुलनात्मक अध्ययन।**

मैं श्री _____ अपनी पसंद की स्वतंत्र शक्ति का उपयोग कर रहा हूं; इसके द्वारा खुद को एक विषय के रूप में शामिल करने के लिए मेरी सहमति दे रहा हूं। मुझे विवरण में अनुसंधान के बारे में सब कुछ समझाया गया है और उस चिकित्सा के बारे में जो मुझे दिया गया था। मैं समझता हूं कि अध्ययन में मेरी भागीदारी स्वैच्छिक है और मैं किसी भी समय, बिना किसी कारण के, मेरी चिकित्सा देखभाल या कानूनी अधिकारों को प्रभावित किए बिना, वापस लेने के लिए स्वतंत्र हूं।

मैं समझता हूं कि अध्ययन के माध्यम से प्राप्त डेटा का उपयोग शोध पत्र प्रकाशन के लिए किया जा सकता है और मैं यह भी समझता हूं कि मेरी पहचान तीसरे पक्ष में जारी या प्रकाशित किसी भी जानकारी में प्रकट नहीं होगी।

रोगी का नाम: दिनांक:
साइन इन करें:
फिजियोथेरेपिस्ट का नाम:
साइन इन करें:

સંમતી પત્રક :
વ્યક્તિ નું નામ : _____
જાતી - સ્ત્રી / પુરુષ ઉંમર : _____
વ્યક્તિ નું સરનામું : _____
હું હુકદાર સંશોધન પ્રોજેકટ

તુલનાત્મક અભ્યાસ

હું પણ તમામ પરીક્ષણો બિનઆક્રમણ અને કોઈ આડઅસર વગર છે કે સમજાવી કરવામાં આવી છે. મારા વિધ્યાત્મકક્ષમતા અને આરોગ્યાં સિથતી વગેરે આકારણી હાથ ધરવામાં આવેશે કે જે વિવિધ પરિક્ષણે વિશે વિગતવાર સમજાવયેલ કરવામાં આવી છે.

હું અભ્યાસ માં સહયોગ સ્વૈચ્છિણ છે જે સમજવા અને તે હું અસર થઈ રહી. મારા તબીબી કાળજી અથવા કાનૂની અધિકાર વગર કોઈકારણ આપ્યા વગર, હું કોઇ પણ સમયે પાછી ખેંચી મુકત છું.

હું અભ્યાસ દ્વારા મેળવી માહિતી સંશોધન પેપેર પ્રકાશન માટે ઉપયોગ કરી શકાય છે જે સમજે છે એને હું પણ મારી ઓળખતતીય પક્ષ રજૂ અથવા પ્રકાશીત કોઇ પણ માહિતી જાહેર કરવામાં આવશે નહિ કે અમજે છે.

હસ્તાક્ષર(અથવાઅંગુઠાનીછાપ)વ્યક્તિની_____
કાયદાકીય રીતે સ્વીકાર્ય પતિનીધી :_____
સાક્ષી ની સહી :_____
તપાસનાર ની સહી :_____
સાક્ષીનું નામ:_____તારીખ : _____

ANNEXURE B

Data collection sheet

Group: ☐ Date: _____

Name of the patient: _____

Age: _____

Gender: _____

Weight: _____kg

Height: _____m

BMI: _____Kg/m^2

Address:

_____

_____

_____

Contact number: _____

Signature of the investigator

Nidhiba M Zala

ANNEXURE C

OUTCOME MEASURES

BMI (Body Mass Index):

BMI is the value deprived from the weight and height of a person.
It is defined as the body weight divided by the square of the height and is expressed in units as kg/m^2.

BMI = weight of the person/(height of the person)^2

Classification	BMI (kg/m^2)	Risk of associated illness
Underweight	< 18.5	Low (but greater risk of other clinical problems)
Normal range	18.5–24.9	
Overweight	> 25.0	Average
Pre-obese	25.0–29.9	Increased
Obese class I	30.0–34.9	Moderate
Obese class II	35.0–39.9	Severe
Obese class III	> 40.0	Very severe

ANNEXURE D

MASTER CHART

GROUP1

SR NO.	NAME OF THE PATIENT	AGE	GENDER	WT (Kg)	HT (m)	BMI (PRE)	BMI (POST)
1.	Dipali Parikh	30	F	50.50	1.5	21.573	17.573
2.	Hiral Makwana	32	F	52	1.6	19.814	16.814
3.	Niyati Patel	28	F	55	1.7	20.202	18.202
4.	Payal Chabra	26	F	56	1.5	24.889	19.889
5.	Anushka Prajapati	27	F	50	1.5	23.139	19.139
6.	Poonam Patel	29	F	60	1.5	26.667	20.667
7.	Rinkal Vaghela	28	F	65	1.5	27.767	19.919
8.	Priya Vyas	31	F	63	1.6	24.919	17.186
9.	Ankit Patel	33	M	55	1.6	21.186	20.373
10.	Deep Goswami	35	M	60	1.5	26.667	17.168
11.	Sunil Prajapati	28	M	53	1.5	24.527	21.336
12.	Anil Roy	36	M	59	1.4	32.373	20.372
13.	Manish Patel	26	M	54	1.5	25.337	21.336
14.	Jayesh Makwana	29	M	59	1.5	26.222	23.222
15.	Prakash Patel	31	M	52	1.6	21.367	19.368

GROUP2

SR NO.	NAME OF THE PATIENT	AGE	GENDER	WT (Kg)	HT (m)	BMI(PRE)	BMI (POST)
1.	Tara Parmar	36	F	60.50	1.6	23.931	19.931
2.	Aditi Raval	28	F	65	1.5	27.767	22.767
3.	Twinkal Trivedi	27	F	55	1.4	26.524	21.524
4.	Tanya Patel	26	F	63	1.5	26.913	20.913
5.	Anjali Rao	28	F	47	1.5	21.750	18.750
6.	Anisha Sharma	32	F	52	1.6	21.367	19.378
7.	Janal Raval	33	F	56.50	1.5	25.111	21.111
8.	Mahek Patel	31	F	58	1.5	26.841	23.841
9.	Soham Shah	28	M	62	1.7	22.773	20.773
10.	Kartik Patel	35	M	65	1.6	26.709	20.709
11.	Ayush Yadav	26	M	60	1.5	26.667	23.667
12.	Darshil Rao	28	M	57	1.4	27.488	23.488
13.	Jay Sharma	29	M	49	1.5	21.778	20.222
14.	Bharat Patel	32	M	52	1.6	21.367	18.368
15.	Himanshu Rai	36	M	58	1.5	24.776	21.931

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"EFFECT OF PILATES EXERCISE VERSUS MYOFASCIAL RELEASE IN PATIENTS WITH CHRONIC LOW BACK PAIN - A COMPARATIVE STUDY"

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ABSTRACT

BACKGROUND: Chronic low back pain is defined as pain, muscle tension or stiffness localized below the costal margin and above the inferior gluteal folds, persists for 12 weeks or more. For treating Chronic Low back pain various techniques are available. Basic aim is to compare the effect of Pilates exercise and MFR technique in patients with chronic low back pain.

METHODOLOGY: After taking informed, written consent patients were divided into 2 groups by simple random sampling method. Group A received Pilates exercise plus conventional treatment and Group B received MFR technique plus conventional treatment. Both groups received treatment 4 sessions per week for 4 weeks. Pre and post intervention NPRS were measured. Data were analyzed with both groups.

RESULT: As the data followed normal distribution, parametric tests were used. Paired t test was applied to analyze pre and post outcome measures between both groups. Both the groups showed significant improvement in NPRS scores in within group analysis ($p<0.05$) but there was no statistically significant difference found in NPRS at the end of 4 weeks in between groups analysis ($p>0.05$).

CONCLUSIONS: The present study concludes that Pilates exercise along with conventional treatment and MFR technique along with conventional treatment, both are equally effective in reducing pain in patients with Chronic Low Back Pain.

KEY WORDS: Pilates exercise, MFR technique, Chronic low back pain.

INTRODUCTION

Chronic low back pain is defined as a pain, muscle tension or stiffness localized below the costal margin and above the inferior gluteal folds, which persists for 12 weeks or more[1] Exercise training has collectively been shown to be effective in reducing pain when compared with non-exercise training-based treatments in adults. [2] Risk factor of chronic low back are female sex, middle age, sedentary lifestyle as well as strenuous physical activity, occupational overload, smoking and obesity. [3]

Pilates exercise used for the core strengthening, posture and breathing pattern also. These exercises aim to improve static and dynamic stability, posture and ADLs. [4] The use of specialized Pilates exercise requirements are spring resistance, such as reformer has also recommended for Chronic Low Back Pain (CLBP) patients. [5] It has recommended in management of people with CLBP, this type of exercise helpful to strengthen deep and stabilizing muscle which support to the lumbar spine (transverse abdominis muscle). The muscles are inhibited in people with CLBP. [6]

Myofascial release (MFR) used for manual medicine which include the application of low-load, long duration of stretch to the myofascial complex with intent to restore optimal length of fascia-tissue, reduce pain and improve functional ability. Applied combined intervention of MFR with other therapeutic appear like muscular energy, soft tissue, high velocity-low amplitude thrust and cranial sacral techniques. [7]

Advance stage of research includes the progression towards more functional task giving to the patient to activate of deep muscle and global trunk muscles. [8] In recent years, increased interest in the issues fascia, which until recently was neglected in the etiology of LBP. At the same time as term is defined as fascial system- a network that has ability to transfer forces, where separate elements manually interact and form complex involved in traversing.

Those patients which suffering from long time CLBP gives rise to, restrictions within the fascial tissues. The combination of different structures of the complex lumbar-pelvic- hip joint may cause the source of pain is a considerable distance from the origin of pain. [9] Long standing limitation of motion occurring in people with risk factors for development of LBP, it's cause restrictions within the fascial tissue. Restrictions can cause abdominal tension which lead to an increase in excitability of receptors located in the fascia, bone structures involve in wrong direction, thus leading to excessive compression in the intervertebral joints. As a result, dysfunction and pain.[10]

NEED OF THE STUDY:

According to research done in past the Myofascial release and Pilates both methods individually when given shown beneficial effects but no studies were compared these methods. Both methods are individually effective in low back pain according to the previous research article but which one is more beneficial to reduce pain is not shown till now. Our need of the study is to compare both treatments so it is helpful in clinical practice for better treatment outcome.

AIM AND OBJECTIVES:

AIM: - To compare effects of Pilates exercise and MFR in people with CLBP.

OBJECTIVES: -

1. To find out the effects of Pilates exercise in CLBP on pain

2. To find out the effects of MFR in CLBP on pain

3. To compare effects of Pilates exercise and MFR on pain

HYPOTHESIS:

1. NULL HYPOTHESIS:

- There is no significant difference between effect of MFR and Pilates in chronic low back pain patients.

2. **ALTERNATIVE/ RESEARCH HYPOTHESIS:**

- There is significant difference between effect of MFR and Pilates in chronic low back pain patients.

METHODOLOGY:

STUDY DESIGN**:** A Comparative study

SOURCE OF DATA: OPD of Venus Institute of Physiotherapy

POPULATION: Chronic low back pain patient (Age between 30 to 50 years)

SAMPLING METHOD: Simple random sampling

DURATION OF STUDY: 4 weeks

TREATMENT DURATION**:** 4 sessions per week for 4 weeks

SAMPLE SIZE**:** 30 (Calculated via following formula) [11]

$N = 4\,\Sigma^2\,(Z_\alpha + Z_\beta)^2 / D^2$

N = Sample size

Σ = Standard Deviation

Z_α = Level of desired significance (1.96)

Z_β = Desired Power (0.84 for 80% power)

D = Effect size (Mean difference)

A) Group A: 15

B) Group B: 15

METHOD OF SELECTION OF SUBJECTS: -

INCLUSION CRITERIA:

- Patient's willingness to participate
- Both males and females
- Age group between 30-50 years
- Patient having chronic low back pain with more than 3 months
- Without identifiable specific anatomical/neurological factors

EXCLUSION CRITERIA:

- Any orthopedic or neurological condition of lumbar spine

- Patient with previous spinal injury
- Spondylolisthesis
- Past history of vertebral fractures
- Cancer of spine
- Tuberculosis of spine

MATERIALS AND TOOLS REQUIRED: -

1. Consent form
2. Pen, pencil, paper
3. Plinth and Pillow
4. Pilate mat
5. Transcutaneous electrical nerve stimulation (TENS) unit with gel, cotton and
6. Micro-pore

OUTCOME MEASURES: -

NUMERICAL PAIN RATING SCALE (NPRS): [12]

- The NPRS for pain is a Uni-dimensional measure of pain intensity in adults. Similar to visual analogue scale (VAS), the NPRS is anchored by describing pain severity extremes. The NPRS can be administered verbally on graphically for self-completion.
- A 11-point numeric scale with 0 representing one pain extreme (e.g., no pain), and 10 representing the other pain extreme (e.g., "pain as bad you can imagine" and "worse pain imaginable"). The patient is asked to indicate the numeric value on the segmented scale that best describes their pain intensity. Scores range from 0-10. Higher scores indicate greater pain intensity.
- Reliability: High test-retest reliability has been observed in both literate and illiterate patients with rheumatoid arthritis (r=0.96 and 0.95, respectively) before and after medical consultation.
- Validity: For construct validity, the NPRS was shown to be highly correlated to the VAS in patients with rheumatic and other chronic pain conditions (pain>6 months) range from 0.86 to 0.95.

CLINICAL INTERVENTIONS: -

All the participants/ patients of the study were advised to continue their normal routine activities but they should not take any pharmacological agents or other form of treatment Other than the designed protocol, during the period of study. After taking informed consent patients were divided into 2 groups by simple random sampling method and treatment was given 4 sessions per week for 4 weeks.

Group A: Patients of these group received Pilates exercise plus conventional treatment.

Group B: Patients of these group received MFR technique plus conventional treatment.

Conventional therapy for both groups:

Patients received conventional therapy in the form of Transcutaneous Electrical Nerve Stimulation [Pulse width - 50-300 µs, Frequency - 150 Hz, Pulse shape - rectangular shape, Intensity - 0 to 60 mA (Milliamps) (It can be varying from patient to patient), Duration - 10 minutes], hamstrings and calf stretching, cat and camel exercise, extension of trunk (cobra pose), static glutes and static back exercise for 4 days a week for 4 weeks.

FLOW CHART OF THE STUDY PROCEDURE

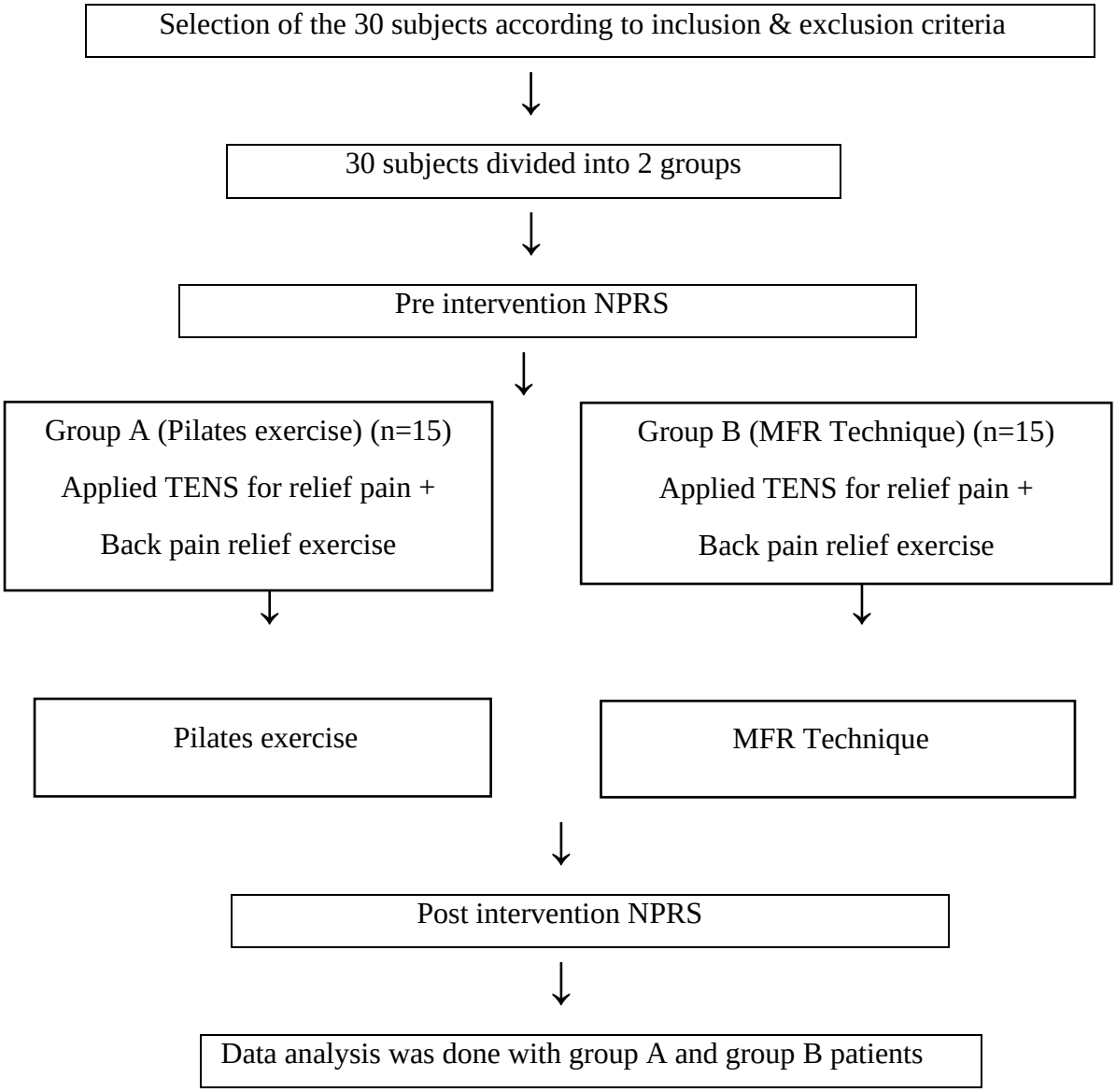

Figure 1: Flow chart of study Procedure

■ **<u>Group A [Pilates exercise plus conventional treatment]</u>:**

Pilates exercise: -

(1) <u>CURL-UPS</u>:

- Patient position: supine with knee semi-flexed
- First instruct the patient to perform the contraction of abdominal muscles and then lift the head. Progress by lifting the shoulders until the scapula and thorax clear the mat, keeping the arms horizontal.
- Hold this position as much as patient can (maximum 10 seconds) and then relax. 10 repetitions with 3 second interval.

(2) <u>BRIDGING</u>:

- Patient position: hook-lying position
- Have the patient press upper back and feet into the met, elevate the pelvis and extend the hips.
- Hold this position for 10 seconds and then relax. 10 repetitions with 3 second interval.

(3) KNEE TO CHEST:

- Patient position: supine
- Gently pull one knee up to chest until feel a stretch in lower back. Bring the knee as close to your chest as comfortably possible. Keep the opposite leg relaxed in a comfortable position, either with knee bent or with leg extended. Hold for about 5 seconds and then relax. 10 repetitions with 3 second intervals.

(4) BILATERAL STRAIGHT LEG RISING:

- Patient position: supine
- Bend the knee of one leg at 90-degree angle, planting the foot flatly on the floor. Stabilize the muscles on straight leg by contracting the quadriceps.
- Inhaling slowly, lift the straight leg at least 6 inches off the ground. Hold for 3 seconds then relax. 10 repetitions with 3 seconds interval.

(5) BIRD DOG EXERCISE:

- Patient position: Quadruped
- Place patient's knees under their hips and their hands under the shoulders. Maintain a neutral spine by using an abdominal muscles. Raise right arm and left leg, keeping shoulders and hips parallel to the floor. Hold this position for the few seconds, then lower back down to the starting position. Raise opposite arm and leg (left arm and right leg), holding this position for a few seconds. Return to the starting position. This is 1 round. Repeat this 10 times with 2 sets and each round 3 second interval time.

■ **Group B [MFR technique plus conventional treatment]:**

❖ **MFR technique: -**

- Myofascial release is a hands-on soft tissue technique that facilitates a stretch into the restricted fascia. A sustained pressure is applied into the tissue barrier, after 60 to 90 seconds. The tissue will undergo histological length changes allowing the first release to be felt. The therapist Follows the release into a new tissue barrier and holds. After a few releases the tissue will become softer and more pliable.
- Patient position: prone
- Therapist stands contra lateral to the side to be treated, at the level of patient's iliac crest. The therapist's superior hand is positioned thinner sided adjacent to the lumbar spine with extensive contact at the TFL at the level of L1 to L4 and acts as a palpation hand.
- The superior hand work as a palpation hand and initiates a direct stretch of the fascia laterally to a noticeable tissue resistance. The therapist follows the creep of myofascial tissue to initiate further stretching of the TFL and piriformis muscle. The applied force on the tissue is only moderate in the direction of the abdominal muscles.
- The duration of entire technique is 60 to 90 seconds at the same place of the lower back. [NOTE: The therapist contact (which could involve thumb, finger, knuckle or elbow) moves longitudinally along muscle fibers, distal to the proximal.]

RESULT:

Data analysis: Statistical analysis was performed on the data obtained from 30 patients. Data was analysed using SPSS (Version 16). Descriptive statistics for all outcome measures were expressed as mean, standard deviations and test of significance such as paired 't' test used for comparing data within each group and independent 't' test for comparing between the groups. Data was considered statistically significant with P<0.05. Pre and post mean difference of pain (NPRS) shows 1.46 ± 2.12 in group A and 1.73 ± 1.22 in group B. Independent "t" test values chronic LBP shows not significant difference between both groups.

Table 1: Paired "t" test values for Chronic LBP (NPRS)

Groups	Within group analysis	Mean	Mean Difference	Standard Deviation	"t" Value	"p" Value
Group A	Pre-Test Post Test	5.46 4	-1.46	2.12	-3.8977	P<0.05
Group B	Pre-Test Post Test	6.33 4.6	-1.73	1.22	-5.49	P<0.05

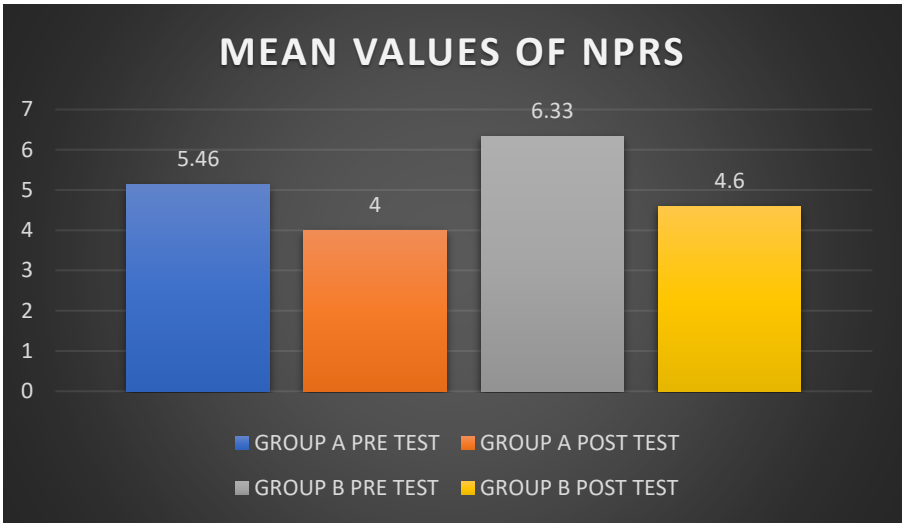

Figure 2. Mean Values of NPRS

Table 2: Independent "t" test values chronic LBP

Outcome Measures	"t" Value	"p" Value
NPRS	-1.16	0.1267

DISCUSSION:

The present study was designed to study effects of Pilates exercise and MFR technique in patients with chronic low back pain. Total 30 patients with low back pain more than 3 months were included in the study with the age group of 30 to 50 years and according to the inclusion and exclusion criteria.

After taking informed, written consent subjects were divided into two groups by simple random Sampling method. Group A received Pilates exercises plus conventional treatment and group B received MFR technique plus conventional treatment. Both groups were assessed before and after treatment duration to determine the extent of reduction of pain using Numerical pain rating scale taken as outcome measures.

At the end of 4 weeks, patients in both groups showed reduction in pain and improvement in NPRS scores on statistical analysis. The result showed that there was no statistically significant difference of effectiveness of pain between Both groups (group A and group B).

So here, both groups were improved after intervention. By comparing NPRS measure group A showed statistically significant improvement in pain equal to the group B. The mean difference of NPRS is almost equal to the both groups. So, Pilates exercise along with conventional treatment and MFR technique along with conventional treatment both are equally effective in reducing pain in patients with Chronic Low Back Pain.

CONCLUSION:

The present study concludes that Pilates exercise along with conventional treatment and Myo Fascial Release technique along with conventional treatment both are equally effective in reducing pain in patients with Chronic Low Back Pain.

LIMITATIONS

- In this study age limit is 30-50 years.
- MFR technique only assessed in chronic low back pain patients.
- Long term follow up is not taken.

FURTHER RECCOMENDATION

- Study can be done with chronic low back pain patients with other age groups.
- MFR technique effectiveness can also be determined for acute low back pain patients.
- Long term follows up of the patients can be taken to compare sustainability of treatment.

ABBREVIATIONS

- **CLBP** = Chronic low back pain
- **MFR** = Myofascial release
- **LBP** = low back pain
- **ADLs** = Activities of daily living
- **TENS** = Transcutaneous electrical nerve stimulation
- **TFL** = Tensor fascia late
- **SLR** = Straight leg raise
- **NPRS** =Numerical pain rating scale
- **VAS** = Visual Analogue Scale

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ATTITUDE AND BELIEF TOWARDS PHYSICAL ACTIVITY AND EXERCISE IN PATIENTS WITH CHRONIC LOW BACK PAIN A LITERATURE REVIEW

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INTRODUCTION

Chronic pain is a major public health problem all over the world.[1] The chronic low back pain is define as the chronic lower back pain is established by the persistence of pain beyond 3 month of symptoms.[1] CLBP can have a debilitating effect on patient's lives, resulting in disability and reducing their ability to carry out activities of daily living.[1] Acute low back pain is pain remains for less than 6 months.[2] Sub-acute back pain is back pain for between 6weeks and 3moths.[2]

Low back pain can affect all age and genders.[2] back pain is then further categorized into specific or non-specific back pain. Non-specific back pain refers to a pain is diagnosed when the cause of back pain is unknown. And specific back pain refers to a specific cause

for the pain, for example an infection or a fracture.[3] back pain is a major health issue in western countries and 60%-80% of adults are likely to experience low back pain[4]. Chronic pain is a significant health problem that leads to major consequences for the individuals afflicted, their families, and society.[4] Chronic pain can lead to various disabilities. Currently, there are in general no curative options for chronic pain, so treatments focus on reducing pain and disability.[4]

Physical activity and physical exercise are commonly prescribed as treatment for chronic pain. Physical activity is defined as any bodily movement produced by skeletal muscles that results in energy expenditure[5]. Physical exercise is described as a subset of physical activity characterized by planned, structured, and repetitive physical activities with an objective to maintain or improve physical fitness.[5] Because the terms physical activity and physical exercise are often used 3 interchangeably in the literature, the term physical activity and exercise (PA&E) is used in this study[6]. PA&E interventions for chronic pain patients can include aerobic exercises, strength exercises, and motor control exercises[6]. PA&E as treatment has shown significant improvements (up to medium effect sizes) for pain intensity, physical disability, and psychological distress in chronic neck pain, chronic low back pain.[6]

WHO defines physical activity as any bodily movement produced by skeletal muscles that requires energy expenditure – including activities undertaken while working, playing, carrying out household chores, travelling and engaging in recreational pursuits.[7] An increase in physical activity is one of the measures that is said to have the greatest positive effect on public health.[7] Physical activity plays an important role in the prevention and treatment of chronic musculoskeletal pain, but chronic pain may implicate a poor rehabilitation outcome.[7] PA increases the blood flow to the back which is important for the healing process of the soft tissues in the back.[7] Physical activity can reduce the risk of chronic disease including cancer, depression, cardiovascular diseases.[8] physical activity is reduced in the people who is suffered from chronic pain.[8]

Activity has been identified as the most important health-related behavior to change, the patients ask health care staff for support in making lifestyle changes.[8] Physical activity increases the blood flow to the back which is important for the healing process of the soft tissues in the back.[8]

The term "physical activity" should not be confused with "exercise", which is a subcategory of physical activity that planned, structured, repetitive, and aims to improve or maintain one or more components of physical fitness.[8] Physical activity to increase aerobic capacity and muscular strength, especially of the lumbar extensor muscles, is important for patients with CLBP in assisting them to complete activities to daily living.[8]

Pain is a subjective and personal experience, and its presence in the chronic form brings not only biological changes but emotional, cognitive and also behavioral changes.[8] The Back Pain Attitudes Questionnaire (Back-PAQ) was developed following these Interviews with people experiencing acute and chronic LBP. It aims to assess beliefs which underlie common attitudes about back pain[9]. Evidence showed that patients with chronic pain that had depression, anxiety and anguish have reported higher intensity of pain and disability.[10] A considerable body of research, based on cognitive-behavioral theory, has established the importance of individuals' pain-related cognitions and coping responses in their adaptation to chronic pain.[11] Beliefs and attitudes influence the acceptance, the results and the satisfaction

with treatment, also impacting the capacity of individuals to build an active and satisfactory life, despite the pain.[12]

For the beliefs facing pain, the Brief Pain Inventory (BPI-brief) was used, validated for the Portuguese language in 2006.[12] The purpose of this instrument is to evaluate the attitudes and beliefs facing pain in patients with non-oncologic chronic pain[12]. It has 30 items corresponding to seven domains: solicitude, emotion, medical cure, control, disability, physical damage, and medication.[12]

The "solicitude" domain relates to how much the patient believes that his/her family and other people should be more solicitous during the pain episodes. "Emotion" relates to the belief of the emotional effects, good or bad, in the painful experience."Medical Cure" relates to how much the patient believes in medicine to cure his/her pain. "Control" relates to how much the patient believes that he/she has control over his/her pain. "Disability" relates to how much the patient believes that the pain has disabled him/her. "Physical Damage" relates to how much, in the patient's point of view, the pain hurts him/herself, and because of it, exercises should be avoided."Medication" relates to how much the patient believes that drugs are the best treatment for chronic pain.[12]

Beliefs are culturally learned certainties; they are each individual's notion concerning its own reality, of the others and of the space, which interferes with the behavior[12]. Beliefs have been described as 'a cognitive process resulting in a concrete cognition of how we think things are'.[13] Attitudes are organized in affective arrangements, relatively stable, that reflect the trend to respond positively or negatively to something or some event. Both are formed from personal experiences[14]. Attitudes are 'a more complex cognitive state involving beliefs and feelings as well as values and predispositions to act in a certain way'.[15] Beliefs and attitudes influence the acceptance, the results and the satisfaction with treatment, also impacting the capacity of individuals to build an active and satisfactory life, despite the pain.[16]

Beliefs about a stressor such as pain, and in particular, appraisals of threat, influence an individual's coping responses (Lazarus, 1993). Coping has been defined as `constantly changing cognitive and behavioral efforts to manage specific external 6 and/or internal demands that are appraised as taxing or exceeding the resources of the person'[17]

Review question

- **What is the attitude and belief towards physical activity in chronic low back pain?**

- **What is the most appropriate treatment to cure the chronic low back pain?**

NEED OF STUDY

NEED OF STUDY

- To understand determinants of belief and attitude towards physical activity and exercise in patients with chronic low back pain.

OBJECTIVE OF REVIEW

OBJECTIVE OF REVIEW

- To identify attitude and belief towards physical activity and exercise in chronic pain.
- To identify attitudes and beliefs about LBP in the general population to analyse their association with individual characteristics and the belief that exercise is an effective treatment for LBP.

HYPOTHESIS

- ***Null Hypothesis(H0):***

There will be no effect or zero pain relief in patient with chronic low back pain.

- ***Alternative Hypothesis(H1):***

There will be significant effect or progress in pain relief in patient with chronic low back pain.

METHODOLOGY

- **KEYWORDS USED FOR SEARCH :**
  - Chronic low back pain, Attitude and belief towards physical activity and exercise

- **SEARCH STRATEGY :**
  - For the literature review, we used standard search strategies involving the querying of online databases MEDLINE (pub med) , Google scholar using key words followed by relevant articles. We included articles in overview.
  - Eligible criteria for the articles were :

Eligible criteria for the articles were:

- Duration of publication : 2013 Onwards
- Article should be in English language
- Age criteria : 45 – 65 years
- Article that assess the physical attitude and the need of exercise
- Exclusion criteria for the articles were :
- Unpublished articles
- Article which published in another language

➢ **DATA SEARCHED** :

- To identified potentially relevant articles in the medical
- Literature, we searched MEDLINE (PUBMED), Google scholar, Sci-hub data bases

➢ **DATA SYNTHESIS :**

- Narrative synthesis of data will be done.

Prisma chart:

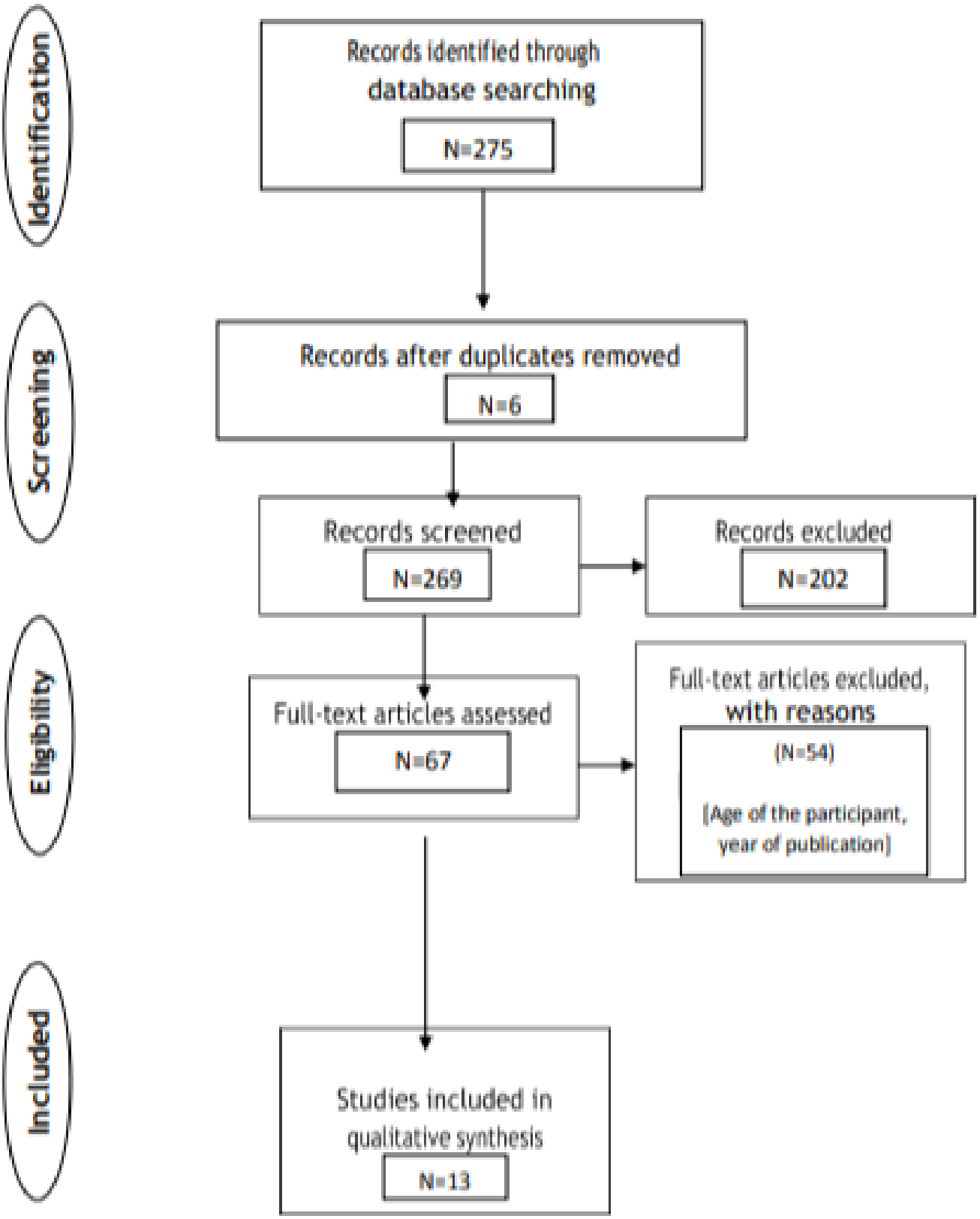

Table-1:

Sr.No..	1
AUTHORS	Anil Chankara mangala m Mathew, Rowther Shamna Safar, Thazhuth ekudiyil Sathyam Anithade vi, Moosa Saira Banu, Singanall ur Lakshma nan ,Ravi Shankar, Beliyur Krishna Dinakar Rai Thomas Vengail Chacko
YEAR	2013
STUDY DESIGN	A cross sectional study
AIM & OBJECTIVE	The aim of this study was to estimate the prevalence of low back pain and its association with height, fat distribution, reproductive history and socioeconomic influence.
OUTCOME	HEIGHT ,WEIGHT,BMI ,WEIST CIRCUM FARANCE, WEST HIP RATIO
REMARKS	The Back Pain Attitudes Questionnaire (Back-PAQ) was developed following these interviews with people experiencing acute and chronic LBP. It aims to assess beliefs which underlie common attitudes about back pain.
Sr.No.	2
AUTHORS	GARIMA GUPTA and NUPUR NANDINI
YEAR	2014
STUDY DESIGN	A cross sectional study
AIM& OBJECTIVE	The purpose of the study was to evaluate the prevalence of low back pain in non- working rural housewives w. also an attempt has been made to determine thew impact of social burden on low back pain.
OUTCOME	Nordic Musculoskeletal Questionnarie– NMQ, Oswestry Disability Index – ODI, and Zarit Burden Interview – ZBI
REMARKS	The findings of the present study suggest that 83% of the non working rural housewives have low back pain and activity restriction due to their pain
Sr.No.	3
AUTHORS	Rebecca gordon and Saul Bloxham
YEAR	2016
AIM&	This paper explores the impact of back pain on society and the role of physical

OBJECTIVE	activity for treatment of non-specific low back pain.
REMARKS	Exercise intervention programmes involving either muscular strength, Flexibility, aerobic, fitness is beneficial for NSCLBP but not acute low back pain. Non- specific acute low back pain patients recover in 4–6 weeks with or without a treatment , and exercising should be avoided to reduce the swelling of the affected area.
Sr.No.	4
AUTHORS	Linn Karlsson Björn Gerdle Esa- Pekka Takala Gerhard Andersso n Britt Larsson
YEAR	2018
STUDY DESIGN	Qualitative interview study
AIM& OBJECTIVE	The purpose of this study was to describe how patients with chronic pain experience physical activity and exercise (PA&E).
OUTCOME	International Physical Activity Question naire (IPAQ) Hospital, Anxiety and Depressio n Scale (HADS), Pain Self- Efficacy Questionnarie (PSEQ), Fear Avoidance Beliefs Questionnarie(FABQ), Psychological.
REMARKS	Physical activity was highly valued in daily life although experiences of PA&E were characterized by difficulties and failure. A will to engage in desired PA&E was apparent, but it was seldom successful even though the participants tried a variety of strategies. This intention– behavior gap identified might be related to the pain condition as well as to motivational aspects, self- efficacy, and action-control, a conclusion that requires careful analysis and support when PA&E is applied as treatment for chronic pain.
Sr.No.	5
AUTHORS	Gerthi Persson, Annika Brorsson , Eva Ekvall Hansson, Margaret a Troein and Eva Lena Strandber g.
YEAR	2013
STUDY DESIGN	Qualitative study
AIM& OBJECTIVE	The aim of the study was to explore and understand the meaning of prescribing physical activity from the general practitioner' s perspective
REMARKS	There is uncertainty about using PAP as a treatment since physicians lack education in non- pharmaceutical methods. the GPs do not regard the written refferal as a prioritized task and rather refer to other professionals in the health care system to prescribe PAP.
Sr.No.	6
AUTHORS	Monica Joelssona , Susanne Bernhard ssona and Maria E. H.

YEAR	2017
STUDY DESIGN	Qualitative study
AIM& OBJECTIVE	The objective of this study was to describe the experiences of and thoughts about receiving a prescription for physical activity of people with chronic Musculoskeletal pain.
REMARKS	This study suggests that patients with chronic musculoskeletal pain have a greater need for information and extra support to overcome existing barriers, before or when physical activity is prescribed.
Sr.No.	7
AUTHORS	Fernanda Martins Barbosa, Érica Brandão de Moraes Vieira , JoãoBatista Santos Garcia
YEAR	2018
STUDY DESIGN	Cross sectional study , Quantative study
AIM& OBJECTIVE	The objective of this study was to evaluate the behavior of beliefs and attitudes inchronic low back pain and to correlate them with the intensity of pain, disability, anxiety, and depression
OUTCOME	NPRS, BPI, ODI, HADS
REMARKS	It was observed in this study that patient with chronic low back pain often present dysfunctional beliefs in relation to pain and that such beliefs showed, in many cases, an association with the intensity of pain, anxiety, depression and mainly disability, with probable consequences in the therapeutic management of these patients.
Sr.No.	8
AUTHORS	D.W. Griffin a, D.C. Harmon b, N.M. Kennede
YEAR	2012
STUDY DESIGN	Systemic review
AIM & OBJECTIVE	The aim of this systematic review was to determine, based on the current body of evidence, if patients with chronic low back pain have a lower level and/or alteredpattern of physical activity compared with asymptomatic,healthy individuals.
OUTCOME	Newcastle Ottawa Scale (NOS)
REMARKS	There is no conclusive evidence that patients either CLBP are less active than healthy individuals. based on limited number of studies , there is some evidence that the distribution of activites over the course of a day is different between patients with CLBP and controls.

Sr.No.	9
AUTHORS	Janet K. Freburge rGeorge M. Holmes, Robert P. Agans, Anne M. Jackman, Jane D. Darter, Andrea S. Wallace, Liana D. Castel, William D. Kalsben and Timothy S. Carey,
YEAR	2009
STUDY DESIGN	Cross sectional , telephone survey
AIM& OBJECTIVE	The objective of this study was to determine whether the prevalenceof chronic LBP, and the demographic, health- related, andcare- seeking characteristi cs of individuals with the condition have changed over the past 14 years.
REMARKS	The prevalence of chronic, impairing LBP has risen significantly in NC, with continuing high levels of disability and care utilization. A substantial portion of the rise in LBP care costs overthe past two decades may be related to this rising prevalence.
Sr.No.	10
AUTHORS	Elin Dysvik, Torill Christine Lindstrøm, Ole- Johan Eikeland, and Gerd Karin Natvig
YEAR	2004
STUDY DESIGN	Survey design
AIM& OBJECTIVE	The present study focused on HRQL as measured by the Medical Outcomes Survey- Short Form (SF-36) and addressed possible relationship s between pain beliefs as measured by the Pain Beliefs and Perceptions Inventory (PBAPI).
OUTCOME	.VAS, SF-36, PBAPI, HRQL
REMARKS	According to CBT altering pain beliefs and improving coping skills may modified the pain experiences and there by improve the health related quality of life.
Sr.No.	11
AUTHORS	Tom Mayer, Robert J. Gatchel, and Trent Evans
YEAR	2000

STUDY DESIGN	Prospective cohort study
AIM& OBJECTIVE	To assess the association between age and objective psychosocio economic treatment outcomes for work- related spinal disorders undergoing functional restoration
OUTCOME	VAS, DALLAS BACK PAIN INVENT ORY
REMARKS	Age does not affect additional surgery rates, subsequent injuries, or delays in settling financial disputes.
Sr.No.	12
AUTHORS	Ivan P.J. Huijnen a,*, Jeanine A. Verbunt a,b,c, Madelon L. Peters d, Philippe Delespau l e,Hanne P.J. Kinderm ans d , Jeffrey Roelofs d, Marielle Goossens d,Henk A.M. Seelen
YEAR	2000
STUDY DESIGN	Cohort study
AIM& OBJECTIVE	This study evaluates whether patients with Chronic Low Back Pain (CLBP) who are more depressed and/or report more pain indeed have a lower objectively assessed daily life activity level or whether they only perceive their activity level as lower
OUTCOME	Roland Disability Question naire (RDQ) Baecke Physical Activity Question naire (BPAQ) VAS Beck Depressio n Inventory II (BDI- II)
REMARKS	The patients with CLBP, who had a higher level of depression, underestimated their daily activity level, although their actual activity level did not differ
Sr. No.	13
AUTHORS	Judith A. Turnera, Mark P. Jensenb, Joan M.Romanao
YEAR	1999
STUDY DESIGN	Cross sectional study
OUTCOME	NPRS
REMARKS	This result of the study confirm that beliefs, coping, and catastrophizing would each be associated significantly with physical disability and depression in patients beginning a multidisciplinary pain treatment program.
Sr. No.	14

AUTHORS	Gur Prasad Dureja, Paraman and N. Jain ,Naresh Shetty, Shyama Prasad Mandal, Ram Prabhoo, Murlidhar Joshi, Subrata Goswami, Karthic Babu, Natarajan, Rajgopalan Iyer, D. Tanna ; Pahari Ghosh Ashok Saxena, Ganesh Kadhe, Abhay A Phansalkar
YEAR	2013
STUDY DESIGN	Epidemiological telephonic survey
AIM& OBJECTIVE	The present epidemiological study identified point prevalence of chronic pain in India, impact on individual's QoL, unveiling current pain treatment practices, and levels of satisfaction with treatment.
REMARKS	A significant population of India suffers from chronic pain, and their QoL is affected leading to disability. A proportion of respondents receiving pain treatment were taking nonprescription medications with a majority of respondents on NSAIDs. A very few were consulting pain management specialists.
Sr. No.	15
AUTHORS	S. Slade, S. Patel, M. Underwo od,J. Keating
YEAR	2015
STUDY DESIGN	Systematic review
AIM& OBJECTIVE	To identify and synthesize qualitative empirical studies that explored what peoplewith non-specific chronic low back pain believe about exercise therapy and physical activity or training for the management of their condition and make recommendations for clinical practice and research.
REMARKS	People are likely to prefer and participate in exercise or training programs and activities that are designed with consideration of their preferences, circumstances, fitness levels and exercise experiences. In the area ofexercise and low back pain research there is a paucity of qualitative data.
Sr.No.	16
AUTHORS	Geneen LJ, Moore RA, Clarke C, Martin D, Colvin LA, Smith BH
YEAR	2020
STUDY DESIGN	Cochrain review
AIM& OBJECTIVE	To provide an overview of Cochrane Reviews of adults with chronic pain to determinethe eIectiveness of diIerent physical activity and exercise intervention s in reducing pain severity and its impact on function, quality of life, and healthcare use & the evidence for any adverse eIects or harm associated with physical activity and exercise interventions.
OUTCOME	NPRS,SF36

REMARKS	There is limited evidence of improvement in pain severity as a result of exercise. Thereis some evidence of improved physical function and a variable effect on both psychological function and quality of life. physical activity and exercise is an intervention with few adverse events that may improve pain severity and physical function, and consequent quality of life. physical activity and exercise is an intervention with few adverse events that may improve pain severity and physical function, and consequent quality of life.
Sr.No.	17
AUTHORS	Melda Soysal,Bi lge Kara, M. Nuri Arda2
YEAR	2012
AIM& OBJECTIVE	To investigate physical activity level in patients with chronic low back and neck pain
OUTCOME	Oswestry Disability Index (ODI), Physical Activity Question naire (IPAQ), (SF-36), Sleep Quality Index (PSQI) , Beck Depressio n Inventory
REMARKS	Physical activity modification was found in patients with chronic low back and neck pain. Physical activity level, disability, sleep, depression and quality of life scores of preoperative patients with low back pain more affected than neck patients.
Sr.No.	18
AUTHORS	Tania Gardner, Kathryn Refshaug e , Lorraine Smith , James McAuley c,Markus Hübscher c, Stephen Goodall
YEAR	2017
STUDY DESIGN	SYSTEMATIC REVIEW
AIM& OBJECTIVE	What influence do physiotherapist' s beliefs and attitudes about chronic low back pain have on their clinical management of people with chronic low back pain
OUTCOME	PABS-PT SCORE FEAR AVOIDANCE
REMARKS	Both quantitative and qualitative studies showed a relationship between treatment orientation and clinical practice. The inclusion of qualitative studies captured the influence of patient factors in clinical practice in chronic low back pain. There is a need to recognize that both beliefs and attitudes regarding treatment orientation of physiotherapists, and therapist-patient factors need to be considered when introducing new clinical practice models, so that the adoption of new clinical practice is maximised

Sr.No.	19
AUTHORS	Tomoko Fujii, Hiroyuki Oka, Kenichir o Takano2, Fuminari Asada3, Takuo Nomura4 , Kayo Kawamat a1,Hiros hi Okazaki5 , Sakae Tanaka6 and Ko Matsudai
YEAR	2015
STUDY DESIGN	Cross sectional study
AIM& OBJECTIVE	High prevalence of low back pain (LBP) in nurses has been reported globally. Ergonomic factors and work- related Psychosocial factors have been focused on as risk factors.
OUTCOME	Fear- Avoidanc e Beliefs Question naire (FABQ), Kessler Psycholo gical Distress Scale (K-6)
REMARKS	A small number of nurses had chronic disabling LBP that interfered with their work. In the nurses who had any type of LBP, high FABs were significantly associated with experiencing chronic disabling LBP. FABs about physical activity might be a potential target for LBP management in nurses.
Sr.No.	20
AUTHORS	Wing S. Wong and Richard Fieldingy
YEAR	2011
STUDY DESIGN	Cross sectional study
AIM& OBJECTIVE	prevalence of chronic pain in the general population of Hong Kong; evaluate the relationship of chronic pain with sociodemographic and life-style factors;
OUTCOME	NPRS, HADS, SF-36
REMARKS	chronic pain is common in the general population of Hong Kong, and the prevalence is highest among women and middle-aged adults.
Sr.No.	21
AUTHORS	Ben Darlow, Meredith Perry, James Stanley, FionaMathieso n,Markus Melloh, G David Baxter, Anthony Dowell
YEAR	2014
STUDY DESIGN	Cross sectional study
AIM& OBJECTIVE	To explore the prevalence of attitudes and beliefs about backpain in New Zealand and compare certain beliefs based on back pain history or health professional exposure.

OUTCOME	.Back Pain Attitudes questionnaire (Back- PAQ).
REMARKS	A large proportion of respondents believed that they needed to protect their back to prevent injury; we theorise that this belief may result in reduced confidence to use the back and contribute to fearavoidance. Uncertainty regarding what is a safe level of activity during an episode of back pain may limit participation
Sr.No.	22
AUTHORS	Corinna Leonhard t,Dirk Lehr,Judi th Luckman n,Heinz-Dieter Basler Erika Baum,Mi chael Pfingsten Jan 36ildebran dt Michael M. Kochen, Annette Becker
YEAR	2009
STUDY DESIGN	Across- lagged panelanalysis
AIM& OBJECTIVE	The assumption that low back pain (LBP) patientssuffer from "disuse" as a consequence of high fear avoidance beliefs is currently Corinna Leonhardt Dirk Lehr under debate
OUTCOME	International physical activity questionnaire, FBQ
REMARKS	study demonstrate demonstrated that a fear- avoidance based physical therapy only showed beneficial effectsin patients who scored high on a FAB- scale at the beginning
Sr.No.	23
AUTHORS	Jeanine A. Verbunt, Klaas R. Westerter p, Geert J. van der Heijden, Henk A. Seelen, Johan W. Vlaeyen, J. Andre Knottnerus
YEAR	2001
STUDY DESIGN	Cross sectional study
AIM& OBJECTIVE	To evaluate disuse (ie, a decreased Daily physical activity level) in patients with chronic low Back pain(LBP) and to evaluate the construct validity of accelerometrv 36inesio phobi physical activity in daily life
OUTCOME	Roland Disability Questionnaire (RDQ), scoring low back disability, Tampa Scale for 36inesio phobia (TSK), VAS
REMARKS	Decrease physical activity levels in this sample of chronic LBP patients was not confirmed. The tracmor is a valid instrument for measuring daily activity in LBP patients.
Sr.No.	24
AUTHORS	Richard MH Evering, Marit GH van Weering, Karin CGM Groothui s-

	Oudshoo rn,Miria
YEAR	2010
AIM& OBJECTIVE	To give an overview of the physical activity level of patients with chronic fatigue syndrome in comparison with asymptomatic controls.
OUTCOME	IPAQ
REMARKS	Patients with chronic fatigue syndrome appear to be less physically active compared with asymptomatic controls. There is no difference in variation of physical activity levels between patients with chronic fatigue syndrome and healthy control subjects, butthe validity and reliability of some methods of measuring Physical activity is questionable or unknown.
Sr.No.	25
AUTHORS	R A Iles, M Davidson , N F Taylor
YEAR	2008
STUDY DESIGN	Systematic review
AIM& OBJECTIVE	To identify psychosocia l predictors of failureto return to work in non-chronic (lasting less than3 months) non-specific low back pain (NSLBP)
REMARKS	To predict work outcome in non-chronic NSLBP, psychosocial assessment should focus on recovery expectation and fear avoidance.The importance of fear avoidance beliefs in chronic pain has been established and it appears these beliefs and behaviours also play an important role in the non-chronic phase of NSLBP and can assist in predicting work outcome.

RESULT

RESULT

275 records were identified using databases searching. Duplicates screening was performed and 6 articles were removed in duplicates screening and than 3 reviews independently scanned the abstract and title or both and determined which studies were to be assessed further and if there were any discrepancies it were then further remove by the supervisor. Prisma flowchart was adapted for the study selection. Following it 275 studies were screened after the duplicates were removed out of which 6 studies were screened after the duplicates were removed. Furthermore excluded as full texts of 67 articles were screened out of which studies were excluded due to many reasons as mentioned in prisma flowchart of study selection. At last we included 13 studies in our data synthesis. The detail of study used in the data synthesis were be mentioned I the data extraction table which include the following detailed: author and year of publication, study design, aim and objective, outcome measure and remarks.

In this study we have observed that chronic low back pain often present dysfunction belief and attitude in relation to pain and that such belief showed in many cases, an association with intensity of pain anxiety and depression. A large proportion of respondents believed that they needed to protect their back to prevent injury; we theorise that this belief may result in reduced confidence to use the back and contribute to fear avoidance. People experiencing back pain may benefit from more targeted information about the positive prognosis. The provision of clear guidance about levels of activity may enable confident participation in an active recovery. According to cognitive behavior therapy altering pain beliefs and improving coping skills may modified the pain. experiecnces and thereby improve the health related quality of life

A very high proportion of respondents believed they should stay active when they have back pain. Among from all the people who are suffering from chronic low back pain, women are having a increasing complain of low back pain in compare of men. If we look most specifically than we found that age group of 41-50 years are those who are suffering from chronic low back pain. In addition to that smoking in men had no significant relationship with low back pain, because those who were found positive chronic low back pain where non smoker. The assosiation of low back pain with reproductive history is found significantly. According to that those women who has history of caesarean section more prone to have a low back pain later a time. Even those who have history of sterilization.

Some study also shows that both men and women who where household and in lower socio economical status reported more back pain than those who were in higher socio economic status. We have found that low back pain in ruler housewifes is around 83%, out of those more than 50% of housewife have severe disability with low back pain. They have also significant impact of social burden on their daily life.

Chronic fatigue syndrome is characterized by severe, disabling chronic fatigue lasting for at least six months. Other symptoms can include musculoskeletal pain, sleep disturbances, impaired concentration and headaches. Patients with chronic fatigue syndrome appear to be less physically active compared with asymptomatic controls.

There is no difference in variation of physical activity levels between patients with chronic fatigue syndrome and healthy control subjects, but the validity and reliability of some methods of measuring physical activity is questionable or unknown.

DISCUSSION

DISCUSSION

The present review was intended to understand determinants of belief and attitude towards physical activity and exercise in patients with chronic low back pain. Main aim of the review was to identify what are the multiple dimension bother the patient to perform physical activity and exercise in chronic low back pain[1]. As well as the review suggests belief may result in reduced confidence to use the back and contribute to fear avoidance[2].

We have found that the prevalence of chronic low back pain more common in aged population (41-50years). In general the prevalence of LBP was higher in women (52.9%) compared to men (28.4%). The alterations in sleep due to the chronic low back pain are very common results and show the impact of this painful syndrome on the quality of life and disability of the individual[4]. Study has also showed that a reduce the level of basic activity in patient with chronic low back pain, whereas increased their sportive and leisure time activities.

There are several studies that conform to the pattern that height is not correlated with the occurrence of low back pain in women, though in men many studies reported a positive correlation[15,17,18]. This study has also examined the association between low back pain and weight. The results conform to the pattern wherein weight does not correlate with the occurrence of low back pain and is consistent with previous studies.[24] These findings provide no evidence that a greater body mass index and waist-hip ratio is associated with an increased risk of low back pain.

The current review found that treatment orientation and fear avoidance beliefs of the physiotherapist had an influence on clinical practice and advice given to patients. A therapist with higher biomedical orientation and fear avoidance beliefs towards chronic low back pain was associated with advice to restrict return to work duties and restrict return to activity, a higher perception of risk associated with work or activity, and increased certification of sick leave. Healthcare professionals' beliefs about chronic low back pain have been shown to have an influence on patient beliefs.

The findings of the present study suggest that 83% of the non working rural housewives have low back pain and activity restriction due to their pain. They have significant impact of social burden on their low back pain. High prevalence (83%) of low back pain among rural housewives is an alarming sign for our society. Better health-care measures to enhance rural housewives education about good posture, ergonomic measures, health schemes, health awareness, and activity pacing could help rural housewives.

In this study, women who have undergone caesarean section or sterilization reported more low back pain than who have not undergone these procedures. This may be due to the sedentary life style after the caesarean section. Nevertheless, it was also observed that women who have occupation described as “Physically demanding” also have higher risk of low back pain suggesting that extremes of activity are probably not ideal.

CONCLUSION

CONCLUSION

Majority of available literature review suggest that patient with chronic low back pain often present dysfunctional beliefs and attitude in relation to pain. A large population subjects believed that they need to protect their back to prevent injury: Which shows that this belief may result in reduce confidence to use the back and contribute to fear avoidance.

Key findings of this literature review are:

- The reason for chronic low back pain are multi factorial which include reduce physical activity, food habit, occupation, under lying disease.
- Patient with low back pain often present that dysfunctional belief and attitude in relation to pain.
- Chronic pain often may lead to disability.

LIMITATIONS

Limitations

- Our review includes limited number of articles so some of the causes of attitude and belief might be missed
- Number of article were very less

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ANNEXURE

	AUTHORS	YEAR	STUDY DESIGN	AIM & OBJECTIVE	OUTCOME	REMARKS
1	1. Anil Chankaramangalam Mathew, Rowther Shamna Safal, Thazhuthekudiyil Sathyam Anthadan, Moosa Saira Banu, Singanallur Lakshmanan, Ravi Shankar, Bellyur Krishna Dinakar Rai, Thomas Vengall Chacko	2013	A cross sectional study	The aim of this study was to estimate the prevalence of low back pain and its association with height, fat distribution, reproductive history and socioeconomic infl uence.	HEIGHT WEIGHT BMI WEIST CIRCUMFARANCE, WEST HIP RATIO	The Back Pain Attitudes Questionnaire (Back-PAQ) was developed following these interviews with people experiencing acute and chronic LBP.23 It aims to assess beliefs which underlie common attitudes about back pain.
2	2. GARIMA GUPTA and NUPUR NANDINI	2014	A cross sectional study	The perpose of the study was to evaluate the prevalence of low back pain in non-working rural housewivwsw. also an attempt has been made to determine thew impact of social burden on loe back pain.	Nordic Musculoskeletal Questionnaire – NMQ, Oswestry Disability Index – ODI, and Zarit Burden Interview – ZBI	The findings of the present study suggest that 83% of the non working rural housewives have low back pain and activity restriction due to their pain
3	6. Rebecca gordon and Saul Bloxham	2016	Systematic Review	This paper explores the impact of back pain on society and the role of physical activity for treatment of non-specific low back pain.		Exercise intervention programmes involving either muscularstrength,flexibility, aoraeroic, fitness is beneficial for NSCLBP but not acute low back pain. Non-specific acute low back pain patients recover in 4–6 weeks with or without a treatment , and exercising should be avoided to reduce the swelling of the affected area.
4	4. Linn Karlsson Björn Gerdle Ewa-Pekka Takala Gerhard Andersson Britt Larsson	2018	qualitative interview study	The purpose of this study was to describe how patients with chronic pain experience physical activity and exercise (PASE).	International Physical Activity Questionnaire (IPAQ) Hospital Anxiety and Depression Scale (HADS), Pain Self-Efficacy Questionnaire (PSEQ), Fear Avoidance Beliefs Questionnaire (FABQ), Psychological Inflexibility in Pain Scale (PIPS)	Physical activity was highly valued in daily life although experiences of PASE were characterized by difficulties and failure. A will to engage in desired PASE was apparent, but it was seldom successful even though the participants tried a variety of strategies. This intention–behavior gap identified might be related to the pain condition as well as to motivational aspects, self-efficacy, and action-control, a conclusion that requires careful analysis and support when PASE is applied as treatment for chronic pain.
5	5.Gerthi Persson,Annika Brörsson , Eva Ekvall Hansson,Margareta Troein and Eva Lena Brandberg	2013	qualitative study	The aim of the study was to explore and understand the meaning of prescribing physical activity from the general practitioner's perspective		There is uncertainty about using PAP as a treatment since physicians lack education in non-pharmaceutical methods, the GPs do not regard the written referral as a prioritized task and rather refer to other professionals in the health care system to prescribe PAP
7	6.Monica Joessona , Susanne Bernhardssona and Maria E. H. Larsson.	2017	qualitative study	The objective of this study was to describe the experiences of and thoughts about receiving a prescription for physical activity of people with chronic musculoskeletal pain		There is uncertainty about using PAP as a treatment since physicians lack education in non-pharmaceutical methods, the GPs do not regard the written referral as a prioritized task and rather refer to other professionals in the health care system to prescribe PAP
8	7.Fernanda Martins Barbosa, Erica Brandão de Moraes Vieira , João Batista Santos Garcia	2018	cross-sectional , quantitative study	The objective of this study was to evaluate the behavior of beliefs and attitudes in chronic low back pain and to correlate them with the intensity of pain, disicability, anxiety, and depression	NPRS, BPI, CDI, HADS	This study suggests that patients with chronic musculoskeletal pain have a greater need for information and extra support to overcome existing barriers, before or when physical activity is prescribed.
9	8.D.W. Griffin a, D.C. Harmon b, N.M. Kennede	2012	systematic review	The aim of this systematic review was to determine, based on the current body of evidence, if patients with chronic low back pain have a lower level and/or altered pattern of physical activity compared with asymptomatic, healthy individuals.	Newcastle Ottawa Scale (NOS)	there is no conclusive evidence that patients eith CLBP are less active than health individuals, based on limited number of studies , there is some evidence that the distribution of activites over the course of a day is different between patients with CLBP and controls.
10	9.Janet K. FreburgerGeorge M. Holmes, Robert P. Agans, Anne M. Jackman, Jane D. Darter, Andres S. Wallace, Liana D. Castel, William D. Kaiser and Timothy S. Carey,	February, 2009	cross-sectional, telephone survey	The objective of this study was to determine whether the prevalence of chronic LBP, and the demographic, health-related, and care-seeking characteristics of individuals with the condition have changed over the past 14 years.		The prevalence of chronic, impairing LBP has risen significantly in NC, with continuing high levels of disability and care utilization. A substantial portion of the rise in LBP care costs over the past two decades may be related to this rising prevalence
11	10.Elin Dysvik, Torill Christine Lindstrøm, Ole-Johan Eikeland, and Gerd Karin Natvig	2004	survey design	The present study focused on HRQL as measured by the Medical Outcomes Survey-Short Form (SF-36) and addressed possible relationships between pain beliefs as measured by the Pain Beliefs and Perceptions Inventory (PBAPI).	,VAS, SF-36, PBAPI, HRQL	according to CBT altering pain beliefs and improving coping skills may modified the pain exeperiences and there by improve the health related quality of life.
12	12.Ivan P.J. Huijnen a,*, Jeanine A. Verbunt a,b,c, Madelon L. Peters d, Philippe Delespaul e,Hanne P.J. Kindermans d , Jeffrey Roelofs d, Marielle Goossens d,Henk A.M. Seelen	2010	cohort study	This study evaluates whether patients with Chronic Low Back Pain (CLBP) who are more depressed and/or report more pain indeed have a lower objectively assessed daily life activity level or whether they only perceive their activity level as lower	Roland Disability Questionnaire (RDQ) Baecke Physical Activity Questionnaire (BPAQ) VAS Beck Depression Inventory II (BDI-II)	the patients with CLBP, who had a higher level of depression, underestimated their daily activity level, although their actual activity level did not differ.
13	13.Judith A. Turnera, Mark P. Jensenb, Joan M. Romanoa	October 1999			NPRS	This result of the study confirm that beliefs, coping, and catastrophizing would each be associated significantly with physical disability and depression in patients beginning a multidisciplinary pain treatment program.
14	14.Gur Prasad Dureja, Paramanand N. Jain,Naresh Bhatty,Bhyana Prasad Mandal, Ram Prabhoo Murallidhar Joshi, Subrata Goswami, Karthic Babu Natarajan, Rajagopalan Iyer, D. Tahina, Pahari Ghosh Ashok Saxena, Ganesh Kadhe, Abhay A. Phansalkar	2013	epidemiological telephonic survey	The present epidemiologic study identified point prevalence of chronic pain in India, impact on individual's QoL, unveiling current pain treatment practices, and levels of satisfaction with treatment.		A signiTcant population of India suffers from chronic pain, and their QoL is affected leading to disability. A proportion of respondents receiving pain treatment were taking nonprescription medications with a majority of respondents on NSAIDs. A very few were consulting pain management specialists.
15	15.S. Slade, S. Patel, M. Underwood J. Keating	May, 2015	systmetic review	To identify and synthesize qualitative empirical studies that explored what people with non-specific chronic low back pain believe about exercise therapy and physical activity or training for the management of their condition and make recommendations for clinical practice and research.		People are likely to prefer and participate in exercise or training programs and activities that are designed with consideration of their preferences, circumstances, fitness levels and exercise experiences. In the area of exercise and low back pain research there is a paucity of qualitative data
16	16.Geneen LJ, Moore RA, Clarke C, Martin D, Colvin LA, Smith BH	2020	cochrain review	To provide an overview of Cochrane Reviews of adults with chronic pain to determine the effectiveness of different physical activity and exercise interventions in reducing pain severity and its impact on function, quality of life, and healthcare use & the evidence for any adverse effects or harm associated with physical activity and exercise interventions.	NPRS, SF-36	There is limited evidence of improvement in pain severity as a result of exercise. There is some evidence of improved physical function and a variable effect on both psychological function and quality of life. physical activity and exercise is an intervention with few adverse events that may improve pain severity and physical function, and consequent quality of life. physical activity and exercise is an intervention with few adverse events that may improve pain severity and physical function, and consequent quality of life.
17	17.Melda Boysal,Bilge Kara, M. Nuri Arda2	2012		To investigate physical activity level in patients with chronic low back and neck pain.	Oswestry Disability Index (ODI), Physical Activity Questionnaire (IPAQ), (SF-36), Sleep Quality Index (PSQI) , Beck Depression Inventory	Physical activity modification was found in patients with chronic low back and neck pain. Physical activity level, disability, sleep, depression and quality of life scores of preoperative patients with low back pain more affected than neck patients.
18	18.Tania Gardner, Kathryn Refshauge , Lorraine Smith , James McAuley c,Markus Hübscher c, Stephen Goodall	2017	systmetic review	What influence do physiotherapists' beliefs and attitudes about chronic low back pain have on their clinical management of people with chronic low back pain	FABB-PT SCORE FEAR AVOIDANCE	Both quantitative and qualitative studies showed a relationship between treatment orientation and clinical practice. The inclusion of qualitative studies captured the influence of patient factors in clinical practice in chronic low back pain. There is a need to recognise that both beliefs and attitudes regarding treatment orientation of physiotherapists, and therapist-patient factors need to be considered when introducing new clinical practice models, so that the adoption of new clinical practice is maximised.
19	19.Tomoko Fujii, Hiroyuki Oka, Kenichiro Takano2, Fuminori Asada3, Takuo Nomura4, Kayo Kawamata1, Hiroshi Okazaki5, Sakae Tanaka6 and Ko Matsudaira	June 2015	cross-sectional study	High prevalence of low back pain (LBP) in nurses has been reported globally. Ergonomic factors and work-related psychosocial factors have been focused on as risk factors.	Fear-Avoidance Beliefs Questionnaire (FABQ), Kessler Psychological Distress Scale (K-6)	A small number of nurses had chronic disabling LBP that interfered with their work. In the nurses who had any type of LBP, high FABs were significantly associated with experiencing chronic disabling LBP. FABs about physical activity might be a potential target for LBP management in nurses.
20	20.Wing S. Wong and Richard Fielding	Feb 2011	cross-sectional study	prevalence of chronic pain in the general population of Hong Kong; evaluate the relationship of chronic pain with sociodemographic and life-style factors;	NPRS, HADS, SF-36	
21	21.Ben Darlow,Meredith Perry, James Stanley, Fiona Mathieson,Markus Melloh, G David Baxter, Anthony Dowell	2014	cross-sectional study	To explore the prevalence of attitudes and beliefs about back pain in New Zealand and compare certain beliefs based on back pain history or health professional exposure.	Back Pain Attitudes Questionnaire (Back-PAQ).	A large proportion of respondents believed that they needed to protect their back to prevent injury; we theorise that this belief may result in reduced confidence to use the back and contribute to fear avoidance. Uncertainty regarding what is a safe level of activity during an episode of back pain may limit participation
22	22.Corinna Leonhardt,Dirk Lehr, Judith Luckmann,Heinz-Dieter Basler Erika Baum,Michael Pfingsten Jan Hildebrandt Michael M. Kochen,Annette Becker	2009	Across-lagged panelanalysi	The assumption that low back pain (LBP) patients suffer from "disuse" as a consequence of high fear avoidance beliefs is currently Corinna Leonhardt Dirk Lehr under debate	international physical activity questionnaire, FBQ	study demonstrate demonstrated that a fear-avoidance based physicaltherapyonlyshowedbeneficialeffectsinpatients who scored high on a FAB-scale at the beginning

21 Ben Darlow,Meredith Perry, James Stanley, Fiona Mathieson,Markus Mellish, G David Baxter, Anthony Dowell	2014	cross-sectional study	To explore the prevalence of attitudes and beliefs about back pain in New Zealand and compare certain beliefs based on back pain history or health professions exposure.	Back Pain Attitudes Questionnaire (Back-PAQ).	A large proportion of respondents believed that they needed to protect their back to prevent injury; we theorise that this belief may result in reduced confidence to use the back and contribute to fear avoidance. Uncertainty regarding what is a safe level of activity during an episode of back pain may limit participation
22 Corinna Leonhardt,Dirk Lehr,Judith Luckmann,Heinz-Dieter Basler Erika Baum,Michael Pfingsten,Jan Hildebrandt Michael M. Kochen,Annette Becker	2009	Across-lagged panelanalysi	The assumption that low back pain (LBP) patients suffer from 'disuse' as a consequence of high fear avoidance beliefs is currently Corinna Leonhardt Dirk Lehr under debate	International physical activity questionnaire, FBQ	study demonstrate demonstrated that a fear-avoidance based physicaltherapyonlyshowedsomebeneficialeffectsinpatients who scored high on a FAB-scale at the beginning
23 Jeanine A Verbunt, Klaas R. Westerterp, Geert J. van der Heijden, Henk A. Seelen, Johan W. Vlaeyen,J. André Knottnerus	Jun 2001	cross-sectional study	To evaluate disuse (ie, a decreased daily physical activity level) in patients with chronic low back pain (LBP) and to evaluate the construct validity of accelerometry formeasuring physical activity in daily life.	Roland Disability Questionnaire (RDQ), scoring low back disability, Tampa Scale for Kinesiophobia (TSK), VAS	Decrease physical activity levels in this sample of chronic LBP patients was not confirmed. the tracmor is a valid instrument for measuring daily activity in LBP patients.
24 Richard MH Bleijenberg, Marit GH van Weering, Karin CGM Groothuis-Oudshoorn,Miriam MR Vollenbroek-Hutten	Jun 2010	systmetic review	To give an overview of the physical activity level of patients with chronic fatigue syndrome in comparison with asymptomatic controls.	IPAQ	Patients with chronic fatigue syndrome appear to be less physically active compared with asymptomatic controls. There is no difference in variation of physical activity levels between patients with chronic fatigue syndrome and healthy control subjects, but the validity and reliability of some methods of measuring physical activity is questionable or unknown.
25 R A Iles, M Davidson, N F Taylor	April 2008	systmetic review	To identify psychosocial predictors of failureto return to work in non-chronic (lasting less than3 months) non-specific low back pain (NSLBP)		To predict work outcome in non-chronic NSLBP, psychosocial assessment should focus on recovery expectation and fear avoidance.The importance of fear avoidance beliefs in chronic pain has been established and it appears these beliefs and behaviours also play an important role in the non-chronic phase of NSLBP and can assist in predicting work outcome.

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Association Of Physical And Mental Health During Covid-19 In College Going Students

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Abstract

Background:
Exercise is an important component of healthy lifestyle to reduce a person's risk of developing the disease and subsequent disability. Stress, anxiety, and depression are overwhelmingly prevalent across the globe during this COVID-19 pandemic, and multiple factors can influence the rate of mental health conditions. Our factorial analysis showed notable associations and manifestations of stress, anxiety, and depressive symptoms. In Corona pandemic one can easily understand that new world order has established and many things changed drastically but importance of physical activity is still at utmost importance so one shouldn't neglect importance of same.

Objectives:
To find out the association of physical activity and mental health in college going student's and to know their mental health status.

Methodology:
This study involved 150 participants between the ages of 18 to 25 years college going students. This survey based study was conducted via mail incitation.

Results:
Self-reported PA was lower post-COVID among participants reporting being previously active (mean change: - 32.3% [95% CI: - 36.3% to - 28.1%]) but largely unchanged among previously inactive participants (+2.3% [- 3.5% to +8.1%]). Decreased PA and increased screen time were associated with worsening in depression, anxiety and stress.

Conclusion:
The current findings strongly support the mental health benefits of implementing measures that promote physical activity.

Key-words:
COVID-19, physical impact, psychological impact, university students.

INTRODUCTION

COVID-19 outbreak: As per World Health Organization (WHO) - Coronavirus disease (COVID-19) is an infectious disease caused by a newly discovered coronavirus. Most people who fall sick with COVID-19 will experience mild to moderate symptoms and recover without special treatment. It was caused by a novel coronavirus, which originated from a wet market in Wuhan, China, and has spread worldwide, earning the pandemic status by WHO on March 11, 2020.[1] As of the 3rd week of July, India has emerged as the third hardest-hit country with 10, 40,980 confirmed cases of COVID-19 and 25,602 deaths and the numbers are still increasing. According to WHO, the most common symptoms: are fever, dry cough, and tiredness. Less common symptoms: aches and pains, sore throat, diarrhoea, conjunctivitis, headache, loss of taste or smell, a rash on skin, or discoloration of fingers or toes. Serious symptoms: difficulty breathing or shortness of breath, chest pain or pressure, loss of speech or movement, Seek immediate medical attention if you have serious symptoms.[2]

Owing to COVID 19, prolonged home stay may lead to increased sedentary behaviours such as spending excessive amounts of time sitting, reclining, or lying down for screening activities (playing games, watching television, using mobile devices); reducing regular physical activity (hence lower energy expenditure); or engaging in avoidance activities that consequently, lead to inactivity and contribute to anxiety and depression and stress, which in turn can lead to a sedentary lifestyle known to result in a range of chronic health conditions. Maintaining regular physical activity and routinely exercising in a safe home environment is an important strategy for healthy living during the coronavirus crisis as an improvement in mental health status of college going students. Mental health is a state of well-being in which an individual realizes their abilities and to cope up with daily stresses of life and able to do productive work and to contribute to society.[3]

Mental health has core symptoms such as anxiety, depression and stress lead to disturbance in mental health. For accurate analysis of depression, anxiety, stress standard scale is DASS-21 (Depression, Anxiety, and Stress Scales – 21) this scale was developed by Lovibond. The three-dimensional self-reporting scales assess the presence and intensity of affective states of depression, anxiety, and stress. And to measure physical Activity standard scale is IPAQ (International physical activity questionnaire) it comprises a set of 4 questionnaires, long (5 activity domains asked independently) and short (4 generic items) versions for use by either telephone or self-administered methods are available.[4]

METHODOLOGY

Research Design: Cross-sectional Survey

Study setting: Online mode

Sampling Method: Convenient Sampling

Sample size: 150

Inclusion criteria:

- Indian college-going students between 18-25
- Able to read, write and understand English language
- Has Internet facility with e-mail

Exclusion criteria:

- Mini-mental scale less than 24
- Any systemic illness (musculoskeletal, cardiovascular, degenerative, and neurological)

Data collection tool:

- Physical activity assessed by: International Physical Activity Questionnaire (IPAQ)
- Mental health assess by DASS-21 (Depression, anxiety, stress scale)

Procedure:

The study was conducted among the college-going students of the Indian population between the ages of 18 to 25 years. Participants entered into the study from different fields of education. A random selection of the participants was used. Firstly, the Google form was created and circulated on an online platform via mail. The online consent form was taken from all the participants before they answered the questions. Secondly, with respective permission, they entered into the online survey of the DASS-21 and IPAQ along with consent and demographic details. Google form consisted of three pages and a total of 28 questions. The first page was about consent and the demographic detail of the participants. The second page was about the depression anxiety, stress scale which consisted of 21 questions and the rating scale was from 0 to 3. Whereas, 0 means did not apply at all and 3 means apply to very much and most of the time. After fillip in the second page, they entered the third page of the survey form. The third page was about the international physical activity questionnaire which consisted of 7 subparts the physical activity in different circumstances. They filled the form with tangible self-experience. The distribution of the survey form was extended to the whole country, however mostly in Gujarat where the majority of students belong. Then we waited for two days for survey collection. Initially, we received 100 responses from the first circulation. After that, we did follow up with the college-going students again via calls and messages. Moreover, we sent a new invitation to other students of the colleges. Then again we waited for the 2 days for more responses. Eventually, at the end of the survey collection, we received more than 160 responses. After the collection of the sample size, we started statistical analysis of the online survey.

DATA ANALYSIS

- Descriptive analysis was done for demographic details.

- Pearson correlation coefficient was to find out the association between physical activity and mental health of college-going students.

RESULT:

160 responses were received, out of which 10 responses were incomplete and hence excluded. The final sample size was 150. The participants were of age group 18 to 25 years with an average age of 21.6 ± 2.15 years.

Table 1: Number the participants according to Gender and Educational Status

Variables	Subgroups	No of Participants	%
Gender	**Male**	79	51.97
	Female	73	48.03
Educational Status	**Bachelor's Degree**	140	92.10
	Master's Degree	11	7.23
	PhD	1	0.65

Table 2: DASS-21 Score for number the participants

	Depression	Anxiety	Stress
Normal	89	72	108
Mild	17	13	14
Moderate	27	23	15
Severe	6	21	8
Extremely Severe	13	23	7

Table 3: IPAQ Analysis for the participants

Type of Activity	Average Days/Weeks	Average Minute/Weeks
Vigorous Physical Activity	3.85	62.5
Moderate Physical Activity	4.33	53.29
Walking	3.85	63.71
Travelling	2.88	67.38
Bicycling	4.17	43.17
Leisure Time	4.68	27.15

DISCUSSION

This research presents a timely investigation of changes in physical activity, sitting time, and screen time as a result of COVID-19 public health restrictions, and their associations with mental health in students. The current findings indicate: (1) large reductions in physical activity and increases in sedentary time across the population and particularly among previously physically active and self-isolated/quarantined individuals; (2) consistent associations between reductions in physical activity and increases in screen time with higher negative mental health and lower positive mental health; and, (3) more severe anxiety and depressive symptoms for those in self-isolation compared to less restrictive situations, which were not moderated by changes in physical activity or sedentary behaviour. We found that females were 1.7 times more likely to be present with depressive symptoms, 2.6 times as likely to show symptoms of anxiety, and twice as likely to show stress symptoms when compared to males but when adjusted for other confounding factors, females were quadruple times as likely as males to have depression and 3.5 times as likely as males to have anxiety. Our results are similar to previous studies conducted during the SARS and COVID-19 pandemic in Italy and China, where the prevalence of psychological disorders was steadily associated with the female gender[4, 5, and 6]. This trend was noted in India before the outbreak too where the prevalence of depression and anxiety disorders was more in females than males. There was no significant association between gender and the likelihood of stress which is in accordance with studies conducted during earlier epidemic/pandemic situations[7]. Gender-specific help and counselling should be offered to mitigate the psychological strain on the population. An interesting finding in our study was the variation in the association between age and depression, anxiety, and stress. Educational status influences the occupation and income of the individual, which are in turn associated with psychosocial wellbeing. The economic crisis due to lockdown might put the individuals without formal education at a higher risk of developing anxiety. Counselling, guidance, or any form of mental health help should include verbal or pictorial representations to aid this group population.

CONCLUSION

The current findings strongly support the mental health benefits of implementing measures that promote physical activity during periods of societal modification due to a pandemic. Potentially effective methods to do so may be through enhanced telehealth or public broadcasting time devoted to the promotion/implementation of home-based physical activity.

LIMITATIONS

- This cross-sectional design precludes inference of causality and the sample is predominantly well-educated.
- In particular, as this study sample is not representative of the entire Indian population, generalizations should be limited based on the sample characteristics.
- All behaviours and currently followed public health guidelines were self-reported and included a recall of pre-COVID-19 activity, which is potentially subject to misreporting. The self-selection and convenience sampling of participants to complete the survey may also affect the results, although a >70% completion rate for those who began the survey is high.

FUTURE RECOMMENDATIONS

Future research should replicate these findings in other large samples, investigate potential cross-national differences, longitudinally assess dynamic relationships between these factors, and integrate device-based measures.

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Effect of Zumba Exercise on Low Back Pain in Obese People: An Experimental Study

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Abstract

Background
Physical inactivity is a commonly observed cause of increasing incidence of lifestyle diseases like obesity which has increased the incidence of low back pain. As dancing is a physical activity that can be tailored to fit a target population's age and culture therefore, Zumba is becoming a global dance fitness activity to reduce lifestyle disease epidemic. It has a mixture of popular entertaining music, different dance styles and aerobic exercises which improves the health of all age groups. Thus, physiological effects of Zumba can be used as adjuncts to conventional medicine for prevention of various lifestyle diseases e.g., diabetes and obesity. Zumba incorporates movement of large muscle groups for aerobic endurance, strength training and flexibility thereby contributing in reducing obesity and thus decreasing back pain in all ages, especially in the geriatric population. Various researchers have also recorded the positive effect of Zumba on weight, BMI, body fat mass. To summarize, these findings reflect that Zumba intervention can be explored further as a therapeutic tool in complementary and alternative medicine for improving low back pain in obese people.

Methodology
An experimental study with a pre-test/post-test design. 30 obese participants between the ages of 18 to 45 years with low back pain were included. We evaluated changes over time (pre-test to post- test) in all outcome measures. Paired t-tests were used to analyze pain and BMI.

Result
Statistically significant improvements were seen in the Pain ($p = 0.0000005$) and BMI ($p = 0.0000002$).

Conclusion
Conclusion the current finding strongly support that Zumba has health benefits and it reduces lower back pain in obese people.

Keywords
ZUMBA, Low back pain, Obesity, Life style disease.

INTRODUCTION

Low back pain is a symptom not a disease, and can result from several different known or unknown abnormalities or diseases. It is defined by the location of pain, typically between the lower rib margins and the buttock creases. It is commonly accompanied by pain in one or both legs and some people with low back pain have associated neurological symptoms in the lower limbs. For nearly all people presenting with low back pain, the specific nociceptive source cannot be identified and those affected are then classified as having so-called non-specific low back pain. People with low back pain often have concurrent pain in other body sites, and more general physical and mental health problems, when compared with people not reporting low

back pain. The combined effect on individuals of low back pain and co-morbidity is often more than the effect of the low back pain or the co-morbidity alone and results in more care, yet typically a poorer response to arrange of treatments.[1]

Obesity is one of the co morbidity which has been associated with low back pain. Obesity is defined by waist circumference was associated with increased incidence of radiating low back pain after adjustment for age, gender, educational status, occupational status, and smoking status.[2] Scientifically, obesity is caused by consuming more calories than needed by the body, they are not burnt through physical activity / exercise. One of the diseases of inactivity is obesity or overweight. Lack of physical work such as sitting for long periods will give a negative effect on health and can lead to obesity, therefore Physical exercise is vital for a healthy life and has several positive influences on the body.[3] Despite this evidence, many clinicians consider obesity to be a self-inflicted condition of little medical significance. It is thus important to focus on obesity which can decrease the incidence of low back pain immensely.[4]

In an effort to reduce rates of obesity Zumba Exercise has deliberately chosen, for reasons that it can be made in the form of weight-bearing exercise program that is homogeneous in an attempt to lose weight by exercise in the right dose. Lately, Zumba dance workout has been highly in demand by the women and young mothers, as it is evident from the increasing amount of participation in gym. In such case, it appears that high moving motivation overtake fatigue and directly influence the reduction of body fat.[3]

Zumba can be used as a physical activity which provides a large calorie burn through aerobic activities done with interval training. The average person will burn around 600 to 1,000calories in a single Zumba class. It Burn an excessive amount of calorie in compared to cardio workout and improves coordination as it is needed when you grow old. It is a full body workout besides this it help you reach your target heart rate, 145 beats per minute which can help in increasing the cardiovascular endurance.[5]

This study is necessary because the prevalence of low back pain is very high in obese people and this study will help to find the effectiveness of Zumba exercise in low back pain in obese people.

METHODOLOGY

Study Design: Experimental Study

Study setting: Community

Sampling Method: Convenient Sampling

Sample size: 30

Inclusion criteria:

- Age- 18 to 45years
- BMI- 30 or higher
- Low Back Pain

Exclusion criteria:

- Age- Below 18 years and above 45 years.
- People with active lifestyle.
- People suffering from cardiovascular, neurological and musculoskeletal conditions.

Outcome Measure:

- Numeric Pain Rating Scale (NPRS).
- Modified Oswestry low back pain disability questionnaire (MODQ)
- Body Mass Index (BMI)

Procedure:

Identification of subjects were done according to the inclusion criteria. Each of them was explained about the study and its benefits and written consent was obtained from each individual. Subjects who fulfilled inclusion and exclusion criteria along with BMI scoring were recruited and assigned into group: **Zumba Exercise group**. Each individual's weight, pain and disability level i.e. BMI, NPRS and MODQ score were taken Pre and Post Intervention.

Exercise group:

30 subjects were taken into the group for 4 weeks, each session was of 45minutes.

The Zumba Exercise schedule consists of:

a) Warm-up session- 5-10minutes

• Upper limb stretching

• Lower limb stretching

• Trunk stretching

b) Zumba exercise - 30minutes

c) Cool-down - 10minutes

• Slowly decrease the intensity of exercise

• Stretching

DATA ANALYSIS

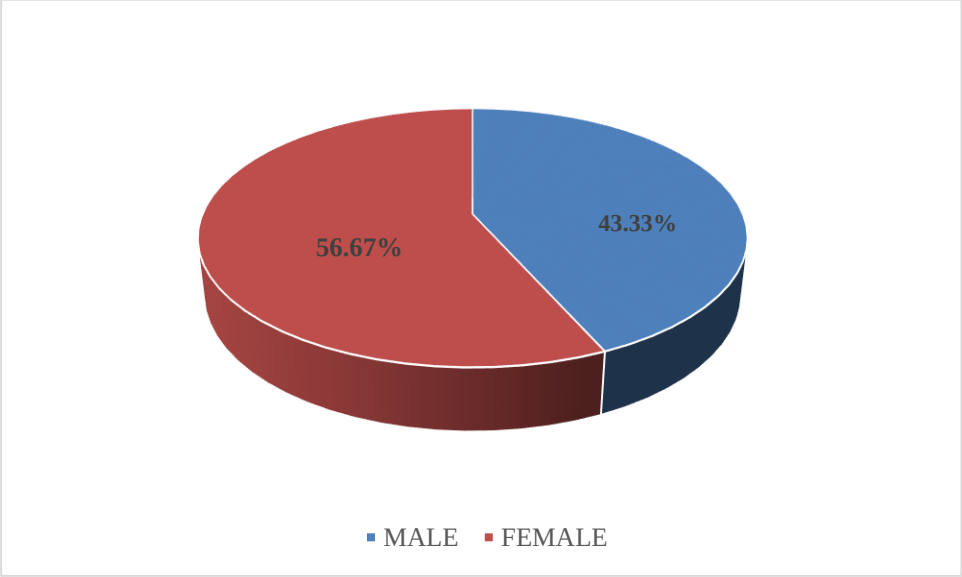
Data were analysed using SPSS statistical software using an intention-to-treat approach. Prior to all hypothesis testing, independent sample t-tests were conducted to examine whether significant mean differences existed in demographic, MODQ, BMI, NPRS scale variables among the group at baseline. We examined whether outcomes changed differentially from baseline to post intervention.

RESULT:

Demographic Profile:

1. GENDER DISTRIBUTION:

There were total 30 participants among which 17 were females and 13 were males.

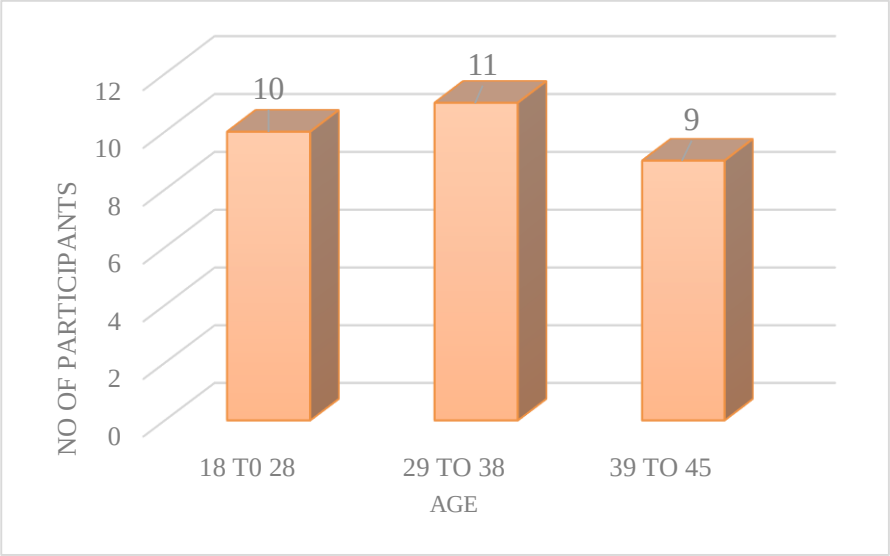


GRAPH 1: GENDER DISTRIBUTION

2. AGE DISTRIBUTION:

MEASURES	MEAN
GROUP	32

TABLE No. 1: Mean of Age Distribution within group



GRAPH 2: AGE DISTRIBUTION

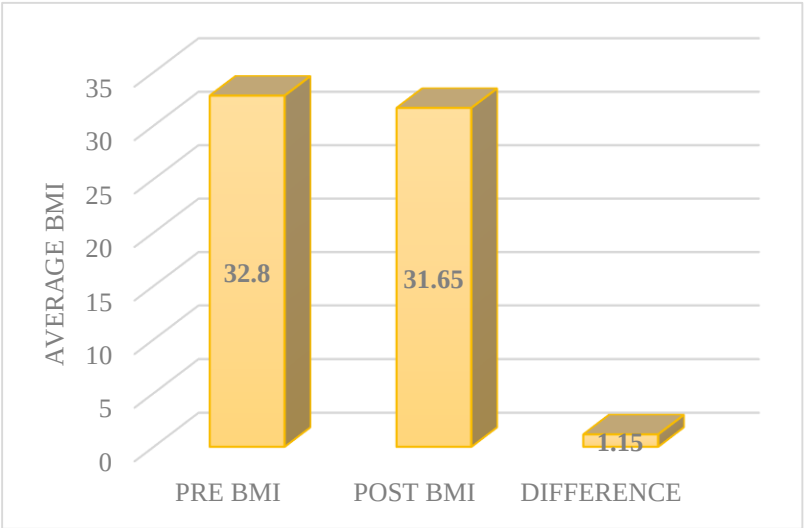
The above given age chart depicts the information about the number of participants taken in different age groups. It is apparent that the highest participant are in the age group of 29 to 38 which is 11, whereas in the age group of 18 to 28 there are 10 participants. In the age group of 39 to 45 there are 9 participants which is the lowest among all.

Clinical Parameters:

3. BMI:

MEASURES	BMI		DIFFERENCE	T-VALUE	P-VALUE
	PRE	POST			
GROUP (comparison within group)	32.70±2.86	31.65±2.39	1.05	0.00000000421308	< 0.01

TABLE No. 2: Comparison of within Groups for BMI



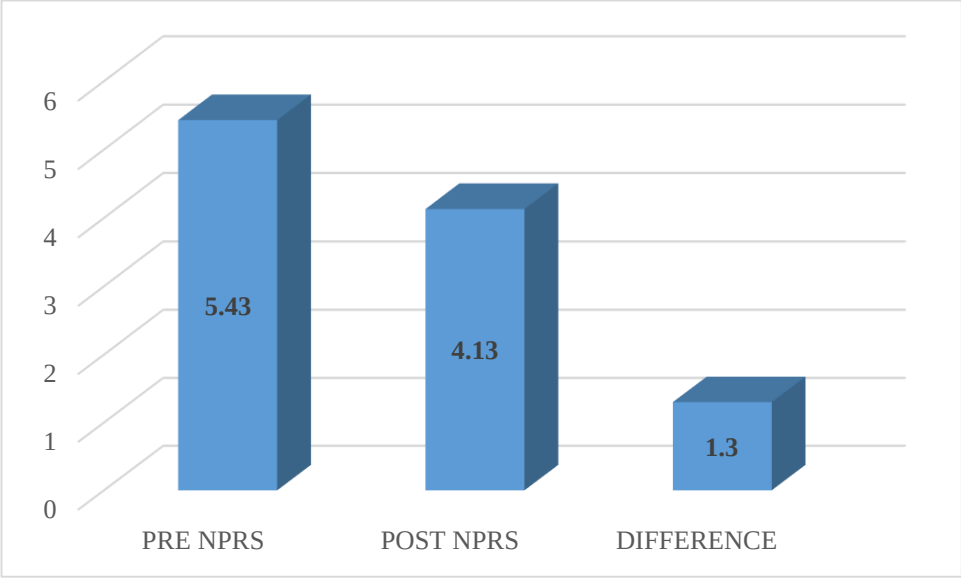
GRAPH 3: Comparison of within Groups for BMI

The above given graph shows the comparison of BMI within the groups. The average BMI were taken before the treatment and it seemed to be 32.8, whereas when the post BMI were taken it had decreased up to 31.65, hence the difference between both turns out to be 1.05.

4. NPRS (NUMERIC PAIN RATING SCALE)

MEASURES	NPRS (NUMARIC PAIN RATING SCALE)		DIFFERENCE	T-VALUE	P-VALUE
GROUP (comparison within group)	PRE	POST	1.3	0.00000000421308	< 0.01
	5.43	4.13			

TABLE No. 3: Comparison of within Groups for NPRS (NUMERIC PAIN RATING SCALE)



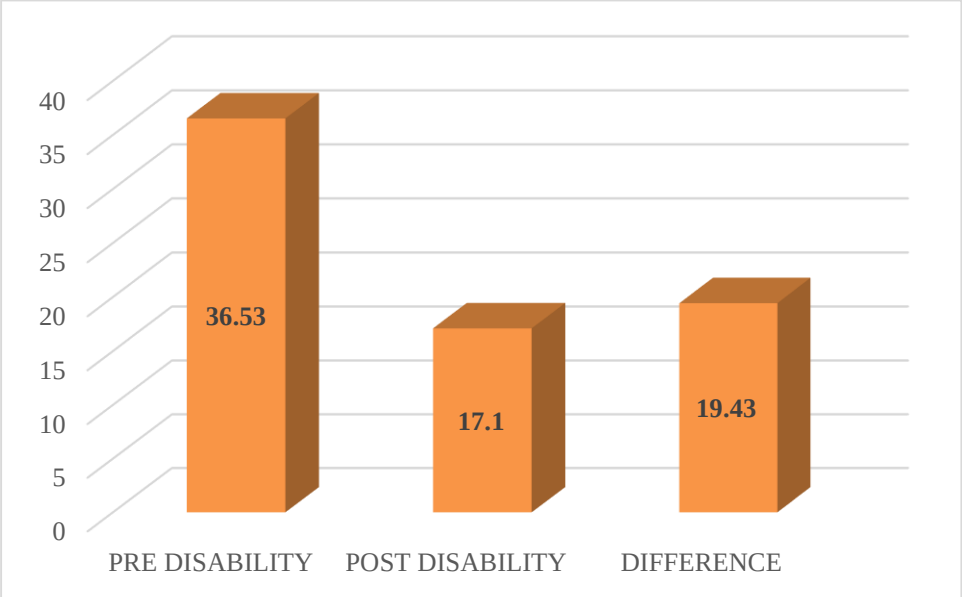
GRAPH 4: Comparison of within Groups for NPRS (NUMERIC PAIN RATING SCALE)

The above given chart shows the comparison of NPRS between the pre and post group. The pre NPRS was noted to be 5.43, however the post NPRS which was taken after the treatment was up to 4.13, hence the difference was noted to be 1.3.

5. MODIFIED OSWESTRY LOW BACK PAIN DISABILITY QUESTIONNAIRE (MODQ).

MEASURES	MODQ		DIFFERENCE	T-VALUE	P-VALUE
GROUP	PRE	POST	19.43	0.00000000000000589	< 0.01
	36.53	17.1			

TABLE No. 4: Comparison of within Groups for MODQ



GRAPH 5: Comparison of within Groups for MODQ.

The above given disability chart illustrates comparison of MODQ within the groups. The number of disability points seem to be high in pre-treatment part which is 36.53, nevertheless after the treatment a drastic change was noted and it dropped at 17.1 in the post phase of treatment, hence the difference seems to be 19.43.

DISCUSSION

The results of the study support the use of effectiveness of Zumba among obese people in low back pain. The findings obtained suggest that 4 weeks of Zumba exercise (five, forty five minute sessions a week) shows significant differences in Disability, Pain, and BMI on Obese individual.

Excessive body weight is directly related to several conditions of the spine, including the number of lumbar discs with degeneration, progression of disc disease, increased likelihood of radicular pain and neurologic symptoms and a higher prevalence of lumbar facet osteoarthritis. There are known postural changes with obesity that are likely contributing factors to an increase in mechanical load to the spine that include:

- A more flexed trunk posture leading to a decrease in flexion motion of the thoracic and thoracolumbar segments.
- An increased lordosis and decreased lateral bending of the lumbar spine.
- An increased hip joint movement.
- An increased anterior pelvic tilt.
- An increased hip-to-bench ratio for table-top work activities (a person has to stand further back from the table due to the size of the abdomen and reach farther forward). This limited spinal mobility has a negative impact on disc nutrition by limiting fluid movement and rehydration. The discs and facet joints are also affected directly by increased inflammatory responses generated by the adipose cells in the form of cytokines and acute-phase reactants.[6]

Despite these proposed and known theories of the effects of obesity on the spine, the role of obesity in directly causing LBP is still being confirmed. A review by Leboeuf-Yde of 56 research studies between 1965 and 1997 led to a conclusion that increased body weight may be a possible weak risk factor for LBP, but there were insufficient data to link it as a clear causative factor.[7]

Snow et al. randomized 54 obese patients (mean BMI 42.6 kg/m2) with musculoskeletal pain as measured by VAS (0–10 points) >5 to a physical therapy treatment program versus control group prior to a weight-loss program. The group receiving physical therapy experienced a significant reduction in VAS to 2.3 with the weight-loss program.[8]

The most recent study of nonsurgical weight loss in 46 adults with LBP and a mean BMI of 44.7 kg/m2 used a 52-week multidisciplinary program. This program included liquid meal replacements for 12 weeks (phase 1) followed by supervised caloric restriction from weeks 13–52 (phase 2). Study participants went to weekly educational meetings and group therapy sessions for the first 26 weeks, and monthly group meetings for the Second 26 weeks. During the second 26 weeks, they also participated in 60–90 min of physical activity. Over the year-long study, mean BMI was reduced to 39.6 kg/m2 (mean decrease of 5.1 kg/m2 [11.4%]) and ODI improved significantly from 31.9 to 27.1, and Numerical Pain Score (NPS) showed improvement (3.3 at baseline; 2.6 at 1 year). Weight, BMI, NPS and ODI all showed the most improvement during the initial 13 weeks of liquid meal replacements, and as the mean weight and BMI decreased, the NPS and ODI scores also decreased.[9]

Many health-associated problems are caused by the increased body fat mass and overweight. Given the global prevalence of overweight, using an accurate method is necessary to decrease overweight. Although Zumba is currently used to lose weight, this type of sport is rarely addressed in practical research as a weight loss method. Thus through this study it can be said that Zumba can be used as a conservative management to reduce weight which significantly decreases low back pain and Disability.

CONCLUSION

The current findings strongly support that Zumba exercise benefits the people having low back pain and who are suffering from obesity.

LIMITATIONS

- Small sample size.
- Limited age group of 18-45 years.
- The self-selection and convenience sampling of participants to complete the study may also influence on the result.

FUTURE RECOMMENDATIONS

- Future research should replicate these findings in other large samples, take larger age groups
- Investigate relationship between Pain and Obesity.

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Job and Career Satisfaction among Physiotherapists of Gujarat State - A Prevalence Study

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Abstract

Background:
Job and career satisfaction is an integral part of an individual's professional life. It affects job performance, consequently influencing growth of the profession. This study aims to assess the level of job and career satisfaction among physiotherapists of Gujarat State.
Methodology:
A cross-sectional survey was done with a self-administered e-questionnaire. 467 surveys collected were subjected to descriptive statistical analysis.
Result:
Overall job satisfaction is 39.83% (3.14±1.20) and career satisfaction is 42.84% (3.18±1.23).
Conclusions:
The majorities of physiotherapists were not satisfied with their jobs and moderately satisfied with their careers. It is essential to incorporate favourable factors in the workplace that promote professional satisfaction and there is a need to enhance opportunities for continued medical education.
Keywords:
Job satisfaction, Career satisfaction, Physiotherapists, Gujarat

INTRODUCTION

Work plays a prominent role in our lives. It occupies more time than any other single activity and provides the economical basis for our life style. Therefore, job satisfaction is a key research area for numerous specialists and is one of the most frequently studied work attitudes.[1]

Health services are affected by many factors such as human resources, delivery system and health infra structures. Among these human resources is a vital component in delivering health services. Job satisfaction of the health workers is highly important in building up employee motivation and efficiency as higher job satisfaction determine better employee performance and higher level of patients' satisfaction. Job satisfaction in health care workers has a great impact on quality, effectiveness and work efficiency and at the same time on health-care costs. Besides its importance for patients and health care system as a whole, professional satisfaction in health care workers is directly connected with absence from work, human relations and organization of work.[2, 3, 4]

Job satisfaction is how an individual feels about his or her job.[5] Job satisfaction, or dissatisfaction, not only depends on the nature of the job, but also on the individual's expectations from the job, and relies on the degree of motivation an employee has. The most common predictors for job satisfaction are leadership, interpersonal relationships, salary and promotion.[6]

Job satisfaction is under the influence of a series of factors such as: The nature of work, Salary, Advancement opportunities, Management, Work groups and Work conditions. [7] Job satisfaction is an important factor in increasing the level of work performance

and career aspirations. It is noted in the literature that there is high correlation between job satisfaction, commitment and better performance.[8, 9.]

One common research finding is that job satisfaction is correlated with life satisfaction. This correlation is reciprocal, meaning people who are satisfied with life tend to be satisfied with their job and people who are satisfied with their job tend to be satisfied with life. However, some research has found that job satisfaction is not significantly related to life satisfaction when other variables such as non-work satisfaction and core self-evaluations are taken into account.[10, 11]

There are important reasons why the researcher should be concerned with job satisfaction the first is that the people deserve to be treated fairly and with respect. Job satisfaction to some extent is a reflection of good treatment. It can also be considered as an indicator of emotional wellbeing or physiological health. The second reason is that job satisfaction can lead to behaviour of employees that affects organizational functioning .Furthermore job satisfaction can be a reflection of organizational functioning. Differences among organizational units in job satisfaction can be diagnostic of potential trouble spots.[12] Dissatisfied workers are more likely to provide inferior services, the physical and mental status and the social functioning of these workers can be affected substantially by the level of their job satisfaction.[13]

In recent years the scope of physiotherapy is also expanding to outside of medical institutions. So, that physiotherapist is increasingly expected to practice according to the social needs.[14] this necessitates practitioners to improve their quality of treatment. In order to deliver high quality of physiotherapy service it is necessary for the physiotherapist to have a firm commitment to their work, awareness of themselves as a professional & motivation & ambition to apply present and past learning and work experience to their future work.[15] One of the premises for quality treatment is job satisfaction, and this, in turn, influences employee retention in the work field, decreases absenteeism, improves work productivity and enhances performance.[16]

Knowledge about Physiotherapists job satisfaction will indirectly influence career choice and professional preferences in students for choosing Physiotherapy as a profession. One of the premises for quality treatment is job satisfaction, and this, in turn, influences employee retention in the work field, decreases absenteeism, improves work productivity and enhances performance.[17] Knowledge about Physiotherapists job satisfaction will indirectly influence career choice and professional preferences in students for choosing Physiotherapy as a profession.[18]

METHODOLOGY

Study design: A cross sectional survey study

Source of data: Physiotherapy colleges of Gujarat, Hospitals and Private Clinics of Gujarat, Social Media (Google, Facebook, Instagram, LinkedIn, and Whatsapp)

Population: Physiotherapists with more than 6 months of experience

Method of collection of data: Online survey form

Sample size: Convenient

Duration of study: 1 year

Inclusion criteria:

- Physiotherapists working in Physiotherapy Colleges of Gujarat.
- Physiotherapists having private practice or working at hospitals of Gujarat
- Physiotherapists having postal and/or email address.
- Physiotherapists having more than 6 months of work/teaching experience.

Exclusion criteria:

- Physiotherapists not willing to participate in the study.
- Physiotherapists not replying to the questionnaire in the fixed time period.
- Physiotherapists having less than 6 months of work/teaching experience.

Procedure:

The questionnaire was constructed with closed questions pertaining to job and career satisfaction. Job satisfaction included a set of questions on knowledge, work ethics, qualification, remuneration, rewards, communication among co-workers, and opportunities provided at the workplace. Career satisfaction included a set of questions on professional status, opportunities, immigration, career path, contribution, and research activity. It also covered basic demographics such as age, gender, years of experience and qualification (i.e. master‘s/bachelor‘s degree). Only the responses of individuals with more than 6 months of experience were included. The questionnaire was developed on Google Forms and consisted 15 closed questions, equally distributed on job and career satisfaction, eight of which focused on job satisfaction, and seven on career satisfaction.

STEP: 1

Identifying eligible candidates according to the inclusion criteria

STEP: 2

Selecting suitable candidates

STEP: 3

Sending consent form

STEP: 4

Sending survey form after receiving consent form

STEP: 5

Collection of data

STEP: 6

Assessment of collected data

STEP: 7

Statistical data analysis

STEP: 8

Result

DATA ANALYSIS

Statistical analysis was carried out with SPSS (v.26). Convenience sampling was used and descriptive statistics was performed. Mean, standard deviation and percentage were used and the level of satisfaction for each question was expressed in percentage. Finally, overall combined job and career satisfaction was calculated in percentage.

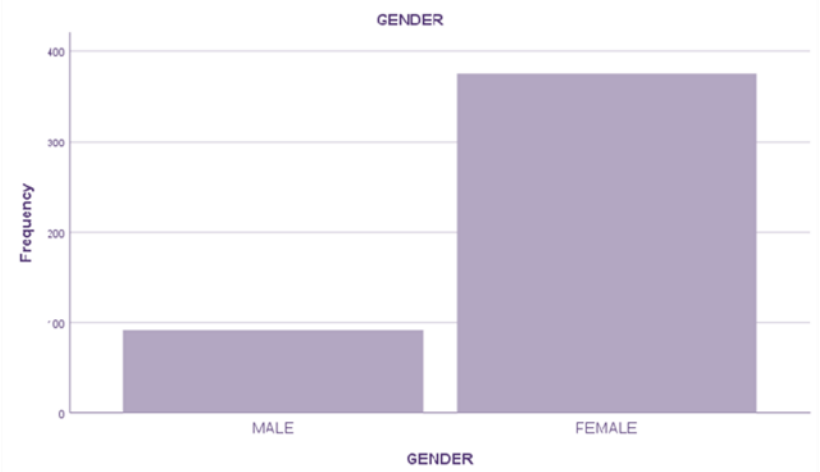
RESULT:

The demographic detail of the respondents is shown in the tables below. There were a total of 467 responses.

GENDER					
		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	**Male**	92	19.7	19.7	19.7
	Female	375	80.3	80.3	100.0
	Total	467	100.0	100.0	

TABLE.1

As shown in the table 1, out of total number of respondents, 92 were male and 375 were female.

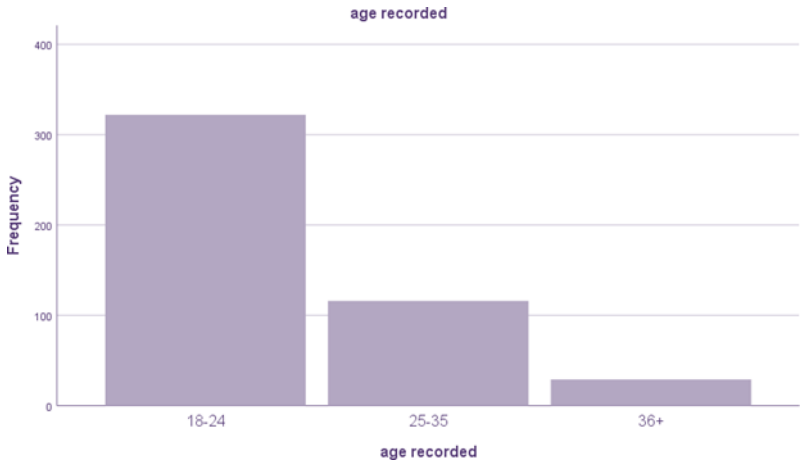


GRAPH.1

AGE RECORDED					
		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	**18-24**	322	69.0	69.0	69.0
	25-35	116	24.8	24.8	93.8
	36+	29	6.2	6.2	100.0
	Total	467	100.0	100.0	

TABLE.2

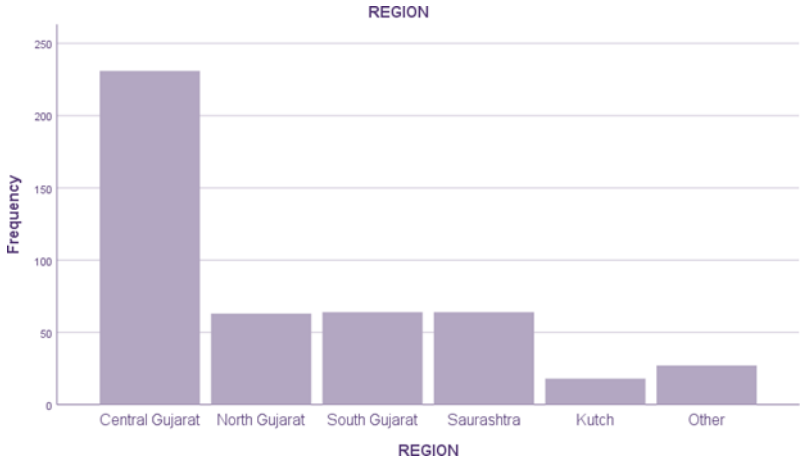
As shown in the table 2, 322 respondents were of age group ranging from 18-24 years, 116 respondents were of age group ranging from 25-35 years and 29 respondents were of age group ranging from 36-45 years.



GRAPH.2

REGION					
		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	**Central Gujarat**	231	49.5	49.5	49.5
	North Gujarat	63	13.5	13.5	63.0
	South Gujarat	64	13.7	13.7	76.7
	Saurashtra	64	13.7	13.7	90.4
	Kutch	18	3.9	3.9	94.2
	Other	27	5.8	5.8	100.0
	Total	467	100.0	100.0	

TABLE.3



GRAPH.3

As shown in the table 3, from the respondents, 231 were from Central Gujarat, 63 were from North Gujarat, 64 were from South Gujarat, 64 were from Saurashtra, 18 were from Kutch and 27 were from other regions of Gujarat.

WORK EXPERIENCE					
		Frequency	**Percent**	**Valid Percent**	**Cumulative e Percent**
Valid	**6 months to 12 months**	288	61.7	61.7	61.7
	1 year to 5 years	135	28.9	28.9	90.6
	More than 5 years	44	9.4	9.4	100.0
	Total	467	100.0	100.0	

TABLE.4

As shown in the table 4, from the respondents 288 were having 6-12 months of experience, 135 were having 1-5 years of experience, 44 were having more than 5 years of experience

GRAPH.4

The tables below represent the statistical analysis (frequency, percentage) of the responses of all the questions asked in the survey which were rated on 5 point likert scale by the respondents

LOJS1					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Extremely dissatisfied	37	7.9	7.9	7.9
	Moderately dissatisfied	63	13.5	13.5	21.4
	Neither satisfied nor dissatisfied	138	29.6	29.6	51.0
	Moderately satisfied	138	29.6	29.6	80.5
	Extremely satisfied	91	19.5	19.5	100.0
	Total	467	100.0	100.0	

TABLE.5

LOJS2					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Extremely dissatisfied	19	4.1	4.1	4.1
	Moderately dissatisfied	27	5.8	5.8	9.9
	Neither satisfied nor dissatisfied	173	37.0	37.0	46.9
	Moderately satisfied	185	39.6	39.6	86.5
	Extremely satisfied	63	13.5	13.5	100.0
	Total	467	100.0	100.0	

TABLE.6

LOJS3					
		Frequency	Percent	Valid Percent	CumulativePercent
Valid	Extremely dissatisfied	55	11.8	11.8	11.8
	Moderately dissatisfied	46	9.9	9.9	21.6
	Neither satisfied nor dissatisfied	138	29.6	29.6	51.2
	Moderately satisfied	146	31.3	31.3	82.4
	Extremely satisfied	82	17.6	17.6	100.0
	Total	467	100.0	100.0	

TABLE.7

LOJS4					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Extremely dissatisfied	64	13.7	13.7	13.7
	Moderately dissatisfied	45	9.6	9.6	23.3
	Neither satisfied nor dissatisfied	90	19.3	19.3	42.6
	Moderately satisfied	157	33.6	33.6	76.2
	Extremely satisfied	111	23.8	23.8	100.0
	Total	467	100.0	100.0	

TABLE.8

LOJS5					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Extremely dissatisfied	83	17.8	17.8	17.8
	Moderately dissatisfied	63	13.5	13.5	31.3
	Neither satisfied nor dissatisfied	156	33.4	33.4	64.7
	Moderately satisfied	119	25.5	25.5	90.1
	extremely satisfied	46	9.9	9.9	100.0
	Total	467	100.0	100.0	

TABLE.9

LOJS6					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Extremely dissatisfied	82	17.6	17.6	17.6
	Moderately dissatisfied	117	25.1	25.1	42.6
	Neither satisfied nor dissatisfied	148	31.7	31.7	74.3
	Moderately satisfied	46	9.9	9.9	84.2
	Extremely satisfied	74	15.8	15.8	100.0
	Total	467	100.0	100.0	

TABLE.10

LOJS7					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Extremely dissatisfied	46	9.9	9.9	9.9
	Moderately dissatisfied	118	25.3	25.3	35.1
	Neither satisfied nor dissatisfied	184	39.4	39.4	74.5
	Moderately satisfied	36	7.7	7.7	82.2
	Extremely satisfied	83	17.8	17.8	100.0
	Total	467	100.0	100.0	

TABLE.11

LOJS8					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Extremely dissatisfied	91	19.5	19.5	19.5
	Moderately dissatisfied	110	23.6	23.6	43.0
	Neither satisfied nor dissatisfied	156	33.4	33.4	76.4
	Moderately satisfied	46	9.9	9.9	86.3
	Extremely satisfied	64	13.7	13.7	100.0
	Total	467	100.0	100.0	

TABLE.12

LOCS9					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Extremely dissatisfied	100	21.4	21.4	21.4
	Moderately dissatisfied	18	3.9	3.9	25.3
	Neither satisfied nor dissatisfied	118	25.3	25.3	50.5
	Moderately satisfied	139	29.8	29.8	80.3
	Extremely satisfied	92	19.7	19.7	100.0
	Total	467	100.0	100.0	

TABLE.13

LOCS10					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Extremely dissatisfied	80	17.1	17.1	17.1
	Moderately dissatisfied	82	17.6	17.6	34.7
	Neither satisfied nor dissatisfied	208	44.5	44.5	79.2
	Moderately satisfied	97	20.8	20.8	100.0
	Total	467	100.0	100.0	

TABLE.14

LOCS11					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Extremely dissatisfied	73	15.6	15.6	15.6
	Moderately dissatisfied	54	11.6	11.6	27.2
	Neither satisfied nor dissatisfied	110	23.6	23.6	50.7
	Moderately satisfied	100	21.4	21.4	72.2
	Extremely satisfied	130	27.8	27.8	100.0
	Total	467	100.0	100.0	

TABLE.15

LOCS12					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Extremely dissatisfied	56	12.0	12.0	12.0
	Moderately dissatisfied	18	3.9	3.9	15.8
	Neither satisfied nor dissatisfied	127	27.2	27.2	43.0
	Moderately satisfied	147	31.5	31.5	74.5
	Extremely satisfied	119	25.5	25.5	100.0
	Total	467	100.0	100.0	

TABLE.16

LOCS13					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Extremely dissatisfied	55	11.8	11.8	11.8
	Moderately dissatisfied	74	15.8	15.8	27.6
	Neither satisfied nor dissatisfied	162	34.7	34.7	62.3
	Moderately satisfied	120	25.7	25.7	88.0
	Extremely satisfied	56	12.0	12.0	100.0
	Total	467	100.0	100.0	

TABLE.17

Locs14					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Extremely dissatisfied	74	15.8	15.8	15.8
	Moderately dissatisfied	36	7.7	7.7	23.6
	Neither satisfied nor dissatisfied	156	33.4	33.4	57.0
	Moderately satisfied	146	31.3	31.3	88.2
	Extremely satisfied	55	11.8	11.8	100.0
	Total	467	100.0	100.0	

TABLE.18

Locs15					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Neither satisfied nor dissatisfied	15	3.2	3.2	3.2
	Moderately satisfied	422	90.4	90.4	93.6
	Extremely satisfied	30	6.4	6.4	100.0
	Total	467	100.0	100.0	

TABLE.19

The tables below represent the statistical analysis (mean, standard deviation) of the responses of all the questions asked in the survey which were rated on 5 point likert scale by the respondents.

Statistics						
		LOJS1	LOJS2	LOJS3	LOJS4	LOJS5
N	Valid	467	467	467	467	467
	Missing	0	0	0	0	0
Mean		3.3919	3.5268	3.3298	3.4411	2.9615
Std. Deviation		1.17310	.93847	1.21614	1.31933	1.22326

TABLE.20

Statistics						
		LOJS6	LOJS7	LOJS8	LOJS9	LOJS10
N	Valid	467	467	467	467	467
	Missing	0	0	0	0	0
Mean		2.8137	2.9829	2.7473	3.2248	2.6895
Std. Deviation		1.28610	1.19895	1.26541	1.39080	.98702

TABLE.21

Statistics						
		LOJS11	LOJS12	LOJS13	LOJS14	LOJS15
N	Valid	467	467	467	467	467
	Missing	0	0	0	0	0
Mean		3.3426	3.5460	3.1028	3.1542	4.0321
Std. Deviation		1.39833	1.24797	1.16555	1.21410	.30908

TABLE.22

Table 23 represents the level of job satisfaction among PTs. The results reflected that the majority of PTs were satisfied with their job in all aspects measured.

Table 23. Level of job satisfaction among physiotherapists				
	Questions	**Mean**	**Std. deviation**	**Level of satisfaction (%)**
QI	**Are you satisfied with the opportunities provided at your workplace to improve and update your knowledge and clinical skills?**	3.3919	1.17310	49.1%
Q2	**What is your level of satisfaction with the communication between your co- workers and supervisors in workplace?**	3.5268	0.93847	53.1%
Q3	**What is your level of satisfaction with work ethics at your workplace?**	3.3298	1.21614	48.9%
Q4	**Are you satisfied with your qualification matching the designation?**	3.4411	1.31933	57.4%
Q5	**Are you satisfied with remuneration for the service you provide?**	2.9615	1.22326	35.4%
Q6	**Are there regular increments in your salary in the organization/hospital you are working in?**	2.8137	1.28610	25.7%
Q7	**Are you satisfied with the criteria implemented in your organization/hospital for promotion?**	2.9829	1.19895	25.5%
Q8	**Are you satisfied with the rewards received for your performance (excluding timely promotion)?**	2.7473	1.26541	23.6%
	Overall job satisfaction	3.1493	1.2025	39.8375%
20–40% dissatisfied; 41–60 moderately satisfied; 61–80 satisfied; >80 highly satisfied				

The results were as follows for satisfaction with:

- Opportunities provided in the workplace to improve knowledge and skill level: 49.1% (3.39± 1.173)
- Communication among co-workers: 53.1% (3.526± 1.216)
- Work ethics: 48.9% (3.32±1.216)
- Qualification matching with designation: 57.4% (3.44±1.319)
- Remuneration: 35.4% (2.96 ±1.223)
- Rewards at workplace: 25.5% (2.98±1.198)
- Overall job satisfaction among physiotherapists: 39.83% (3.14± 1.202).

Table 24. Results demonstrating level of career satisfaction among physiotherapists				
		Mean	**Std deviation**	**Level of career satisfaction (%)**
Q9	**Are you satisfied with your professional status in the community and social life?**	3.224	1.39080	49.5%
Q10	**Are you satisfied with the opportunities available in India for continued professional education?**	2.6895	0.98702	20.8%
Q11	**Are you satisfied with the career path you chose?**	3.3426	1.3983	49.2%
Q12	**Are you satisfied with your contribution towards the growth of the physiotherapy profession in India?**	3.5460	1.2479	57%
Q13	**Are you satisfied with opportunities provided for research activity at your work place?**	3.1028	1.1655	37.7%
	Overall career satisfaction	3.180	1.237	42.84%
20–40% dissatisfied; 41–60 moderately satisfied; 61–80 satisfied; >80 highly satisfied				

Table 25. Results regarding qualification/income and immigration				
		Mean	**Std. Deviation**	**Level of agreement**
Q14	**Your qualification (1/2/PhD) influences your income**	3.1542	1.21410	43.1%
Q15	**Indian PTs are immigrating for better prospects**	4.0321	.30908	96.8%
20–40% disagree; 41–60% moderately disagree; 61–80% agree; >80% highly agree				

Table 24 and Table 25 represent career satisfaction level among physiotherapists

The results were as follows for satisfaction with:

- Satisfaction with professional status: 49.5% (3.224±1.390)
- Opportunities for continued medical education: 20.8% (2.68±0.987).
- Satisfied with the career path chosen: 49.2% (3.76±1.363)
- Contribution to the profession: 57% (3.546 ±1.247).
- Opportunities at work: 37.7% (3.10±1.165)
- Qualification level influences the income: 43.1% (2.74±1.439),
- Physiotherapists emigrating for better prospects: 96.8% (4.032±0.309).
- Overall career satisfaction among physiotherapists: 42.84% (3.18±1.137).

DISCUSSION:

In this state level survey, it was found that most physiotherapists surveyed were moderately dissatisfied with their job and career. The authors were unable to find literature on career satisfaction among Physiotherapists of Gujarat State.

Job satisfaction

Workplace opportunities, communication, ethics, and qualification-matching designation:

Physiotherapy is a skill-based profession where most of the techniques require a hands-on approach. Therefore, it is important for individual physiotherapists to have periodic training to update their skills and knowledge within their workplaces based upon international standards. Developing countries like India lack such opportunities. However, this study reveals that the majority of the

individual surveys were happy about the current opportunities provided to them. Interpersonal relationships, which affect communication among co-workers, is another sensitive area that has an impact on professional development[19]. The survey within this study showed that 53.1% of the physiotherapists were satisfied with their communication with co-workers and supervisors. One of the important aspects of job satisfaction is having an appropriate designation based on an individual's qualification. This is the indirect way of keeping workers effective at work. Depending on their designation, their remuneration and work responsibilities can change. In this study, 57.4% of physiotherapists were happy with their designation based on their qualification. Work ethics is also one of the important factors, which determines employee satisfaction on. This study shows that the majority of the employees reported being satisfied with their organization's work ethics.[20]

Career satisfaction

Professional status, qualification influence on income, and immigration:

In the current study, 49.5% of the physiotherapists were satisfied with their professional status in the community. The majority of the participants agree that physiotherapists are immigrating to other places for better prospects. This indirectly states that the majority of them are dissatisfied working in Gujarat, and it is presumed to be the same in other developing countries. Since this survey has been able to reach only a few of the PTs in Gujarat, however, this statement cannot be generalized. There is a need for extensive research regarding this aspect.

Remuneration, salary increments, organizational criteria and rewards:

Remuneration is another important element of job satisfaction. This survey reveals that only 35.4% of physiotherapists were happy with the remuneration they receive for the work they do. This provides some insight into the situation in India where it appears physiotherapists feel they are underpaid. Motivating the employee to improve their performance in the workplace is necessary, as is rewarding them periodically for their performance.[21]

In the current survey, 25.5% of the respondents was satisfied with the rewards they received for their work performance.

Career choice, contribution to the profession and opportunities for research activity:

The most encouraging aspect of this survey is that the majority of the participants were happy about the career they have chosen. It is essential to keep ourselves updated with recent information in order to provide safe, effective and quality care for our patients. Of the population in the current study, 79.2% expressed dissatisfaction towards the opportunities provided for continued professional education.

CONCLUSION

The majority of physiotherapists in the current study were not satisfied with their job and moderately satisfied with their career in the state of Gujarat. This study represents the scenario in state of Gujarat in India, providing insight into the situation in developing countries and also provides a global outlook when compared with developed countries.

LIMITATIONS

- Convenient sample size. Responses were collected from the physiotherapists whose contacts were possible either through email or social media.
- The main limitation of the study was the participation in the survey. As the survey was sent electronically, the response rate was solely dependent on participants 'motivation.
- The major drawback of the study was that it could only reach the major cities in Gujarat, and those who used networks. This should be a consideration for future study.
- This was a preliminary survey which does not represent the entire population; hence, a detailed study should be carried out with large sample size in order to be able to generalize the results.

FUTURE RECOMMENDATIONS:

- Other factors affecting job satisfaction can be considered.
- Individual factor for job satisfaction can be studied.
- Inclusion of all the physiotherapists in Gujarat.
- Job satisfaction of Physiotherapists can be compared with other health care professionals.
- Job satisfaction among Physiotherapists working in different health care settings can be studied.

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Find Prevalence Of Osteoarthritis In Young Working Professionals A Cross-Sectional Study

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ABSTRACT

BACKGROUND AND OBJECTIVES :

This study was conducted to find the prevalence of osteoarthritis of knee in young people age between 21 to 30 years having sitting or standing work profession. The purpose of the study was to find prevalence ratio of OA in young people. Osteoarthritis (OA) is defined as a heterogeneous group of conditions that lead to joint symptoms and signs associated with a defective articular cartilage and related changes in bone morphology. It is considered the most common type of arthritis, as well as one of the most significant health problems that pervades our modern world. In 2019, it was estimated that 43 million adults suffered from arthritis. Of those, 26.9 million adults aged 25 years or older had OA. One in four people is expected to develop symptomatic OA in his or her lifetime.

INTRODUCTION :

Arthritis is a common joint problem usually associated with older adults. And there are very less study/,research Conducted on osteoarthritis in young age. According to the National Library of Medicine (NLM)Trusted Source, most people show symptoms of osteoarthritis by the time they are 70 years old, but there are also potential chances of osteoathritis in young age. So, this research helps to determine the Prevalence rate in various conditions. So this study may help to determine the prevalence ratio of OA in young people.

METHODOLOGY:

Research will be done on around 100 subjects age between 21 to 30 years with having sitting or standing profession to find Prevalence ratio for OA in young people.

Prevalence rate will be calculated by below formula.
* Prevalence percentage = OA will be found for given
Criteria / OA Will be not found for given criteria (Number of sub.) * 100 %

An observational study was conducted by using the convenient sample method. One hundred working professionals of ahmedabad and nearby area participated in this study by performa validated assessment form and clinical measures.

RESULT:

The prevalence of OA varies according to the definition of OA, the specific joint(s) under study, and the characteristics of the study population. The age standardized prevalence of radiographic knee OA in given subjects age between 21-30 years was only 5% among the all participants. Out of 100 subjects only 5 subjects primarily suspected of having OA of knee. Out of 100 subjects there was 56 female and 44 male subject in this survey. And OA was found in 3 female and 2 male subject after assessing clinical measures.

So, the prevalence percentage of OA of knee in young people age between 21 to 30 years having prolonged sitting or standing work profession would be as below:

$$\text{Prevalence percentage} = \frac{\text{OA will be found for given Criteria}}{\text{OA Will be not found for given criteria}} \times 100$$

PREVALENCE PERCENTAGE = 5/95 * 100% = **5.2631%**

A sum of 100 working professionals responded answering the questionnaire. An analysis was done by excel & calculation was done by chi square test calculator. The chi- square statistics found as **0.1695.** The p value is **0.918761**. The result is not significant at **p < .01**.

Keywords : Osteoarthritis , Prevalence , Young working professionals

Introduction

●Osteoarthritis (OA) is a common chronic condition resulting in pain, fatigue, functional limitations, increased healthcare utilization and high economic costs to society. The burden of OA is projected to increase, due in part to obesity and population aging.
●While the prevalence of OA increases with age, there is a growing recognition that OA affects people at younger ages.
●Recent US data demonstrated that half of people with symptomatic knee OA are diagnosed by age 55.

• Osteoarthritis (OA) is one of the most devastating chronic conditions that affect people around the world.
• Although the usual population associated with the condition is the elderly, who are mostly inactive, athletes and younger individuals are also susceptible.
• Depending on the population, the etiology may differ; injuries, occupational activities, and obesity appear to be the most common
causes of OA in young and athletic populations. [1]

Fig 1.1 X-RAY FINDING OF KNEE OA

Left) In this x-ray of a normal knee, the space between the bones indicates healthy cartilage (arrows). (Right) This x-ray of an arthritic knee shows severe loss of joint space.

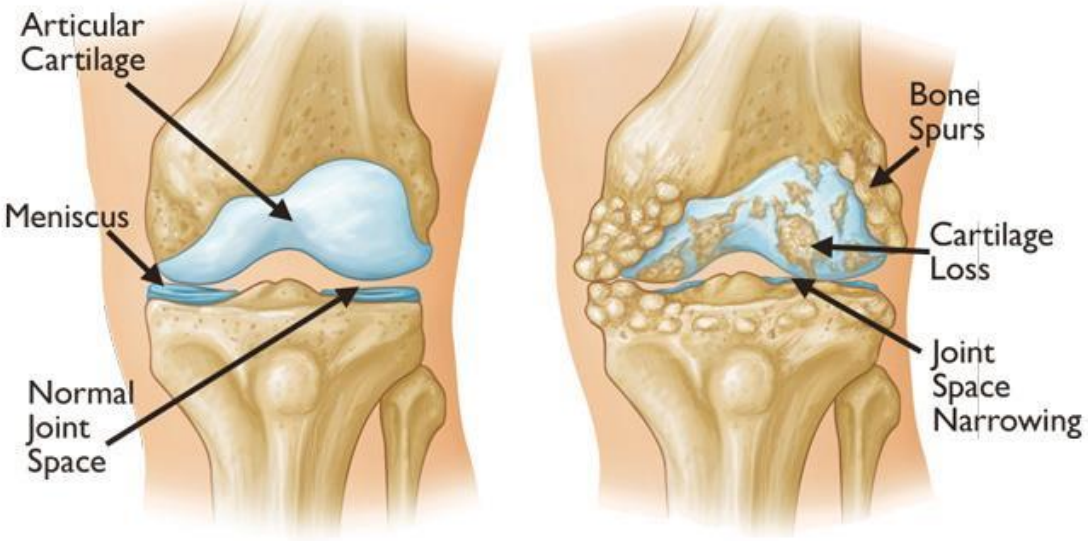


Fig 1.2 NORMAL KNEE VS OA KNEE

Osteoarthritis often results in bone rubbing on bone. Bone spurs are a common feature of this form of arthritis.

Stage 0 represents a normal joint.

- Stage 1 represents very minor wear and tear on a joint, but pain is unlikely.
- Stage 2 represents mild osteoarthritis, which is when most will typically begin experiencing pain and discomfort.
- Stage 3 is designated moderate, where there is obvious cartilage erosion. This may come with joint stiffness, more severe pain, and the experience of popping or snapping sounds.
- Stage 4 osteoarthritis is severe, where the joint space between the bones is considerably reduced. This creates greater friction, which generates more pain and discomfort.

What Are the Symptoms of Osteoarthritis?

• Symptoms of osteoarthritis most often develop gradually and include:
• Joint aching and soreness, especially with movement
• Pain after overuse or after long periods of inactivity
• Stiffness after periods of rest
• Bony enlargements in the middle and end joints of the fingers

(which may or may not be painful)

• Joint swelling
Some Of Potential Causes That Can Develop OA In Young People.
• There are several factors that increase a person's chances of developing osteoarthritis. These include:

• **Heredity**. Some people have an inherited defect in one of the genes responsible for making cartilage. This causes defective cartilage, which leads to more rapid deterioration of joints.
•People born with joint abnormalities are more likely to develop osteoarthritis, and those born with an abnormality of the spine (such as scoliosis or curvature of the spine) are more likely to develop osteoarthritis of the spine.[3]

• **Obesity** . Obesity increases the risk for osteoarthritis of the knee, hip, and spine. Maintaining ideal weight or losing excess weight may help prevent osteoarthritis of these areas or decrease the rate of progression once osteoarthritis is established.

• **Injury**. Injuries contribute to the development of osteoarthritis. For example, athletes who have knee-related injuries may be at higher risk of developing osteoarthritis of the knee. In addition, people who have had a severe back injury may
be predisposed to develop osteoarthritis of the spine. People who have had a broken bone near a joint are prone to develop osteoarthritis in that joint.[3]

• **Joint overuse**. Overuse of certain joints increases the risk of developing osteoarthritis. For example, people in jobs requiring repeated bending of the knee are at increased risk for developing osteoarthritis of the knee.
• Other diseases. People with rheumatoid arthritis, the second most common type of arthritis, are more likely to develop osteoarthritis. In addition, certain rare conditions, such as iron overload or excess growth hormone, increase the chance of developing OA.[3]

•OA isn’t restricted to older adults. Younger adults can also experience symptoms that may signify OA, including:

• morning joint stiffness
• aching pain
• tender joints
• limited range of motion
• Most often pathology develops in women but found in men.
Usually it is detected when it has already happened to
fracture, especially of the femur, which is considered the
most serious and life-threatening.[4]

• After pain, stiffness was identified as a significant
symptom that…
• impacted daily life. Other impactful symptoms included:

• - functional, walking and standing limitations
• - loss of flexibility
• - sleep disturbance
• - fatigue
• - grating (bone on bone) sensation
• - joint swelling
• - disfigurement
• - other numbness and instability (OA VOP 2017)[4]

• Diagnosing OA in athletes and young individuals is sometimes challenging because of their increased pain tolerance. However, the treatment of OA in these populations does not differ from its management in the general population.
• Several considerations need to be taken into account when choosing a treatment modality. The purpose of this review is to address OA in athletes and younger individuals and to discuss its presentation, diagnosis, and treatment.[4]

Clinical Findings for OA

X-Rays – Cartilage loss, a tell-tale sign of osteoarthritis, appears as a narrowing of the space between bones in the joint. While an X-ray image will not show the cartilage itself, your doctor can use this bone proximity to provide a diagnosis. An X-ray can also show bone spurs around a joint, which may cause pain and tenderness.

MRI – A magnetic resonance imaging test, or MRI, can produce detailed images of bone and soft tissues. This includes cartilage. This test is not typically needed for an initial diagnosis, but it can provide more information about the disease's progression.

Blood tests – Certain blood tests can help rule out other causes of joint pain, like rheumatoid arthritis, narrowing your doctor's field of potential diagnoses.

Joint fluid analysis – In this test, your doctor will use a syringe to draw fluid from the affected joint. They then test the fluid to determine whether the inflammation is caused by an infection or gout, homing in on a definitive diagnosis.

Epidemiology

●Osteoarthritis (OA) of the knee is the most common form of joint disease and prevalence of both radio graphically evident and symptomatic. The females having higher prevalence than males (11.4% vs 6.8%).

●The gender difference in prevalence has recently been emphasized in a meta-analyses, which provides evidence for a greater risk in females for prevalent and
incident knee OA.

●The meta-analysis also reported that females tend to have more severe knee OA radio graphically assessed than males and that the gender differences increase with
age > 55 years. The prevalence of OA will increase as the population of the kingdom ages, especially if the incidence of obesity remains at over 50% in the 45+ age.

• OA in adults is frequently accompanied by comorbidities that
• contribute to decreased quality of life:
• - obesity or being overweight (90 percent)
• - hypertension (40 percent)
• - depression (30 percent)
• Osteoporosis at a young age is very rare, so at the first manifestations should be sure to look for the causes of the disease.[2]
• Activity Limitation: • Arthritis limits the activities of 23.7 million US adults. Around 44% of adults with doctor-diagnosed arthritis had arthritis attributable activity limitations in 2013–2015.
• Leading Cause of Work Disability
• Arthritis and other rheumatic conditions are a leading cause of work disability among US adults.3
• In all US states, 1 in 25 working-age adults aged 18 to 64 years face work limitations they attribute to arthritis; among those with arthritis, at least 1 in 4 have work limitations. The prevalence of work limitations due to arthritis varies by state.
•Risks of revision surgery are especially pronounced in the younger patient, who may be more physically active and, consequently, subject to multiple revision surgeries over a lifetime. (DR.S.Bhandari 2012)[5]

NEED OF STUDY

• Arthritis is a common joint problem usually associated with older adults. And there are very less study/research Conducted on osteoarthritis in young age. According to the National Library of Medicine (NLM)Trusted Source, most people show symptoms of osteoarthritis by the time they are 70 years old, but there are also potential chances of osteoathritis in young age. So, this research helps to determine the Prevalence rate and percentage of OA in young working professionals who have prolonged sitting ans standing work profession. So this study may help to determine the prevalence ratio of OA in young people.

OBJECTIVE OF THE STUDY

• To find prevalence of OA in young people(Age between 21 to 30 years) having prolonged sitting or standing work profession in ahmedabad and gandhinagar area.

• *REVIEW OF LITERATURE*

1. Prevalence of osteoarthritis of knee joint among adult population in a rural area of Kanchipuram District, TN [Venkatachalam.J, Natesan.M, Bharath Z] Year -2018.[9]

•A total of 1986 adult respondents were interviewed out of which 27.1% had OA of knee. Age more than 50 years, female gender, tobacco usage, illiteracy, lower socioeconomic class, positive family history of OA, diabetes, and hypertension were found to be associated with OA knee ($P < 0.05$).

• Conclusion: The burden of osteoarthritis knee was high in this region. Hence, effective preventive strategy has to be taken to minimize this burden.

2. Osteoarthritis Affects Younger People, Too by ILANA N. ACKERMAN, PT, PhD (Article published in 2019)[10]

●Conclusion of this study

• In this article researcher found that In younger people presenting with persistent joint pain and transitory stiffness (particularly those who have sustained a previous traumatic joint injury), the early signs of OA should be suspected. Routine imaging is not indicated for the diagnosis of uncomplicated knee or hip OA.
•While X-rays are inexpensive, radiographic findings are not well correlated with symptoms and are unlikely to alter the management plan or predict future disease progression. Magnetic resonance imaging can detect early OA changes that may be useful in a research context,but the clinical significance of these changes is questionable. Overuse of MRI is costly for health systems and may lead to unwarranted surgical interventions.

• These include activity-related joint pain and either no joint-related morning stiffness or morning stiffness lasting no longer than 30 minutes.Atypical features (eg, a hot swollen joint, prolonged morning stiffness, or rapid worsening) warrant investigation, as they may indicate other diagnoses, including inflammatory or septic arthritis, or malignancy.

3. Hip and knee osteoarthritis In young age (ADAM G. CULVENOR, PT, PhD), RANA S. HINMAN, PT, PhD(Vol 2. Feb. 2017)[11]

• Hip and knee OA is not restricted to older age groups and can profoundly affect quality of life and work participation among younger people. Knee joint injury is a strong risk factor for subsequent knee OA, and early signs and symptoms may present in the decade following injury or reconstructive surgery.

•Thorough physical examination can identify key impairments, and PROMs are valuable tools for tracking changes in pain, function, and well-being. Nonsurgical management approaches relevant to younger patients include education and self-management support, physical therapist–prescribed exercise programs, and weight management.

4. Epidemiology of osteoarthritis: state of the evidence. Kelli D. Allen, Yvonne M. Golightly [2019].[12]

• This study concludes the Risk factors with strong evidence for osteoarthritis onset and/or progression include age, sex, socioeconomic status, obesity, family history, joint injury, joint alignment, and occupational joint loading.Traditional epidemiologic studies and mining of large health administrative databases show a large and increasing impact of osteoarthritis.

5. Risk Factors for Osteoarthritis and Contributing Factors to Current Arthritic Pain in South Korean Older Adults.Kyoung Min Lee, Chin Youb Chung, Ki Hyuk Sung, Seung Yeol Lee, Sung Hun Won, Tae Published online 2014 Dec 10.[13]

• The Fourth Korean National Health and Nutrition Examination Surveys was conducted in 2009. Therein, 720 males and 1008 females aged between 25 years to 45 years older were included. Comprehensive data on habitual, socioeconomic, medical, nutritional, and psychological factors were collected along with the presence of osteoarthritis and arthritic pain. After univariate analysis, binary logistic regression analysis was performed to identify risk factors for osteoarthritis and contributing
factors to current arthritic pain. And the study conclude that higher BMI, lack of weekly moderate intensity activity, and unfavorable subjective health status were significant factors contributing to current arthritic pain. More attention needs to be paid to psychiatric effects on osteoarthritis and joint related pain.

6. What Are the common risk factors that cause OA in younger athletes (Whittaker.J 2015)[14]

This study concludes some major and most common risk factors that cause OA in younger athletes that mentioned as below.

• Five common athletic injuries have been identified as placing patients at greater risk of developing post-traumatic OA:

• - anterior cruciate ligament (ACL) ruptures
• - meniscus tears (the second most common structure damaged in athletes)
• - shoulder dislocation
• - patellar dislocation
• - ankle instability (the most commonly injured joint in the body)

7.Osteoarthritis in Young, Active, and Athletic Individuals. *Adae O Amoako(2018)*[10]

This study concludes several risk factors associated with OA. In the athlete or young individual, injury, occupational activities, and obesity are the main factors that contribute to OA. Diagnosis of OA in the athlete is often delayed and difficult

because of high tolerance to pain, as well as the athlete's preference for expedited return to play. History, physical examination, laboratory tests, and radiographic findings may be used to make a definite diagnosis of OA. Exercise remains the recommended initial treatment for OA in all populations. NSAIDs, braces, and surgery are other treatment modalities for OA. The treatment of OA in the athlete or young individual should be patient specific, with consideration for the patient's expectations and the period of absence from sports activities.

8. Workplace policies and prevalence of knee osteoarthritis: the Johnston County Osteoarthritis Project. J-C Chen, L Linnan, L F Callahan, E H Yelin, and J B Renner, J M Jordan [2007 Jun 13]

The negative associations between KOA and workplace policies raise concerns about possible employment discrimination or beneficial effects of workplace policies.

Longitudinal studies are needed to clarify the dynamic complexities of KOA risks and outcomes in relation to workplace policies.

Studies on the interrelations of work and osteoarthritis (OA) remain an active area of research because of their profound implications for clinical practice and public policy. As indicated in recent reviews of epidemiological literature on the relationship between occupational factors and risks of knee OA (KOA),[1,2] both case–control and prospective cohort studies have shown the positive associations between KOA and physical exposures in the workplace, and the strength of scientific evidence is moderate.

Specifically, previous studies have shown that certain occupational activities (e.g., kneeling, squatting or climbing) increase the risk of KOA,[3,4,5,6] presumably due to increased biomechanical loads on knee joints.

However, most of the previous studies were primarily focused on individual-level attributes; very little data are available to examine the potential link between KOA and organisation-level workplace characteristics (e.g., workplace policies, employers' commitment), many of which play an important role in occupational health and safety.

HYPOTHESIS

NULL HYPOTHESIS :

There's no correlation find between knee OA and young people (Age between 21 to 30 years) having prolonged sitting or standing work profession. That's why prevalence rate is difficult to find and result is not significant.

RESEARCH HYPOTHESIS :

There's some correlation find between knee OA and young people (Age between 21 to 30 years) having prolonged sitting or standing work profession. Hens prevalence

rate can be find and significance can be find through this research.

METHODOLOGY

MATERIALS AND METHODOLOGY :-

STUDY DESIGN : Cross-sectional study

SOURCE OF DATA : Hospitals and Offices

POPULATION : Young Working professionals having age between 21 to 30 years who have prolonged sitting or standing work profession.

SAMPLING METHOD : Convenient Sampling Method

DURATION OF STUDY : 1 month

SAMPLE SIZE : 100

•Method of selection of data:

Research will be conducted on young people age between 21 to 30 years having prolonged standing or sitting work profession. An observational study was conducted by using the convenient sample method. One hundred working professionals of ahmedabad and nearby area participated in this study by perform validated assessment form and clinical measures.

• *INCLUSION CRITERIA*

• Subject having age between 21 to 30 Years.

• Both male and female subject.

• Subject who having prolonged sitting or standing work profession (Ex: Nurse, Teacher/Professor, Petrol filler man).

• *EXCLUSION CRITERIA*

• Subject having diabetes, hyperthyroidism, hypertension, osteoporosis, rickets and various type of muscular disorders.

• Subject having autoimmune disease.

• Subject with previous history OA surgery.

• Subject with history of any other neurological and cardio-thoracic conditions.

• Subject having OA of hip, wrist or hand and feet.

• OUTCOME MEASURES

• Clinical assessment forms

• Patient's X-ray, and other radiological reports

• Clinical Measures

• Excel sheet

• The Visual Analogue WOMAC 3.0 scale & VAS scale

• Goniometer

RESULT :

PROCEDURE OF RESEARCH:

Survey of the working professionals

Data collection by using the questionnaire

Data analysis

Data Interpretation

Result

Conclusion

A sum of 100 working professionals responded answering the questionnaire. An analysis was done by excel & calculation was done by chi square test calculator. The chi- square statistics found as 0.1695. The p value is 0.918761. The result is not significant at $p < .01$.

RESULTS			
	NONE	MILD	MODERATE
MALE	42 (41.80) [0.00]	1 (1.32) [0.08]	1 (0.88) [0.02]
FEMALE	53 (53.20) [0.00]	2 (1.68) [0.06]	1 (1.12) [0.01]

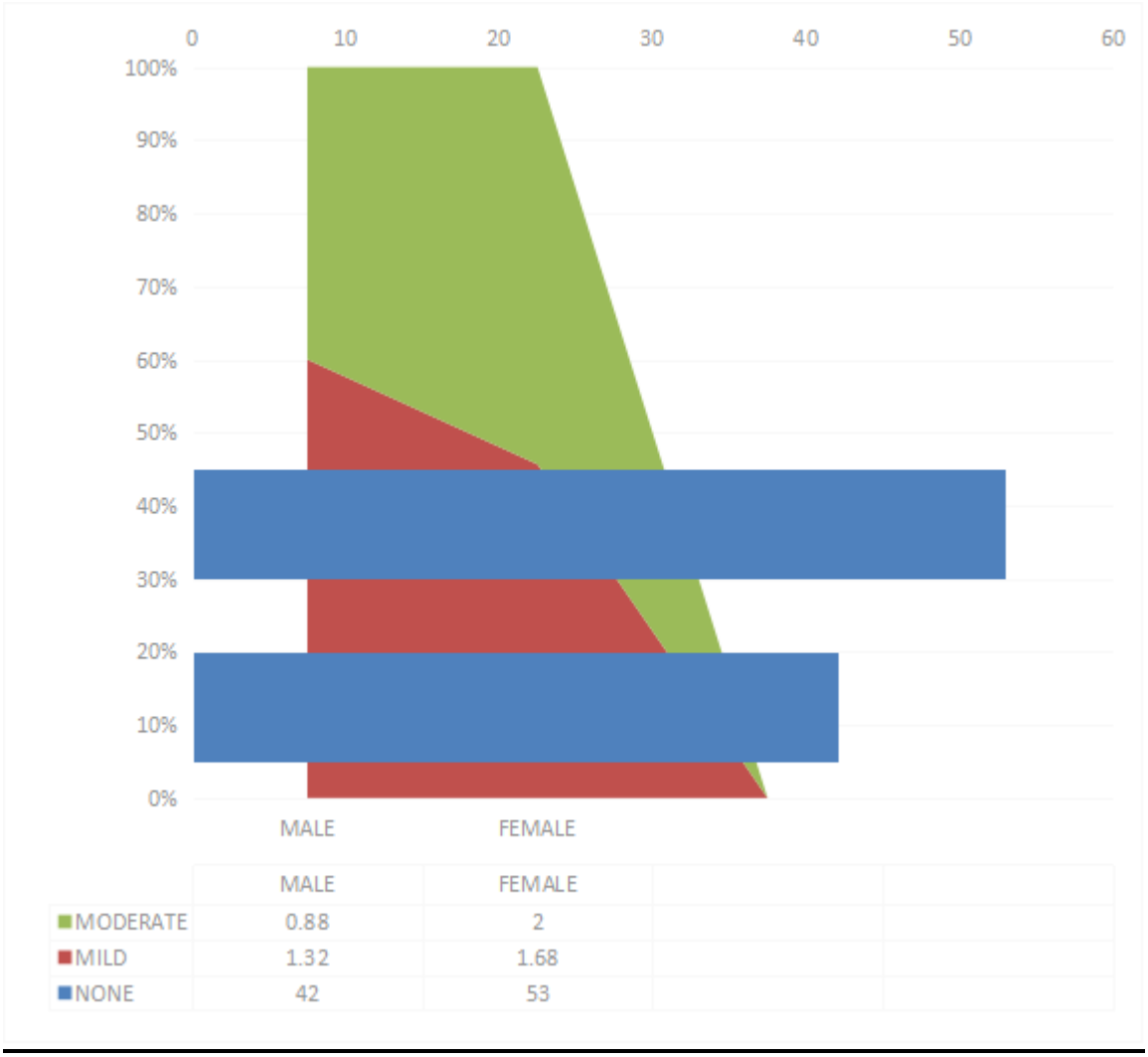
1.1 RESULT TABLE WITH P VALUE AND CHI SQUARE DATA

The prevalence of OA varies according to the definition of OA, the specific joint(s) under study, and the characteristics of the study population. The age standardized prevalence of radiographic knee OA in given subjects age between 21-30 years was only 5% among the all participants. Out of 100 subjects only 5 subjects primarily suspected of having OA of knee. Out of 100 subjects there was 56 female and 44 male subject in this survey. And OA was found in 3 female and 2 male subject after assessing clinical measures.

So, the prevalence percentage of OA of knee in young people age between 21 to 30 years having prolonged sitting or standing work profession would be as below:

Prevalence percentage = OA will be found for given Criteria **DEVIDED BY** OA Will be not found for given criteria **INTO 100%**

TOTAL PREVALENCE PERCENTAGE = **5.2631%**
PREVALANCE PERCENTAGE IN MALES = **2.10%**
PREVALANCE PERCENTAGE IN FEMALES = **3.15%**

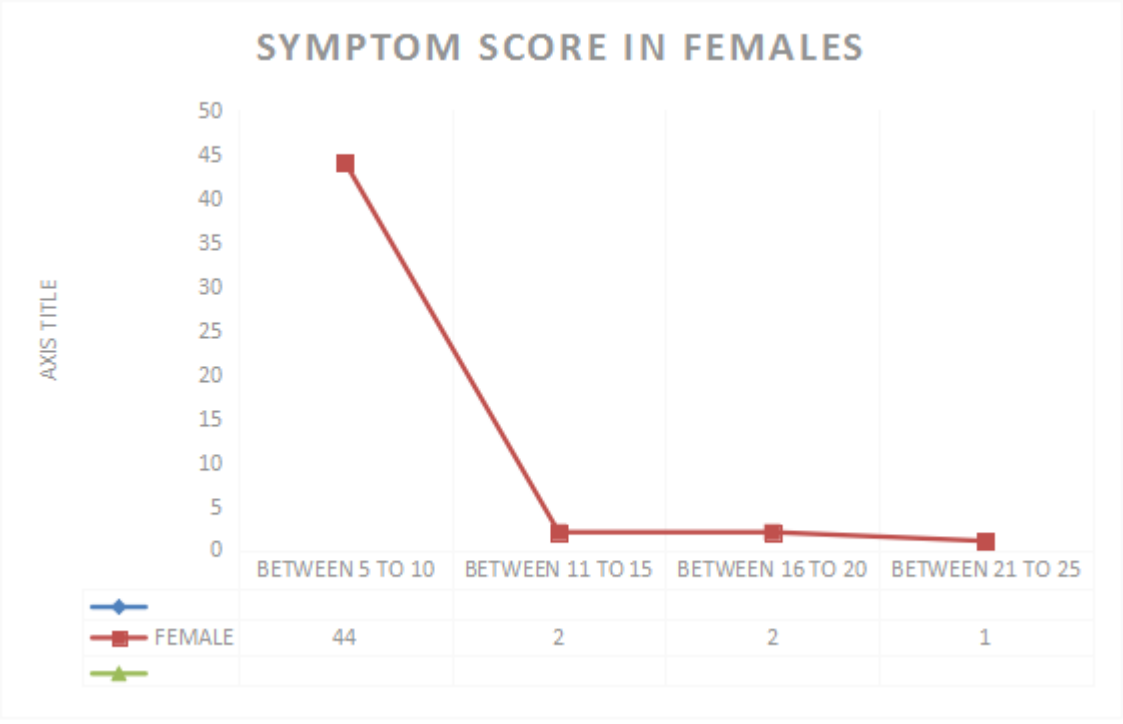


GRAPH 1.1 CHI SQUARE

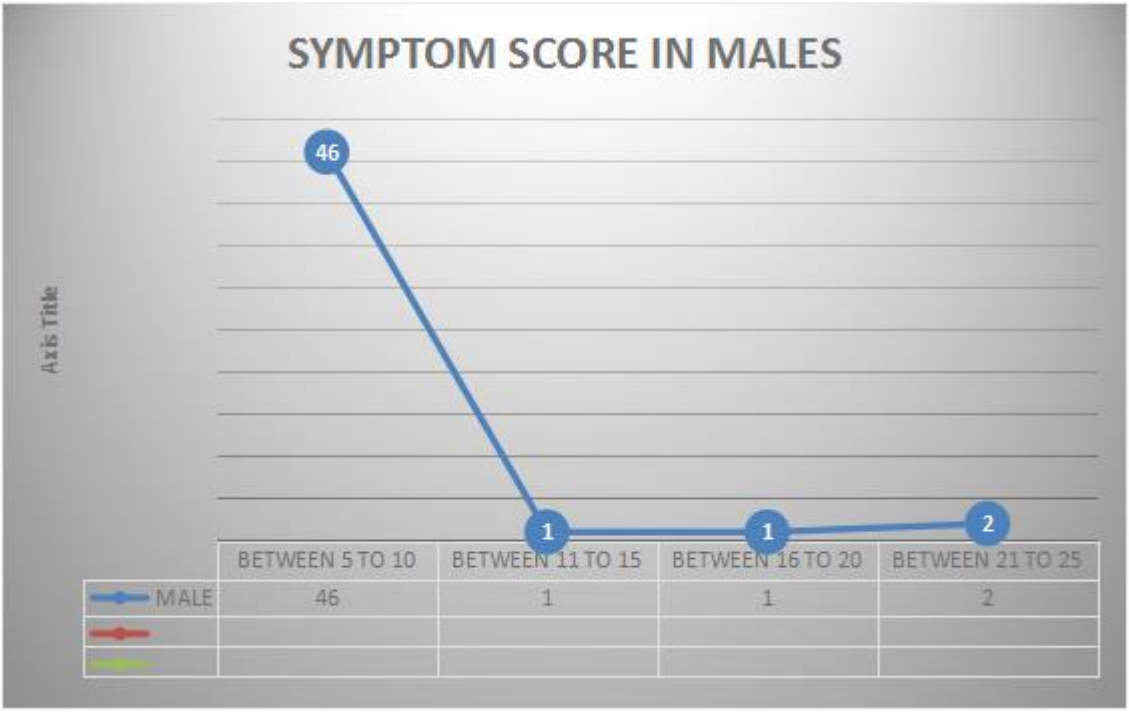
➡ ***CHI SQUARE STATISTICS WITH PREVALANCE DATA***

A chi-squared test (also chi-square or χ^2 test) is a statistical hypothesis test that is valid to perform when the test statistic is chi-squared distributed under the null hypothesis, specifically Pearson's chi-squared test and variants thereof. Pearson's chi-squared test is used to determine whether there is a statistically significant difference between the expected frequencies and the observed frequencies in one or more categories of a contingency table.

Symptoms - These questions should be answered thinking of your knee symptoms during the **last week**

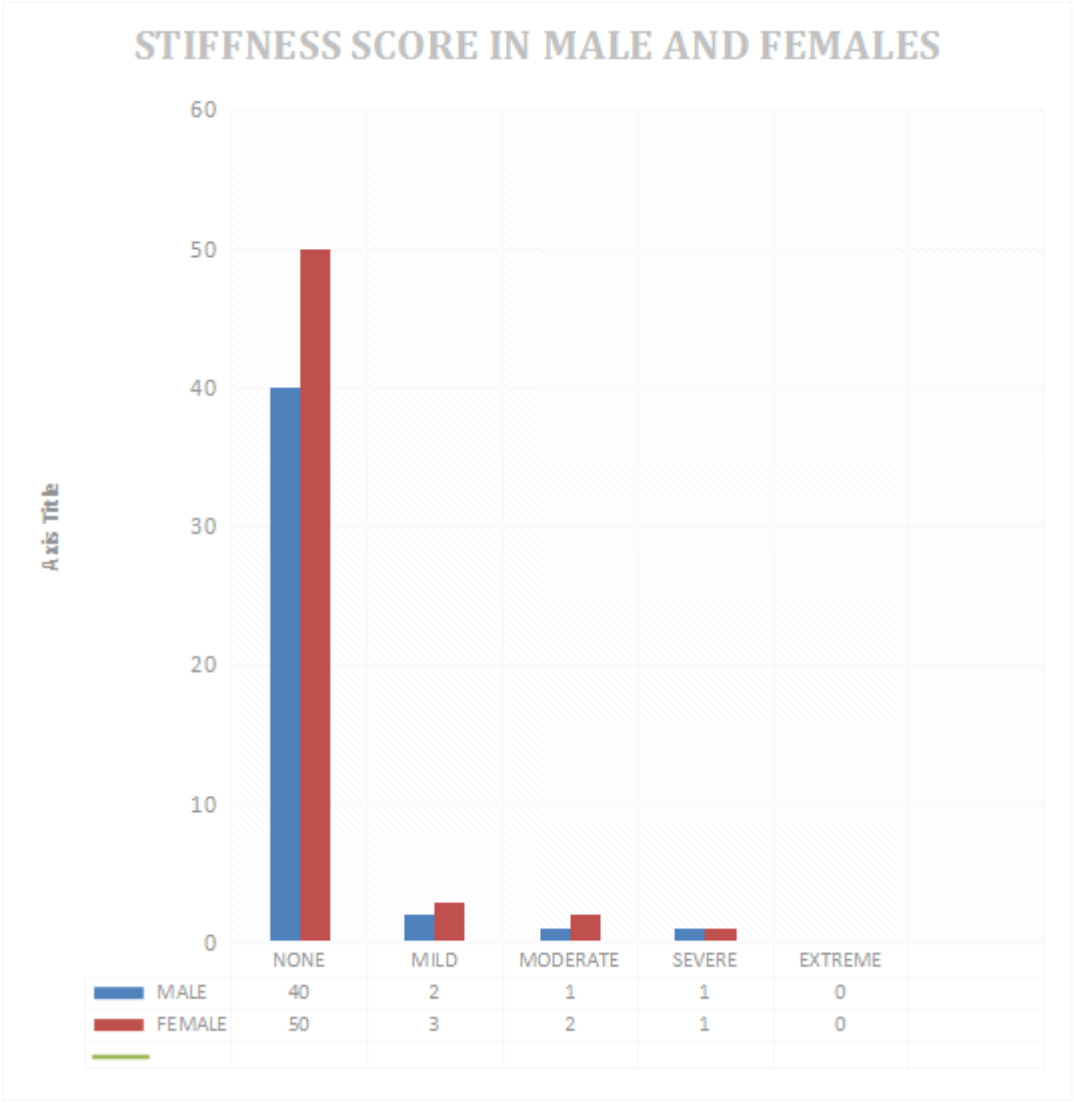


GRAPH 1.2

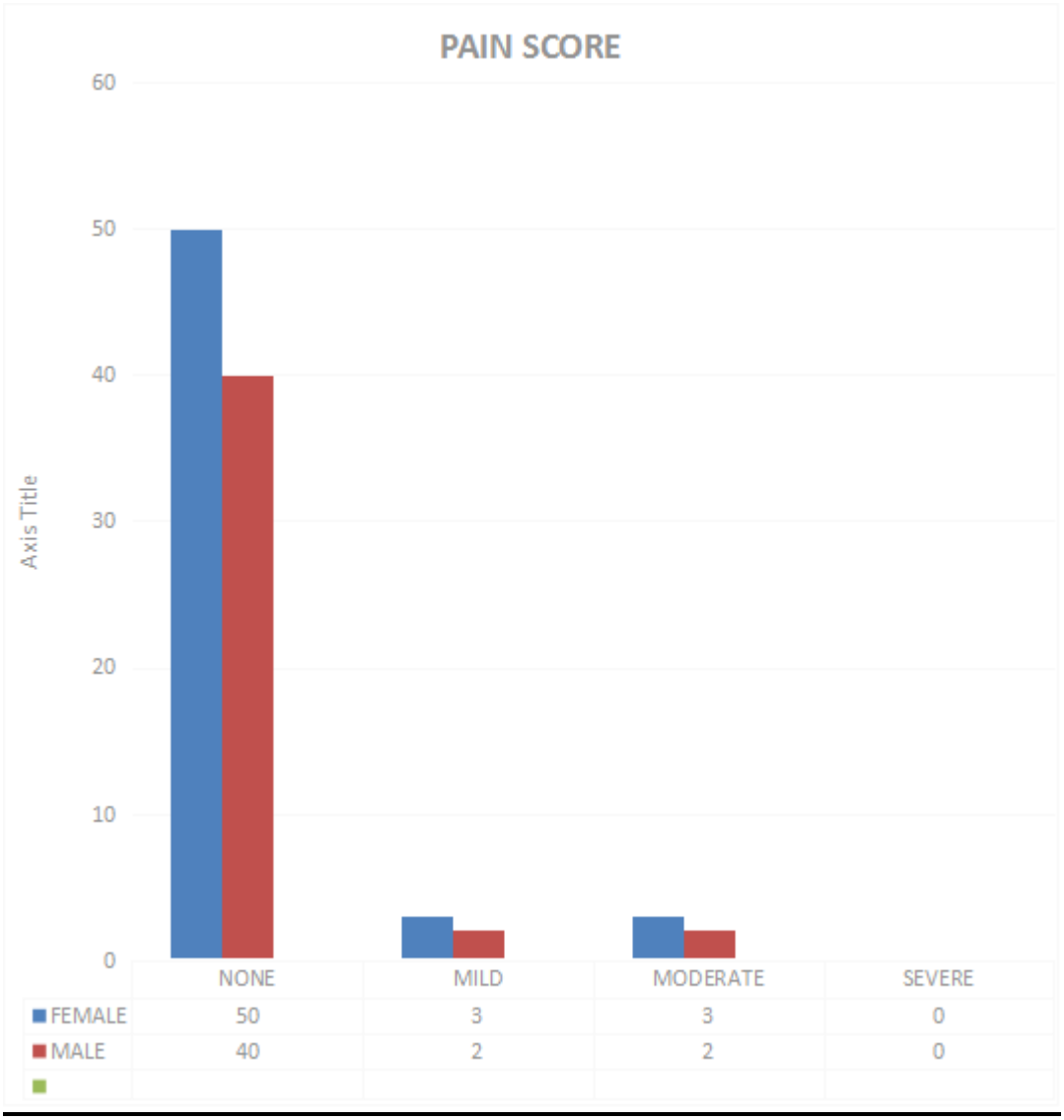


GRAPH 1.3

Stiffness - The following questions concern the amount of joint stiffness you have experienced during the **last week** in your knee. Stiffness is a sensation of restriction or slowness in the ease with which you move your knee joint.

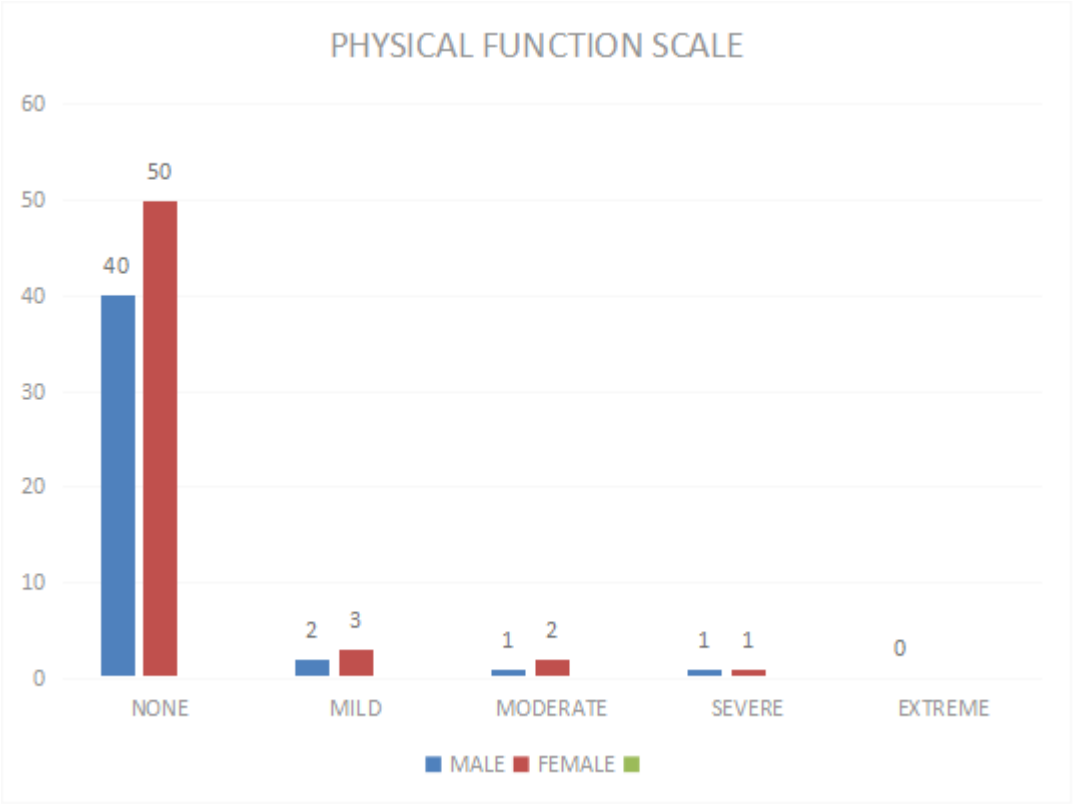


GRAPH 1.4


PAIN SCORE
60
50
40
30
20
10
0
Axis Title
NONE
MILD
MODERATE
SEVERE
FEMALE
50
3
3
0
MALE
40
2
2
0

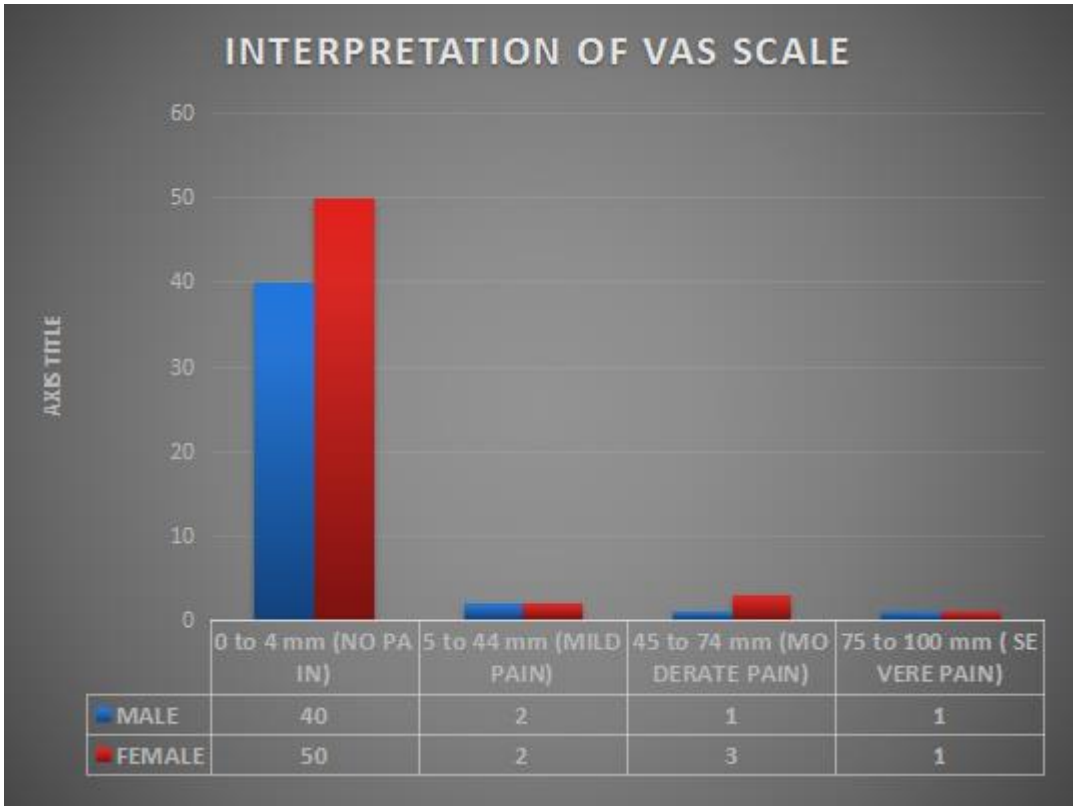
GRAPH 1.4

Function, daily living - The following questions concern your physical function. By this we mean your ability to move around and to look after yourself. For each of the following activities please indicate the degree of difficulty you have experienced in the last week due to your knee



GRAPH 1.5

VAS SCALE RESULTS



GRAPH 1.7

DISCUSSION :

The present study was carried out to find prevalence of osteoarthritis in young people (Age between 21 to 30 years) having prolonged sitting and standing profession. This study was performed in the ahmedabad and nearby areas. any damage to the joints cannot be reversed, the symptoms of osteoarthritis can be managed, allowing sufferers to live as normal a life as possible.

Treatments for osteoarthritis include lifestyle advice, medications, orthobiologics and surgery.

Lifestyle changes include taking steps to lose weight if necessary and doing low impact exercise, such as yoga, to help strengthen muscles around the joint to stabilise it. Your doctor may refer you to a physiotherapist if your job or choice of physical activity is causing your symptoms. They may also recommend topical treatments or the use of hot or cold compresses.

Osteoarthritis typically affects people over the age of 50, but young people can be affected as well.[2] The CDC estimates that about 7% of the U.S. population aged 18–44 had been diagnosed with OA from 2013–2015.

Younger people who are active in sports or other physically demanding activities, or who have sustained an injury such as a torn meniscus—a tear in the cartilage of the knee—may be more prone to developing the condition earlier in life.

Over 32 million people across the U.S. live with osteoarthritis.[3] While this condition can affect any joint, it typically affects the knees, hips, back, hands, and neck. Symptoms such as pain or swelling may not occur right away and can worsen over time.

This study was conducted to find the prevalence of osteoarthritis of knee in young people age between 21 to 30 years having sitting or standing work profession. The purpose of the study was to find prevalence ratio of OA in young people. Osteoarthritis (OA) is defined as a heterogeneous group of conditions that lead to joint symptoms and signs associated with a defective articular cartilage and related changes in bone morphology. It is considered the most common type of arthritis, as well as one of the most significant health problems that pervades our modern world. In 2019, it was estimated that 43 million adults suffered from arthritis. Of those, 26.9 million adults aged 25 years or older had OA. One in four people is expected to develop symptomatic OA in his or her lifetime.

SUMMARY & CONCLUSION

The prevalence of OA varies according to the definition of OA, the specific joint(s) under study, and the characteristics of the study population. The age standardized prevalence of radiographic knee OA in given subjects age between 21-30 years was only 5% among the all participants. Out of 100 subjects only 5 subjects primarily suspected of having OA of knee. Out of 100 subjects there was 56 female and 44 male subject in this survey. And OA was found in 3 female and 2 male subject after assessing clinical measures.

A sum of 100 working professionals responded answering the questionnaire. An analysis was done by excel & calculation was done by chi square test calculator. The chi- square statistics found as 0.1695. The p value is 0.918761. The result is not significant at $p < .01$.

This study concludes that prevalence of osteoarthritis is very less in young working professionals that's why we can conclude that young people is not very prone for OA.
But there are some potential chances for having OA is present like lifestyle, genetic factors and other factors that can cause OA in young age.

LIMITATION & FUTURE RECOMMENDATION

1. Small sample size.
2. Limited research area.
3. The self selection and convenient sampling of participates to complete the study may also influence the result.
4. Very limited access to clinical measures.
5. Very small subject group.

FUTURE RECOMMENDATION

- Future research should replicate these findings in other large samples , take larger age groups to find most accurate prevalence of OA in young working professionals.

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ANNEXURE A

Clinician's name (or ref) **Patient's d.o.b :**

INSTRUCTIONS: This survey asks for your view about your knee. This information will help us keep track of how you feel about your knee and how well you are able to do your usual activities.

Answer every question by ticking the appropriate box. If you are unsure about how to answer a question, please give the best answer you can.

Symptoms - These questions should be answered thinking of your knee symptoms during the **last week.**

S1. Do you have swelling in your knee?

○ Never ○ Rarely ○ Sometimes ○ Often ○ Always

S2. Do you feel grinding, hear clicking or any other type of noise when your knee moves?

○ Never ○ Rarely ○ Sometimes ○ Often ○ Always

S3. Does your knee catch or hang up when moving?

○ Never ○ Rarely ○ Sometimes ○ Often ○ Always

S4. Can you straighten your knee fully?

○ Never ○ Rarely ○ Sometimes ○ Often ○ Always

S5. Can you bend your knee fully?

○ Never ○ Rarely ○ Sometimes ○ Often ○ Always

Stiffness - The following questions concern the amount of joint stiffness you have experienced during the **last week** in your knee. Stiffness is a sensation of restriction or slowness in the ease with which you move your knee joint.

S6. How severe is your knee joint stiffness after first wakening in the morning?

○ None ○ Mild ○ Moderate ○ Severe ○ Extreme

S7. How severe is your knee stiffness after sitting, lying or resting **later in the day?**

○ None ○ Mild ○ Moderate ○ Severe ○ Extreme

Pain[1]

P1. How often do you experience knee pain?

○ Never ○ Monthly ○ Weekly ○ Daily ○ Always

What amount of knee pain have you experienced the **last week** during the following activities?

P2. Twisting/pivoting on your knee

○ None ○ Mild ○ Moderate ○ Severe ○ Extreme

P3. Straightening knee fully

○ None ○ Mild ○ Moderate ○ Severe ○ Extreme

P4. Bending knee fully

○ None ○ Mild ○ Moderate ○ Severe ○ Extreme

P5. Walking on flat surface

○ None ○ Mild ○ Moderate ○ Severe ○ Extreme

P6. Going up or down stairs

○ None ○ Mild ○ Moderate ○ Severe ○ Extreme

P7. At night while in bed

○ None ○ Mild ○ Moderate ○ Severe ○ Extreme

P8. Sitting or lying

○ None ○ Mild ○ Moderate ○ Severe ○ Extreme

P9. Standing upright

○ None ○ Mild ○ Moderate ○ Severe ○ Extreme

Function, daily living - The following questions concern your physical function. By this we mean your ability to move around and to look after yourself. For each of the following activities please indicate the degree of difficulty you have experienced in the **last week** due to your knee.

Al. Descending stairs				
○ None	○ Mild	○ Moderate	○ Severe	○ Extreme

A2. Ascending stairs				
○ None	○ Mild	○ Moderate	○ Severe	○ Extreme

For each of the following activities please indicate the degree of difficulty you have experienced in the **last week** due to your knee.

A3. Rising from sitting				
○ None	○ Mild	○ Moderate	○ Severe	○ Extreme

A4. Standing				
○ None	○ Mild	○ Moderate	○ Severe	○ Extreme

A5. Bending to floor/pick up an object				
None	Mild	Moderate	Severe	Extreme

A6. Walking on flat surface				
○ None	○ Mild	○ Moderate	○ Severe	○ Extreme

A7. Getting in/out of car				
○ None	○ Mild	○ Moderate	○ Severe	○ Extreme

A8. Going shopping				
○ None	○ Mild	○ Moderate	○ Severe	○ Extreme

A9. Putting on socks/stockings				
○ None	○ Mild	○ Moderate	○ Severe	○ Extreme

A10. Rising from bed				
○ None	○ Mild	○ Moderate	○ Severe	○ Extreme

A11. Taking off socks/stockings

○ None ○ Mild ○ Moderate ○ Severe ○ Extreme

A12. Lying in bed (turning over, maintaining knee position)

○ None ○ Mild ○ Moderate ○ Severe ○ Extreme

A13. Getting in/out of bath

○ None ○ Mild ○ Moderate ○ Severe ○ Extreme

A14. Sitting

○ None ○ Mild ○ Moderate ○ Severe ○ Extreme

A15. Getting on/off toilet

○ None ○ Mild ○ Moderate ○ Severe ○ Extreme

For each of the following activities please indicate the degree of difficulty you have experienced in the **last week** due to your knee

A16. Heavy domestic duties (moving heavy boxes, scrubbing floors, etc)

○ Never ○ Rarely ○ Sometimes ○ Often ○ Always

A17. Light domestic duties (cooking, dusting, etc)

○ Never ○ Rarely ○ Sometimes ○ Often ○ Always

Thank you very much for completing all the questions in this questionnaire.

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ACUTE EFFECT OF SCAPULAR PROPRIOCEPTIVE NEUROMUSCULAR FACILITATIONS TECHNIQUE VERSUS CLASSIC SHOULDER EXERCISES IN ADHESIVE CAPSULITIS

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[2]SWARRNIM STARTUP & INNOVATION UNIVERSITY,

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ABSTRACT

BACKGROUND:

Frozen Shoulder Is An Idiopathic Diseases Characterized By Fibrosis, Decrease Volume Of The Glenoid Capsule, And Progressive Pain With Loss Of ROM.

SCAPULAR PNF TECHNQUES :

PNF Is A Treatment Concept With Four Theoretical Mechanisms, Referred To As Autogenic Inhibition, Reciprocal Inhibition, Stress Relaxation, And The Gate Control Theory, That Enhance ROM And Muscle Activation. PNF Has An Positive Effect On Pain, Muscle Strength.

CLASSIC SHOULDER EXERCIES :

- **Strengthening exercises :**

- Codman Pendulum exercises.
- Wand (stick) exercises.
- Pulley exercises.

- Finger walk.
- Resisted Exercise With Theraband

- **OBJECTIVES:**

- To Determine The Acute Effect Of Scapular PNF Techniques With Tens In Patients With Adhesive Capsulitis.
- To Determine The Acute Effect Of Classic Shoulder Exercises With Tens In Patients With Frozen Shoulder.
- To Compare The Acute Effect Between The Scapular PNF Techniques With Tens And Classic Shoulder Exercises With Tens In Patients With Adhesive Capsulitis.

METHODOLOGY:

30 Patients are Allocate To 2 Groups Scapular PNF Exercise And Tens, Classic Exercise And Tens. The Intervention Were Apply In A Single Session. The Visual Analog Scale(Vas), Lateral Scapular Slide Test, Range Of Motion And Simple Shoulder Test Were Evaluate Before And After The Intervention. All The Participants Of The Study Were Be Given Treatment According To The Group For 4 Weeks.

Subjects – 30 Subjects

Groups – 2 Groups

Sampling Method – Randomized Sampling Method

	Group 1	Group 2
Treatment Method	Scapular PNF With TENS	Classic Shoulder Exercise With TENS
Subjects	15	15
Duration: 4x/W/4 Weeks	4x/W/4 Weeks	

Inclusion Criteria:

- Having A Painfull Stiff Shoulder For At Least 3 Months, And Diagnosed As Frozen Shoulder.

- Having Limited Rom Of Shoulder Joint(Rom Losses Of 25% Or Greater Compared With The Non Involved Shoulder In At Least 2 Of The Following Shoulder Motion; Glenohumeral Flexion, Abduction.

Exclusion Criteria:

- Diabetes Mellitus
- A History Of Surgery On The Particular Shoulder
- A Pain Full Stiff Shoulder After A Severe Trauma
- Fracture Of The Shoulder Complex
- Rheumatoid Arthritis
- Rotator Cuff Rupture
- Tendon Calcification

Analysis:

- Between group analysis of obtained data were be done by using Unpaired T- test.
- Within the same group analysis (pre and post) of obtain data were be done by using paired T-test.

RESULT & CONCLUSIONS:

During The Course Of The Study It Has Been Concluded That Scapular PNF Techniques And Classic Shoulder Exercises Both Are Improved Pain, Scapular Dyskinesis And Functional Impairment The Patients With Adhesive Capsulitis. There Is Significant Increase In Both Scapular PNF Techniques And Classic Shoulder Exercises After 4-Week Treatment Duration In Both Groups. But Group Receiving Scapular PNF Techniques Showed More Power Full Improvement In Pain, Scapular Dyskinesis And Functional Improvement.

INTRODUCTION

INTRODUCTION

Adhesive capsulitis, Describes The common Shoulder condition Characterized By Painful And Limited Active And Passive Range of Motion(Rom). Individuals With Primary Adhesive capsulitis Are Commonly

Between 40 and 65 Years And The Incidence Appears Higher In Females Than Males.(1)

- The Term Adhesive capsulitis Were BE Used, Because It Encompasses Both Primary Adhesive Capsulitis And Secondary Adhesive Capsulitis Related to Systemic Diseases And Extrinsic or Intrinsic Factors, Excluding Cerebral Vascular Accident, Proximal humeral #, And Causative Rotator Cuff or Labral Pathology.(1)

(FIG 1: ADHESIVE CAPSULITIS)

Adhesive capsulitis IS Estimated To Affected 2% Of The General Population, With A Cumulative Incidence Between Of 2.4 Per 1000 Person-Years. It Is Rare Before The Age Of 40,With A Peak Incidence Between 40 and 60 And Is Unsual In Patient Over 70 Years (Except Secondary Traumatic Adhesive Capsulitis) And In Manual Workers. It Affects Women Slighly More Often Than Men. The Economic Impact Of The Condition Is Underscored By Its Predilection For Adults Of Working Age(8.2% For Men And 10.1% For Women).(2)

Diabetes Mellitus Is The Common Condition Most Commonly Associated With Adhesive Capsulitis. The Combined Prevalence Of A Diabetic Predisposition And Adhesive Capsulitis Is Estimated To Be As High As 71.5% Diabetics Have A 10% to 20% Lifetime Risk Of Developing A Adhesive Capsulitis, With A 4% Point Prevalence, And A Two To Four Times Greater Risk Than The General Population.(2)

The Glenohumeral joint Is An Incongruous, Ball & Socket Triaxial Joint With A Lax Joint Capsule. Its Supported By The Tendons Of The Rotator Cuff And The Glenohumeral (Suprior, Middle, Inferior) And Coracohumeral Ligaments.(3)

ANATOMY OF SHOULDER JOINT

PRESENTOR :DR.B.VAMSHIKIRAN

(FIG 2: NORMAL SHOULDER ANATOMY)

The Coracohumeral Ligament Originated From The Base And Lateral Border Of The Coracoid Process And Runs Transversely To The Grater Tuberosity. Its Anterior Border Is Distrincts Medially And Merges Laterally. Whereas Its Posterior Border Is Indistinct. it's a Primary Restraint To The Long Head Of Biceps Tendon.(4)

Causes:

The Causes are mainly idiopathic and are due to fibrosis following chronic inflammation. This could be due to:

1}Primary shoulder

2}Secondary Non-shoulder

1 Primary shoulder cause problems directly related to shoulder joint which can give rise to adhesive capsulitis :

tendinitis of rotator cuff

bicipitaltenditis

and dislocation around the shoulder

2 Secondary Non shoulder causes problems not related to shoulder joint like

Diabetes

Hyperthyroidism

Reflex sympathetic dystrophy

Frozen hand syndrome

Complication of Collis's fracture can all leads to adhesive capsulitis.

The reason could be prolonged immobilization of the shoulder joint due to reffered pain, Etc.(5)

Classification:

The Classification System By Including Disease Such As Diabetes Mellitus, Myocardial Infraction Or Various Neurological Disorder Under Secondary Frozen Shoulder Classification Scheme Where, **Primary Adhesivecapsulitis**And Idiopathic Adhesive capsulitis Are Considered Identical And Non AssociatedWith A Systemic Condition Or History Of Injury.

1. Secondary Adhesive capsulitis Was Defined By 3 Subcategories Extrinsic Secondary Adhesive capsulitis Includes Patients Whose Pathology Is Not Directly Related To The Shoulder, And Intrinsic Secondary Adhesive capsulitis Describes Patients With A Known Pathology Of The Glenohumeral Joint Soft Tissues Or Structures. Specific Causes Of Secondary Adhesive capsulitis May Influence Prognosis. For Instance, Individuals With Secondary Adhesive capsulitis Related To Insulin-Dependent Diabetes Are More Likely To Have A More Protracted And Difficult Clinical Course.(6)

Stage Of Adhesive Capsulitis

Stage 1

- Duration Of Symptoms: 0 To 3 Months.
- Pain With Active And Passive Rom.
- Pathologic Changes: Hypertrophic, HypervascularSynovitis, Rare Inflammatory Cell
- Infiltrates, Normal Underlying Capsule.

Stage 2: Freezing stage

- Duration Of Symptoms: 3 To 9 Months
- Chronic Pain With Active And Passive Rom
- Significant Limitation Of Forward Flexion, Abduction, Internal Rotation, External Rotation
- Pathologic changes: hypertrophic, hypervascularsynovitis with perivascular and subsynovialscar ,fibroplasias and scar formation in the underlying capsule.

Stage 3: Frozen Stage

- Duration Of Symptoms: 9 To 15 Months.
- Minimal Pain Except At End Rom.
- Significant Limitation Of Rom With Rigid End Feel.
- Pathologic Changes: “Burned-Out” SynovitisWithout Significant Hypertrophy Or Hypervascularity. Underlying Capsule Shows Dense Scar Formation.

Stage 4: Thawing Phase

- Duration Of Symptoms: 15 To 24 Months.
- Minimal Pain.
- Progressive Improvement In Rom.(1)

Common Structural and Functional Impairments

- Night Pain And Disturbed Sleep During Acute Flares.
- Pain On Motion And Often At Rest During Acute Flares.
- Mobility: Decreased Joint Play And ROM, Usually Limiting External Rotation And Abduction With Some Limitation Of Internal Rotation And Elevation In Flexion.
- Posture: Possible Faulty Postural Compensations With Protracted And Anteriorly Tilted Scapula, Rounded Shoulders, And Elevated And Protected Shoulder.
- Decreased Arm Swing During Gait.

- Muscle Performance: General Muscle Weakness And Poor Endurance In the Glenohumeral Muscles With Overuse Of The Scapular Muscles Leading To Pain In The Trapezius, LevatorScapulae, And Posterior Cervical Muscles.
- Substitution For Limited Glenohumeral Motion With Increased Scapular Motion, Especially Elevation.(3)

Common Activity Limitation And Participation Restriction

- Instability To Reach Overhead, Behind Head, Out To The Side, And Behind Back; Thus, Having Difficulty Dressing (Putting On A Jacket Or Coat Or In The Case Of Women, Fastening Undergarments Behind Their Back), Reaching Hand Into Back Pocket Of Pants (To Retrieve Wallet), Reaching Out A Car Window (To Use An ATM Machine), Self-Grooming (Combing hair, Brushing Teeth, Washing Face), And Bringing Eating Utensils To The Mouth.
- Difficulty Lifting Weighted Objects, Such As Dishes Into A Cupboard.
- Limited Ability To Sustain Repetitive Activities.

Scapular Dyskinesis:

- The Scapula Is The Large Triangular-Shaped Bone At The Back Of Your Shoulder Frequency Known As The Shoulder Blade. Its Only Attachment To The Rest Of The Skeleton Is Throught The Collarbone At The Acromioclavicular Joint. Therefore, The Bone Is Primarily Held In Place By The Attached And Surrouding Muscles. Many Muscle Use The Large Area Of The Scapula For Attachment and They Enable The Vast Range Of Shoulder Motion.(7)
- At The Order Edge Of The Scapula A Shallow Socket Form And Is Where The Humeral Heads Sits Forming The Shoulder Joint. Proper Positioning And Movement Of The Scapula Is Critical For Full And Normal Shoulder Range Of Motion.(7)
- We Use The Acronym **SICK(Scapular Malposition, Inferior Medial Border Prominence, Coracoid Pain And Malposition, And Dyskinesis Of Scapular Movement)** To Refer to An Injury Resulting From Overuse And Fatigue Of The Muscle That Stabilize And Provide Motion For The Scapula.(7)

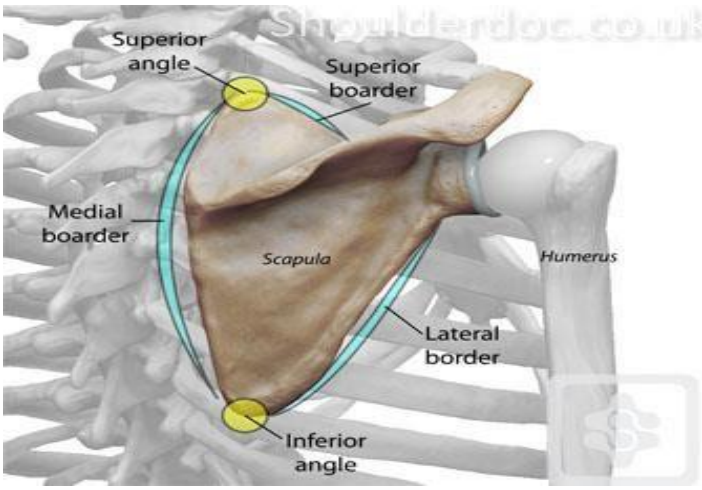

FIG 3: SICK SCAPULA

Risk Factors

- Intense, Repetitive Overhead Activity (Throwing, Tennis, Volleyball)
- Overuse Fatigue.
- Injury To Other Structure Of The Shoulder.
- Direct Trauma
- Muscle Strain
- Tense Pectoralis Major Possibly Resulting From Unbalanced Weight Training(7)

Signs And Symptoms

- Affected Shoulder Appears Dropped Or Lower Than Unaffected Shoulder
- Medial Scapular Protrusion
- Noticeable Hitches And Jumps In Scapular Motion During Arm Movements.
- Scapular Pain
- Pain At The Front, Back, Or Top Of The Shoulder.
- Pain On The Outside Of Your Upper Arm.(7)

Scapular Dyskinesis Classification System(8,9)

- **Type 1: Inferior Border**
- At Rest, The Inferior Medial Scapular Border May Be Prominent Dorsally. During Arm Motion. The Inferior Angle Tilts Dorsally And The Acromion Tilts Ventrally over The Top Of The Thorax.
- The axis Other Rotation Is In The Horizontal Plane.

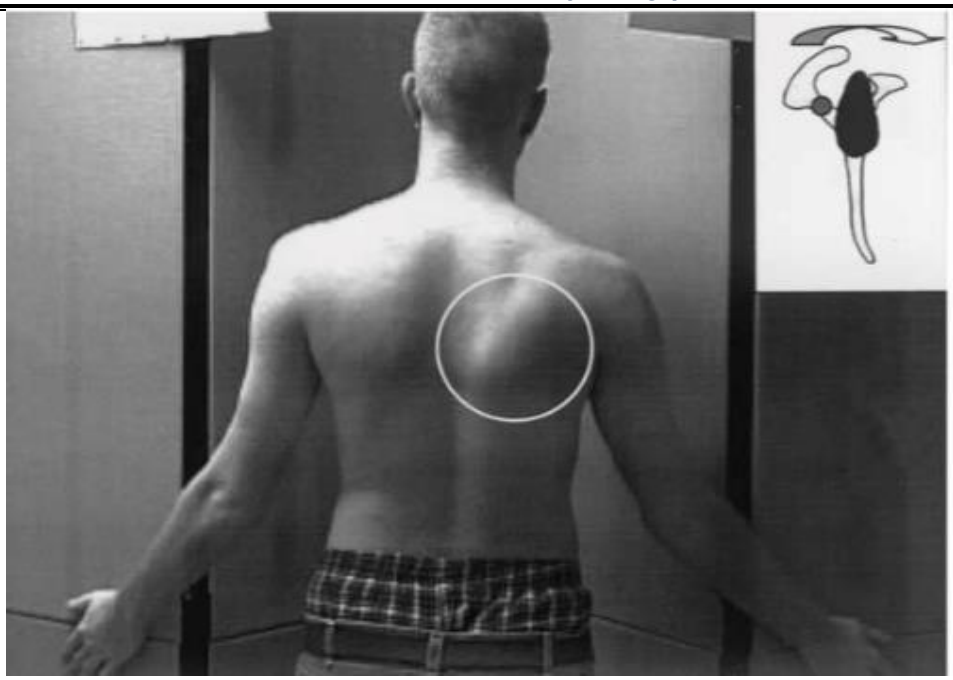

FIG 4: INFERIOR BORDER SCAPULA DYSKINESIS

TYPE 2: MEDIAL BORDER

- At Rest, The Entire Medial Border May Be Prominent Dorsally. During Arm Motion, The Medial Scapular Border Tilts Dorsally Off The Thorax. The Axis Of The Rotation Is Vertical In The Frontal Plane.

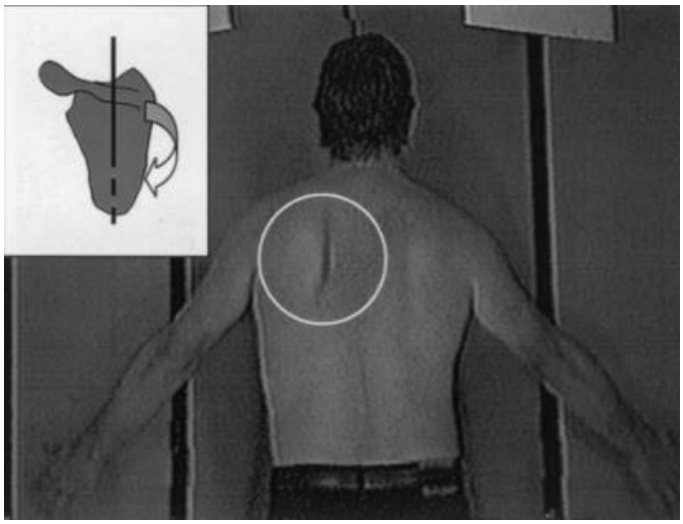

FIG 5: MEDIAL BORDER OF SCAPULAR DYSKINESIS

TYPE 3 : Superior Border

- At Rest, The Superior Border Of The Scapula May Be Elevated And The Scapula Can Also Be Anteriorly Displaced. During Arm Motion, A Shoulder Shrug Initiates Movement Without Significant Winging OF The Scapula Occurring. The Axis Of This Motion Occurs In The Sagittal Plane.

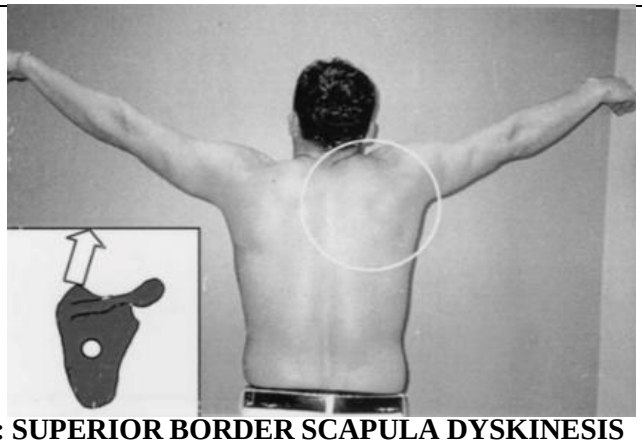

FIG 6: SUPERIOR BORDER SCAPULA DYSKINESIS

Type 4 : Symmetric Scapulohumaral

- At Rest, The Position Of Both Scapula Are Relatively Symmetrical, Taking Into Account That The Dominant Arm May Be Slightly Lower. During Arm Motion, The Scapulae Rotate Symmetrically Upward Such That The InferiorAngles Translate Laterally Away From The Midline.

FIG 7: SYMMETRIC SCAPULOHUMERAL

The Studies Cited Have Shown That Various Forms Of Exercise Are Effective In Reducing The Motion Restriction And Pain Of Patients With Adhesive Capsulitis. Physical Therapists, As Specialists Dealing With Exercise And Movement Dysfunction, Play A Major Role In Restoring Function To These Persons. After Performing The Necessary Tests To Confirm The Diagnosis Of Adhesive Capsulitis Ascertain The Current Status Of The Condition, And Identify Causative Factors, A Physical Therapist Is Prepared To Design A Treatment Program. Each Individual Case Were Dictate Whether Physical Therapy Is To Be Used Alone Or In Conjunction With Other Medical Or Surgical Treatment.

A Combination Of Exercise And Physical Modalities Helps Accomplish This Objective. Activate And Active-Assistive Exercises Such As Pedulum, Wand , And Physiologic ROM Should Be Performed For At Least One Half-Hour Three Times A Day. Passive Exercise Has Multiple Benefits. Gentle Passive Movement, Short Of Pain And The Pathological limit Of Motion, Reduces Pain. Often, Reflex Muscle Spasm Prevents A Patient From Performing Active Exercise, Whereas A TherapistCan Passively Guide The Lime Further Into The Range Without Eliciting Spasm Or A Stretch Reflex. Also , Because Many Patients Are Reluctant Psychologically To Perform Regular, Appropriate Active Exercise, Passive Exercise Becomes The Treatment Of Choice(10).

Evaluation Of The Position Of The Scapula Is Very Important In The Pathologies Of The Shoulder Because These Pathologies Are Responsible For The Second And Third most Common Causes Of Musculoskeletal Pain. Abnormal Changes In The Position Of The Scapula At Different Angles Of The Shoulder Indicate A Disturbance Of The ScapulohumeralRhythm(11,12).

Even Though Scapular Alterations Have Been Assessed In Patients With Frozen Shoulder, Treatment Programs Were Focused On Pain Relief And Improvement In ROM. Scapular Exercises Were Not Included In The Programs

Even Though The Scapula Plays Several Roles In Facilitating Optimal Shoulder Funcation(13).

SCAPULAR PNF TECHNQUES :

PNF Is A Treatment Concept With Four Theoretical Mechanisms, Referred To As Autogenic Inhibition, Reciprocal Inhibition, Stress Relaxation, And The Gate Control Theory, That Enhance ROM And Muscle Activation.(14,15)

PNF Has Been Reported To Be Effective In Relieving Pain And Improving Functional Abilities. PNF Methods, Particularly Those Involving Reciprocal Activation Of The Agonist And Antagonist To The Desired Motion, Provide The Greatest potential For Muscle Functioning.(16,17)

Among Therapeutic Approaches, Joint Mobilization Using PNA Has A Positive Effect On Pain, Muscle Strength, And ROM. Proper Function Of The Upper Extremities Requires Both Motion And Stability Of The Scapula.(19,20)

The Scapula Patterns Defined In PNF Are Activated Within The Upper Extremity Patterns And Scapular Motion Together(21). The Effects Of The Shoulder Have Been Investigated In Some Studies(22-29). However, No Previous Study Has Investigated The Effects Of Scapular PNF Exercises In AC Rehabilitation.

CLASSIC SHOULDER EXERCIES :

- **Strengthening exercises :**
- Codman Pendulum exercises.
- Wand (stick) exercises.
- Pulley exercises.
- Finger walk.
- Resisted Exercises With Theraband(30).
- Therefore, The **Aim Of This Study** Was To Compare The Acute Effects Of Scapular PNF Techniques And Classic Shoulder Exercises With TENS On Pain, Scapular Dyskinesis, Shoulder ROM, And Functionality In Patients With AC.
- In This Study, Pain, Scapular Dyskinesis And Shoulder Function Were Be Measured Using Visual Analogue Scale(VAS), Lateral Scapular Slide Test (LSST) And Simple Shoulder Test.

REVIEWOF LITERATURE

1. **Positional stretching of the coracohumeral ligament on a patient with adhesive capsulitisJose Orlando Ruiz Et Al(2009)** Performed A Study On Positional Streching Of Coracohumeral Ligament On A Patient With Adhesive Capsulitis And Concluded That the Coracohumeral Ligament Streching Is An Effective Therapeutic Strategy To Help Reduce Loss Of Joint Mobility And Function.(31)

2. **Adhesive shoulder capsulitis : Does the timing of manipulation influence outcome ?Olivia Flannery Et Al (2007)** Conducted A Study On The Adhesive Shoulder Capsulitis. In Their Study They Mentioned That Duplay Was The First To Describe A Painful, Stiffening Condition Of The Shoulder, Which He Termed **Peri** – Arthritis Scapula Humerale And Codman In 1934 Named The Condition **Adheshive Capsulitis** Conclued That It Was Characterized By Slow Onset, Pain near The Insertion Of The Deltoid, Instability To Sleep On The Affected Side, Painful And Restricted Elevation And Term **Adheshive Capsulitis** Was Introducted By Neviaser In 1945, Based Upon His Finding Of Synovial Changes In The Gleno - Humeral joint.(32)

3. **The Pathology Of Frozen ShoulderG.C.R. Hand Et Al (2007)** Studies The Pathology Of Adhesive capsulitis. Twenty Two Subjects, Diagnosed As Primary Adhesive capsulitis Was inclued In Their Study Biopsies Were Taken From This Site And Histological And Immunocyto -chemical Analysis Was Performed To Identify The Type Of Cell Present. The Tissue Was Characterized By The Presence Of Fibroblast, Profiferating, Fibroblast And Chronic Inflamatory Response With Fibroblastic Proliferation Which May be Immune Modulated(33).

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5. **Adhesive Capsulitis : Does The Timing Of Manipulation Infulence Outcome. AetaOrthop. Belg, 2007,73,21-25.Oliva Flannery, HanamMullett Et Al(2007)** Performed A Study On Adhesive Shoulder capsulitis. In Their Study Used VAS For The Assessment Of Pain In The Shoulder In Subjects Suffering from Adhesive capsulitis And They Concluded That VAS Was Significant To Assess Pain In The Affected Shoulder(35).

6. **Non Operative Management Of Idiopathic Adhesive Capsulitis Journal Of Shoulder And Elbow Surgery 2006.569-573.Wereiam N> Levine Et Al (2006)** Performed A Study On Non Operative Management Of Idiopathic Adhesive capsulitis. In Their study They Said That This Condition Was First Describe By Duplay In 1872 And Named As **FROZEN SHOULDER** In 1934 And Is Characterized By Pain And Restriction Of Both Active and Passive ROM. They Concluded That the Pathology Is Anatomy Was First Describe For Frozen shoulder.(36)

7. **Frozen Shoulder Richard Dias Et Al (2005)** Performed A Study On The Clinical Review Of Frozen Shoulder. They Studied The Incidence, Clinical Presentation, Diagnosis And Treatment Modalities In Adhesive capsulitis. Regarding The Incidence They Concluded That The Onset Of This Condition Before The Age Of 40 Is Very Uncommon. The Peak Age Is 56 Yrs And The Condition Occurs Slightly More Often In Women Than Men. In 6-17% Of Patients, The Other Shoulder Becomes Affected. The Non Dominant Shoulder Is Slightly More Likely To Be Affected.(37)

8. **Acromiohumeral distance in a seated position in persons with impingement syndrome Hebert LJ Et Al(2003)** Had Done A Prospective Cohort Study To Identify The Bestindicators Of The Current Disability Of Patients With Shoulder Impingement Syndrome(Sis)And The Strongest Predictors Of 3 Months SIS-Related Disability. The SPADI Score ALBaseline And The Presence Of Sis On The Dominant Side,Among Other Variables Predicted86% The Variance Of The SPADI At 3 Months And Concluded That Variables That BestExplain The Current Disability Level And Predictors Of Short-Term Leval Of DisabityShould Be Considered In SIS Treatment Planning As Well As For Establishing Prognosis.(38)

9. **Influence of Comorbidity on Self-Assessment Instrument Scores of Patients with Idiopathic Adhesive Capsulitis Jennifer Moriatis Wolf And Andrew Green(2002)** Did A Study To Determine The"Influence Of Co- Morbidity On Self - Assessment Instruments Scots Of Patients With Adhesive Capsulitis. Phase 2 Adhesive Capsulitis Were Prospectively Evaluated With The Use Of VAS And They Found That The Score On VAS Can Be Applied To The Evaluation Of The Patient And May Help To Identify Patients Who Potentially Require A Longer Treatment Course Or Those Outcome WereBe Less Satisfactory.(39)

10. **End-range mobilization techniques in adhesive capsulitis of the shoulder joint: A multiple-subject case report VermeulenHM Et Al (2000)** Did A Study On Effectiveness Of End Range Mobilization Technique In Adhesive

    Capsulitis Of Shoulder Joint In 45 Subjects And The Results Concluded End Range Mobilization Technique To Be Beneficial In Improving Joint Mobility.(40)

11. **Idiopathic adhesive capsulitis. A prospective functional outcome study of nonoperative treatment Griggs Et Al (2000)**Reported That Following A Physical Therapy Program Consisting Of Passive Stretching Exercises (Forward Elevation, External Rotation, Horizontal Adduction And Internal Rotation) At A Mean Follow - Up Of 22 Months, Patients Demonstated A Reduction In Pain Score From 1-57 To 1 -16 In Range From One To Five Points Improvements in Active Range Of Motion, And 64 Patients (20%) Reported A Satisfactory Outcome.(42)

12. **Reliability of goniometric measurements Boone DC, Azen SP Et Al(1987)** Conducted A Study To Determine The Intra - Tester And Inter-Tester Variability And Reliability Of Goniometric Measurement Taken By Four Physical Therapists On Upper And Lower Extremity Motions. Their Findings Indicated The Necessity For Using The Same Lester When Effects Of Treatment Are Evaluated.(43)

NEEDOF STUDY

NEEDOFSTUDY

NEEDOFSTUDY

- There Are Lots Of Study Available Which Suggest The Treatment Of Adhesive Capsulitis Which Includes Scapular PNF Techniques , Classic Shoulder Exercises, Strengthning Exercises , Mobilization Techniques Etc. But There Are Lack Of Evidence Which Compare The Acute Effect Of Scapular PNF Techniques And Classic Shoulder Exercises With TENS In The Effectiveness Between These Treatment Groups For Adhesive Capsulitis Patients.

OBJECTIVESOFTHESTUDY

OBJECTIVES OFTHESTUDY

OBJECTIVEOFTHESTUDY

To Determine The Acute Effect Of Scapular PNF Techniques With Tens In Patients With Adhesive Capsulitis.

To Determine The Acute Effect Of Classic Shoulder Exercises With Tens In Patients With Frozen Shoulder.

To Compare The Acute Effect Between The Scapular PNF Techniques With Tens And Classic Shoulder Exercises With Tens IN Patients With Adhesive Capsulitis.

HYPOTHESIS

HYPOTHESES

HYPOTHESIS

- **Null Hypothesis :**

  There Is No Significant Difference In Effect Of Scapular PNF Techniques And Classic Shoulder Exercises With Tens In The Patients With Adhesive Capsulitis.

- **Alternate hypothesis :**

  There Is Significant Difference In Effect Of Scapular PNF Techniques And Classic Shoulder Exercises With Tens In The Patients With Adhesive Capsulitis.

METHODOLOGY

Participants Were Allocate To Treatment Groups Using Sealed, Opaque Envelopes. The Envelopes Contained Stickers Denoting 1 Or 2. Subjects Who Picked 1 Were Included In The Groups 1 (scapular PNF techniques) And The Subjects Who Picked 2 Were Included In Group 2 (classic shoulder Exercises). Following This, Demographic Information were Conducting. Duration Of Symptoms And Side Affected Noted And Initial Evaluation Of Pain Profile Was Done Using Visual Analogue Scale (VAS).
Functional Performance Were Assessing Using The simple shoulder test scale (SST), And Lateral Scapular Slide Test (LSST).

Group 1 : Subjects Received scapular PNF techniques.
Group 2 : Subjects Received classic shoulder Exercises.

PROCEDURE:

The Purpose And The Procedure Of The Study were Explain In Details To The Patients Who Satisfied The Inclusion Criteria Both The Treatment Groups Completed With Written Informed Consent Form. Patients were Allocate To Treatment Groups Using Sealed, Opaque Envelopes. The Envelopes Contained Stickers Denoting 1 Or 2. Then Both Treatment Groups Of Each Patients Completed 2 times (Pre & Post) VAS, SST, LSST.

The Patients were Collect Along With The Routine Evaluation With Emphasis On; Pain Scores Using VAS Where A Horizontal Line (10cm Long) Was Drawn On A Paper And Patients Were Ask To Mark A Ponton The Line That Beat Defined The Present PAIN Level, Where – 0 Indicated No Pain And – 10 Indicated Severe Pain, Functional Performance were Assessed Using SST Scale. Outcome Measure Were Taken On Day 1 And After Completion Of Treatment Protocol I.E. After 4 Weeks.

SUBJECTS AND METHODS

This Study wereDesign As Randomized Control Trial. Thirty Subjects (Females, Males) Shoulder Exercises Groups And TENS (N=15),Simple Randomization And A Random-Number Table Were Used As The Method Of Sequence Generation For Patients.Same Therapist Evaluated All The Patients, While Another Therapist Applied The Intervention Methods The Therapist Who Applied The Interventions Was Experienced In Ac Treatment And Also Had A PNF Certificate.
All Patients Received An Explanation About The Purpose And Test Procedures Involved In The Study Before Enrollment. Each Patient Was Informed About The Study And Gave Written Informed Consent To Patient

GROUP 1 :

- **SCAPULAR PNF TECHNIQUES :**

In the PNF groups, scapular PNF was applied by a therapist in two diagonals, anterior elevation and posterior depression and posterior elevation and anterior depression with 20 repetitions. Patients lay on the unaffected side while the therapists stood in the line of desired motion. Firstly, the therapist gave preparatory instructions. In the beginning of the
Pattern, the therapist pulled the scapula to the elongated position and then gave instructions for the desired movement. Rhythmic initiation and repeated contractions facilitation techniques were applied in all patterns. These techniques are the best matchedmatched scapular facililation techniques of the PNF agonistic techniques.

GROUP 2 :

In the **classic Shoulder exercise group,** TENS were applied using the same procedure as describe above. After the TENS, strengthening exercises with Theraband and dumbbells were assigned to the patients. One set of want , finger walk , pulley and Codman pendulum exercises scapular elevation adduction (posture), and scapular stabilization exercises were also performed with 20 repetitions for each exercise.
wereRecruite For This Study Form The Near by Clinics In Kalol.
Subjects Werebe Randomly Allocated To Two Groups :SCAPULAR PNF TECH. And TENS (N=15), Classic

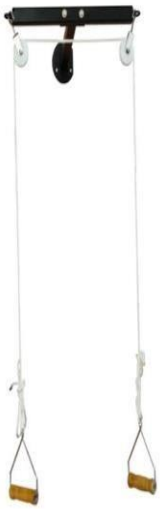
Materials & Tools Used:

1. Inform Consent Form.
2. Pen ,Pencil ,Eraser ,Sharpener ,Stapler
3. Pillow , Plinth ,High Stool

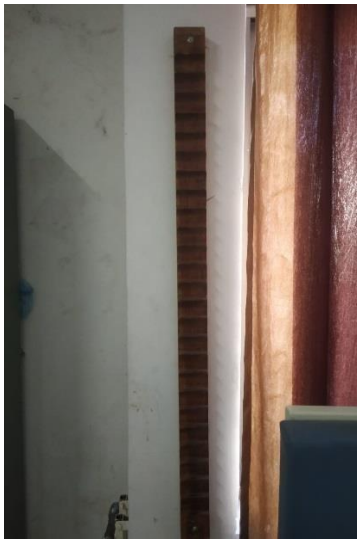
.

4. Pulley.
5. Measure Tape.
6. Dumbbells.
7. Theraband.
8. Finger walk
9. TENS.
10. Goniometer

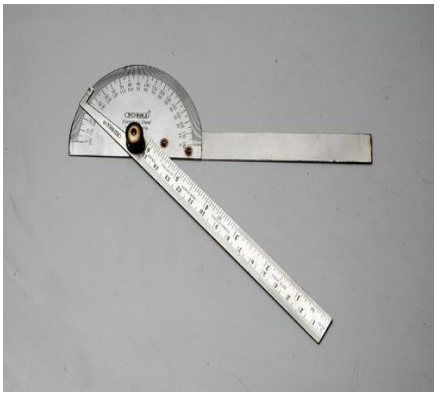
TENS



PULLY



FINGER WALK



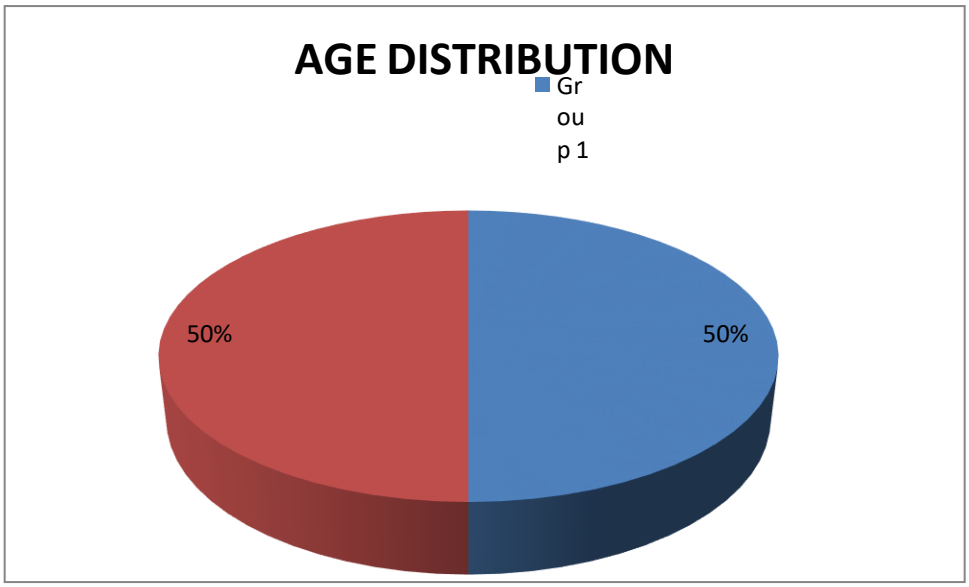
GONIOMETER

MEASURETAPE

RESULT

Table 1: Age Distribution Of Both Groups

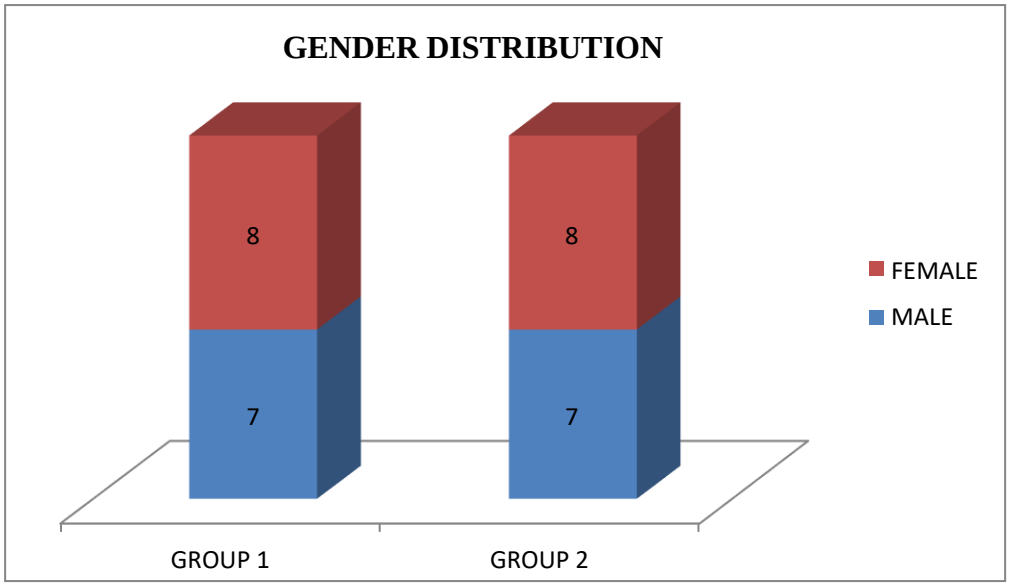
	NO OF PATIENT	MEAN AGE	SD
GROUP 1	15	52.06667	5.612062
GROUP 2	15	51.2	4.443294



(FIG 8: AGE DISTRIBUTION OF BOH GROUPS)

Table 2: Gender Distribution In Both Groups

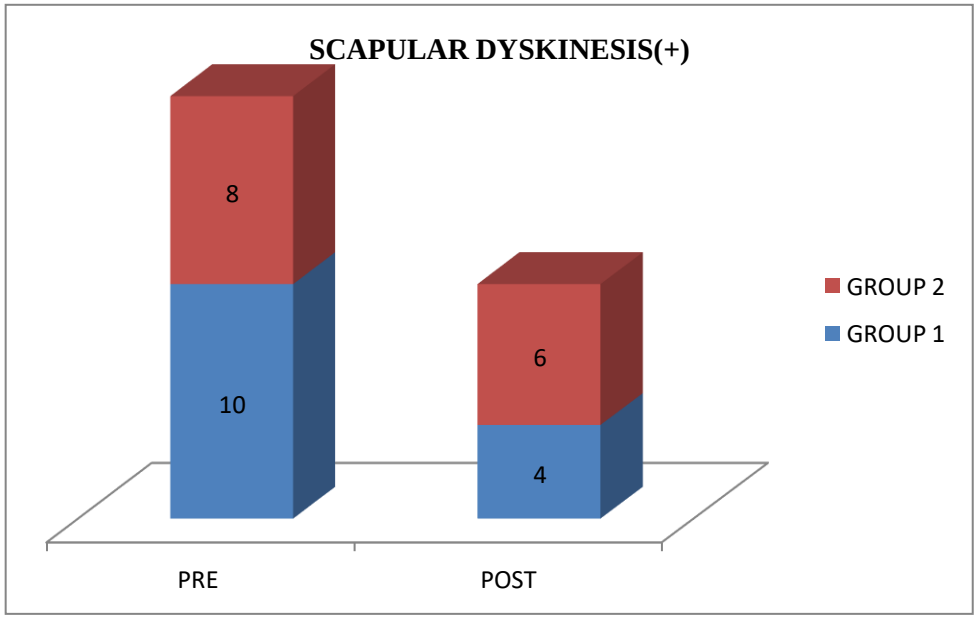
GENDER	MALE	FEMALE	TOTAL
GROUP 1	7	8	15
GROUP 2	7	8	15



(FIG 9: GENDER DISTRIBUTION IN BOTH GROUPS)

Table 3: Comparison Of Pre And Post Scapular Dyskinesis (+) In Both Groups

	PRE	POST
GROUP 1	**10**	**4**
GROUP 2	**8**	**6**

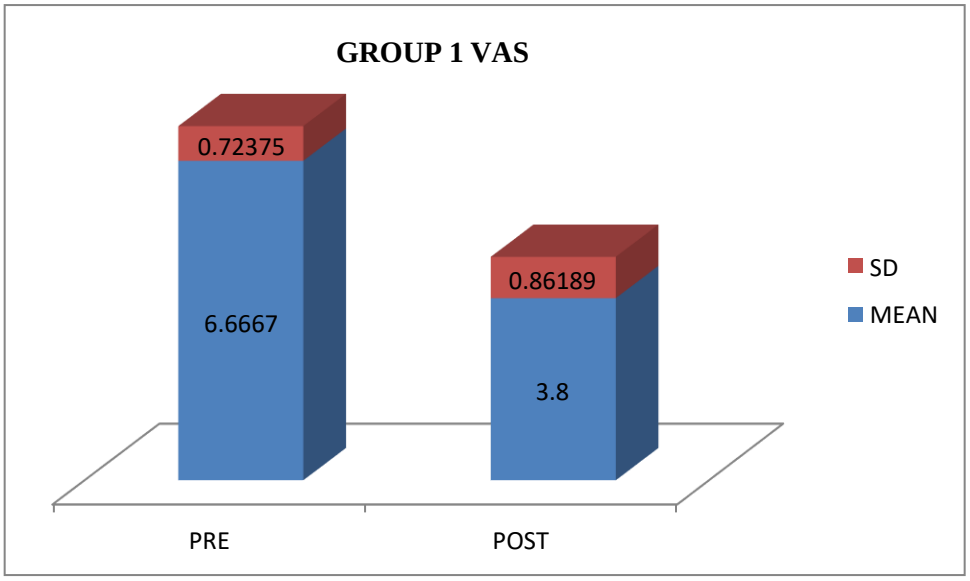


(FIG 10: COMPARISION OF PRE AND POST SCAPULAR DYSKINESIS IN BOTH GROPUPS)

Table 4: Comparison Of Pre And Post VAS In Group 1

GROUP 1 VAS					
TIME	**MEAN**	**SD**	**DF**	**t-value**	**p-value**
PRE	**6.66667**	**0.72375**	**14**	**14.938**	**0.0001**
POST	**3.800000**	**0.86189**			

Here Paired Test Was Used For Analysis And P- Value< 0.0001 Between Pre And Post, Hence, It Shows Highly Significant Difference.

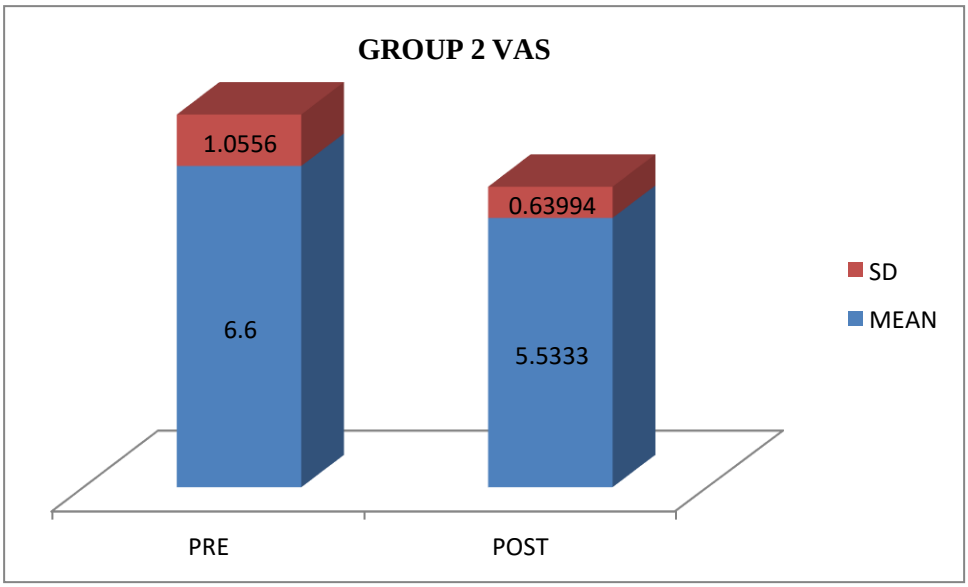


(FIG 11: COMPARISON OF PRE AND POST VAS IN GROUP 1)

Table 5: Comparison Of Pre And Post VAS In Group 2

GROUP 2 VAS					
TIME	**MEAN**	**SD**	**DF**	**t-value**	**p-value**
PRE	**6.6000**	**1.05560**	**14**	**4.298**	**0.0001**
POST	**5.5333**	**0.63994**			

Here Paired Test Was Used For Analysis And P- Value< 0.0001 Between Pre And Post, Hence, It Shows Highly Significant Difference.

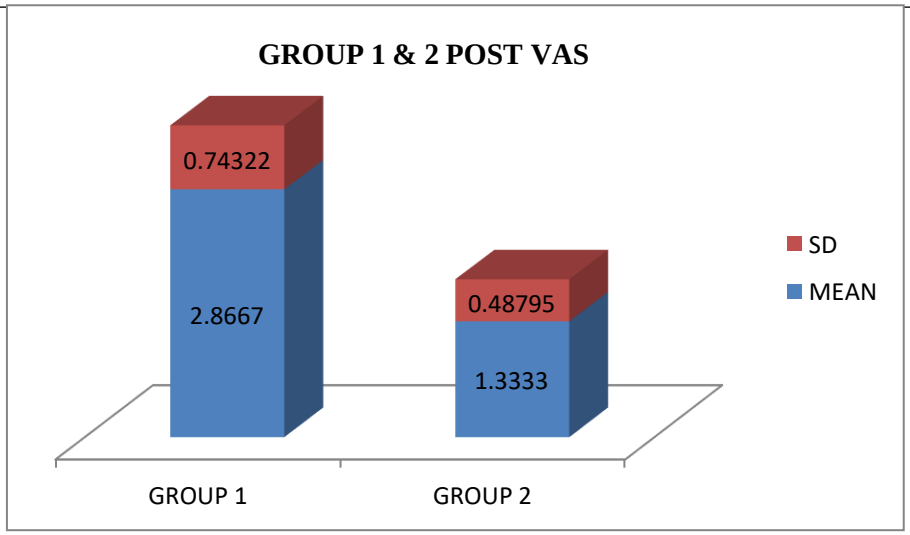


(FIG 12: COMPARISON OF PRE AND POST VAS IN GROUP 2)

Table 6: Comparison Of Difference Between Post VAS Group 1 And Group 2

POST VAS GROUP 1 & 2					
	MEAN	**SD**	**DF**	**t-value**	**p-value**
GROUP 1	**2.8667**	**0.74322**	**28**	**6.679**	**0.0001**
GROUP 2	**1.3333**	**0.48795**			

Here Independence t-Test Was Used For Analysis And P- Value< 0.0001 Between Group 1 And Group2. Hence, It Shows Highly Significant Difference.

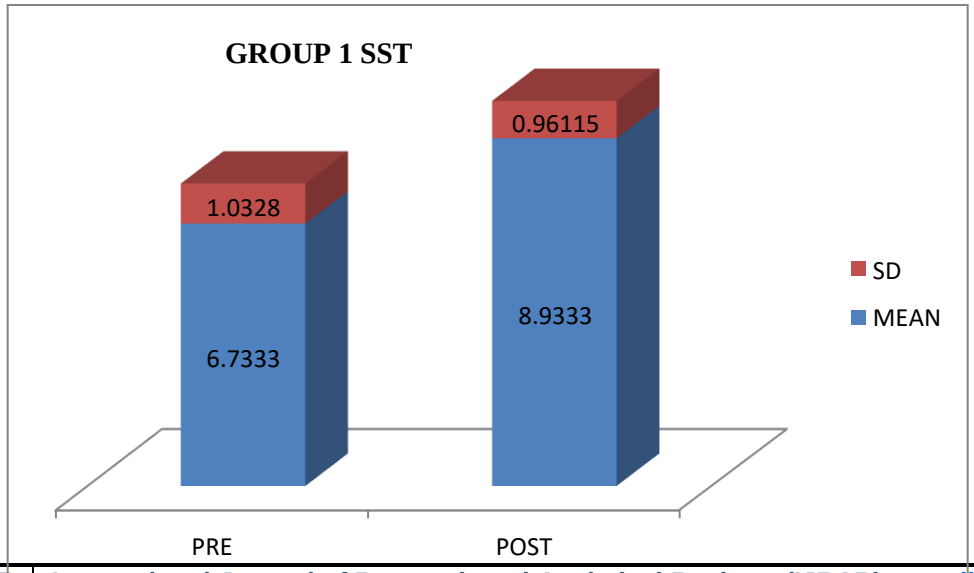


(FIG 13: COMPARISON OF DIFFERENCE BETWEEN POST VAS IN GROUP 1 AND 2)

Table 7: Comparison Of Pre And Post SST In Group 1

GROUP 1 SST					
TIME	**MEAN**	**SD**	**DF**	**t-value**	**p-value**
PRE	**6.7333**	**1.03280**	**14**	**12.602**	**0.0001**
POST	**8.9333**	**0.96115**			

Here Paired Test Was Used For Analysis And P- Value< 0.0001 Between Pre And Post, Hence, It Shows Highly Significant Difference.

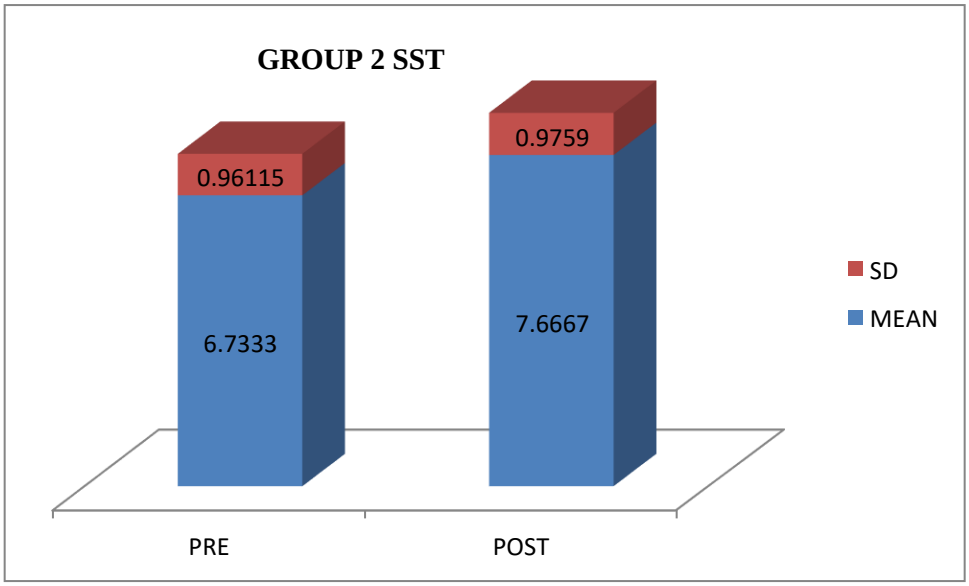


(FIG 14: COMPARISION OF PRE AND POST SST IN GROUP 1)

Table 8: Comparison Of Pre And Post SST In Group 2

GROUP 2 SST					
TIME	**MEAN**	**SD**	**DF**	**t-value**	**p-value**
PRE	**6.7333**	**0.96115**	**14**	**4.090**	**0.0001**
POST	**7.6667**	**0.9759**			

Here Paired Test Was Used For Analysis And P- Value< 0.0001 Between Pre And Post, Hence, It Shows Highly Significant Difference.



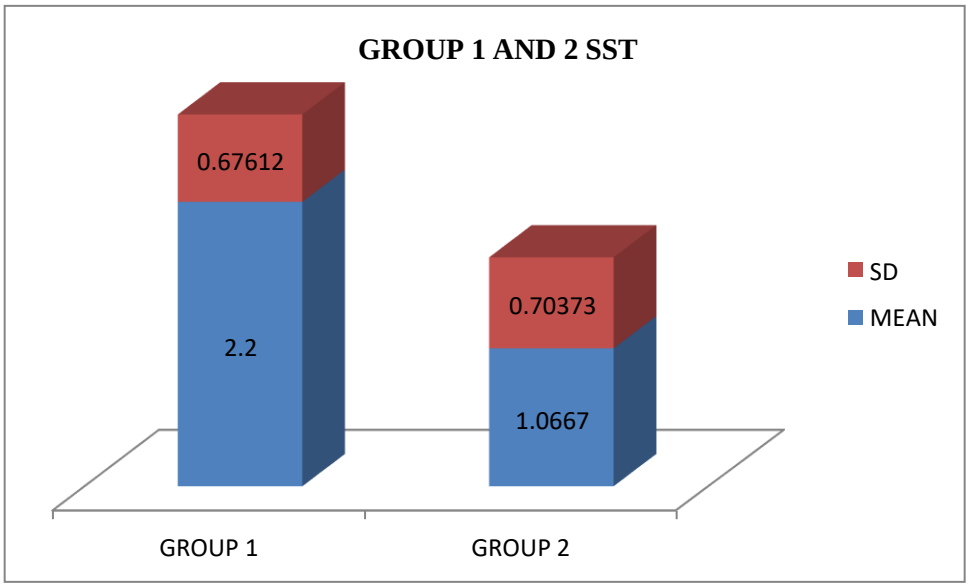
(FIG 15: COMPARISION OF PRE AND POST SST IN GROUP 2)

Table 9: Comparison Of Difference Between Post SST Group 1 And Group 2

POST SST GROUP 1 & 2					
	MEAN	**SD**	**DF**	**t-value**	**p-value**
GROUP 1	**2.2000**	**0.67612**	**28**	**4.498**	**0.0001**
GROUP 2	**1.0667**	**0.70373**			

Here Independence t-Test Was Used For Analysis And P- Value< 0.0001 Between Group 1 And Group2. Hence, It

Shows Highly Significant Difference



(FIG 16: COMPARISION OF DIFFERENCE BETWEEN POST SST IN GROUP 1 AND GROUP 2)

DISCUSSION

DISCUSSION

DISCUSSION

Adhesive Capsulitis Is Characterized By Painful Stiffness Of Shoulder That May Persist For Several Years. It Is A Common Disorder; With An Estimated Annual Incidence Of 3% To 5% In The General Population (Bridgman 1972, Pal Et Al 1986). Advocated Treatments Include Rest And Analgesics, Corticosteroid Injections, Acupuncture, Physical Therapy, Manipulation Under Anesthesia, And Arthroscopic Or Open Surgery. There Is No General Acceptance Of One Standard Treatment.

Adhesive Capsulitis Is A Contracture Of The Capsule And Depending On How Severe The Contracture Is (For It Varies In Intensity From Patient To Patient) The Treatment Is Decided. The First Objective In The Treatment Of Patients With Adhesive Capsulitis Is Pain Relief. This Is Essential, For It Permits Patients To More Readily Participate In An Exercise Program Aimed At Restoring Motion And Recovering Function.

The Primary Mode Of Treatment For Adhesive Capsulitis Is Prevention. Avoiding Prolonged Immobilization Of The Shoulder After Trauma Or When Shoulder Pain Develops Is Key. The Overall Goal Of Treatment Is To Relieve Pain, Restore Motion, And To Restore Function. Although Adhesive Capsulitis Is Generally Considered To Be A Self- Limiting Condition That Can Be Treated With Physical Therapy, The Best Treatment Has Been The Subject Of Extensive Investigation. A Variety Of Different Treatments Have Been Recommended.

CONCLUSIONANDSUMMARY

CONCLUSION &SUMMARY

CONCLUSION

The Study Rejects The Null Hypothesis – There Is No Significant Effect Of Scapular PNF Techniques And For Improving Pain, Scapular Dyskinesis And Functional Impairments The Patients With Adhesive Capsulitis And Accept The Experimental Hypothesis – There Is **Highly Significant Effect Of Scapular PNF Technique** And For Improving Pain, Scapular Dyskinesis And Functional Impairments The Patients With Adhesive Capsulitis .

During The Course Of The Study It Has Been Concluded That Scapular PNF Techniques And Classic Shoulder Exercises Both Are Improved Pain, Scapular Dyskinesis And Functional Impairments The Patients With Adhesive Capsulitis. There Is Significant Increase In Both Scapular PNF Techniques And Classic Shoulder Exercises After 4-Week Treatment Duration In Both Groups. But Group 1 Receiving **Scapular PNF Techniques Showed More Power Full Improvement In Pain, Scapular Dyskinesis And Functional Improvement.**

LIMITATIONS

LIMITATIONS

Limitations

- Sample Size Was Limited.
- There Is No Control Group.
- No Follow Up

Futurerecommendation

- The Same Study Can Be Done With Large Group.
- The Same Study Can Be Done With A Longer Follow- Up.
- The Same Study Can Be Done With Control Group.

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ANNEXURE A

સંમતીપત્રક :

વ્યક્તિનું નામ :

જાતી - સ્ત્રી / પરુષઉંમર _____

:

વ્યક્તિનું સરનામું

: _____

હું હ

કદારસુંશોધનપ્રોજક્ટે ટ

ત્લનાત્મકઅભ્યાસ

હું પણતમામપરીક્ષણોની નઆક્રમણઅનેકોઈઆડઅસરવગરછકે સમજાવીકરવામાું આવીછે.

મારાવય્યાત્મકક્ષમતાઅનેઆરોગ્ય કારણીહાથધરવામા ેજ વયવપરક્ષણવશવગતવારસમજાવયેલ સથતીવગેરકરવામાું આવીછે. ું આવેશક

હું અભ્યાસમાું સહયોગસ્વેછણછેજસમજવાઅનેતહું અસરથઈરહી.

મારાત ીક ીકાળજીઅથવાકાનૂનીઅધકારવગરકોઈકારણઆપ્યાવગર,
હું કોઈપણસમયેપાછીખેંચીમ્કતછું .

હું અભ્યાસદ્વારામેળવીમાહતીસુંશોધનપેપરપ્રકાશનમાટે ઉ મજછેએનહું પણમારીઓળખતતીયપક્ષ પયોગકરીશકાયછેજસ ુરજૂ અ

થવાપ્રકાશીતકોઈપણમાહીતીજાહેરકરવામાટેઆવશેનાહકે અમજછે.

હસ્તાક્ષર (અથવાઅંગૂઠાનીછાપ)

વ્યક્તની_____

કાયદાકીયરીતેસ્વીકાયતનીઘી :_____ સાક્ષીનીસહી :_____

તપાસનારનીસહી :____

સાક્ષીનુંનામ :_____ તારીખ : _____

PATIENTINFORMATIONFORM

What Cause Your Shoulder To Hurts?

Please Rate Your Pain on The Following Scale (circle one)

None	Slight	After Unusual activity
Moderate	Marked	Complete Disability

Do you Have Shoulder Pain At Night? YES/NO

Do You Take Pain Medicine? YES/NO

Name: _____

How Much Per Day? _____

Does Your Shoulder Feel Stiff? YES/NO

Does Your Shoulder Feel Loose Or Unstable? (if any) _____ What

Is The Hardest Thing That You Do At Work Or Home?

Please Rate Your Ability To Perform The Following Tasks Your Affected Shoulder.

Rating Scale
4=normal
3=mild compromise
2=difficulty
1=only with aid
0=unable

A_____Use back pocket H_____Dress your self

B_____Perineal care I_____Sleep on affected sideC

_____Wash opposite axilla

D_____Eat with utensil

E_____Comb hair

_____Use hand with arm at Shoulder level

G_____Cary 10-15 lbs with arm At side

J_____Pulling

K_____Use hand overhead

L_____ThrowingF

M_____Lifting

N_____Do usual work

O_____Do usual sport

Study Tittle: **Acute effect of scapular proprioceptive neuromuscular facilitations technique versus classic shoulder exercises in adhesive capsulitis**

I Mr/Mrs_____Exercise My Free Power Of Choice; Here By Give My Consent To Include My Self As A Subject. In The Study And To Publish The Data Obtain. I Have Been Diagnosed As Having Adhesive Capsulitis. I Have Been Informed To My Satisfaction By The Attending Physiotherapist. The Purpose And Method Of The Study As Any Time During The Course Of The Study Without Giving Reason To Do So I Agree To Adhere To The Physiotherapist's Instruction And Co-operate Fully With Those Conducting The Study And Inform Them If My Condition Deteriorates Or If I Experience Any Unwanted Symptoms.

Patient's Name:_____ **Date:**_____

Sign: _____

Physiotherapist Name:_____

Sign: _____

.

ANNEXURE C

DATA COLLECTION SHEET

GROUP: ☐ DATE: _____

NAME OF PATIENT: _____

OPD No: _____

Age: _____

Sex: _____

BMI:_____ Weight:_____Kg Height:_____cms

Address & Contact No:

_____

_____

_____

_____

Affected Side: _____

Signature of the Investigator

AjaydeepsinhVaghela

ANNEXURE D

ASSESSMENT SHEET

DEMOGRAPHIC DATE:

NAME:
AGE:
GENDER:
OCCUPATION:
ADDRESS:
REFFERRED BY:
CONTACT NO:
HAND DOMINENCY:

CHIEF COMPLAIN:

HISTORY:

HISTORY OF PRESENT ILLNESS:

PAST HISTORY:

PERSONAL HISTORY:
SOCIO-ECONOMIC STATUS:

MEDICAL HISTORY:

ON OBSERVATION:

POSTURE:
DEFORMITY.
SWELLING:
EXTERNAL AIDS;
TROPICAL CHANGES:

ON PALPITAION:

TRIGGER POINT:
TENDERNESS:
SPASM:
WARMTH:
SENSATION:
SOFT TISSUE PALPITAION:

BONY PALPITAION;
ACCESSORY
MOVEMENT:0

ON EXAMINATION:

ROM:
MMT:
GIRTH MEASUREMENT:

PAIN ASSESSMENT:

TYPE OF PAIN:
SITE OF PAIN:
AGGRAVATING FACTOR:
RELIEVING FACTOR:

- **Pain assessment by VAS(cms)**

  a. Pre treatment VAS

  0 _____ 10 Score ☐

  b. Post treatment VAS

  0 _____ 10 Score ☐

- **Scapular dyskinesis using a measure tape:**

  Scapular dykineis

  PRE :

POST;

ANNEXURE E

Name:_____ Date:_____

Simple Shoulder Test

Answer each question by circling "Yes" or "No"

If you do not normally do the activity, try to imagine if you could. Would your shoulder restrict you. If the activity causes no pain, or rarely produces pain, then answer "Yes". If your shoulder hurts sometimes, often or always when you do the netivity, answer "No"

1.Is your shoulder comfortable with your arm at rest by your side?	Yes	No
2.Does your shoulder allow you to sleep comfortably?	Yes	No
3.Can you reach the small of your back to tuck in your shirt?	Yes	No
4.Can you place your hand behind your head with the elbow straight out to the side?	Yes	No
5.Can you place a coin on a shelf at the level of your Shoulder Without bonding your albow?	Yes	No
6.Can you lift one pound (full pint container) to the level at your shoulder without bending your elbow?	Yes	No
7.Can you lift eight pound (full gallon container) to the level of your shoulder without bending your elbow?	Yes	No
8.Can you carry twenty pounds at your side with the affected extremity?	Yes	No
9.Do you think yon can toss a softball under- hand twenty yards with the affected extremity?	Yes	No
10.Do you think you can toss a softball over hand twenty yards with the affected extremity?	Yes	No

11.Can you wash the back of your opposite shoulder with the affected extremity? Yes No

12.Would your shoulder allow you to work full-time at your regular job? Yes No

ANNEXURE F
MASTER CHART

GROUP 1								
SR NO:	AGE	GENDER	VAS		SST		VAS DIFFERENT	SST DIFFERNT
			PRE	POST	PRE	POST		
1	45	F	6	4	6	9	2	3
2	47	M	7	5	6	7	2	1
3	50	F	6	3	7	9	3	2
4	46	F	7	4	8	9	3	1
5	60	M	6	3	8	10	3	2
6	57	M	7	4	5	8	3	3
7	60	F	8	4	6	9	4	3
8	47	F	7	5	7	9	2	2
9	57	M	6	4	8	10	2	2
10	46	F	6	3	7	9	3	2
11	55	M	7	4	5	7	3	2
12	47	M	8	4	6	9	4	3
13	59	F	7	5	8	10	2	2
14	51	F	6	2	7	10	4	3
15	54	M	6	3	7	9	3	2

GROUP 2								
SR NO:	AGE	GENDER	VAS		SST		VAS DIFFERENT	SST DIFFERNT
			PRE	POST	PRE	POST		
1	48	F	7	6	7	9	1	2
2	51	M	7	5	5	7	2	2
3	50	F	4	5	7	8	1	1
4	49	F	8	6	8	9	2	1
5	54	M	6	5	7	8	1	1
6	56	F	6	5	8	8	1	0
7	47	M	7	6	6	7	1	1
8	50	F	8	6	6	8	2	2
9	59	M	8	6	7	7	2	0
10	56	F	6	5	7	8	1	1
11	54	F	7	5	7	9	2	2
12	56	M	6	5	8	8	1	0
13	47	F	6	5	5	6	1	1
14	43	M	6	7	7	6	1	1
15	48	M	7	6	6	7	1	1

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Immediate changes in Pain after TENS in patients with Abdominal Surgeries: A Case Series

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Abstract

Background:
Abdominal surgical procedures cause tissue damage by direct visceral manipulation, through the incision on anterior abdominal wall and by the use of surgical retractors that help to expose the surgical field. Pain is an important negative influence in the postoperative evolution of abdominal surgeries so the study was conducted to see the changes in pain after TENS in patients' abdominal surgeries through VAS.

Methodology:
A case series was done in six patients in Dhiraj General Hospital, Vadodara. Physiotherapy treatment was given in form of TENS was given to the patients with abdominal surgeries twice a day. Prior to treatment patients were assessed for pain through VAS. Routine physiotherapy management was continued according to patient's conditions.

Result:
SIX patients were included in case series. There was reduction in visual analogue scale in patient with abdominal surgeries.

Conclusions:
There was reduction in pain in all the patients with abdominal surgeries who received physiotherapy treatment in form of TENS for 3 consecutive days.

Keywords:
Abdominal surgeries, physiotherapy

INTRODUCTION

Abdominal surgical procedures cause tissue damage by direct visceral manipulation, through the incision on anterior abdominal wall and by the use of surgical retractors that help to expose the surgical field. Pain after surgery causes discomfort to the patient, preventing the patient from relaxing, leading shallow breathing and hindering the patient's movements in bed. Thus decrease diaphragmatic breathing and cough efficacy that might lead to atelectasis, especially in the lower lung fields. Pain is an important negative influence in the postoperative evolution of abdominal surgeries.The concept of Pain Gait control theory is based on the fact that peripheral stimulation produces impulses that are transmitted to three spinal cord systems: substantial gelatinoids fibers in dorsal horn, dorsal column fibers projecting towards the brain and first central transmission (T cells) in the dorsal horns. What the theory proposes is that substantial gelatinoids is a gait system which modulate efferent impulses before T cells are activated. TENS can be used as conventional analgesia for postoperative pain. Besides being a non- invasive and non-pharmacologic technique; it is comfortable for the patient in 95% of the cases. It can be effective in controlling pain after abdominal surgeries without any side effects.[1] Transcutaneous electrical nerve stimulation (TENS) is a physical therapy tool widely used to relieve pain. The effects of TENS follow the "Pain Gait Theory" (Melzek and Wall, 1965)[2].Laparoscopic surgery has become the standard approach for a large number of gynecologic procedures. The frequency of laparoscopy varies widely across the globe. Laparoscopic operations are performed annually for the following indications: sterilization, diagnosis, cyst enucleating, and salpingooophorectomy.Pain is often a problem after gynecologic laparoscopic surgery, even if the postoperative pain is less significant when compared to that after a similar major laparotomy surgery[3].

Appendectomy was performed through a skin crease incision and muscle splitting approach. An absorbable suture was used to legate and buries the appendix stump. Closer was in layer with an absorbable suture and skin closure was with 3.0 nylon. Patients were excluded if the wound had to be extended by cutting muscle or if there was generalized peritonitis[4]. Electro therapy can treat diverse symptoms produced by diseases that affect the human body. Electro therapy using transcutaneous electrical nerve stimulation is a low cost, non-invasive and easily accessible technique to treat pain. In this context, numerous description emerge on the effectiveness of transcutaneous electrical nerve stimulation (TENS) for treating diverse types of pain, knee osteoarthritis and dysmenorrhea[5]. Transcutaneous electrical nerve stimulation (TENS) is a technique in which a special device transmits low voltage electrical impulses through electrodes on the skin to the area of the body that is in pain. Clinic studies on the role of transcutaneous electrical nerve stimulation (TENS) on postoperative pain were systematically searched and reviewed with the aim to determine its role in post-operative analgesic efficacy[6].

Technical Aspects of Transcutaneous electrical nerve stimulation:-

A TENS unit consists of electrical signal generator, battery and a set of electrodes. The TENS unit is small and programmable and the generator can deliver stimuli with variable current strengths, pulse rates and pulse width. The waveform in TENS machine can be monophonic or biphasic.

The usual settings for the stimulus parameters used clinically are the following:

- Amplitude-TENS unit's intensity ranges from 1 to 100 mA6 Pulse width-40-250 μs.6
- Pulse rate-1 or 2 Hz to 200-250 Hz.
- There are a number of TENS devices available in the market, the main types being conventional TENS acupuncture TENS and intense TENS[6].

Mechanism of action of transcutaneous electrical nerve stimulation:-

The mechanism of pain relief by TENS has been explained by various theories. According to the gate control theory by Melzack and Wall. When an electrical current is applied to a painful area, transmission of the perception of pain through small diameter fibers to the brain is inhibited by the activity of the large diameter, fast-conducting highly militated, proprioceptive sensory nerve fibers, closing the gate to the pain perception to the brain. Another mechanism proposed is activation of descending inhibitory pathway, through release of endogenous opioids. The areas involved in descending inhibition include nucleus raphe Magnus in rostral ventral medulla (RVM) and the periaqueductal gray (PAG). The PAG sends projections to the RVM, which in turn send projections to the spinal dorsal horn. The stimulation of PAG or the RVM produces inhibition of dorsal horn nucleus including spin thalamic tract cells. Specific and different opioids receptors are activated through release of endogenous opioids by different frequencies of TENS. Application of low frequency TENS causes activation of δ-opioids receptors and high frequency TENS activates μ-opioids receptors. These opioids receptors in turn activate the PAG-RVM pathway.8 Uncontrolled postoperative pain may produce a range of detrimental acute and chronic effects. Attenuation of postoperative pathophysiology that occurs during surgery through reduction of nociceptive input into the central nervous system (CNS) and optimization of preoperative analgesic may decrease complications and facilitate the patient's recovery during the immediate postoperative period and after discharge from the hospital[7]. Evidence based practice is essential in clinical practice to hasten the recovery of a patient. In electro therapy the applied energy is the trigger that stimulates or activates physiological events, which achieve therapeutic benefits that bring about pain relief[8].

METHODOLOGY

Research design: Case series

Study Population: Patients with abdominal surgeries

Source of data: Patients coming to Dhiraj General Hospital, Vadodara.

Sample size: 6 patients

Outcome measures: VAS (visual analogue scale)

Inclusion criteria:

- Subjects referred for post-operative physiotherapy following abdominal Surgery:- Gynaecologic Laparoscopy
- Appendectomy

Exclusion criteria:

- History of pain other than incision site.
- Patients with cognitive deficiencies.
- Patients with Cardiovascular instability

Outcome Measures:

- Visual analogue scale

Materials used:

- TENS-Transcutaneous electrical nerve stimulator.
- Electrode gel.
- Carbon rubber electrode.
- Microspore tape

After getting approval from Institutional Ethical Committee of Venus Institute of Physiotherapy, a referred post-operative surgery patients coming to Dhiraj General Hospital, Vadodara were screened according to assessment format. The patient fulfilled the inclusion criteria he/she was included in the study. Each subject was explained about the study and informed consent was taken.The purpose of the study was explained to the participants. Then pre VAS was taken. Accordingly, patient was treated with TENS at the incision site.In gynaecological laparoscopy the electrodes were placed over the area of pain, usually at dermatome Th11- L1for approximately 60 s. High-intensity stimulation was achieved through increasing the stimulation step by step to reach a stimulation intensity of 40 to 60 mA. The pain intensity was reassessed immediately after the end of treatment, i.e., after 60 s of stimulation. Then post VAS was taken. This procedure repeat for twice a day.The purpose of the study was explained to the participants. Then pre VAS was taken. Then Appendectomy was performed through a skin crease incision and muscle splitting approach. Electrodes applied to either side of the wound for 30 minutes. The pain intensity was re-assessed immediately after the end of treatment, i.e., after 60 s of stimulation. Then post VAS was taken. This procedure repeat for twice a day.

- Frequency - 100 Hz
- Plus duration - Short
- Time duration - 30 minutes

Visual analogue scale is used to measure intensity of pain for example the amount of pain that patient feels ranges across a continuum from none to an extreme amount of pain.A VAS is usually a horizontal line 100mm in length, anchored by word descriptors at each end as illustrated in figure. The patient marks on the line the point that they feel represents their perception of their current state. The VAS score is determined by measuring in millimetres from the left hand end of the line to the point that the patient mark.Other than TENS regular medical management was continued.

DATA ANALYSIS

Descriptive statistical analysis was carried out in the present study. Scale Vas scale (VAS). Significance was assessed at 5% level of significance $p<0.005$ (2-tailed hypothesis test considered).

Statistical tests:

- Paired “T” test as a parametric was used for analysis of Vas scale (VAS) variables within the Case series calculation of percentage of change.

Statistical software:

- **T**he Statistical software namely SPSS2.1.0.1 will be used for the analysis of the data and Microsoft word and Excel was used to generate graphs, tables etc.

RESULT:

In present study 6 peoples with the age group of 24 to 66 were taken. 6 subjects follow the session, 6 subjects were analysed. All the 6 participants were evaluated with the transcutaneous electrical nerve stimulation by the same rather before and after Vas scale (VAS scale). The data obtained in the gender are as follows. Statistical package for social science (SPSS) version 20 was used for the data analysis

Sr No.	Age/Gender	Day 1				Day 2				Day 3				Result
		Morning		Afternoon		Morning		Afternoon		Morning		Afternoon		
		Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post	
1	24/F	5	4	5	4	5	3	4	3	4	3	3	2	<3
2	50/F	6	5	6	5	5	4	5	4	4	3	4	2	<5
3	24/M	5	4	5	4	5	4	4	3	3	2	2	1	<4
4	66/M	6	5	6	5	6	5	5	4	5	4	5	4	<4
5	35/F	7	7	7	6	6	5	6	6	6	5	6	5	<5
6	56/M	6	5	5	4	5	4	5	4	4	3	4	3	<4

Table no 1:Represent the ratioof male and female

GENDER	SCALE	PRE	POST	T-	P-
		MEAN/SD	MEAN/SD	VALUE	VALUE
	VAS	181.0000 ±12.56777	192.7500±14.13987	-9.945	.000

Table no 2: Pre-Post Mean Value of VAS SCALE

Intra analysis: The above table shows the Visual Analogue Scale (VAS) for functional assessment the done through paired t test. The p value of pre and post treatment Scale of VAS is 0.000. The p value is < 0.05 which shows that is significant in improving Visual Analogue Scale (VAS). So, Null hypothesis is H0 is rejected and alternate hypothesis H1 is accepted.

	GENDER	MEAN/SD	T-VALUE	P-VALUE
VAS	MALE	-12.000± 6.07644	-426	0.671
	FEMALE	-11.5000 ±4.26675		

Table no 3: INTER MALE / FEMALE FOR VAS SCALE

The above table shows inter -group comparison of post treatment 6MWT scores for functional assessment of group A and B. the analysis was carried out by. At base line, the p value is <0.05. It shows that there is significant difference between the post-treatments scores of both groups. The value comparing the post treatment score for Group A and Group B is 0.671 which is suggestive of significant improvement both groups.However, statistically significant result were noticed in both the groups, clinically it was observed and also observed that PMR technique had greater effects than conventional therapy.

DISCUSSION

Abdominal surgical procedures cause tissue damage by direct visceral manipulation, through the incision on anterior abdominal wall and by the use of surgical retractors that help to expose the surgical field. Pain after surgery causes discomfort to the patient, preventing the patient from relaxing, leading shallow breathing and hindering the patient's movements in bed. Thus decrease diaphragmatic breathing and cough efficacy that might lead to atelectasis, especially in the lower lung fields. Pain is an important negative influence in the postoperative evolution of abdominal surgeries. Transcutaneous electrical nerve stimulation (TENS) is a physical therapy tool widely used to relieve pain.[1]

Laparoscopic surgery has become the standard approach for a large number of gynaecologic procedures. The frequency of laparoscopy varies widely across the globe. Laparoscopic operations are performed annually for the following indications: sterilization, diagnosis, cyst enucleating, and salpingo-oophorectomy.Pain is often a problem after gynaecologic laparoscopic surgery, even if the postoperative pain is less significant when compared to that after a similar major laparotomy surgery.[3] Appendectomy was performed through a skin crease incision and muscle splitting approach. An absorbable suture was used to legate and buries the appendix stump. Closer was in layer with an absorbable suture and skin closure was with 3.0 nylon. Patients were excluded if the wound had to be extended by cutting muscle or if there was generalized peritonitis.[4] Transcutaneous electrical stimulation (TENS) is not major benefit compared with the usual opioids and non-opioids analgesics when pain intensity is high but it can be used as an adjunct to other medications when the pain is moderate and can be the only pain therapy when the pain is mild[6].Uncontrolled postoperative pain may produce range of determinate acute and chronic effects. Electrotherapy can treat diverse symptoms produced by disease that affect the human body[7].In electro therapy the applied energy is the trigger that stimulates or activates physiological events which achieve therapeutic benefits that bring about pain relief. Hence, this study is designed to see the immediate change in pain after TENS application in patient with abdominal surgeries[8].Electro therapy can treat diverse symptoms produced by diseases that affect the human body. Electro therapy using transcutaneous electrical nerve stimulation is a low cost, non-invasive and easily accessible technique to treat pain. In this context, numerous description emerge on the effectiveness of Transcuteous electrical nerve stimulation (TENS) for treating diverse types of pain, knee osteoarthritis and dysmenorrheal[5].Transcutaneous electrical nerve stimulation (TENS) is a technique in which a special device transmits low voltage electrical impulses through electrodes on the skin to the area of the body that is in pain. Clinic studies on the role of transcutaneous electrical nerve stimulation (TENS) on postoperative pain were systematically searched and reviewed with the aim to determine its role in post-operative analgesic efficacy[6].In a case series a total of 6 patients of abdominal surgeries referred for physiotherapy were included in study according to inclusion criteria. Patients were assessed and treated for 3 consecutive days. •TENS was given for 3 consecutive days two times in a day to see the changes in incision pain.In this study high TENS was given for 30 minutes twice a day with frequency 100 Hz.Result showed the changes in visual analogue scale (VAS) after applying transcutaneous electrical nerve stimulation (TENS) in abdominal surgeries. The visual analogue scale for pain is a straight line with one end meaning no pain and the other end meaning the worst pain imaginable. A patient marks a point on the line that matches the amount of pain he or she feels. It may be used to help choose the right dose of

pain medicine. Also called VAS.There was reduction in pain in all the patients with abdominal surgeries who received physiotherapy treatment in form of TENS for 3 consecutive days.

CONCLUSION

In this case series we found that there was decrease in pain in all the patients of abdominal surgeries who received physiotherapy treatment in form of TENS for 3 consecutive days.Exploration of the effect of PMR on stress, fatigue, and quality of life during postpartum

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ORIGINAL ARTICLE

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Global Postural Re-Education is More Effective than Motor Control Exercises in patients with Non-Specific Low Back Pain

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ABBREVIATIONS:
GPR: Global Postural re-education
MCE: Motor control exercises
LBP: Low back pain
MOLBPDI: Modified Oswestry Low back pain Disability Index
NPRS: Numerical pain rating scale
FFT: Fingertip to floor test
NSLBP: Non-specific low back pain
CNS: Central nervous system
LBA: Low back ache
PAR-Q: Physical activity readiness-questionnaire
SPSS: Statistical package for social sciences

SUMMARY

Background. LBP is one of the major problems in a primary care communal illness with a lifetime prevalence estimating to be as high as 84%. The unspecified structural problems can ascend from day to day mechanical and postural stress on the spine and its related ligaments and muscles. It is associated worldwide with vast amounts of expenditure in terms of direct health care and losses in relation to disability. Currently, there has been a huge focus on physical exercises intended to enhance segmental motion control and lumbar spine stabilization.

Methods. The study sample comprises a total of 239 patients with non-specific LBP. From the sample population, a total of 100 patients were evaluated to GPR based intervention therapy and the 100 patients evaluated with MCE based intervention therapy after dropout. After the end of the intervention procedure the following were evaluated: pain level by numeric pain rating scale, disability by Modified Oswestry Low back pain Disability Index and functional status by fingertip to floor test. The frequency of the session performed in both groups were three times in a week over the study period of five weeks

Results. While comparing the evaluated report pain intensity was effectively reduced in both study groups ($p < 0.001$). The GPR group effectively reduced pain intensity at the end of the intervention compared to the MCE group ($p < 0.001$). The Modified Oswestry Low back pain Disability Index reduced in both groups; however, the GPR Group more significantly reduced the score compared to MCE Group ($p < 0.001$). Fingertip to Floor test showed that the GPR Group had a significantly higher flexibi - ity than the MCE Group ($p < 0.001$).

Conclusions. Patients allocated to the GPR group showed significant improvement in functional status, disability and pain intensity as compared to the MCE group ($p < 0.001$) in patients with nonspecific low back pain

KEY WORDS

Global postural reeducation; disability; motor control exercises; numerical pain rating scale; non-specific low back pain; lumbar stabilization

BACKGROUND

Low back pain (LBP) is one of the most common illnesses with a lifetime prevalence estimating to be as high as 84% (1). The definition of LBP defined as stiffness in the lower back under the costal margin or muscle tension and above the inferior gluteal folds, without or with leg pain (2). Low back pain is found to be one of the foremost causes of health problems worldwide. The prevalence of low back pain differs from 5-65%. It has been reported that the 90% of LBP related to unspecified causes (2)

The lumbar region of back pain which lasts for 4 weeks and more has not been diagnosed as a specific disease or spinal

abnormality is termed as NSLBP (3). It has been reported that the weakened abdominal, back muscles, poorly stretched muscles, incorrect posture, obesity, strained muscles from incorrect body mechanics which often results in the NSLBP pain (4). Lower levels of physical fitness and shorter duration of sitting activities at home may be associated with reduced extensor muscle endurance instead of long duration sitting posture in nonspecific chronic LBP (5)

It has been observed that there are many physiotherapy therapeutic approaches including therapeutic electric stimulation currents, and exercises of CNLBP have been evolved as one most effective therapeutic approach, focus on maintaining spine stability (6, 7). Core stability exercises with neuromuscular electric stimulation was shown to reduce pain and improve the function and stability of the lumbopelvic complex (8).

Motor control exercise was advanced based on a perception that persons with LBP showed some variations in control and coordination of spine muscles. Lumbar muscles must have enough strength and endurance to meet the demands needed for control of spine, but the accuracy and efficacy of the muscular system is controlled by the CNS (9). The CNS must interpret continuously the status of stability and movement, then plan mechanisms and rapidly initiate appropriate activity in response to overcome unexpected challenges. Many studies have shown that low back pain patients may exhibit a delayed onset of activity of the deep spine muscles (10, 11). In summary, the evidence seems to suggest that, with LBP, there is an alteration in control of the deep intrinsic spinal muscles that consistently manifests as hypoactivity. Although others argue that paraspinal muscles react to pain and injury with hyperactivity (12-14).

MCE emphasis on stimulation of deep spine muscles (*i.e.*, transverse abdominals and multifidus), pointing reinstatement of control and synchronization of this muscle (15).

GPR is based on an assimilated awareness of muscular schema as shaped by muscle chains, which can facade lessening resultant from legitimate, behavioral, and psychological features. The intention of GPR is to expand the shortened muscles by means of creep property of viscoelastic tissue and to enhance contraction of the antagonist muscles, thus avoiding postural asymmetry (16).

Two randomized controlled trials showed that GPR was more effective than analytic stretching and mobilizing exercises in improving clinical and functional measures (18). Available studies do not provide sufficient evidence for exact conclusions. This study compared the effectiveness of Lumbopelvic Stabilization Exercises and McKenzie Method in Low Back Pain and found that both techniques were efficient in reducing pain and improving function in patients with low back pain due to disc protrusion. However, the groups that used stabilization exercises showed better results in activating lumbopelvic stabilizing muscles (19). The present study compared the effectiveness of GPR and MCE on nonspecific low back pain patients

MATERIALS AND METHODS

Design of the study

The study design incorporated in the following research is "Experimental Study". The study was conducted at the USB college of Physiotherapy of the Rajasthan University of Health Sciences, Rajasthan, India from January 2013 to December 2019. The study was approved by the USB Institutional Ethics Committee of the USB Group of colleges under Ref. no. USB/Ethical/21, dated: 06/01/2013. The study meets the ethical standards of the Helsinki protocol.

Sampling and randomization

Three hundred two patients were initially selected and included in the study for baseline evaluation. During evaluation sixty-three were excluded because forty-four did not meet inclusion criteria and nineteen chosen not to participate in the study. Therefore, remaining two hundred thirty-nine were concluded the study.

Two hundred thirty-nine patients were randomly allocated to the MCE group (n = 123) and GPR group (n = 116) by an independent researcher by means of sealed envelopes containing the group name. Twenty-three patients dropout from MCE group and sixteen patient dropout from GPR group. Finally, hundred patients were completed study and analyzed at the end of intervention in both group (**figure 1**).

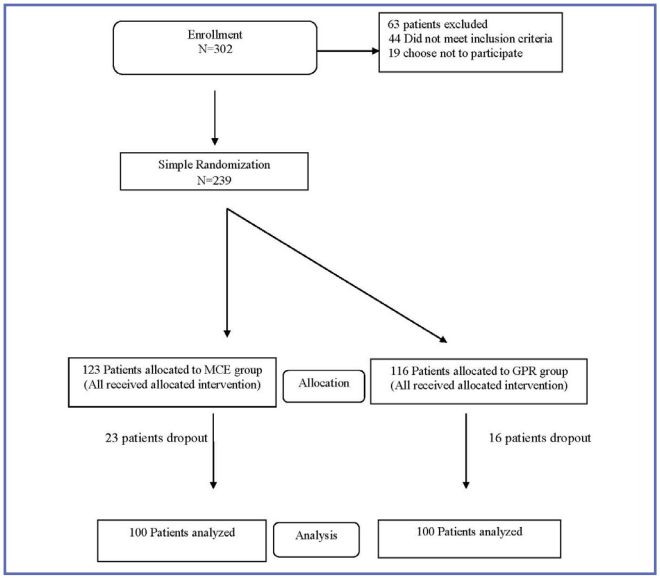

Figure 1. Study Flow Chart.

Eligibility criteria

Inclusion criteria were aged 18 years or above for both genders suffering from non-specific LBP for more than 4 weeks and willing to participate in the study.

Exclusion criteria were the LBP less than 4 weeks (acute LBP), specific LBP caused due to previous/existing medical conditions such as disc herniation, lumbar stenosis, spinal deformity, fracture, spondylolisthesis, neurologic signs (both central/peripheral), systemic illness such as rheumatologic diseases and tumor, psychiatric/mental deficits, patients who had a previous surgical history (within 6 months) were also excluded prior to the baseline assessment.

Evaluation protocol

The baseline evaluation was performed initially prior to randomization and at the end of the intervention in both the group. Evaluator had more than 10 years of experience with the evaluation tools used in the study. Selected modules of physical fitness, anthropometric measurements (height, weight and finall , the BMI), and physiological variables were taken from each subject

The PAR-Q self-screening tool used before starting any intervention either MCE or GPR group for safety or possible risk of exercising for an individual based on their health history, and current symptoms and risk factors.

Outcome measures of the study were subjected to objectively determining the patient's baseline function at the beginning of intervention period, for evaluating the intervention's/treatment's end outcome. The outcome measures employed in the following study were: Modified Oswestry Low Back Pain Disability Index (MOLBPDI), Numeric Pain Rating Scale (NPRS) and Fingertip to Floor Test (FFT). Pain analysis was done using the Numeric Pain Rating Scale (NPRS).Moreover, functional status and disability were evaluated through the Modified Oswestry Low Back Pain Disability Index (MOLBPDI) and Fingertip to Floor Test (FFT).

Intervention protocol

Each session of the intervention lasts up to one hour with one-to-one supervision to avoid unnecessary complication while undergoing intervention procedure by the sample patients. The frequency of the sessions performed three times in a week, with each session being distributed on an even scale, over the study period of five weeks, totaling 15 intervention sessions in both the group.

Group A: the Motor Control Exercise (MCE) Intervention Group

The sample populations belonging to Group-A received the MCE program. The intervention procedure incorporated numerous preparatory exercises prior to intervention procedure. The interventions started immediately after the baseline evaluation. Each individual belonging to the group was suggested to rehearse the proposed exercises that were taught by the researcher in their previous physical therapy session. The patient must perform the proposed exercise at home every day for 15 minutes. The holding time and the number of repetitions performed were increased progressively (increased up to 10 contraction repetitions × 10-second duration for each exercise).

The patients were taught and instructed how to contract trunk muscles. The patient was instructed to perform a slow and normal breathing while performing the intervention and while activating/holding muscular contraction in each step of the intervention exercise. The intervention program was initiated with low-load activation of local motor control composing of local motor control exercises which were intended to activate the muscle regions isometrically with minimal loading positions. The motor control exercise intervention was based on the treatment method described in previous publications (15). The treatment approach has been designed into 3 progressive stages (**figure 2**). The motor control exercise treatment program has been given through three phases.

Figure 2. Activation of multifidus in prone lying position.

Table I. Intervention protocol with motor control exercises.

Phases	Exercises (Repetitions/Time Max up to 10 × 10 sec)
Phase 1 Low-load activation of local motor control (Mainly TrA, Deep Multifidus, Diaphragm and Pelvic floor	Crook lying abdominal hollowing exercise for transverse abdominis activation
	Activation of multifidus in pron
	Abdominal hollowing in sitting
	Abdominal hollowing in four points kneeling
	Activation of multifidus from sitting to lumbar neutral positio
Phase 2 Closed chain with low load and low velocity	Bridge in supine position
	Bridge in prone position
	Lateral bridge
Phase 3 Open chain with high load and velocity	Lower limb abduction
	Knee and hip extension in Crook lying
	Leg cycling
	Sitting knee raises on gym ball
	Abdominal slide
	Lying trunk curl with leg lift
	Basic superman

Group B: Global Postural Re-education (GPR) Intervention Group

The sample populations belonging to Group-B received the GPR program. The intervention group was taught with three postures that were found to be quite effective in stretching/lengthening the anterior as well as the posterior chains of the muscle group. For this study purpose to make the treatment uniformity, 2 or 3 postures were used (**table II**). The GPR intervention was based on the treatment method described in previous publications (16). These therapeutic postures held for 15-20 minutes each (**figure 3**). These postures are as follows:

- the lying posture with an extension of the legs and flexion of hip joints;
- the lying posture with flexion of hip joints
- the standing posture with flexion of the trunk

Statistical analysis

Standard Statistical Package for Social Sciences (SPSS) software was used for analyzing the data. This tests the reliability and validity of the scales by administering paired sample t-test. This is followed by testing of hypotheses by applying mean, median, mode, standard deviation, charts, and chi-square. The simple features of the study data are described by using descriptive statistics. They provide simple summaries about the measures and samples. Togeth-

Figure 3. The standing posture with flexion of the trunk.

Table II. Intervention protocol with Global Postural Reeducation.

Posture	Description (Postures held for 15-20 minutes each)
1.The lying posture with an extension of the legs and flexion of hip joints to release anterior muscle chain including diaphragm muscle	The patients were instructed to lie down in the supine position with upper limbs abducted to 30° and placing the forearms in the supine position. The hip region was flexed, abducted and rotated on the lateral aspects. The foot sole must be touching each other while performing the posture. Manual traction was applied along the neck region for aligning the dorsal and cervical portion of the spinal column. Sacral traction was also performed to straighten the lumbar part of the spinal column.
2.The lying posture with flexion of hip joints to release posterior muscle chain	The patients were instructed to lie down in supine position with adduction of the upper limbs followed by flexion of hip joint to stretch the posterior part of the muscle chain. Progression consisted of increasing hip flexion, knee ex ension and ankle dorsiflexion
3. The standing posture with flexion of the trunk to release posterior muscle chain	The sample patients were instructed to maintain a posture in an upright position followed by the patient to progressively bending towards the forward direction, as well as maintaining the occiput, sacral and thoracic spine portion to be aligned properly.

er with simple graphics analysis, they form the basis of virtually every quantitative data analysis. The level of significance was established at P-value < 0.05.

Sample size and calculation

The sample size was calculated using following formula:

$N = 4\ \sigma 2\ (Z_{\alpha} + Z_{\beta})\ 2/D2$

Where:

- N is the total sample size require;
- σ is the standard deviation of the outcome variable same for both the group;
- Z_{α} is the confidence level
- Z_{β} is the power;
- D is the effect size.

Level of significance taken was as per 0.05 value and power was 0.80. Effect size was calculated from mean and standard deviation of previous study. Values of standard deviation, mean was taken from previous study and effect size was calculated on the basis of previous study also (16, 17).

RESULTS

The study participants were subjected to MCE group and GPR group, each group comprising 100 participants in each group were evaluated after dropout of 23 participants from MCE group and 16 participants from GPR group.

The obtained results include the demographic profile of the respondents, descriptive statistics reflecting the characteristics of the sample and response rate of the respondents. The Effectiveness of this study is on a "Global Postural Re-education (GPR)" program and motor control exercises (MCE) for non-specific Low Back Pain

This tests the reliability and validity of the scales by administering paired sample t-test. This is followed by testing of hypotheses by applying mean, median, mode, standard deviation, charts, and chi-square. Standard Statistical Package for Social Sciences (SPSS) software was used for analyzing the data.

Both groups significantly reduced pain after intervention compared to the baseline evaluation. Baseline evaluation in MCE presented a pain level of 4.98 ± 1.26 points. At the end of intervention, the pain reduced to 4.25 ± 1.23 ($p < 0.001$) (**table III**). On the other hand, GPR showed baseline pain level of 4.98 ± 1.26 points and after intervention reducing to 1.72 ± 0.92 ($p < 0.001$) (**table III**). Finally, GPR demonstrated significantly lower pain level (1.72 ± 0.92) than MCE (5.00 ± 1.29) after the intervention protocol ($p < 0.001$) (**table III**).

The MOLBPDI (Modified Oswestry low Back Pain Disability Index) decreased markedly to 37.46 ± 7.41 to 32.66 ± 7.15 in MCE group after the intervention ($p < 0.001$) (**table III**) and GPR group maintained noticeably lower scores of 38.3 ± 8.75 to 20.3 ± 4.81 as compared to pre scores. Both groups improved their scores at the post intervention evaluation ($p < 0.001$) (**table III**), but GPR group scores decreases significantl . There was a statistically significant difference in post mean values of GPR-MOLBPDI and MCE-MOLBPDI, 20.30 ± 4.81 and 32.66 ± 7.15 respectively (**table III**).

Functional status were evaluated by using Fingertip to Floor test ($p < 0.001$) and improved flexibility in both groups but GPR showed a significant increase in functional status of 18.12 ± 4.67 to 9.22 ± 2.88 when compared pre and post mean values (**table III**) and MCE group showed less significant result from 18.93 ± 4.23 to 16.26 ± 3.99 (**table III**).

Table III. Comparison between the GPR and MCE group at pre and post intervention scores.

Outcome measures	Group	Baseline or Pre intervention Scores	Post intervention Scores	Post mean Values	P-value
NPRS for Pain	**MCE**	4.98 ± 1.26	4.25 ± 1.23	5.00 ± 1.29	< 0.001
	GPR	4.98 ± 1.26	1.72 ± 0.92	1.72 ± 0.92	< 0.001
MOLBPDI for Disability	**MCE**	37.46 ± 7.41	32.66 ± 7.15	32.66 ± 7.15	< 0.001
	GPR	38.3 ± 8.75	20.3 ± 4.81	20.30 ± 4.81	< 0.001
FFT for Functional status	**MCE**	18.93 ± 4.23	16.26 ± 3.99	16.26 ± 3.99	< 0.001
	GPR	18.12 ± 4.67	9.22 ± 2.88	9.22 ± 2.88	< 0.001

The GPR group showed a significant reduction in all outcome measures as compared to MCE group when compared pre scores to post scores.

DISCUSSION

The study result demonstrates that the conducts of care provider and the contents of exercise programs based on the home were both important and the contributor follows the programs. Health providers' home-based exercise and style program conditions emerged as powerful themes in our data. Our discovery supports the hypothesis that the GPR involvement is fruitful in non-specific low back pain with less disability levels when compared to MCE. Patients allocated to the GPR group showed significant improvement in functional disability and pain intensity as compared to the MCE group. The results are similar to those get in both male and female but the majority of respondents are male (19), who display the good results of the GPR as a compared program of analytical exercises in patients with ankylosing spondylitis, and those get in other researchers on LBP cited in the review (18). Therefore, it appears that Global Postural re-education is better in reducing pain and disability in subjects with non-specific LBP than segmental techniques. However, these results are varied from those by Cunha *et al.* (20), who did not find various outcomes comparing conventional static stretching and muscle chain stretching in chronic neck pain (20). The causes for these various outcomes may be related to both the areas affected by spinal pain and the fact that GPR might be more effective when compared to analytical stabilization or mobilization techniques, although it is not higher level to other stretching techniques (16).

When bearing in mind the clinical importance of our research, we can state that the GPR program produced a clinically meaningful improvement in comparison with MCE group. Both the groups were treated three times in week for five weeks and one hour per session. The mean fruitful of the MCE program were low relevant than those reported in some previous trials (21) but are in line with those obtained in some other recent studies (22).

Even than these results are slightly varied from Choopani *et al.*, who compared segmental stabilization exercises and general exercises and found that stabilization exercises were more effective in patients with spondylolisthesis ($p < 0.001$) (20). My study also shows effectiveness of stabilization exercise, but GPR technique was more fruitful.

However, the identification of subgroups is a tough process, since it cannot be identified yet be guided by a coherent theory of causation of back pain (24). Moreover, the disability levels of the patients cover in our research are less compared to previously published disability scores in "non-specific LBP" populations. Moreover, both therapies consisted of a one-to-one supervised exercise program actively requiring the patient: according to the literature, these kinds of management are fruitful to decrease disability and improve function in chronic LBP (25).

Apart from the strong clustering, the diagnosis could be adjusted only for patient factors (*e.g.*, because of the variance in socioeconomic factors between patient arms they adjusted for socio-occupational status). The outcome variance can be calculated, and some other factors also describe the part of outcome variance calculation. It is usually assumed that the more experienced physical therapists give the better outcomes in clinical (26). However, some current researchers assess the relationship between year of patient outcomes and the year of experienced physiotherapists, if the outcomes reported were not associated with improved patient outcomes in outpatient rehabilitation (27).

Moreover, the major strength of this study was presence of the simple randomization. This practical choice could have not led to some possible sources of bias: the two groups were having the same baseline, but slightly varied for socio-economical characteristics; this issue was considered in the multivariate analysis, taking this into account the possible different aggregation of patients within the different centres.

Another major restriction was the elevated number of dropouts in both the groups MCE as well as GPR. Furthermore, dropped-out patients varied on critical baseline behaviors from those who completed the study; on the other hand,

they were equally represented in the two groups (MCE and GPR). The high number of dropouts was mainly due to the resolution of patients to give up therapy in the absence of expected results and from GPR group was due to the inability to hold the posture for particular time. Dropouts from both groups had higher levels of disability and pain. This aspect was managed with the intent to treat approach, which confirmed the improvement obtained in the GPR group with respect to the MCE group at the per protocol analysis (28).

According to my views, GPR alone cannot be effective for non-specific LBP treatment, and it can be considered an important approach in the management of non-specific LBP patients at low disability levels. As per results of my study we cannot apply GPR intervention to subjects with high disability level of non-specific LBP. The GPR method is based on the global stretching of antigravity muscles and the stretching of muscles that are organized on muscles kinetic chain (29). When the length of the muscle fibre is chronically altered, the numbers of sarcomeres adjust to compensate the change, which affects the functional capability of muscle. One study shows that the generation of the tension in the skeletal muscle, measured by evaluation the length-tension relationship, is directly correlated with the degree of superimposed of actin and myosin filaments. During rest, less superimposition of actin and myosin fil - ments translating to greater capacity of the muscle of greater tension (30). This principle explains the result of my study as I applied global stretching techniques designed to improve length-tension relationship along with contraction of antagonist muscle, thereby improving postural symmetry and muscle capability because postural asymmetry may results in lower endurance of affected muscles and the increased risk of injury in the future when compared to people without postural asymmetry predicates effectiveness of postural correction (31).

Many physiotherapy methods are effective in management of non-specific LBP according to literature. Now a day's GPR method is not considering as treatment of choice for non-specific low back pain. This may be because of little evidence of effectiveness of GPR method. So, my study will be benefitted to professionals who are working for non-specific LBP and also for community suffering from this ailment.

It also needs higher level of studies. Some suggestions are the measurements of effectiveness of the clinical effects of the GPR on non-specific LBP subgroups, related to the phases of pain as acute, sub-acute and chronic pain and others are age of patients, *etc.*

Furthermore, the GPR effectiveness with other techniques such as manipulation, specific exercises or traction, *etc.*, can be compared.

Moreover, patients follow the home exercise program which could not be monitored. Indeed, follow the therapeutic program represents in a crucial aspect of chronic low back pain therapy (28) and appear to be related to professional characteristic and explanations and to the total number of exercises prescribed, as well as to individual and psychological characteristics (32).

Since the potential effect of physical and sports actions or cognitive-characteristic aspects was not review, the presence of a complex condition as a result of physical and psychosocial factors can be included (33). As an outcome, definitely explain the GPR alone does not helpful for the patient with low back pain, but the GPR can be considered as a significance approach for the management of a patient with low disability level and persistent LBP. Because dropouts from both GPR and MCE groups had increased level of disability and pain than the subjects who completed the trial, they cannot apply our outcomes to the subject with more disabling low back pain.

Many of the physical therapy methods could be helpful in low back pain; most of the therapist studied by serious clinical trials. The current research trend on this title allows to identify clinical prediction restrictions and some of the proposed classifications that can be applied to low back pain subgroups.

Low back pain patients sub grouping is related to techniques as particular exercises or traction, manipulation and stabilization. But the GPR therapy is not considered within that sub grouping. This is mainly due to a usual lack of knowledge and to the compact proof of fruitfulness of this method. Exercise programs based on home is known to interfere with daily routine and normal lifestyles (34). The statement of this study consistent with proof that present contributors have chronic neck or back pain reduction more to follow the prescribed home exercises when the home program requires a longer time for execution or includes exercises which are difficult to perform. To minimize the daily routine interruption caused by exercises it gives a solution for a continuation of home-based exercise (35). One solution would be restricting the number of exercises advice in each program. Similarly, there is evidence suggesting that more than eight exercises in a program play a negative influence on contributor follow the advised exercises (36).

The results proposed that a proper supervision during the exercise execution for the duration of a session may be a further chance to reduce patient's lack of confidence and panic of exercising at home. Health provider's style is fin - ings on the subject of how health provider's style is important for contributor following adherence to home-based exercise program confirm and expand previous findings (37). The contributor to this study recognized that a super-

vised instruction which includes proper feedback which is most important for their adherence. It is proof that exercises based only on written instructions are not often performed properly, and therefore lead to poorer outcomes than when compared with outcomes from exercises learned under the supervision of a care provider (34). Nevertheless, there is also proof that an attractive exercise mode mixed with written command improves adherence to exercises of patients presenting back pain (32).

Put in writing command during particular daily activities were normally used as reminders for our contributor. The contributor to our research often felt that these nudges were important. In the same way, the use of nudge has also been suggested by related studies, due to the fact that patients tend to forget exercising or have serious complexities in fitting the exercises into their daily routine (38)

Our study may represent the first step in this direction, but it should be followed by further, higher level studies. Accordingly, some suggestions for future research are the calculation of the clinical effects of the GPR on specific LBP subgroups, with respect to the age of patients, the phase of disorder (*e.g.*, acute, sub-acute or chronic pain), and the clinical characteristics. The GPR can be investigated with or without the novel lumbar support device on pain modulation and core muscle function among people with CNLBP (39). Moreover, the fruitfulness of GPR should be compared with other techniques, as manipulative treatment, cognitive characteristic treatment, *etc.*

Study limitations

However, there are some weaknesses in our study. The major restriction was the elevated number of dropouts in both the groups MCE as well as GPR.

The study satisfied the sample size, even than the study included short-term intervention such as three times a week for five-week treatment period onl .

Another limitation is lack of short- and mid-term follow-up, which would reveal a significant result (from baseline) in all outcome measures with respect to both the group.

The study should have included a control group, so future study should include control group for obtaining best results. Another limiting factor of my study is lack of sub grouping. Some suggestions are the measurements of effectiveness of the clinical effects of the GPR on non-specific LBP subgroups, related to the phases of pain as acute, sub-acute and chronic pain and others are age of patients, *etc.*

Furthermore, the GPR effectiveness with other techniques such as manipulation, specific exercises or traction, *etc.*, can be compared.

CONCLUSIONS

The evaluated test report of MCG and GPR were compared, all the post effect showed an improvement when compared to pre-results. Both the method Global Postural Re-Educational Program and Motor Control Exercise during the assessment showed less or more similar effectiveness. While comparing the evaluated report and effects from Motor Controlled Exercise and Global Postural Re-education program, effectiveness was found in GPR program than MCE, this is compared and evaluated during the difference obtained from pre-study to post-study results from MOLB-PDI, NPRS and FFT process.

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None.

DATA AVAILABILITY

Data are available under reasonable request to the corresponding author.

CONTRIBUTIONS

AK: responsible for the whole work.

CONFLICT OF INTERESTS

The author declare that he has no conflict of interests.

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"EFFECTS OF STRETCHING EXERCISE ON PRIMARY DYSMENORRHOEA IN ADOLESCENT GIRLS"

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ABSTRACT

Background: Primary Dysmenorrhoea is a difficult menstrual flow in the absence of any pelvic pathology where pain is spasmodic in character and felt mainly in the lower abdomen. Women that participated in sports experienced fewer occurrences of symptoms of dysmenorrhea.

Aim: To assess the effect of one term of stretching exercise on primary dysmenorrhea in adolescent girls.

Materials and Methods: 30 girls aged between 18-28 years with mild to severe primary dysmenorrhea were selected; the girls were non-athletes and volunteered for the study. The participants were randomly divided into 2 groups: an exercise group (n=15) and a control group (n=15). In the intervention group, the subjects were requested to complete an active stretching for 12 weeks (4 days per week, 1 time per day, 10 minutes, and post test was examined 12 weeks later.

Results: After the intervention, however, a significant difference was found between the two groups regarding the mean intensity of dysmenorrhea in the first and second menstrual cycles. Also, a significant difference was observed between the stretching group and the control group. However, no such difference was observed in control group.

Conclusions: Stretching exercises are effective in reducing pain intensity, pain duration, and the amount of absenteeism in schools and colleges due to having pain during menstruation.

Key Words: Dysmenorrhoea, Adolescent girls, Stretching, Exercise, Physiotherapy

INTRODUCTION

Dysmenorrhea literally means painful menstruation but more realistic and practical definition includes cases of painful menstruation of sufficient magnitude so as to incapacitate day to day activities. [1]

It is commonly classified into primary dysmenorrhea when there is no co- existent pathology and secondary dysmenorrhea where there is an identifiable pathological condition. About 40-70% of women of reproductive age suffer with dysmenorrhoea. [2]

Primary dysmenorrhea begins when young girls first experience the ovulatory cycles and its prevalence increases during adolescence (15-17) years and decreases progressively then after. In dysmenorrhea pain begins few hours before or after the onset of menstruation and lasts for 24-48 hours. The pain is more in the first day and rarely continues to next day. [3]

Primary dysmenorrhea is commonly seen only in ovulatory cycles, usually developing within 6 to 12 months of menarche and is characterized by lower abdominal sharp pain that may radiate to the back and upper thighs. The pain of primary dysmenorrhea starts with the onset of menstrual flow or a few hours after the onset and may last for a few hours up to 2 days. The pain of secondary dysmenorrhea usually begins few days before the start of menstrual flow and may be present during much of the menstrual cycle. Pain that occurs with the first menses or after the age of 25 or is associated with an ovulatory cycles is more likely to be secondary dysmenorrhea. [4]

It is characterized by lower abdominal pain that potentially could radiate to the back and thigh regions. The pain may be associated with headache, fatigue, nervousness, nausea, vomiting, mood swings.

Primary dysmenorrhea most likely caused by increased prostaglandin production within the uterus and associated uterine hyper- contractility. [5]

In primary dysmenorrhea pain is spasmodic in character and felt mainly in the lower abdomen, but it may radiate to the back and along the thighs. There may be associated systemic symptoms like nausea, vomiting, diarrhea, and headache. [6]

Despite the widespread use of stretch in physical rehabilitation, considerable uncertainty remains surrounding its lasting effects. There is little doubt that stretch induces immediate increases in muscle extensibility due to the viscoelastic nature of soft tissues. [8] However, these effects are transient and quickly dissipate. The lasting effects of stretch are more controversial but arguably of more importance, particularly for individuals with chronic pain.

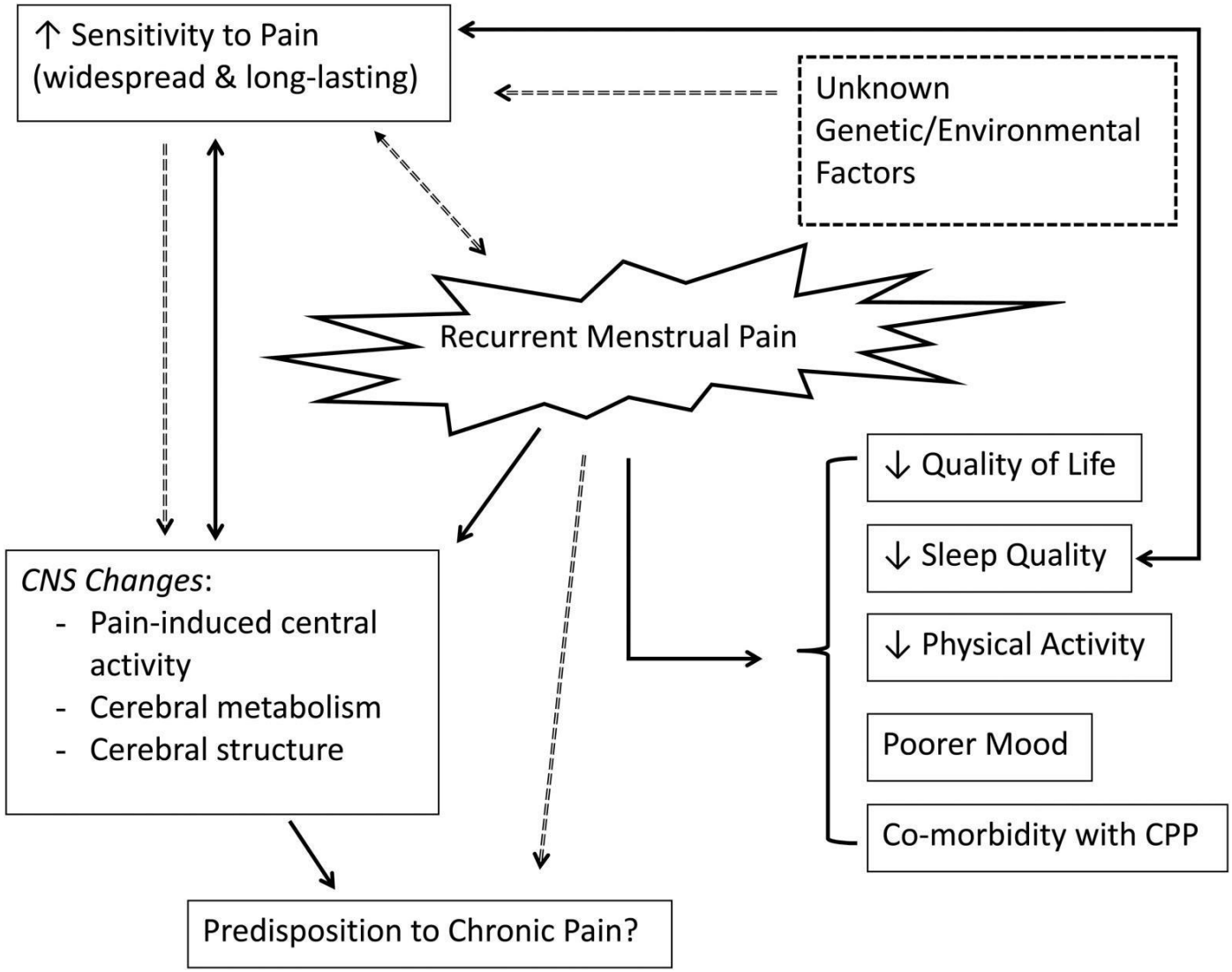


Figure.1 A schematic representation of the proposed (dotted lines) and known (solid lines) effects of recurrent dysmenorrheal pain [7]

The controversy arises from the discrepancy between strong anecdotal evidence and evidence from studies of animals [9] supporting the effectiveness of stretch and high-quality randomized controlled trials indicating otherwise. Studies of animals showed that soft tissues are adaptable and undergo structural remodelling in response to stretch. On the other hand, results of studies of humans are less consistent. In this article, improvements in extensibility refer to an increase in joint ROM when repeat measurements are taken with the same testing torque (torque is the product of applied force and moment arm or the tendency of a force to cause rotation).

Some investigators contend that what appear to be lasting changes in extensibility are in fact changes in people's willingness to tolerate the discomfort associated with stretch over time. For example, following a hamstring muscle stretch program, an individual may touch his or her toes more easily. This patient outcome may not be due to any underlying change in muscle extensibility, but may instead be due to the direct relationship between applied stretch torque and resultant joint ROM. That is, the harder an individual

leans forward (ie, the stretch torque), the further he or she can reach down toward the toes (ie, the joint ROM). The ability to reach further is due to altered perceptions and increased willingness to tolerate the discomfort associated with stretch [10]

The causes of primary dysmenorrhea are still unclear, but one of the most accepted explanations is increased synthesis of prostaglandins, of which types E2 and F2α play a significant role in the development of ischemia and hypoxia, resulting in dysrhythmia uterine contractions and decreased blood flow. [11]

Drug therapies and complementary medicine are often used to treat dysmenorrhea. [12] According to the literature, NSAIDs and OCPs rank among the most frequently used medications. These drugs reduce pain by inhibiting the production and release of prostaglandins. However, long-term use of NSAIDs has been associated with side effects such as headache, dizziness, drowsiness, loss of appetite, nausea, vomiting, gastrointestinal bleeding, increased acute asthma, dysuria, and acne. [13]

OCPs inhibit ovulation, reduce endometrial proliferation, and create an endocrine environment that mimics the early stages of the proliferative phase of the menstrual cycle, in which prostaglandin levels are at theirlowest. Lower prostaglandin levels lead to fewer uterine cramps. In the realm of complementary medicine, methods resorting to herbs, yoga, relaxation, psychotherapy, massage, hypnosis, vitamins (E, B, C), and supplements (calcium and magnesium) as well as acupressure and acupuncture have been used. The herbs used more commonly to treat dysmenorrhea are chamomile, ginger, fennel, cinnamon, and aloe Vera. [14] Common treatments for dysmenorrhea are extensive and in some cases subject to restrictions. For example, NSAIDs are contraindicated for patients with digestive problems, while medicinal plants are not always readily available. This research aimed to investigate the effects of a set of stretching exercises on reducing the pain of dysmenorrhea.

REVIEW OF LITERATURE

1. **An epidemiological study of young women with dysmenorrhoea[15] : B Andersch et al. (1982)**

   The study was conducted in 1982**,** The prevalence of dysmenorrhoea was studied in a random sample of 19 year old women from an Urban-Swedish population, dysmenorrhoea was reported by 72% of the women 15% suffered from dysmenorrhoea which limited daily activity and was unimproved by analgesics.

2. **Prevalence of dysmenorrhea and its effects on quality of life among a group of female university students.[16] : A Unsal et al. (2009)**

   This cross-sectional study was conducted between 15 march and 15 April 2009. The study group included 623 female students. The severity of dysmenorrhea was determined with 10-point visual analog scale. The average age of the study groups was 17-30 years. They concluded that prevalence of dysmenorrhea was found to be 72.7% and it was significantly higher in coffee consumers, females with

menstrual bleeding duration 7 days, and those who had a positive history of dysmenorrhea when compared to the others.

3. **Association of psychologic and nonpsychologic factor with primary dysmenorrhea.[17] : M Faramarzi et al. (2014)**

   This study was conducted in Aug 2014, in this study 180 females with dysmenorrhea and 180 females without dysmenorrhea were enrolled. Psychological risk factors were evaluated in four domains including affects, social support, personality, and alexithymia. The data was collected by using questionnaires and they concluded and high caffeine diet are important risk factors risk factors for women with primary dysmenorrhea.

4. **Comparing the effects of aerobic and stretching exercises on the intensity of primary dysmenorrhea in the students of universities of busher[18]: F Vaziri et al. (2015)**

   The study was conducted in March, 2015. This randomized clinical trial was conducted on 105 females who were suffering from primary dysmenorrhea. The participants were divided into aerobic, stretching and control groups. The 2 groups performed exercise three times a week for 8 weeks. Then after the intensity of dysmenorrhea was determined using several modified questionnaires that assessed several symptoms of dysmenorrhea. After all, the data was compared between and within groups through analysis of variance. They concluded the aerobic and stretching exercises are effective in reducing Severity of dysmenorrhea.

5. **Primary dysmenorrhea and its effects on quality of life in young girls.[19]: T Joshi et al. (2015)**

   The study was conducted in March 2015, A cross sectional study and data were collected among 310 young girls on presence and absence of dysmenorrhea, premenstrual symptoms, dietary habits using questionnaire and they concluded that concluded that dysmenorrhea is a leading causes of a absenteeism in colleges and has an adverse effects on the quality of young girls.

6. **Effects of different exercise techniques on primary dysmenorrhea among higher secondary school girls. [20]: D Khare et al. (2016)**

   The study was conducted in 2016, to study the effectiveness of isometric exercises and variousstretching techniques used as a treatment protocol for primary dysmenorrhea. The students were divided into control and experimental groups, both groups performed set protocol from fourth day of menstrual cycle. They concluded that isometric and stretching both exercise has a positive effects on treatments of primary dysmenorrhea in school girls.

7. **Effects of exercises on primary dysmenorrhea in young females.[21]S Shah et al. (2016)**

This study was conducted in year 2016, A convenient sample was taken of 40 participants, randomly and equally divided into 2 groups. Groups A received stretching exercises and group B was control groups. Participants in group A completed an active stretching exercise program for 6 active stretching exercises in the abdominal, pelvic and groin regions for 8 weeks, group B was control group. All the participants were examined for pain intensity with VAS and VMSS. After the research they concluded that stretching exercises are effective in reducing pain in young females with primary dysmenorrhea.

8. **Effects of selected muscle stretching exercise on primary dysmenorrhea among studentnurses.[22]: B Gomathi et al. (2017)**

This study was conducted in July 2017, To assess the effectiveness of selected muscle stretching exercise on primary dysmenorrhea. 67 student nurses with primary dysmenorrhea were selected from college by using non probability purposive sampling technique and they were randomly assigned into experimental group and control group. Muscle stretching exercise taught to the experimental group and practiced for 8 weeks. Pain intensity was assisted by using numerical pain rating scale and they concluded that selective muscle stretching exercise are effective in reducing pain in dysmenorrhea.

9. **What we know about primary dysmenorrhea today: a critical review[23]S Lacovides et al. (2015)**

Comprehensive literature searches on primary dysmenorrhea were performed using the electronic databases PubMed, Google Scholar and the Cochrane Library. Full-text manuscripts published between the years 1944 and 2015 were reviewed for relevancy and reference lists were cross-checked for additional relevant studies. In combination with the word „dysmenorrhea" one or more of the following search terms were used to obtain articles published in peer-reviewed journals only: pain, risk factors, etiology, experimental pain, clinical pain, adenomyosis, chronic pain, women, menstrual cycle, hyperalgesia, pain threshold, pain tolerance, pain sensitivity, pain reactivity, pain perception, central sensitization, quality of life, sleep, treatment, non-steroidal anti-inflammatory drugs.

NEED OF STUDY

Dysmenorrhea pain is associated with restriction of activities and it is considered as the leading cause of absenteeism from work place and colleges in young girls. Dysmenorrhea is the most commonly relieved by medication ranging for commercially available formulas to contraceptive. The side effects from such medication are well known (nausea, breast tenderness, and drowsiness, hearing and visual disturbances).
Despite the widespread belief that exercise can reduce dysmenorrhea, evidence based studies are limited. Several observational studies reported that physical exercise was associated with reduce prevalence of dysmenorrhea, although numerous other studies found no significant association between outcomesevidence

from controlled trials suggests that exercises can reduce dysmenorrhea and associated symptoms. Hence this study is designed to determine the value of stretching exercise weather it is helpful in reducingthe symptoms of primary dysmenorrhea or not.

OBJECTIVE OF THE STUDY

1) **Aims:** To check the effects of stretching exercises on reducing the symptoms of primary dysmenorrhea in adolescent girls.
2) **Objectives of the studies:** To find out effects of stretching exercise on primary dysmenorrhea in adolescent girls.

HYPOTHESIS

1) **NULL HYPOTHESIS**

   There will be no significant effects of stretching exercise on reducing the symptoms of primary dysmenorrhea in adolescent girls.

2) **EXPERIMENTAL HYPOTHESIS**

   There will be significant effects of stretching exercise on reducing the symptoms of primary dysmenorrhea in adolescent girls

METHODOLOGY

Materials and Methods:

- **Study design:** Randomized control trial
- **Source of data:** Nearby colleges and working girls through online question forms
- **Population:** All subjects are adolescent girls that are having symptoms of primary dysmenorrhea
- **Sampling method:** Purposive sampling
- **Sample size:** 30 subjects
- **Duration of study:** 3 months

All the data were collected by general assessment form, questionnaires regarding menstrual characteristics and dysmenorrhea, Numerical rating scale and verbal rating were used for assessment of intensity of pain. The general assessment form and questionnaires were distributed to all the girls who agreed to participatein

the study.

Then participants were explained the procedure and purpose of the study and consent was taken in an understandable language.

Then after participants was randomly divided into 2 groups, Group A: Stretching exercise group, Group B: Control group. Severity of the pain was measured by using Numerical rating scale and Verbal pain rating scale for pretreatment and post treatment.

Group A participants was asked to perform 5 self- stretching exercises in the back, thigh and pelvic regions for 8 weeks (4 days per week). Also they were asked to avoid performing stretching exercise during the menstrual cycle and group B participants were asked not to perform any kind of exercise on daily basis.

The exercises are as follows:

1. **Double Knee Chest**

First you have to lie down on a mat then bring one knee towards the chest then the other one, clasp the hands around the thighs and pull them to the chest, elevating the lower back part off the mat, you should not grasp over the knee part but end area of the thigh. Do it for 20 seconds and 5 times.[This exercise will stretch the lumbar spine muscle and tissues posterior to the spine]

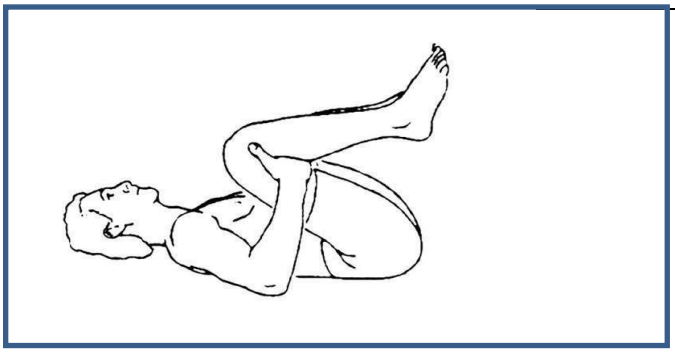


Figure.2 Double knee chest

2. **Gluteal Muscle Stretch**

Knee to chest: Pull your left knee towards your chest while lying on the ground , focus on placing your lower back flat on the ground while breathing long and deep, hold the stretch for 20 seconds and 5 times. Then perform this same on the right side of knee for 20 seconds 5 times.[This exercise will stretch the gluteal muscles , hamstrings and lower back muscles]

Figure.3 Gluteal muscle stretch

3. Child's Pose

Go on all 4 limbs and with both arms reach as far as possible with your elbows locked and your arms straight. Then lean back with your shoulders relaxed.

The stretch should be felt in the lower back and shoulders. Focus on breathing deeply with your long breaths (20 seconds 5 times) [This exercise will stretch the lumbar spine muscle , gluteal Maximus , quadriceps femoris and shoulderextensor muscle].

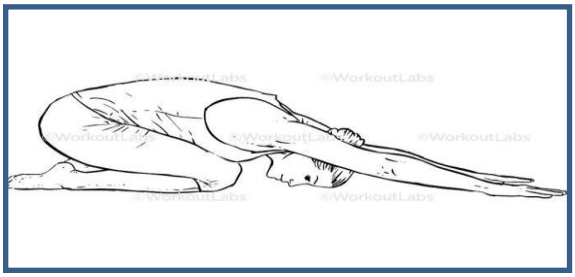


Figure.4 Childs pose

4. Cobra Pose

Lay down on your stomach then place your hands by your sides at chest level and push up while leaving your waist on the floor. Try to relax your back and waist and allow the stretch in your stomach and lower back. Focus on breathing deeply and increase movement in the spine.(20 seconds 5 times) [This exercise will stretch the soft tissues anterior to the lumbar spine and hip joints].

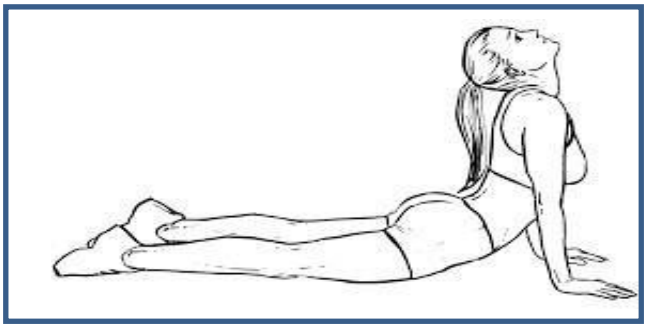


Figure.5 Cobra pose

5. Quadratus Lumborum Stretch

Lay down the ground and pull the left leg over the right side, try to leave the same side of shoulder on thefloor while you are holding the stretch. To increase the intensity of stretch extend your leg and pull the leg closer to your chest, keep inmind that do not stretch beyond your limits. (20 seconds 5times) [This exercise will stretch the quadratus lumborum muscle]

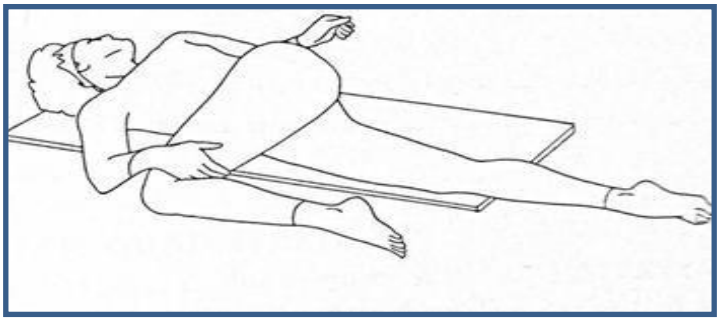


Figure.6 QL stretch

- Then same perform to the right side (20 seconds 5 times)
- Group B will be Control Group and will be asked not to perform any type of exercise during this time of study. Again data will be collected, that includes their menstrual pain before study and menstrual pain after 8 weeks, from both the group. Data will be compared and conclusion will be made on results

- Scales that were used for pain assessment of girls are as follow

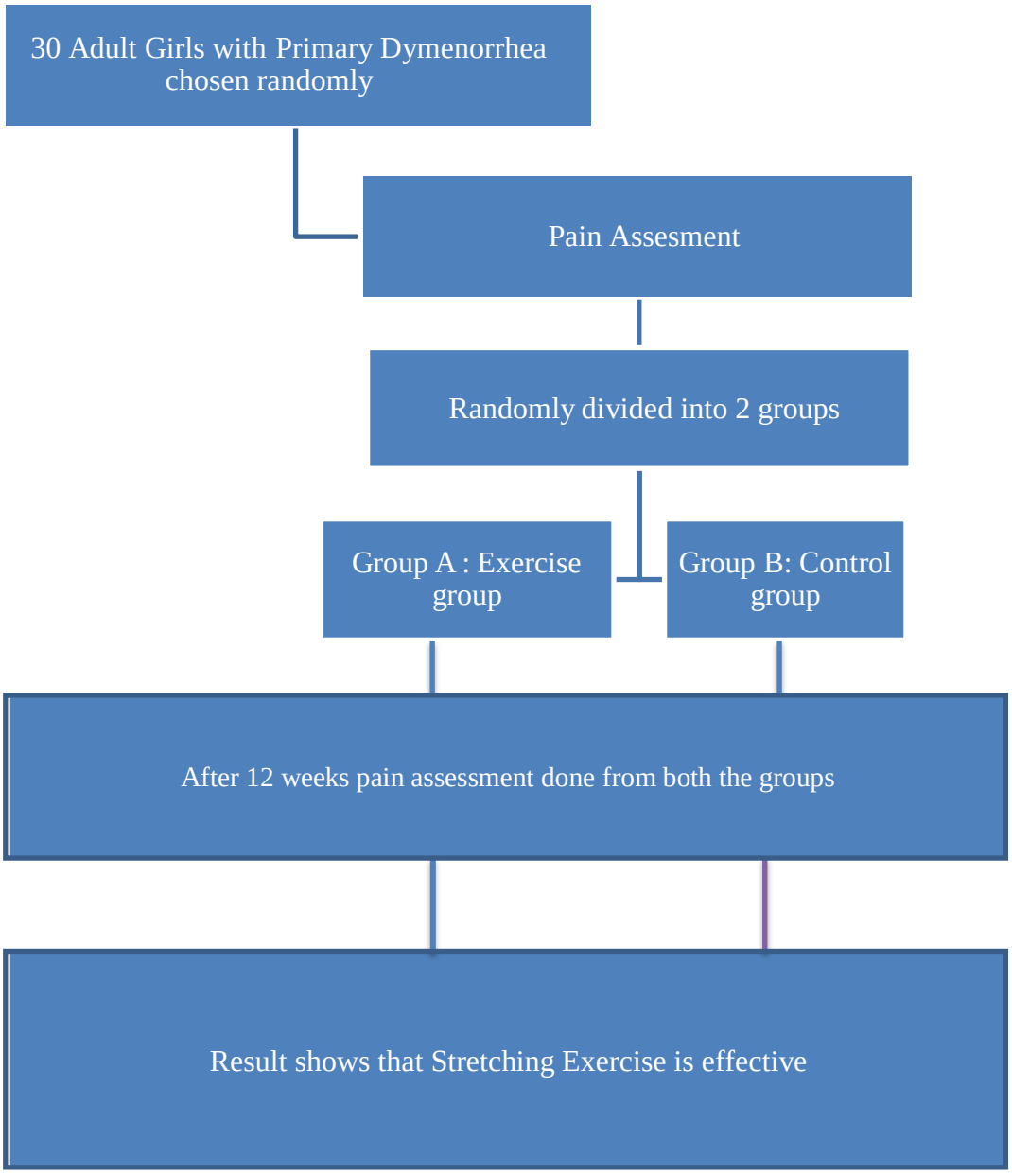
1) Numerical pain rating scale
2) Verbal pain rating scale

. Numerical pain rating scale

0 1 2 3 4 5 6 7 8 9 10

. Verbal pain rating scale

- None
- Mild
- Moderate
- Severe



RESULT

In present study 30 subjects with the age of 18-28 years were selected and divided into two groups:

- Group A – Exercise group
- Group B - Control group

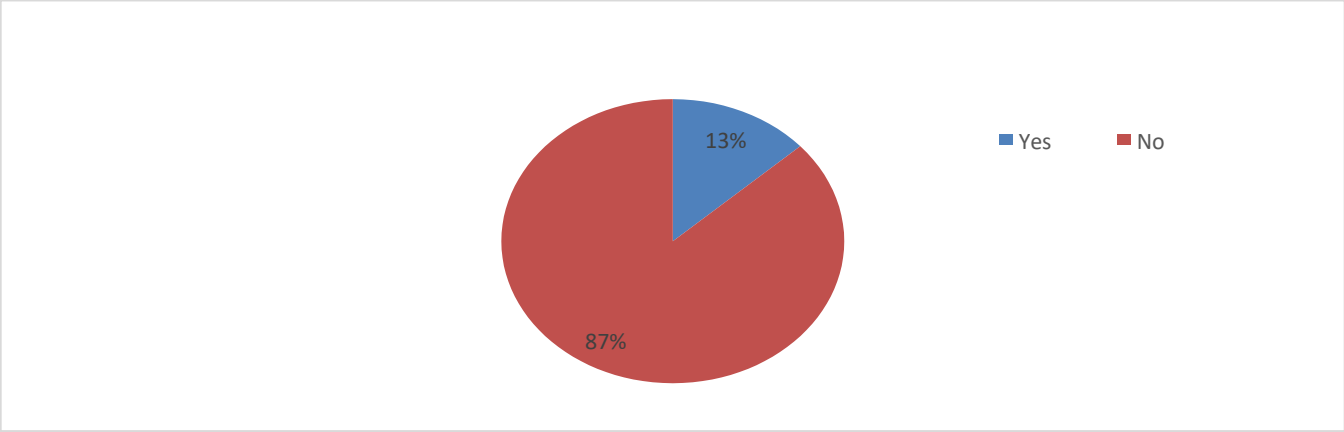
30 individuals completed the study program without any complications. The data obtained in both the groups are as follows.

Table 1 Medication taken by patients

Medicines (pain relief)	NO. of Patients
YES	4
NO	26
Total	30

Interpretation: The above table shows the no. of patients that took medication for pain relief in both the groups

Graph.1



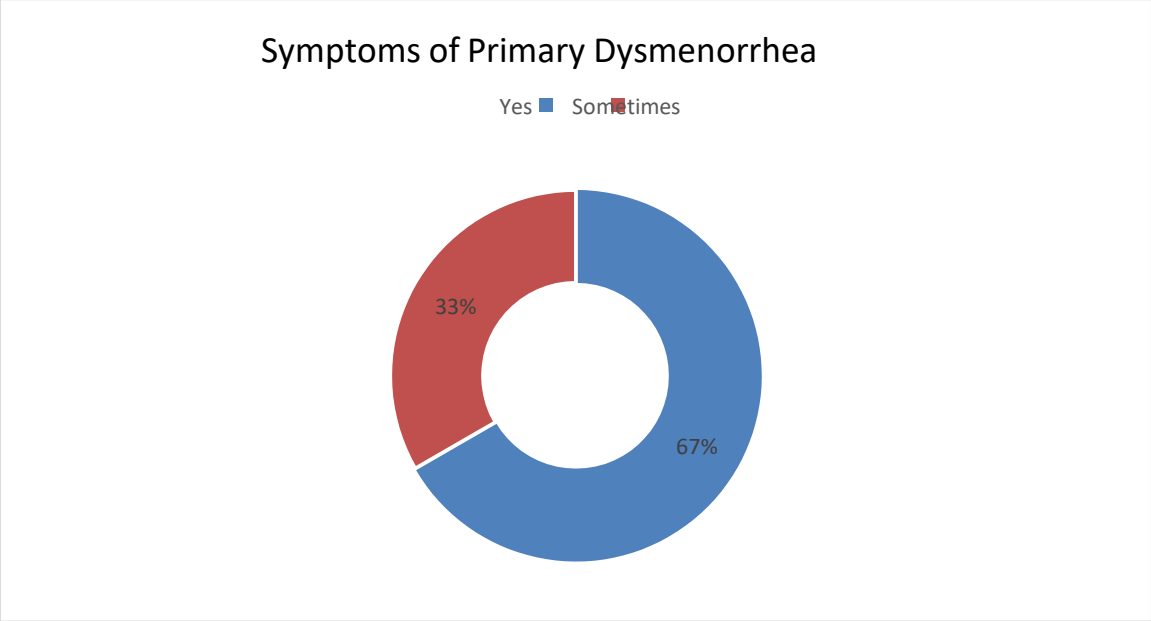
Interpretation: Above graph shows no. of patients who respond yes and no to the medication

Table 2: Pain and any other symptoms

Pain and symptoms	No. of patients
Yes	20
Sometimes	10
Total	30

Interpretation: The above table shows the no. of patients having pain or any other symptoms

Graph.2



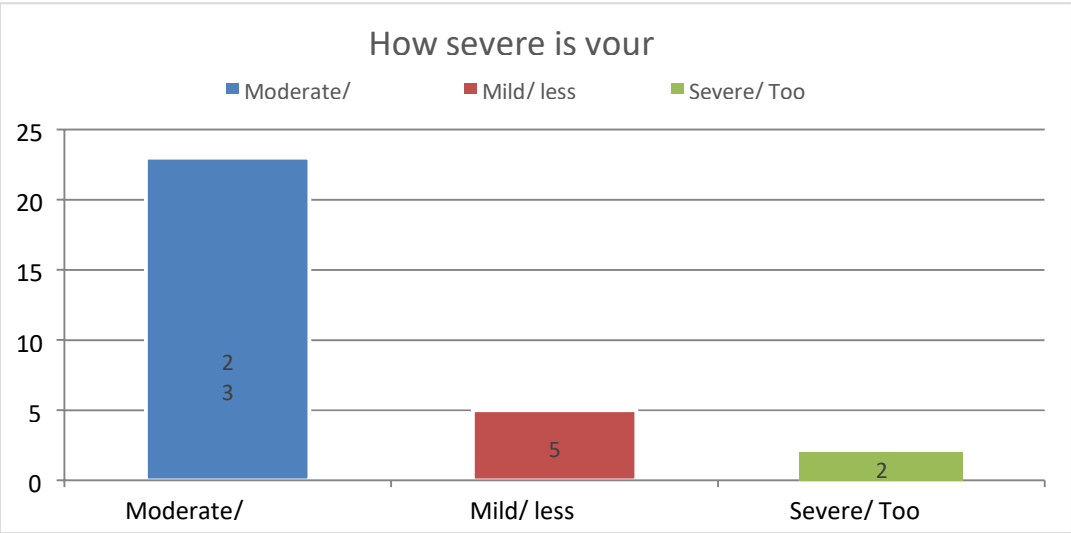
Interpretation: Above graph gives information about having pain and other symptoms in both the groups

Table 3: Severity of Pain

Severity	No. of patients
MILD	5
MODERATE	23
SEVERE	2
Total	30

Interpretation: The above table shows the severity of pain in both the groups before treatment.

Graph.3



Interpretation: Majority of girls were having Moderate pain and few girls were having severe pain during menstruation

Table 4: Mean and SD of Pain Intensity Group A

	Mean	N	Std. Deviation	d. Error Mean
VRS PRE	3.40	15	.632	.163
VRS PRE	.60	15	.737	.190
NPRS PRE	7.40	15	1.242	.321
NPRS POST	1.33	15	1.113	.287

Table.5 Paired Sample T Test of Pain Intensity of Group A

	N	Correlation	Sig.
VRS PRE & VRS POST	15	.368	.177
NPRSPRE &NPRS POST	15	-.775	.001

Paired Sample T Test

		Paired Differences							
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig.(2-tailed)
Pair 1	VRS PRE-VRS POST	2.800	.775	.200	2.371	3.229	14.000	14	.000
Pair 2	NPRS PRE NPRS POST	6.067	2.219	.573	4.838	7.295	10.589	14	.000

Table 6: Mean and SD of Pain Intensity of Group B

	Mean	N	Std. Deviation	d. Error Mean
VRS PRE	3.13	15	.743	.192
VRS PRE	2.80	15	.676	.175
NPRS PRE	7.13	15	1.767	.456
NPRS POST	6.60	15	1.639	.423

Table 7: Paired Sample T Test of Pain Intensity of Group B

	N	Correlation	Sig.
VRS PRE & VRS POST	15	.768	.001
NPRS PRE &NPRS POST	15	.932	.000

Paired Sample Test									
				Paired Difference					
					95% Confidence interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig(2-tailed)
Pair 1	VRSPRE-VRSPOST	333	.488	126	.063	.604	2.646	14	.019
Pair 2	NPRSPRE-NPRSPOST	533	.640	165	.179	.888	3.228	14	.006

Table 8: Unpaired t test between group A and group B of pain measurement scale

Group Statistics					
	GROUP	N	Mean	Std. Deviation	Std. Error Mean
NPRS	A	15	1.33	1.113	287
	B	15	6.60	1.639	423

Independent Samples Test										
		Levene"s test for Equality of vanances								
							or Equality ofMeans		95 % Confidence interval of the Difference	
		F	Sig.	T	df	Sig(2-tailed)	Mean Differences	Std. Error Difference	Lower	Upper
NPRS	Equal variances assumed	5.009	0.33	-10.297	28	000	-5.267	.511	-5.314	-4.219
	Equal variances not assumed			-10.297	24.645	000	-5.267	.511	-6.321	-4.213

DISCUSSION

The present study was conducted to see the effect of stretching exercises on the pain intensity of primary dysmenorrhea. In present study, pain has reduced in primary dysmenorrhea more in stretching exercise group than in control group.

This improvement may be due to the increase in the blood flow and metabolism of the uterus during exercise which may be effective in the reduction of dysmenorrheal symptoms. A study done by Izzo and Labriola (1991) [26] has shown that improved metabolism is a factor in the reduction of symptoms. It is also suggested that increased menstrual pain by uterine muscle contraction is derived from a nervous system that is innervated by the sympathetic nerve hence; stress through hyperactivity of sympathetic nerve system via the increase contractibility of uterine muscles may lead to menstruation symptoms. A study done by Dawood MY (2006) [27] has shown that therapeutic exercise can increase the secretion of endorphins from the brain, and these materials in turn raise the pain threshold of the body. Daley AJ (2009) [28] believed that contracted ligamentous bands in the abdominal region were the causative factor for physical compression of nerve pathways and their irritation, so the proposed series of stretching exercise was considered very effective.

Pain in general has disabling nature and makes dysmenorrhea stressful and it can become important irritating factor in the life of lots of women, particularly who are self-financing. Some women are completely prostrated and cramped to bed, whereas others are able to remain in the works with the support of analgesics. So, many studies were done to replace medication by physical exercises in management of primary. The present study was conducted to see effect of stretching exercises in relieving pain of primary dysmenorrhea. In this study, treated females reported a significant reduction in menstrual pain within an average of 8 weeks of exercises (Group A).

Since time ago, Israel et al. [29] found that after 12 weeks of aerobic training, the intensity of symptoms decreased and Golub et al. [30]expressed that dysmenorrhea in high school girls who were involved in sports and physical activities were less than non-exercise group. In present study, pain of primary dysmenorrhea has reduced in exercise group than in control group as regard intensity and duration. These findings are similar to those of lots of authors who studied the effects of exercises on primary dysmenorrhea. Abbaspour et al. [31] and Shahr-jerdy et al. [32] proved that stretching exercises are effective in reducing pain intensity, pain duration, and the amount of painkillers used by girls with primary dysmenorrhea. Onur et al. [33] studied the impact of home-based exercise on quality of life of women with primary dysmenorrhea and concluded that there is evidence that exercise has a positive effect in the treatment of dysmenorrhea.This improvement may be due to the increase in the blood flow and metabolism of the uterus during exercise which may be effective in the reduction of dysmenorrheal symptoms. Stress tends to enhance sympathetic activity and may increase menstrual pain by exacerbating uterine contraction. Exercise may decrease this sympathetic activity and relief the stress through release of endorphins, substances produced by the brain that raise the pain threshold, so reducing symptoms. [34] Dawood [35] has shown that therapeutic exercise can increase the secretion of endorphins from the

brain, and these materials in turn raise the pain threshold of the body. Daley [36] believed that contracted ligamentous bands in the abdominal region were the causative factor for physical compression of nerve pathways and their irritation, so the proposed series of stretching exercise was considered very effective. Golomb et al. [37] concluded that exercise is widely accepted as a mean of moderating stress and biochemical changes in the immune system. A mechanism by which exercise may improve the symptoms of dysmenorrhea (reducing stress) has been articulated so, findings of different studies have shown that therapeutic exercise and physical activity was related with reduced incidence of dysmenorrhea**.**

CONCLUSION:

Stretching exercises are effective in reducing pain intensity and improve the quality of life and also it helps in reducing the amount of pain killers taken by young girls which might have bad long term effects on their health and it is also shown that the productivity has also increased for those days as having less pain among the girls with primary dysmenorrhea.

SUMMARY:

The study was conducted to find out the effects of stretching exercise in reducing pain symptoms among the adult girls that were having primary dysmenorrhea. 30 girls are voluntarily participated in the study, after that pain assessment and data was collected through assessment form and girls were randomly divided into two groups (A: exercise group, B: control group). After that exercise groups was given a set of exercises to practice for 12 weeks (4 days per week) meanwhile control group was asked not to perform any exercise on daily basis. After the study duration pain assessment was taken from both the groups and compared to find out the effects. Results are seen that stretching exercises are effective in reducing pain in the girls of group A while girls of group B did not felt any change in their pain after 12 weeks.

LIMITATIONS:

There are some drawbacks of this study, such as

This study was conducted through online modes so there are some chances of faulty postures of candidates while doing the exercises which can affect the final results of the exercises.

FUTURE RECOMMENDATIONS;

- Study can be done among various other types of exercise forms which could be effective in reducingthe pain intensity of primary dysmenorrhea.

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EFFECTS OF SUJOK THERAPY IN KNEE PAIN: AN EXPERIMENTAL STUDY

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Abstract : Sujok is a simple, easy and effective way to heal oneself. In Sujok therapy, the palms and feet represent all of the organs and meridians in the body. Sujok can be done in addition to other therapies and it has no side effects. By stimulating points on the hands and feet, this therapy can help cure various ailments throughout the body. Physiotherapists help people with injuries, illnesses or disabilities by providing movement and exercise, manual therapy, education and advice. They provide health care for people of all ages, helping patients manage pain and prevent disease. Physiotherapy is a science-based profession that takes a holistic approach to health and wellbeing, including considering a patient's overall lifestyle. An experimental study was conducted using convenient sampling from the physiotherapy clinics situated in the area of Gandhinagar and Ahmedabad of Gujarat state among 90 adult patients of knee OA aged between 18 to 60 years. Data was collected in the period of April and May 2022. There is a significant difference before and after physiotherapy, Sujok and Sujok + Physiotherapy sessions on all 7 consecutive days. There was a significant decrease in the pains of the patients after 3rd day, irrespective of treatment taken by patient. Significant difference was found between physiotherapy and Sujok treatments after day 5. Physiotherapy and Sujok treatments do differ significantly. But there is no benefit

I. INTRODUCTION

Pain disrupts people's lives, and the ability to recognize and understand pain is an early sign of disease states (1), illness, bodily injury (2), and serious or minor health problems (3). One definition of pain is: An unpleasant sensory and emotional experience associated with, or resembling that associated with, actual or potential tissue damage (4). Several literature reviews indicate that there are two types of pain management strategies: multimodal or multidisciplinary (5) and non-multidisciplinary. Multimodal strategies are commonly referred to as "programs". The non-multidisciplinary program is his second strategy for pain relief. This method includes medical treatment and alternative therapy, usually applied in one treatment. Several studies have shown that Su Jok can be used to treat fatigue and weakness (6), elbow eczema (7), migraines (8), asthma (9), and stroke rehabilitation (10). Su Jok for pain relief can also be used for heel spur pain (11). Su Jok Therapy is a complementary and alternative therapy developed in 1987 by his Professor Park Jae Woo in South Korea. Su Jok can provide fast and meaningful results (12). The term Su Jok is of Korean origin. Su means hand, Jok means foot, and Su Jok functions as a therapeutic group for managing health (12). The Su Jok method of treatment is done by stimulating the hands and feet (13). Because they have many similarities with the human body (12). Stimulate the limbs by massaging, applying paint to the skin, moxibustion, placing seeds, magnets, needles, etc. in specific locations. Su-Jok therapy is considered an easier and cheaper treatment than most alternative therapies, and results are generally quicker.

Su Jok Therapy's view of the healing process is based on the concept that the human body is a living organism subject to various factors and has causal relationships with all the energies of the universe. All changes in the human body must obey universal laws of interaction, so that a person's health is determined not only by individual characteristics, but also by environmental forces (14). The aim of this current study was to assess the effects of Sujok therapy, physiotherapy and Sujok + physiotherapy on patients with knee OA.

II. MATERIALS AND METHODOLOGY

An experimental study was conducted using convenient sampling from the physiotherapy clinics situated in the area of Gandhinagar and Ahmedabad of Gujarat state among 90 adult patients of knee OA aged between 18 to 60years. Data was collected in the period of April and May 2022.

Data was collected for the pain and its intensity. Then the patients were divided in to 3 groups -Group A: Patients will be treated by physiotherapy treatment and Sujok therapy. Group B: Patients will be only treated by Sujok therapy. Group C: Patients will be only treated by physiotherapy. In Sujok therapy patients will be diagnosed by probe and then after finding point on hand. Using Su Jok theory, the first thing to do is to find the corresponding areas of the knee on the hand, and then stimulate those points. The most painful points were found on one or several of the areas on Middle or on ring finger and then massaging those areas. Next stage is to massage areas on the fingers (phalanxes of fingers) corresponding to your knee using a Sujok ring or massage ring. The next step

is heating up these areas with Moxa. After that we will apply seeds to the area corresponding to the knee either on the left or right hand. Patients will be examined by VAS (Visual Analog Scale). The visual analog scale (VAS) is a validated, subjective measure for acute and chronic pain. Scores are recorded by making a handwritten mark on a 10-cm line that represents a continuum between "no pain" and "worst pain." for checking the effect of Sujok therapy. Physiotherapy treatment will include the following: - 1. Quadriceps setting, 2. Quadriceps Strengthening, 3. Hamstring Stretch.

The Study was approved by Institutional Ethical Committee, on 25th February 2021 with the outward number VIP/2021/EC/95.

III. RESULTS AND DISCUSSION

Table I: Descriptive Statistics

		Frequency	Percentage
Gender	**Female**	44	48.9%
	Male	46	51.1%
Treatment Given	**Physiotherapy**	30	33.3%
	Sujok + Physiotherapy	30	33.3%
	Sujok Therapy	30	33.3%

In this study, a total of 90 respondents in this study comprised of 46 males and 44 females. All the 90 respondents were divided equally among all the three treatments. The type of therapy can be seen from Table I.

Table II: Statistical Significant difference between pains in patients before and after physiotherapy sessions

Paired Samples Test							
		Paired Differences			t statistic	df	P-Value
		Mean	Std. Deviation	Std. Error Mean			
Pair 1	**b_day 1 - a_day 1**	0.567	0.568	0.104	5.461	29	0.000
Pair 2	**b_day 2 - a_day 2**	0.567	0.568	0.104	5.461	29	0.000
Pair 3	**b_day 3 - a_day 3**	0.667	0.547	0.100	6.679	29	0.000
Pair 4	**b_day 4 - a_day 4**	0.833	0.461	0.084	9.898	29	0.000
Pair 5	**b_day 5 - a_day 5**	0.833	0.379	0.069	12.042	29	0.000
Pair 6	**b_day 6 - a_day 6**	0.900	0.403	0.074	12.245	29	0.000
Pair 7	**b_day 7 - a_day 7**	0.833	0.379	0.069	12.042	29	0.000

Significant differences before and after Physiotherapy, Sujok and Sujok + Physiotherapy sessions were calculated using t-test on SPSS 20.0 software at 5% level of significance. From the table II it can be concluded that there is a significant difference before and after physiotherapy treatment on day 1, 2, 3, 4, 5, 6, 7 as p-value was found to be 0.000 < 0.05 at 5 % level of significance.

Table III: Statistical Significant difference between pains in patients before and after Sujok sessions + Physiotherapy

Paired Samples Test							
		Paired Differences			t statistic	df	P-value
		Mean	Std. Deviation	Std. Error Mean			
Pair 1	b_day 1 - a_day 1	0.933	0.691	0.126	7.393	29	0.000
Pair 2	b_day 2 - a_day 2	0.867	0.434	0.079	10.933	29	0.000
Pair 3	b_day 3 - a_day 3	0.833	0.379	0.069	12.042	29	0.000
Pair 4	b_day 4 - a_day 4	0.833	0.648	0.118	7.047	29	0.000
Pair 5	b_day 5 - a_day 5	0.767	0.568	0.104	7.389	29	0.000
Pair 6	b_day 6 - a_day 6	0.900	0.548	0.100	9.000	29	0.000
Pair 7	b_day 7 - a_day 7	0.833	0.531	0.097	8.601	29	0.000

From the table III it can be concluded that there is a significant difference before and after Sujok + physiotherapy treatment on day 1, 2, 3, 4, 5, 6, 7 as p-value was found to be 0.000 < 0.05 at 5 % level of significance.

Table IV: Statistical Significant difference between pains in patients before and after Sujok sessions

Paired Samples Test							
		Paired Differences			t statistic	Df	P-Value
		Mean	Std. Deviation	Std. Error Mean			
Pair 1	b_day 1 - a_day 1	1.033	0.183	0.033	31.000	29	0.000
Pair 2	b_day 2 - a_day 2	1.067	0.583	0.106	10.016	29	0.000
Pair 3	b_day 3 - a_day 3	1.100	0.712	0.130	8.462	29	0.000
Pair 4	b_day 4 - a_day 4	1.067	0.691	0.126	8.449	29	0.000
Pair 5	b_day 5 - a_day 5	1.233	0.504	0.092	13.403	29	0.000
Pair 6	b_day 6 - a_day 6	1.067	0.521	0.095	11.217	29	0.000
Pair 7	b_day 7 - a_day 7	0.933	0.450	0.082	11.366	29	0.000

From the table IV it can be concluded that there is a significant difference before and after Sujok treatment on day 1, 2, 3, 4, 5, 6, 7 as p-value was found to be 0.000 < 0.05 at 5 % level of significance in Table IV.

Table V: Significant difference between the pains of patients after physiotherapy session, Sujok session and Sujok + physiotherapy session.

		N	Mean	Std. Deviation	F Statistic	P-Value
Pain after _day 1	Physiotherapy	30	5.43	1.073	0.385	0.682
	Sujok	30	5.27	0.868		
	Sujok + Physiotherapy	30	5.20	1.215		
	Total	90	5.30	1.054		
Pain after _day 2	Physiotherapy	30	5.43	1.073	1.123	0.33
	Sujok	30	5.13	0.860		
	Sujok + Physiotherapy	30	5.07	1.081		
	Total	90	5.21	1.011		
Pain after _day 3	Physiotherapy	30	5.30	1.149	2.239	0.003
	Sujok	30	4.73	0.944		
	Sujok + Physiotherapy	30	4.90	1.094		
	Total	90	4.98	1.081		
Pain after _day 4	Physiotherapy	30	4.97	1.066	2.453	0.092
	Sujok	30	4.43	0.858		
	Sujok + Physiotherapy	30	4.50	1.106		
	Total	90	4.63	1.033		
Pain after _day 5	Physiotherapy	30	4.70	1.119	4.2	0.018
	Sujok	30	3.90	0.803		
	Sujok + Physiotherapy	30	4.33	1.241		
	Total	90	4.31	1.108		
Pain after _day 6	Physiotherapy	30	4.47	1.042	4.698	0.012
	Sujok	30	3.67	0.758		
	Sujok + Physiotherapy	30	4.03	1.189		
	Total	90	4.06	1.053		
Pain after_day 7	Physiotherapy	30	4.37	1.033	5.676	0.005
	Sujok	30	3.57	0.774		
	Sujok + Physiotherapy	30	3.77	1.040		
	Total	90	3.90	1.006		

To test the significant difference between the pains pertaining to patients after giving physiotherapy session, Sujok session and Sujok + physiotherapy session, ANOVA test was applied at 5% level of significance using SPSS 20.0 software. Following results were concluded from Table V:

After applying all the sessions to respective patients, the significant difference between the after therapy, pain of all the three groups on day 1 and day 2, was not found significant, with P-value > 0.05 at 5% level of significance. In other words, there is no significant difference in therapies after day 1 and day 2.

The significant difference between the after therapy, pain of all the three groups on day 3 was found significant, with P-value 0.003 > 0.05 at 5% level of significance. In other words, there is a significant difference in therapies after day 3. Physiotherapy was found least effective with average VAS for pain (5.30), Sujok + Physiotherapy was found second highest with average VAS for pain (4.90) after Sujok and Sujok was highest effective among all the three with average VAS for pain (4.73).

The significant difference between the after therapy pain of all the three groups on day 4 was not found significant, with P-value 0.092 > 0.05 at 5% level of significance. In other words, there is no significant difference in therapies after day 4, though the effectiveness of the therapies remained same as that on day 3 i.e. Physiotherapy was least effective with average VAS for pain (4.97), Sujok + Physiotherapy less than only Sujok with average VAS for pain (4.50) and Sujok was found highest effective with average VAS for pain (4.43).

The significant difference between the after therapy pain of all the three groups on day 5 was found significant, with P-value 0.018 < 0.05 at 5% level of significance. In other words, there is a significant difference in therapies after day 5. Physiotherapy was found least effective with average VAS for pain (4.70), Sujok + Physiotherapy was found second highest with with average VAS for pain (4.33) after Sujok and Sujok was highest effective among all the three with with average VAS for pain (3.90).

The significant difference between the after therapy pain of all the three groups on day 6 was found significant, with P-value 0.012 < 0.05 at 5% level of significance. In other words, there is a significant difference in therapies after day 6. Physiotherapy was found least effective with average VAS for pain (4.47), Sujok + Physiotherapy was found second highest with average VAS for pain (4.03) after Sujok and Sujok was highest effective among all the three with with average VAS for pain (3.67).

The significant difference between the after therapy pain of all the three groups on day 7 was found significant, with P-value 0.005 < 0.05 at 5% level of significance. In other words, there is a significant difference in therapies after day 7.

In two pooled studies (15), (16), the reduction in the VAS pain score from treatment with physiotherapeutic modalities in combination with stretching exercises was statistically superior to treatment with physiotherapeutic modalities alone. (WMD 0.56; 95% CI 0.20 to 0.92; $I^2 = 0\%$; $P < 0.05$; n = 102 pooled sample size). A similar result was obtained from studies (17), (15), using the KOOS pain scale. (WMD 7.52; 95% CI 4.05 to 10.98; $I^2 = 0\%$; $P < 0.05$; n = 76 pooled sample size).

Fitzgerald et al. (18) evaluated these techniques separately, and found no significant evidence that these exercises improve pain and muscle strength in OA patients. This finding does not corroborate the study by Diracoglu et al., (19) who compared kinesthesia and balance exercises or only strengthening exercises in women with knee OA, obtaining positive outcomes on muscle strength, quality of life, and the physical function scale, according to the WOMAC questionnaire.

In the Chen, HL. Et. al (2022)'s study, functional status was primarily assessed using the WOMAC scale, and significant improvements with the implementation of IFC were observed in short-term assessment but not in long-term follow-up. We also discovered that the results for walk tests (short- and long-term) and stiffness scores (short-term) did not favor IFC use over control treatment. The WOMAC scale evaluates activities of daily living, functional mobility, gait, general health, and quality of life in knee osteoarthritis patients (21). It consists of 24 questions that can be divided into the subscales of pain, physical function, and stiffness. The outlier data of one study were removed in sensitivity testing because we observed high heterogeneity, which could be attributed to the study's inadequate blinding of participants and its small sample size (22). The significance of our meta-analysis findings persisted after sensitivity testing, indicating that the outcomes were reliable.

We found many studies pertaining to knee pain treatments, but no study came to our knowledge in regard to Sujok therapy on knee osteoarthritis patients. In our study overall, Physiotherapy was found least effective with average VAS for pain (4.37), Sujok + Physiotherapy was found second highest with average VAS for pain (3.77) after Sujok and Sujok was highest effective (pain relieving technique) among all the three with average VAS for pain (3.57).

IV. CONCLUSION

There are many ways to manage pain, including traditional and unconventional treatments. The development of pain management research continues, and easier, less expensive therapeutic approaches that produce quicker pain relief are still being sought after. In this retrospective study, Su Jok is one of the complementary therapies for pain, offers a successful method of pain relief and highest effective when compared to that of physiotherapy for patients with Knee osteoarthritis. However, future studies must be conducted using stricter procedures, large sample and with more precise standards for pain management.

V. LIMITATIONS OF THE STUDY

Due to low sample size, Su Jok treatment in combination with Physiotherapy doesn't show more effectiveness compared to solely Physiotherapy treatment. So, further research must be conducted using large sample size.

VI. DECLARATION OF COMPETING INTEREST

There is no conflict of interest in this publication.

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EFFECT OF HOLISTIC YOGA ON ANXIETY SYMPTOMS IN COLLEGE GOING FEMALES WITH PCOS IN GUJARAT: A QUASI-EXPERIMENTAL ONE-WAY STUDY.

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ABSTRACT :

BACKGROUND:

To find the effects of holistic yoga on college going girls with anxiety and PCOS. The purpose of the study was to measure the level of depression among females suffering from polycystic ovarian syndrome and to find out the effect of yoga on the level of depression among females suffering from polycystic ovarian syndrome.

METHODOLOGY:

There will be an interactive introductory lecture about the topic and all girls of the college will attend this lecture. 40 girls with PCOS will be selected for the holistic yoga session. The yoga performed will be basically the asanas and meditation and lecturers on holistic yoga lifestyle and stress management. All these asanas will be performed with 6 repetitions with 10 seconds of hold and 15 seconds of resting period. This yoga asanas will be performed daily till 1

hour for 6 weeks.

RESULT:

Changes in the anxiety level after the holistic yoga program were seen and also significant changes in weight, waist and hip circumference have been seen in the college going girls in Gujarat with PCOS.

CONCLUSIONS:

6 Weeks Holistic Yoga Program in college going girls with PCOS was seen as more effective than the other regular exercise to reduce weight, waist and hip circumference with anxiety symptoms respectively.

KEYWORDS:

Yoga; Polycystic ovarian syndrome; Anxiety symptoms

INTRODUCTION

Polycystic ovary syndrome (PCOS) is an abnormal hormonal change in ovaries. It mostly affects the ovaries which produces estrogen and progesterone hormone but sometimes ovaries produce male hormone androgen which results in the excess hair growth, acne, obesity, irregular menstrual cycle, anxiety, depression, stress is also seen in female with PCOS.[1]

The prevalence of PCOS in women is most common in age between 15-30 years. PCOS is the most common endocrine disorder of reproductive women with the prevalence of 5-15%. of women are affected with it.[1]

The common treatment protocol for PCOS are pills for regular menstrual cycle, statins to control the hormonal changes, different exercises like Zumba, aerobics and yoga.[2]

Side-effects of some medications are also seen such as nausea, stomach pain, diarrhea. Lack of vitamin B12 also causes mood swings and memory loss. So proper diet should be taken.[3]

Yoga, a form of holistic mind-body medicine, developed thousands of years ago, is simple and can be performed by all. There is evidence that Yoga reduces anxiety symptoms.[4]

Yoga is a great stress buster. Yoga eases any stress through breathing techniques that bring complete relaxation in the body. Relaxation can work to offset the effects of hormonal imbalance and take care of any negative emotions, irritability and frequent mood swings.[5]

Yoga strengthens the muscles, improves hormonal levels. Yoga along with a healthy diet helps to lose weight.[5]

However, till date, So Many studies and research has been done with yoga and PCOS but with anxiety symptoms only one study was done in south Indian school going girls. The present study will be assessing the effect of yoga on anxiety level in adolescent girls with PCOS.[6]

Depression is a common mood disorder that negatively affects a person's thinking, feeling and behavior. It leads variety of emotional and physical problems.[7]

Depression is more than sadness. People suffering from depression experience lack of interest in daily activities, weight loss or gain, lack of sleep or excessive sleep, lack of energy, excessive guilt and re current thoughts of suicide.[7]

Women experience depression twice as compared to men. Some factors such as biological, life cycle, hormonal and other factors unique in women and it may link to their higher level of depression rate.[7]

Mood is affected by the various PCOS symptoms. According to Farrell and Antoni (2010) women with PCOS experience mood dysfunction and psychiatric problems to a greater degree than women without PCOS.[7]

Many studies show that the level of depression is higher in PCOS than healthy women. PCOS is a common health problem among women. This problem is caused by hormonal imbalance. PCOS Caused by small cysts in the ovary which affect the hormones and dispute the normal menstrual cycle .Around 5-10% women are diagnosed with

PCOS.[7]

Women are suffered from PCOS because of excessive level of stress and strain, perennial tension, following modern faculty lifestyle and some psychological problems like anxiety and depression.[7]

Irregular Periods, Ovarian cyst, pimples, excessive hair fall, abdominal bloating, mood swings, miscarriage, Irritability, hair growth on the face, weight gain, muscles enlargement, imbalance level of sugar in blood, PCOS can also cause type 2 diabetes and heart attack.The aim of the study was to measure the level of depression among females suffering from polycystic ovarian syndrome and to find out the effect of yoga on level of depression among females suffering from polycystic ovarian syndrome.[7]

REVIEW OF LITERATURE

1. **Moran.Effect of suryanamaskar with yoga nidra practices on selected psychological variables among obese women.(2011)[8]** :- They conducted a study on Lifestyle changes in women with polycystic ovary syndrome (PCOS) affects 4% to 18% of reproductive-aged women and is associated with reproductive, metabolic and psychological dysfunction. Obesity worsens the presentation of PCOS, and weight management (weight loss, maintenance or prevention of excess weight gain) is proposed as an initial treatment strategy, best achieved through lifestyle changes incorporating diet, exercise and behavioral interventions.

2. **Panjwani U. Effect of sahaja yogic practice on the psychological changes among the adolescent girls.(1995)[9]** :- They studied the Effect of Sahaja yoga practice on stress management in patients of epilepsy. The study was carried out on 32 patients of epilepsy who were randomly divided into 3 groups: group 1 subjects practiced Sahaja yoga meditation for 6 months, group 2 subjects practiced postural exercises mimicking Sahaja yoga and group 3 served as the epileptic control group.

3. **DiBenedetto M. Effect of varied Yogic practices on selected physiological and psychological variables among adolescents girls.(2000)[10]** :- They examined if a tailored yoga program could improve age-related changes in hip extension, stride length, and associated indices of gait function in healthy elders, changes that have been linked to increased risk for falls, dependency, and mortality in geriatric populations. A 3-dimensional quantitative gait evaluation, including kinetic measurements, was performed pre and post intervention. Home practice on alternate days. Findings of this exploratory study suggest that yoga practice may improve hip extension, increase stride length, and decrease anterior pelvic tilt in healthy elders, and that yoga programs tailored to elderly adults may offer a cost-effective means of preventing or reducing age-related changes in these indices of gait function.

4. **Reshma Mohamed Ansari. Kapalbhati Pranayama: An answer to modern day polycystic ovarian syndrome and coexisting metabolic syndrome.(2016)[11]** :- They examined the role of Kapalbhati pranayama, the modern-day yoga practice to cure the polycystic ovarian syndrome and coexisting metabolic syndrome in women of age group 18-40 years. Yogic exercises are noted to reduce oxidative stress and hence aid in antioxidant defense mechanisms.Pranayama techniques such as Kapalabhati improve autonomic function by balancing the sympathetic and parasympathetic activity which is beneficial in stress-related disorders.Kapalabhati reduces oxidative stress which affects lipid peroxidation.

5. **Valarmathi Selvaraj. Impact of yoga and exercises on polycystic covarian syndrome risk among adolescents school girls.(2016)[12]** :- The Experimental research was conducted among adolescent girls belonging to two Government run schools in Tiruvallur district of Tamil Nadu state, India, from 6 June to 9 December 2016. A standard risk assessment questionnaire was adopted for risk assessment after making few modifications.The experimental group received lifestyle modifications (yoga for two months and walking exercise for two months), with no such intervention provided for the control group. The impact of these interventions was assessed in terms of risk minimization and a P value less than .05 was considered statistically significant.

6. **Vishesha Patel. Regular mindful yoga practice as a method to improve androgen levels in women with polycystic ovary syndrome: A randomized controlled trial.(2020)[13]** :-31 women with PCOS between the ages of 23 and 42 years and living in Erie County, Pennsylvania, were recruited for this randomized, controlled study arm, 22 women completed the 3-month intervention period, 13 in the mindful yoga group and 9 in the control group.The improvements observed suggest that regular mindful yoga practice can be a useful complementary therapeutic option for women with PCOS, particularly for improving serum androgen levels, a hallmark feature of PCOS.

7. **Kamini Balasaheb Bhingardive. Clinical efficacy of vamana karma with ikshvakubeeja yoga followed by shatapusphpadi ghanavati in the management of artavakshaya to polycystic ovarian syndrome.(2017)[14]**:-15 patients of PCOS were clinically diagnosed and treated by Vamana Karma (therapeutic vomiting) procedure with Ikshvaku seed formulation. After completion of Vamana Karma (therapeutic vomiting) and ShatapushpadiGhanavati 2 Vati (each 500 mg) twice in a day with lukewarm water was given for 45 days. Vamana Karma (therapeutic vomiting) followed by ShatapushpadiGhanavati is very effective in the management of obese PCOS patients andincreasing chances of conception.

8. **M. Ezhil Ratnakumari. Study to evaluate the changes in polycystic ovarian morphology after naturopathic and yogic interventions.(2018)[15]** :- 50 PCOS patients of age between 18 and 35 years who satisfied the Rotterdam criteria were recruited for the study.This study revealed Y&N (Yoga and Naturopathy) lifestyle could be the first-line interventions for PCOS. Small changes in lifestyle in accordance with Y & N are known to improve symptoms and psychological well-being of PCOS patients. This study performed to assess morphological changes in the polycystic ovaries in relation to reduction of symptoms has substantiated the approach of Y&N interventions in PCOS.
9. **Anitha. Effect of yoga on level of depression among females suffering from polycystic ovarian syndrome (PCOS).(2017)[16]** :- They determined the prevalence of depression among women with PCOS compared to normal healthy women. They selected 50 cases of PCOS as per the Rotterdam criteria from the Gynecology OPD, Government Chengalpattu Medical College. The depression related information was gathered by Beck's Depression Inventory. The data was compared with that of 50 age matched normal healthy individuals. The finding shows that depression scores were significantly increased in the PCOS group as compared to the

control group. The study showed increased prevalence of mild to moderate depression in PCOS patients compared to the normal subjects.

10. **Arnulfo Ramos-Jiménez. Cardiovascular and metabolic effects of intensive hatha yoga training in middle-aged and older women from Northern Mexico.(2009)[17]** :- An 11-week IHY (Intervention Hatha Yoga) program consisting of 5 sessions/week for 90 min (55 sessions) was found to be capable of improving cardiovascular fitness. Despite the relatively low intensity of the yoga practice, this program increased both VO2max and HDL-C. The data also suggested that HY asanas, practiced as a systematic physical activity and conducted by an expert instructor in untrained and aging individuals, can improve health and serve as the basis for a physically active lifestyle.

11. **Nidhi, R., Padmalatha, V., Nagarathna, R., and Ram, A. Effect of Holistic yoga program on anxiety symptoms in adolescent girls with polycystic ovarian syndrome: A randomized control trial.(2012)[1]**:- They investigated the Effects of a Holistic Yoga Program on Endocrine Parameters in Adolescents with Polycystic Ovarian Syndrome. International Journal of Gynecology and Obstetrics, ninety (90) adolescent (15-18 years) girls from a residential college in Andhra Pradesh who satisfied the Rotterdam criteria were randomized into two groups. The yoga group practiced a holistic yoga module, while the control group practiced a matching set of physical exercises (1 hour/day, for 12 weeks). Anti-müllerian hormone (AMH-primary outcome), luteinizing hormone (LH), follicle- stimulating hormone (FSH), testosterone, prolactin, body-mass index (BMI), hirsutism, and menstrual frequency were measured at inclusion and after 12 weeks.Mann-Whitney test on difference score shows that changes in AMH (Y=-2.51, C=-0.49, p=0.006), LH, and LH/FSH ratio (LH: Y=-4.09, C=3.00, p=0.005; LH/FSH: Y=-1.17, C=0.49, p=0.015) were significantly different between the two intervention groups. Also, changes in testosterone (Y=-6.01, C=2.61, p=0.014) and Modified Ferriman and Gallway (mFG) score (Y=-1.14, C=+0.06, p=0.002) were significantly different between the two groups. On the other hand, changes in FSH and prolactin post intervention were not significantly different between the two groups. Also, body weight and BMI showed non significantly different changes between the two groups, while changes in menstrual frequency were significantly different between the two groups (Y=0.89, C=0.49, p=0.049).A holistic yoga program for 12 weeks is significantly better than physical exercise in reducing AMH, LH, and testosterone, mFG score for hirsutism, and improving menstrual frequency with non-significant changes in body weight, FSH, and prolactin in adolescent PCOS.

NEED OF STUDY

Many studies and research have been done with yoga and PCOS but with anxiety symptoms only one study was done in south Indian school going girls, so we want to do this study in Gujarat, in college going girls how yoga is effective and beneficial for the treatment of PCOS with anxiety symptoms.

OBJECTIVE OF THE STUDY

- To assess the reduction of anxiety symptoms due to PCOS by holistic yoga.
- To assess the effects of holistic yoga on PCOS in college going girls.

HYPOTHESIS

- **NULL HYPOTHESIS** – Holistic Yoga treatment for anxiety and PCOS will be noteffective on adolescent girls.

- **RESEARCH HYPOTHESIS** – Holistic Yoga treatment for anxiety and PCOS will beeffective on adolescent girls.

METHODOLOGY

The study was carried out on college going girls aged 18 to 30 years in Gujarat, India.
Those girls who have satisfied the criteria of PCOS with some features included in it.

INCLUSION CRITERIA

1.) Age group of 18 to 30 years of girl.2.) PCOS for more than 6 months.

3.) Cystic Ovaries

4.) Girls with irregular menstruation

EXCLUSION CRITERIA

1.) Girls taking oral contraceptives

2.) Hormonal treatment

3.) Insulin intake

4.) Thyroid abnormalities

5.) Smoking

6.) Alcohol

7.) Regular exercising girls

All 40 Girls who were selected for the study purpose were gathered through the online zoom yoga sessions of 1hour/every day for 6 weeks and the examination with quasi experimental one way study was performed and checked through pre-intervention to post-intervention in their weight, height, waist and hip circumference and BMI also with decreased anxiety symptoms wereexamined after 6 weeks of program.

There was an interactive introductory lecture about the topic and all girls of the college attended this lecture. 40 girls with PCOS were selected for the holistic yoga session after signing the consent form. The yoga performed was basically the asanas, meditation and lecturers on holistic yoga lifestyle and stress management.

YOGA EXERCISES FOR TREATMENTOF PCOS.[5]

Asanas for PCOS are:

1.) Badhakonasana (Butterfly pose)

2.) SuptaBaddhaKonasana (Reclined bound angle)

3.) Bharadvajasana (Bharadvajasana twist's)

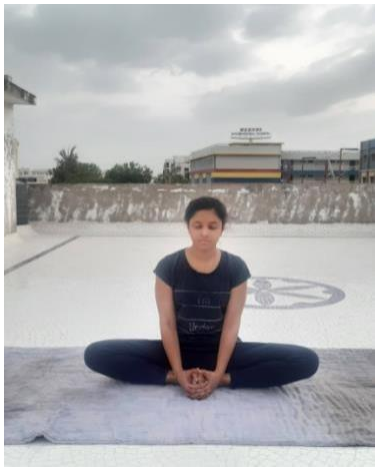
4.) ChakkiChalanasana (Mill churning pose)

5.) Shavasana (Corpse pose)

6.) Padmasana

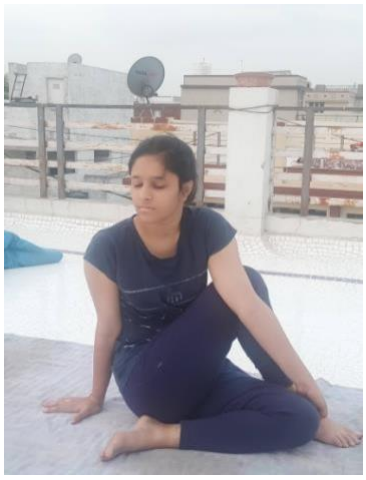
7.) A few rounds of Surya namskar (Sun Salutation)

All these asanas were performed with 6 repetitions with 10 seconds of hold and 15 seconds of resting period. This yoga asanas were performed daily till 1 hour for 6 weeks. Practicing these Asanas would become a reason to boost the health of uterus and ovaries and improve functioning of the endocrine glands. Yoga is safe and effective for treatment of PCOS.



6.1 Badhakonasana.

6.2 SuptaBadhaKonasana



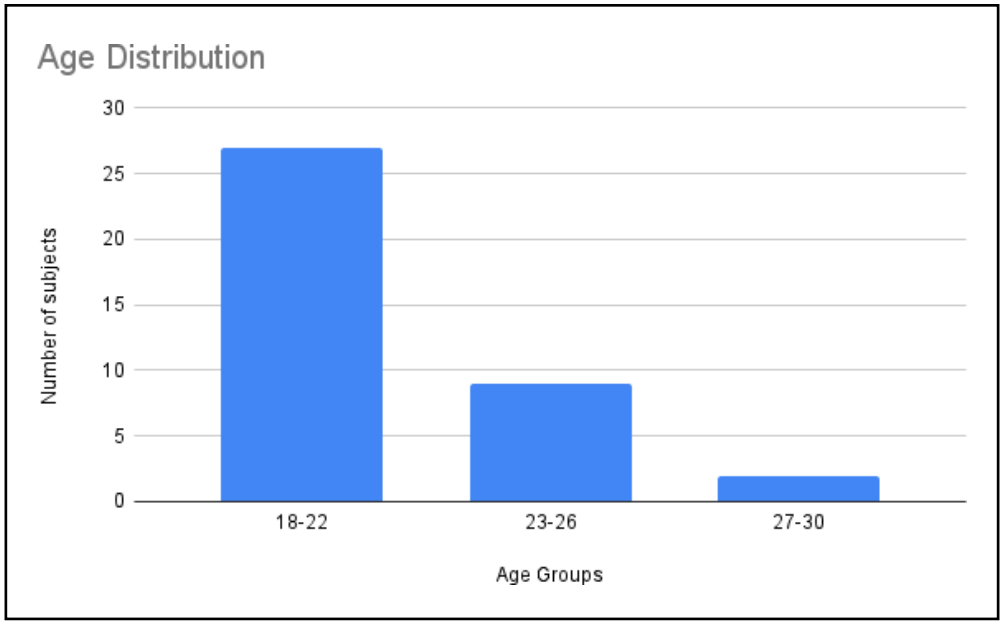
6.3 Bhadravajanasana

6.4 Chakkichalanasana

RESULT

1. Age Distribution

This research was performed on 40 females with PCOS between the age of 18 to 30. There were27 females between the ages of 18 to 22, 9 females between the ages of 23 to 26 and 2 females between the ages of 27 to 30.



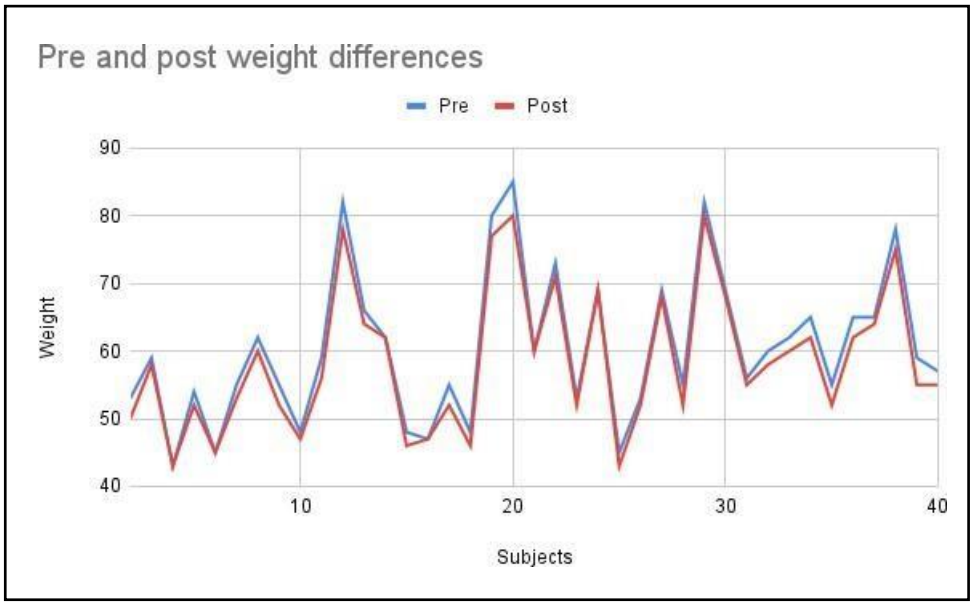
GRAPH: - 7.1.1 AGE DISTRIBUTION CHART

2.Weight Distribution

From the total of 40 subjects, we saw the minor weight change in 34 females while 6 females didnot lose any weight.The pre mean was 60.45 and post mean after yoga and asanas was 58.474 with 1.975 difference among them and P-Value was less than 0.01.

Weight Mean		Difference	P-Value
Pre	Post		
60.45	58.475	1.975	<0.01

Table : 7.1 Mean Weight Distribution



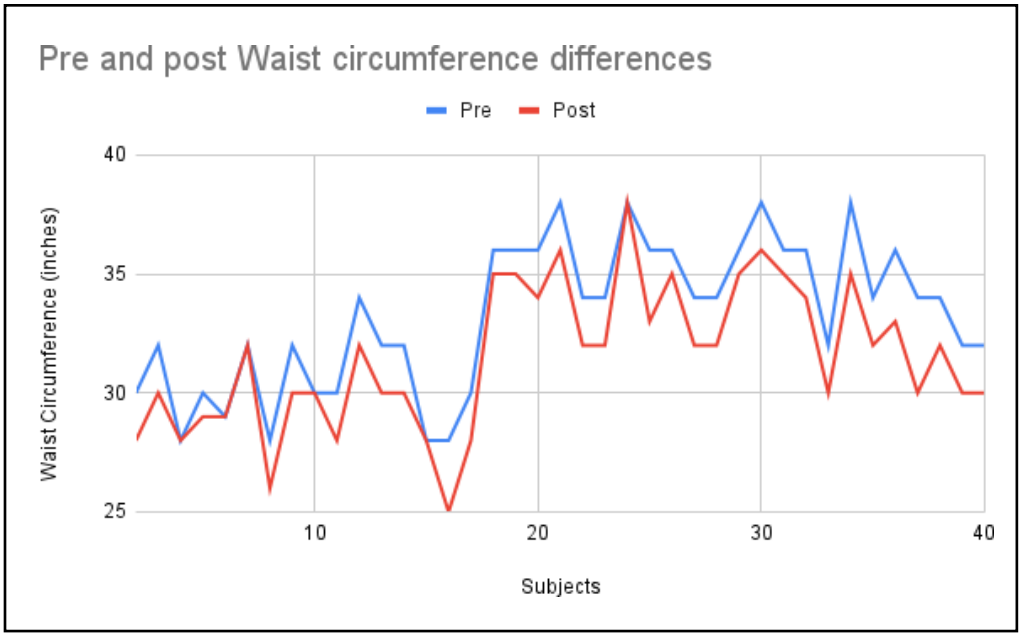
GRAPH: - 7.2.2 WEIGHT DISTRIBUTION CHART

3.Waist Circumference Distribution

From the total of 40 subjects, we saw minor Waist Circumference loss in 34 females while 6 females did not lose any waist. These females were different from the ones who have lost someweight in the previous graph.The pre mean was 33.225 and post mean was 31.525 with 1.7 difference while P-Value was less than 0.01.

Waist Mean		Difference	P-Value
Pre	Post		
33.225	31.525	1.7	<0.01

Table : 7.2 Waist Mean Distribution



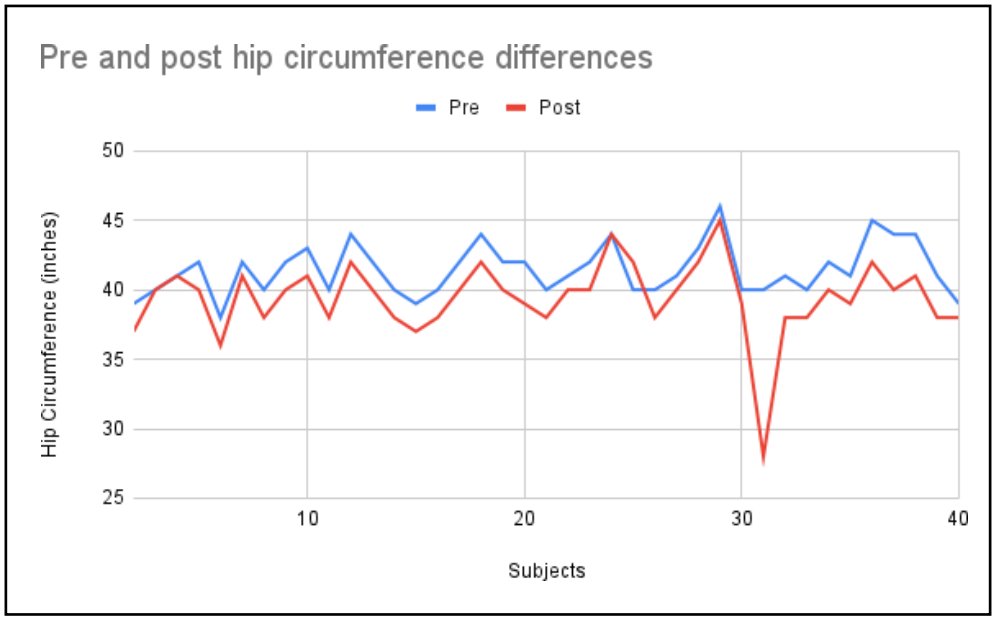
GRAPH: -7.3.3 WAIST CIRCUMFERENCE DISTRIBUTION CHART

4.Hip Circumference Distribution

From the total of 40 subjects, we saw minor hip circumference loss in 36 females while 4 females did not lose any inches as pre mean was 41.425 and post mean was 39.45 as differencewas seen 1.975 among the females after holistic yoga program with P-Value less than 0.01.

Hip Mean		Difference	P-Value
Pre	Post		
41.425	39.45	1.975	<0.01

Table : 7.3 Hip Mean Distribution



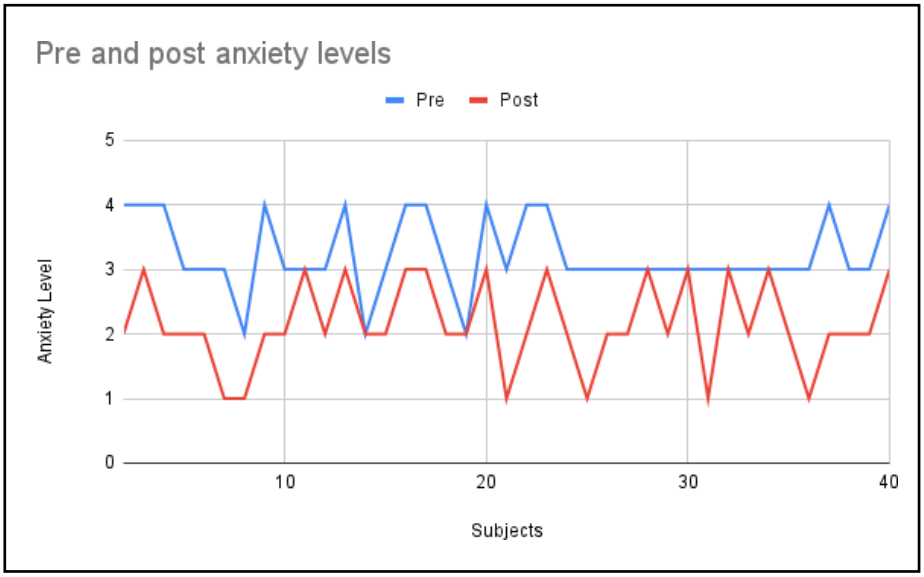
GRAPH: - 7.4.4 HIP CIRCUMFERENCE DISTRIBUTION CHART

5.Anxiety Levels Distribution

From the total of 40 subjects, we noticed a drop in anxiety levels for 33 females while 7 femalesdid not have any decrease as pre anxiety Mean was 3.225 and post was 2.125 with difference of 1.1 and P-Value less than 0.01.

Anxiety Mean		Difference	P-Value
Pre	Post		
3.225	2.125	1.1	<0.01

Table 7.4 Anxiety Mean Distribution



GRAPH: - 7.5.5 ANXIETY LEVEL DISTRIBUTION CHART

DISCUSSION

Many women first experience symptoms of PCOS during anxiety-inducing change, severe stress, or trauma. Patients with PCOS have reported that they feel anxious about their bodies and health. A person's values and culture they live in, also impacts their anxiety level. Because of this behavior, there is a high risk for depression and anxiety in PCOS patients regardless of pregnancy issues, obesity, excess body and facial hair, or lack of control over their health and bodies. In addition, Obesity is a common finding in women with PCOS and between 40-80% women with this condition are reported overweight or obese. In women with PCOS, the metabolic and hormonal issues that are present such as insulin resistance and hyperandrogenism, can lead to weight gain. Obesity in turn can exacerbate the symptoms of PCOS such as further metabolic issues and reproductive abnormalities. In our study the the Anxiety symptoms are also reduced along with the wieght.

When Dr. V. Duraisami from TNPESU, Chennai, did research on the effects of Suryanamaskar with Yoga Nidra practices on selected Psycological variables among obese people, the results showed that these practices helped to reduce anxiety and to increase self-confiedence among the obese people. As compared to this study our research has different holistic yoga program to reduce weight,waist,hip and anxiety symptoms.

L.V.H. Arts, Science & Commerce College, Nashik, did research on the effect of Yoga on Level of depression among Females suffering from PCOS. The sample of the research consisted of 30 females with PCOS where they were provided 1 month Yoga training. The researchers concluded that Providing Yoga training to these females with PCOS has helped in opening the pelvic area leading to relaxation of mind and body.

This Quasi Experimental on-way research presents the effects of Yoga on 40 PCOS adult female patients from age 18 to 30, who are also obese. For six weeks, we provided 1 hour yoga session to these subjects which included BaddhaKonasana, SuptaBaddhaKonasana, Bharadvajasana, ChakkiChalanasana, Shavasana, Padmasana and a few rounds of Surya Namaskar. After the research period, we noticed slight drop in weight, waist and hip circumference and anxiety level. Our research concluded that holistic yoga helps with the anxiety symptoms in females with PCOS.

CONCLUSION

Six Week holistic yoga program in college going girls with PCOS in Gujarat has been significantly proven to reduce the weight, waist and hip circumference with anxiety symptoms. Thus, Yoga and asanas management may help reduce the progression of anxiety symptoms with PCOS.

SUMMARY

The study is to find the effect of holistic yoga on the college going girls with PCOS and anxiety symptoms in Gujarat.40 girls were chosen with the 18-30 age group with weight, waist circumference and hip circumference and body mass index. Hamilton Anxiety rating scale was also taken for the rating of their Anxiety symptoms after holistic yoga asanas. This six-week holistic yoga program was useful in reducing the Anxiety symptoms with weight, waist and hip circumference.

Limitations

- Small sample size.
- Limited age group of 18-30 years.
- The self-selection and convenience sampling of participants to complete the study may alsoinfluence the result.

Future recommendation

- Future research should replicate these findings in other large samples, take larger agegroups and investigatethe relationship between Anxiety and Obesity.

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Reliability and Validity of Gujarati Version of Tinetti Assessment Tool: Validation Study

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Abstract:

Background: The Tinetti Assessment Tool is a valid and reliable self-reporting Tool evaluating the patient's problems toward the effect of their activities of daily living (ADLs) and works on their balance and gait disorder. Till the date it was translated into various languages but is not available in Gujarati language. This study aimed to translate Tinetti Assessment Tool into Gujarati and to study reliability and validity of Gujarati version**.**

Methodology: Translation and cross culture adaptation were performed according to the guidelines. Content validation was executed by the panel of 6 members who were experts in using Gujarati and English. They were completed the content validity .The psychometric properties were tested by administering the tool to 60 samples (40 to 70 years) was recruited by Purposive sampling. For test-retest reliability, people with Balance Gait disorder were tested after a week by Intra-class correlation coefficient (ICC) and internal consistency was assessed by Cronbach's alpha (α).

Result : The content validity of Gujarati translated Tinetti Assessment Tool by a panel of 6 experts were found to be, I-CVI of individual items of Gujarati version of Tinetti Assessment Tool ≥ 0.93 and the overall S-CVI for idiomatic equivalence (S-CVI =0.89) semantic equivalence (S-CVI=0.91) and content relevance(S-CVI=0.92). The test-retest reliability of Gujarati version Tinetti Assessment Tool was good (ICC (2,1) = 0.986 and 0.977). Internal consistency was found to be good (Cronbach's alpha = 0.993 and0.988).

Conclusion : The Gujarati version of Tinetti Assessment Tool was cross-culturally adapted and validated can be use patient with balance and gait disorder in the Gujarati-speaking populations.

Keywords : Cross cultural adaption, Tinetti Assessment Tool, Reliability, Validity , Balance and Gait disorder

INTRODUCTION

Balance and gait disorders are among the most common causes of falls in older adults.[1] more than one third of persons 65 years of age or older fall each year, and in half of such cases the falls are recurrent. Approximately 1 in 10 falls results in a serious injury, such as hip fracture, other fracture, ,subdural hematoma, other serious soft-tissue injury, or head injury.[2] Chronic diseases and aging can affect the balance ability of older people; therefore, an assessment of balance ability is valuable predicting and preventing falls and a reduction in independent living in older people. [3]

Balance is required for maintaining static posture, stabilizing dynamic movements, performing daily activities and moving around the community.[3] The loss of balance response and increased incidence of falls is of concern to physical therapists. Improvement of the balance may be a desired functional outcome for many patients. Balance function has been reported to decline with age, as evidenced by increased postural sway and decreased stability.[4]

Balance difficulties are reported by 13% of patients at age 65,35%at age 75, and 46% at age 85. Gait impairment has been estimated to occur in 8% to 19% of elderly individual living in the community.[5]

Balance can be affected in various ways which include joint motion limitation, weakness, altered muscular tone, sensory deficits, anomalous postural reactions and cognitive problems.[6] Most of changes in gait that occur in older are related to underlying medical conditions, particularly as condition increase in severity, and should not be viewed as merely an inevitable consequence of aging.[1]

Other causes of balance is the dizziness, vertigo, neurological disorder, vestibular migraine and vestibular neuritis. Balance disorders are recognized risk factors for falls. especially in the elderly with high associated morbidity, mortality, and economic cost.[7] Only few studies describe the distribution of gait disorders. Obviously, the spectrum of underlying illnesses will depend on the population under consideration and the assessment technique. Within a relatively healthy subgroup of 153 community residents aged 88 years and older, about 61% reported distinct diseases as a cause of gait impairment.[0] Non-neurological disorders were the leading causes of gait impairment, in particular joint pain (52 of 87 people), whereas many others had multiple causes for their gait impairment.[8]

Non-neurological disorders were the leading causes of gait impairment, in particular joint pain (52 of 87 people), whereas many others had multiple causes for their gait impairment. Stroke was the most common neurological cause. In another study of 120 elderly outpatients seen in a neurological reference practice, the most common causes for gait disorders were sensory ataxia (18%), myelopathy (17%), multiple strokes (15%), and parkinsonism (12%).2 Largely the same causes dominated in a series of 493 neurological inpatients, 60% of whom had a gait disorder.[8]

Determining that a gait is abnormal can be challenging, because there are no clearly accepted standards to define a normal gait in an older adult.10 Studies comparing healthy persons in their 70s with healthy persons in their 20s demonstrate a 10 to 20 percent reduction in gait velocity and stride length in the older population.18,19 Other characteristics of gait that commonly change with aging include an increased stance width, increased time spent in the double support phase, bent posture, and less vigorous force development at the moment of push off. These changes may represent adaptations to alterations in sensory or motor systems to produce a safer and more stable gait pattern.[1]

They may contribute to gait and balance disorders for a variety of reasons, such as causing pain, dyspnea, imbalance, diminished strength, limited range of motion, poor posture, decreased sensory perception, fatigue, deformity, and decreased awareness of and ability to adapt to and traverse through possibly hazardous surroundings.[1]

In addition, recent surgery or hospitalization and other acute medical illnesses may lead to gait and balance disorders. The use of multiple medications, as well as specific classes of medications, can lead to gait disorders and an increased rate of falls.[00] Although data are limited, surgery may improve gait for patients with cervical spondylotic myelopathy,51 lumbar spinal stenosis,52 normal-pressure hydrocephalus,53 or arthritis of the knee or hip.[1]

In many studies ,risk factor for falls have been determined. These are classified as intrinsic and extrinsic factors. Muscular weakness of the Lower extremities ,decreased grip force, impaired postural balance, Functional and cognitive disorders, and visual problems constitute Intrinsic factors ,while extrinsic factors include environmental factors Such as inadequate illumination, slippery floors and lack of safety equipments in bathrooms. Besides, a decrease in the ability to perform daily living activities and usage of walking aids contribute to the frequency of falls.[9,10]

Tests and functional scales used in proportion to variation in risk factors for falls, and excess number of components of postural control are also numerous.[9] One of these scale tinetti balance was developed by mary tinneti 1986 so as determine as risk falls.[9]

One of the most widely used version of the Tinetti Assessment of Balance and Gait scale. It is composed of two separate categories as balance and gait tests. Balance and gait are evaluated with nine and eight items, respectively. Total score of balance category consists of sitting balance, balance on arising to stand, immediate standing balance (within first 5s), standing balance, maintenance of balance when the subject turns 360 degree around him /herself, and tries to sit down from standing position is 16 points. Total score of the gait category which evaluates initiation of gait, step length and height , step symmetry and continuity deviation from a specified path, sways of patient's trunk and the position of heels while walking is 28 points. As a result, the total score of the amounts to 28 points. The highest score indicates the best performance.[9]

REVIEW OF LITERATURE

1. **Jinse Park. Seong-Beom Koh, Hee Jin Kim, Eungseok Oh, Joong-Seok Kim, Ji Young Yun, Do-Young Kwon, Younsoo Kim, Ji Seon Kim, Kyum-Yil Kwon, Jeong-Ho Park, Jinyoung Youn, and Wooyoung Jang. (2018)[10] :-** ·Validity and Reliability Study of the Korean Tineti Mobility Test for Parkinson's Disease**.:-** Twenty-four patients diagnosed with PD were enrolled in this study. For the interrater reliability test, thirteen clinicians scored the TMT after watching a video clip. We also used the test-retest method to determine intrarater reliability. The interrater reliability and intrarater reliability of the Korean Tinetti balance scale were 0.97 and 0.98, respectively. The interrater reliability and intra-rater reliability of the Korean Tinetti gait scale were 0.94 and 0.96, respectively. The Korean TMT scores were significantly correlated with the other clinical scales and three-dimensional motion capture. The cutoff values for predicting falling were 14 points (balance subscale) and 10 points (gait subscale).
2.
3. **Seung-Heon An, Dong-Geon Lee, PT, Yun-Bok Lee, Gyu-Chang. (2014)[11]**. Inter –rater ? absolute Reliability and Concurrent Validity of Tinetti – gait Scale (Korean version) in stroke patients**. :-** The purpose of this study was to investigate the inter-rater absolute reliability and the concurrent validity of the Tinetti-gait scale that was translated into Korean for chronic stroke patients. Fifty-two with post-stroke participated in this study. Results was The inter-rater reliability of the Tinetti-gait scale was high; ICC(3,1)=.91 ICC(3,1)=.91 (95% CI=.85~.95) (very reliable), the range of Kappa coefficient were .73~.92 (substantial~good). The inter-rater agreement of the each item in Tinetti-gait scale ranged from .74 to .92 (95 % CI=.59~.95) (reliable~very reliable). The SEM and MDC were .56 and 1.55, respectively. In the results of concurrent validity, there were moderate positive correlation between Tinetti-gait scale and DGI (r=.78), 10WT (r=.74), OLST (r=.65~.73), FM-LE (r=67). And there was moderate negative

correlation between Tinetti-gait scale and STS (r=-79) (p<.01). The Tinetti-gait scale(Korean version) was a reliable and valid tool to measure gait ability in stroke patient.

4. **Serap D. Yücel & Füsun Şahin & Beril Doğu & Tülay Şahin, Banu Kuran & Sevda Gürsakal.(2012)[9].** Reliability and Validity of the Turkish version of the Performance- Oriented Mobility Assessment 1. **:-** The aim of this study was translate POMA-l to Turkish and to assess its reliability and validity people with amputated lower extremities. Eighty participants enrolled in the study with a mean age of 76.5 ± 6.75 years.The turkih version of POMA were ICC(0.70)and cronbach's alpha(0.72,0.83,0.88). In the reliability evaluation of the scale in validation study POMA total score had a strong positive correlation with BBS total score ($r = 0.86, p < 0.0001$), and also a negative correlation with TUG ($r = - 0.75, p < 0.0001$). According to the results of this study, the Turkish version of the POMA-l scale has been found to be a reliable and a valid scale for elderly Turkish peopl

5. **Camila Rodriez Guevara. Luz Helena Lugo. (2012)[12] .** Validity and reliability of Tinetti Scale for Colombian people :- A validity study was conducted in 2012 to a validate the Tinetti Scale for its use in Colombian populations. The Spanish version of Tinetti scale was applied by two evaluators to elderly persons with different degress of gait and balance functionally. Results of this study was the The content validity suggests the re-structuring of the items in the domain of equilibrium with a Cronbach's alpha of 0.948 and a variance of 13,894, in the construct validity, 46 of the 48 responses of the scale differences statistically significant in the ability to detect changes in a group without alterations in gait and balance (healthy) and a group with these conditions (sick); the concurrent validity had a high correlation r = -0.82 with Timed up and go. The inter and intra- rater reliability was between 0.4 to 0.6 and 0.6 to 0.8, respectively. The Cronbach's alpha was 0.91 so the scale was valid and reliable.

6. **Huma Parveen. Majumi M. Noohu.(2016)[13].** Evaluation of Psychometric properties of Tinetti Performance-Oriented Mobility Assessment Scale In Subjects with Knee Osteoarthritis :- The objective of this study was to determine the psychometric properties of the (POMA) scale to measure balance and gait impairments in individuals with (OA).A convenient sample of 25 individuals with bilateral OA knee were recruited. The Results Score of BBS was significantly correlated with POMA-B scores, $r_s = 0.63$, $p = 0.001$, whereas TUGT showed a negative correlation with POMA-G, $r_s = -0.481$, $p = 0.020$, showing moderate convergent validity. ICC results of the total POMA scale (POMA-T), POMA-B, and POMA-G were 0.96, 0.93, and 0.96, respectively, indicating high test retest reliability. SEM, for POMA-T, POMA-B, and POMA-G was 0.35, 0.27, and 0.35, respectively; MDC values were 0.97 for POMA-T, 0.75 for POMA-B, and 0.63 for POMA-G. The findings indicate that the POMA is a valid and reliable tool to assess balance and gait impairments in people with OA knee.

7. **Anne D Kloos, Deb A. Kegelmeyer ,Gregory S. Young, Sandra K Kostyk.(2010)[14].**Fall risk assessment using the Tinetti mobility test in individuals with Huntington's disease. :- The Tinetti Mobility Test (TMT) is a clinical balance and gait test that predicts fall risk in the elderly. This study examined the concurrent validity, usefulness of the TMT as a fall risk screening tool, and the potential ability of the TMT to predict falls in individuals with Huntington's disease (HD). Data from a retrospective review of 94 patient records were used. TMT scores were correlated with Unified Huntington Disease Rating Scale motor scores. The ability of the TMT to accurately assess fall risk was determined using validity index measures. Logistic regression was used to assess the ability of the TMT to predict falls. TMT scores correlated with motor scores ($r_s = -0.751$, $P < 0.0001$). Using a cutoff value of 21, the TMT had a sensitivity of 74% and a specificity of 60% to identify fallers. Lower TMT scores and younger age were significant predictors of falls. The TMT is a for assessing balance and gait status and fall risk of individual with HD.

8. **Anne D. Kloos.Nora E. Fritz, Sandra K. Kostyk, Gregory S, Deb A. Kegelmeye Young. (2014)[15].**Clinimetric properties of the Tinetti Mobility Test, Four Square Step Test , Activities-Specific Balance Confidence Scale, and spatiotemporal gait measures in individuals with Huntington's disease:- This study examined the reliability and concurrent validity of spatiotemporal gait measures, the TMT, FSST and ABC scale in individuals with HD. Results of this study was participants Spatiotemporal gait measures, the TMT total and the FSST showed good to excellent test–retest reliability (ICC > 0.75). MDC values were 0.30 m/s and 0.17 m/s for velocity in forward and backward walking respectively, four points for the TMT, and 3 s for the FSST. The TMT and FSST were highly correlated with most spatiotemporal measures. The ABC Scale demonstrated lower reliability and less concurrent validity than other measures. The high test–retest reliability over a six week period and concurrent validity between the TMT, FSST, and spatiotemporal gait measures suggest that the TMT and FSST may be useful outcome measures for future intervention studies in ambulatory individuals with HD.

9. **Lorenzo Panella, Tinelli Carmine, Buizza Angelo, Lombardi Remo, Gandolfi Roberto.(2008)[16].** Towards objective evaluation of balance in the elderly: validityand reliability of measurement instrument applied to the tinetti test **:-** The aim of present study was the validation of an instrument for evaluating balance, applied Tinetti test. Trunk inclination was measured by inclinometers during thr Tinetti test in 163 healthy participants. Reliability was evaluated by cronbach;s alpha and its validity by itemscale correlation, discriminant validity and concurrent validity. Influence of age and gender was assessed by regression model. Repeatable and distribution consistent measurement were obtained (cronbach;s alpha=0.88). parameter distribution was significantly different in control and patients ($p<0.001$). optimal threshold fpr discriminating between normal and abnormal performance (153.9/200) corresponded to sensitivity of 84.7% and area under the receiver operating characteristics curve of 93.

10. **Cipriany-Dacko LM, Dana Innerst, Joann Johannsen, Vicki Rude.(1997)[17].** Interrater reliability of the tinetti balance scores in novice and experienced physical therapy clinicians:- A reliability design was used to assess the interrater agreement and consistency of the BPOMA scores in an elderly population. Twenty-six residents of a skilled nursing home, ranging in age from 66 to 90yrs ($\bar{x}$ = 80.4, SD = 6.8), participated in Phase 1. Twenty-four hospital inpatients and five residents of a skilled nursing home, ranging in age from 60 to 92yrs ($\bar{x}$ = 74.7, SD = 7.9), participated in Phase 2.Phase 1 demonstrated fair to excellent κ coefficients (.40–1.00) in all maneuvers across all raters. The ORs had higher agreement compared with the AR, ranging from good to excellent (.75–1.00). Phase 2 demonstrated fair to good κ coefficients (.40–.75) in 5 of 8 maneuvers across all nine raters. When comparing proportion of observed agreement to evaluate the years of experience on rater agreement, there was no significant difference between clinician groups.Fair to good reliability of BPOMA scores occurred across many raters of varied experience with a small amount of BPOMA scores occurred across many raters of varied experience with a small amount of training..

11. **Bahman Moulodi., Akram Azad, Ghorban Taghizadeh, Mahtab Roohi-Azizi, Parvaneh Mohammadi.(2020)[18].**Reliability and Validity of Persian Version of Performance Oriented Mobility Assessment (POMA) in Community- dwelling Iranian older adults:- This study aimed at investigating the construct validity, factor analysis, internal consistency, test-retest and inter-rater reliability, and ceiling/floor effects of the Persian version of Performance-oriented Mobility Assessment (POMA) in community-dwelling elderly**.** One hundred and forty-five older adults aged 65 years and older were recruited from daily care centers of Tehran by convenience sampling method. Timed Up and Go (TUG) test and Berg Balance Scale (BBS) were used to investigate the construct validity of the POMA. Test-retest (7-14 days with interval) and inter-rater reliability of the gait and balance subscales and the total score of the POMA were moderate to very high correlation ($r= 0.67-0.9$, $P\leq 0.05$) was found between the total score of the POMA and BBS, Fullerton Advanced Balance Scale, step test (right and left), TUG, Dynamic Gait index, and walking speed, whereas the correlation between the total score of the POMA and step length was poor ($r= 0.39$, $P\leq 0.05$). The results of confirmatory factor analysis showed a poor goodness-of-fit of POMA with the two-factor

model (balance and gait) in community-dwelling elderly. Internal consistency (Cronbach's alpha= 0.94), test-retest reliability (ICC = 0.97), as well as inter-rater reliability (ICC = 0.92) of the POMA were excellent. The results revealed no floor effect for the total score of the POMA; however, its ceiling effect was 3.44%.The Persian version of POMA showed excellent psychometric properties for evaluating different aspects of balance in community-dwelling

NEED OF STUDY

Tinetti Assessment Tool is one of the most common Tool that has been used by physiotherapist all over the world. Also it is already translated in many language like Turkish,[9] Korean[10], Spanish[12], persian[18] etc. I want to translate this scale in my mother language i.e. Gujarati because it will be more beneficial for patients to understand the scale in Gujarati and it will be helpful to physiotherapists also who are from Gujarat.

OBJECTIVE OF THE STUDY

- To translate Tinetti Assessment Tool in to Gujarati language.
- To find out test-retest reliability and internal consistency of Gujarati version
- Tinetti Assessment Tool.
- To find out face and contact validity of the Gujarati version Tinetti Assessment Tool.

HYPOTHESIS

- NULL HYPOTHESIS : Tinetti Assessment Tool for balance and gait will be not reliable and valid on Gujarati population.
- RESEARCH HYPOTHESIS : Tinetti Assessment Tool for balance and gait will be reliable and valid on Gujarati population.

METHODOLOGY

The study was carried out on elderly people aged 40 to 70 years in Gujarat, India. Those peoples who have balance and gait disorder.

INCLUSION CRITERIA

1) Patients who can write , reading and understand Gujarati language
2) Age group 40 – 70 years
3) Patient who is having problems with balance and gait

EXCLUSION CRITERIA

1) Subjects who don't know Gujarati
2) Subjects who had fracture within 6 months
3) Patient with neurological and psychological problem

The Tineeti Balance Scale had been cross-culturally adapted into Gujarati version of Tinetti Assessment Tool in following eight steps:

1. Initial translation to Gujarati language/ forward translation: The translation of Tinetti Assessment Tool in Gujarati language was performed by two individuals whose native language is Gujarati.

2. Synthesis: After discussion, the 2 translators produced a consensus version of the Tinetti Assessment Tool

3. Back translation: Back translation of preliminary Tinetti Assessment Tool into English was conducted by two native English speakers who were fluent in both English and Gujarati. The two translators were neither aware nor be informed of the concepts explored, and they had no medical background.

4. Reviewer's committee: An expert committee comprising of panel of 6 members performed cross-cultural adaption and validation. After back translation, the Scale were forwarded to back translators. They reviewed all translation and developed the
Pre-final version of Tinetti Assessment Tool with emphasis on semantic, idiomatic, experimental and conceptual equivalence in relation to original back- translated Tinetti Balance Scale versions. Then the Scale was content validation by the expert committee.

5. Content validation: Content validation was excuted by the panel of 6 pre-identified members who experts in using Gujarati and English. They were provided with five options, "agree", "strongly agree", "neutral", "disagree", and "strongly disagree". For providing their valuable opinion regarding Gujarati version of Tinetti Assessment Tool.. Eighty percent consensus of agreement among the experts were required to validate the translated version of Tinetti Assessment Tool .Eighty percent of agreement between the experts were fixed in recommendation by Lynn to yield the item-level content validation index (I-CVI) of 0.93. According to Lynn's (1986) criteria a minimum I-CVI of 0.78 for 6 to 10 experts is required to validate each item in a scale.[19] Hence, we have used an expert panel with 6 members to validate the Gujarati translated content of Tinetti Assessment Tool .They were provided with options, agree, strongly agree, neutral, disagree and strongly disagree in a five point likert scale with Gujarati translated content of Tinetti Balance Scale Neural, disagree and strongly disagree were considered as negative response while agree and strongly agree was considered as positive. Content validation of Tinetti Assessment Tool was performed until the overall scale-level content validation index (S-CVI) reaches SCVI/Ave $\geq$ 0.90.[19]

6. Pretesting: According to inclusion and exclusion criteria, the pre-final Scale was administered to 10 balance and gait disorder patients. The interviewer reported on each respondents understanding the Scale items and making decision on them. As no further adaptation is indicated, the pre-final and final Tinetti Assessment Tool is identical. The objective was to assess whether the translated Scale was understandable, the vocabulary was appropriate and also the expression was relevant for Gujarati culture

7. Validation study: Face validity and Content validity was obtained by the Experts and the translators.

i. Test-retest reliability: The recruited patients with balance and gait disorder were asked to fill Gujarati version of Tinetti Assessment Tool by themselves twice with minimum gap of one week duration. So that person may not copy the same data as well as he/she will not forgot.[19] The readings were recorded to report test-retest reliability.

ii. Internal consistency: Internal consistency was measured with Cronbach's alpha (α), a statistic which was calculated from the pair wise correlations measured between paired readings of Gujarati version of Tinetti Assessment Tool.

Fig: 6.1 (a)

Patient performing Tinetti Assessment Tool

Fig: 6.1 (b)

Patient performing Tinetti Assessment Tool

Process Discussion Result

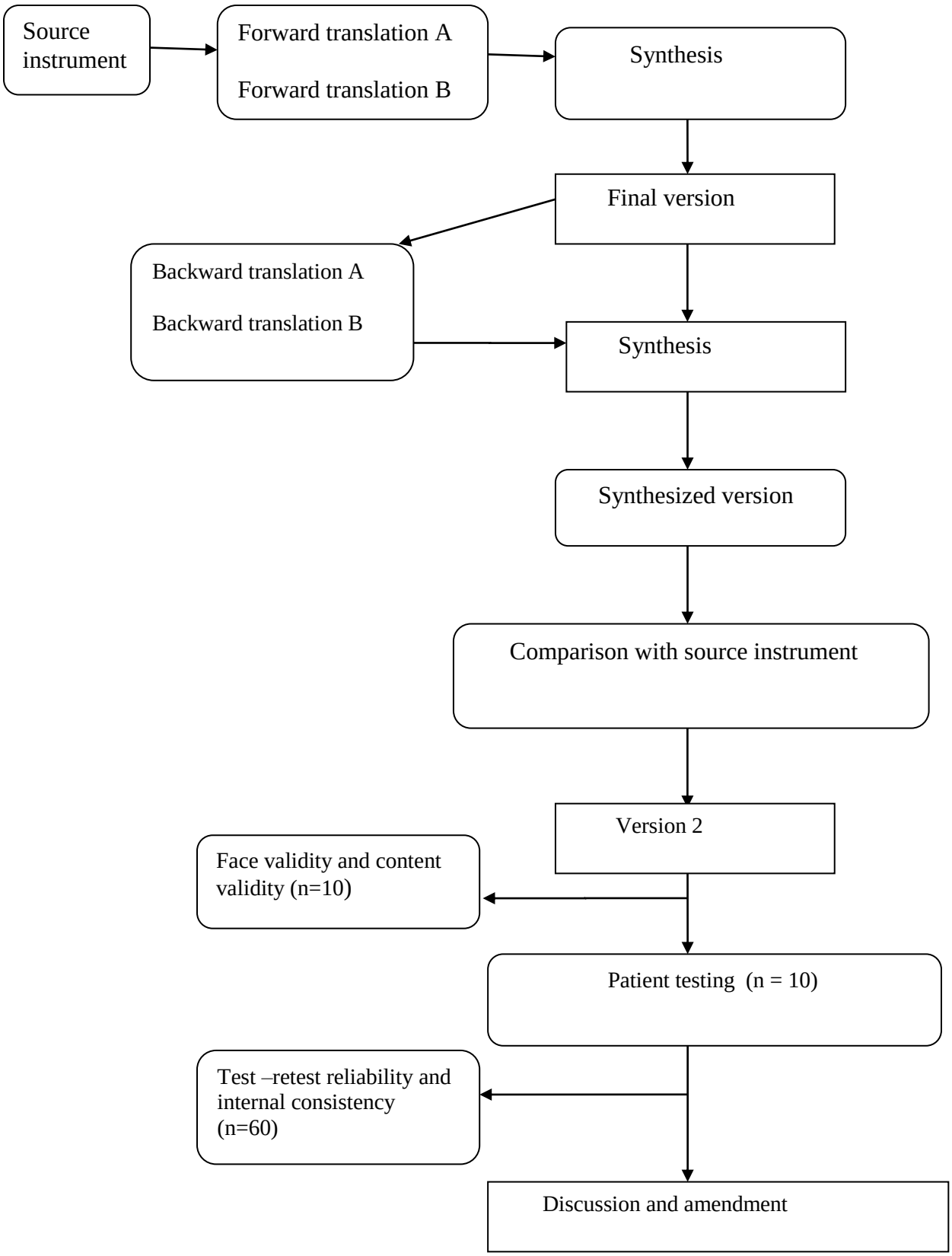
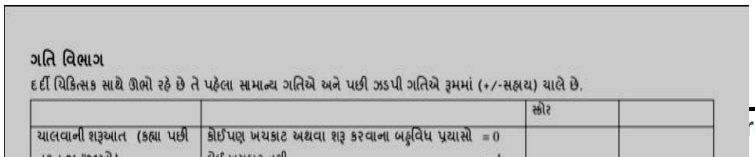
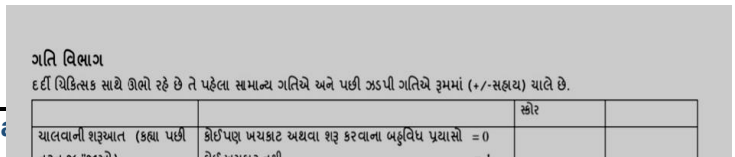


CHART 6.1 CROSS CULTURAL ADAPTION


ગતિ વિભાગ
દર્દી ચિકિત્સક સાથે ઊભો રહે છે તે પહેલા સામાન્ય ગતિએ અને પછી ઝડપી ગતિએ રૂમમાં (+/-સહાય) ચાલે છે.

		સ્કોર	
ચાલવાની શરૂઆત (કહ્યા પછી	કોઈપણ ખચકાટ અથવા શરૂ કરવાના બહુવિધ પ્રયાસો = 0		


ગતિ વિભાગ
દર્દી ચિકિત્સક સાથે ઊભો રહે છે તે પહેલા સામાન્ય ગતિએ અને પછી ઝડપી ગતિએ રૂમમાં (+/-સહાય) ચાલે છે.

		સ્કોર	
ચાલવાની શરૂઆત (કહ્યા પછી	કોઈપણ ખચકાટ અથવા શરૂ કરવાના બહુવિધ પ્રયાસો = 0		

Fig: 6.2

TRANSLATED TINETTI BALANCE SECTION

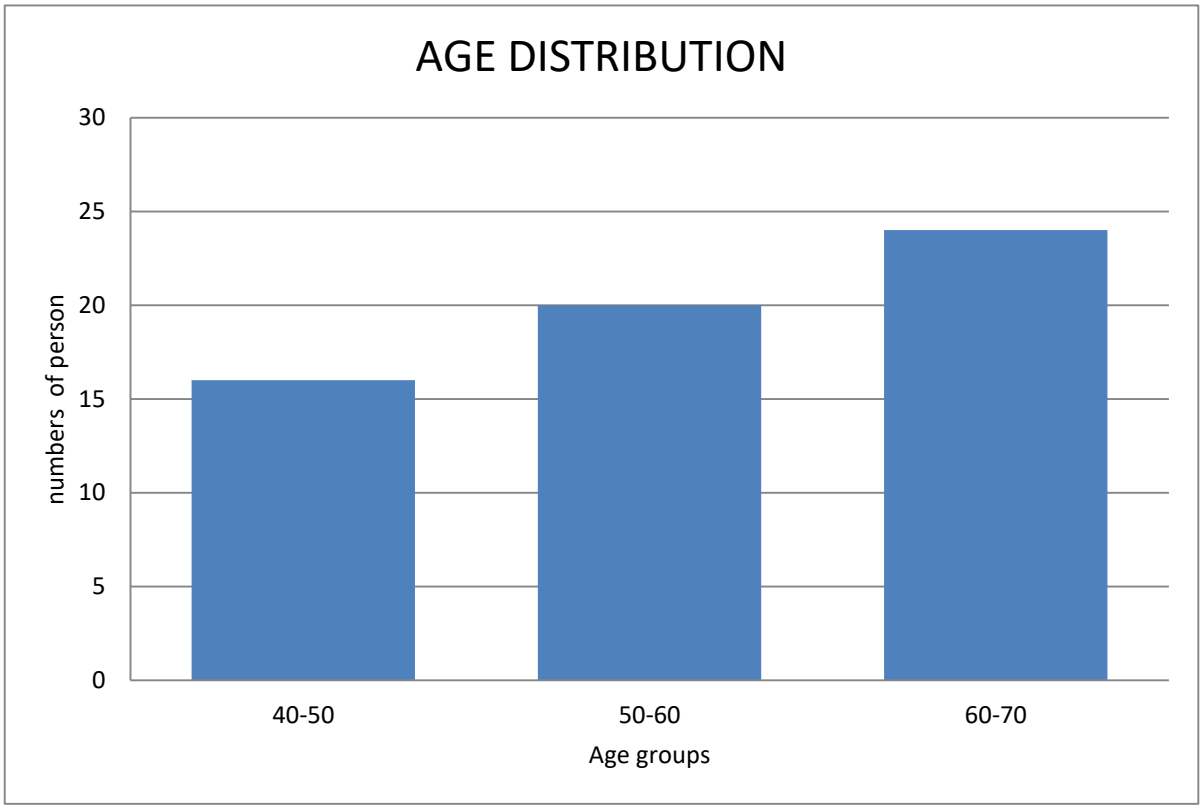
Fig: 6.3

TRANSLATED TINETTI GAIT SECTION

RESULT

1. Age distribution

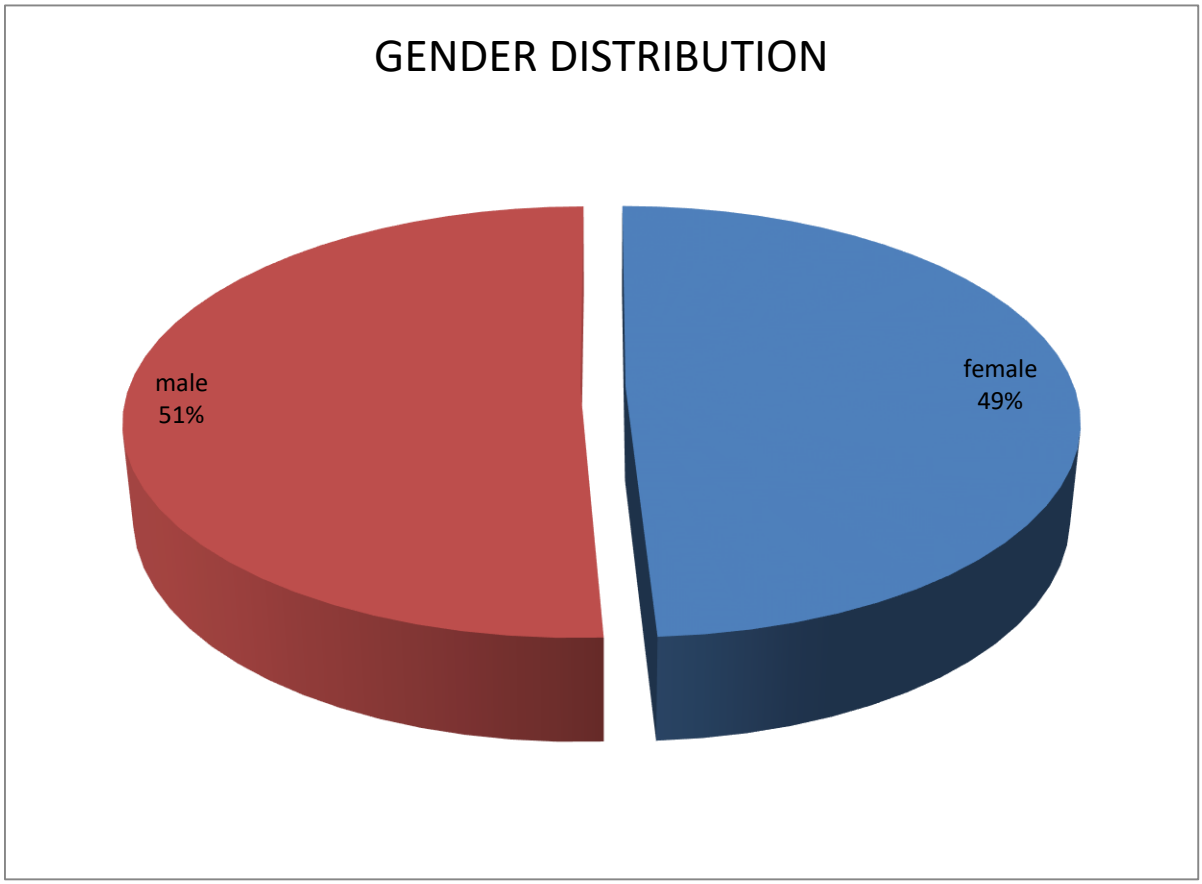
The research was performed on 60 patient with Balance and Gait disorder between the age of 40-70. There were 14 patients between the ages of 40 to 50, 20 patients between the ages 50 to 60, and 24 patients between the ages of 60 to 70. The Mean of age was 20.



GRAPH 7.1 :- AGE DISTRIBUTION CHART

2. Gender distribution

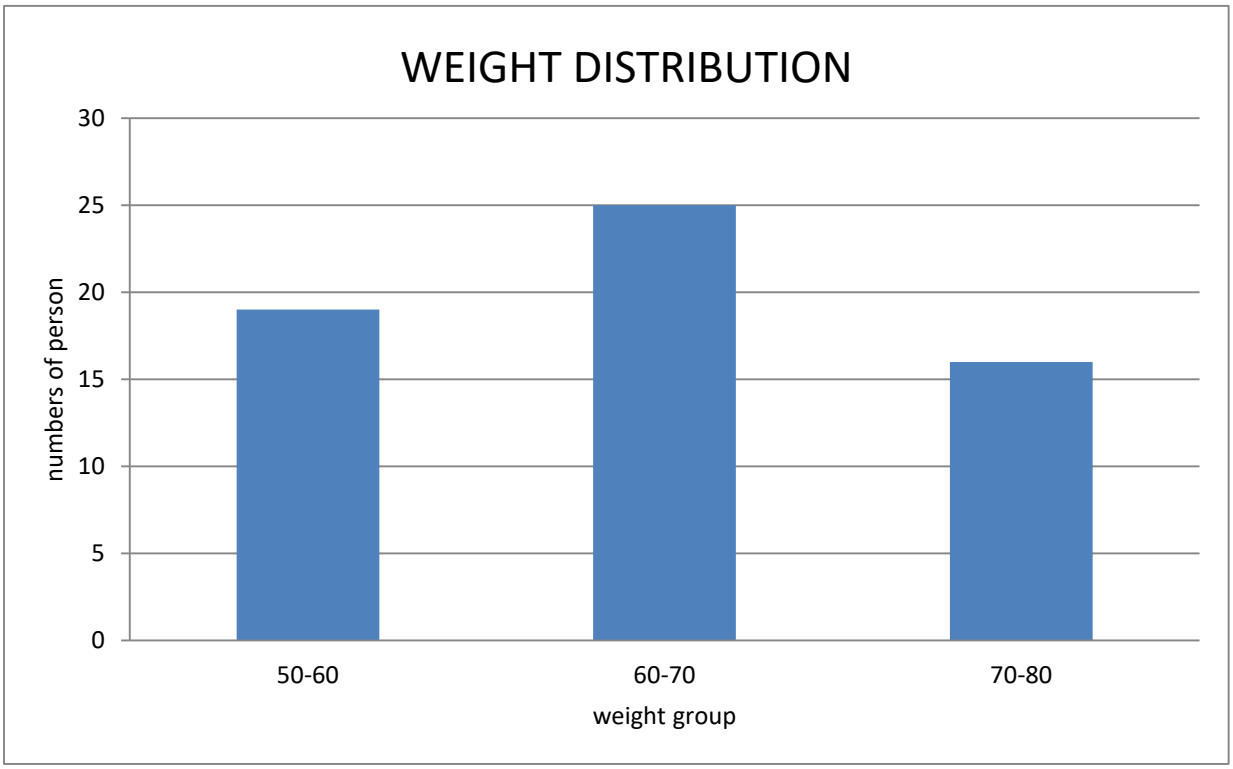
The research was performed on 60 patient with Balance and Gait disorder. In which 30 are Females and 31 are Males. The Mean of gender was 30.5



GRAPH 7.2 :- WEIGHT DISTRIBUTION CHART

3. Weight Distribution

The research was performed on 60 patient with Balance and Gait disorder There were 19 patients between the weight of 50 to 60, 25 patients between the weight of 60 to 70 and 16 patients between the weight 60 to 70 . The Mean of weight was 20.



GRAPH 7.3 :- WEIGHT DISTRIBUTION CHART

The content validity of Gujarati translated Tinetti Assessment Tool by a 6 experts were found to be, I-CVI of individual items Tinetti Assessment Tool of ≥ 0.93 and overall S-CVI for idiomatic equivalence, semantic equivalence and content relevance ≥ 0.90. For content validity equivalence all 6 experts answers were located between mostly agree and strongly agree of Gujarati version of Tinetti Assessment Tool for idiomatic equivalence (average= 0.89) semantic equivalence(average = 0.91) and content relevance (average= 0.92). Test-retest reliability (n=60) was tested by using the intraclass correlation coefficient, ICC (2,1) and Internal consistency (n=60) was reported in terms of cronbach's α measured in two session after 1 week is reported in Table 2.

Tinetti Balance Scale	Session 1	session 2	Cronbach's alpha	ICC	P- value
BALANCE SECTION	10.71±6.34	10.88±6.20	.993	.986	0.980
GAIT SECTION	8.60±3.29	8.41±3.40	.988	.977	0.959

TABLE 7.1 :- TEST-RETEST RELIABILITY OF TINETTI TOO

DISCUSSION

Many elderly people has Balance and Gait disorder caused by neurological disorder, Parkinson, stroke, poor posture, ataxia , myelopathy. They causing pain, dyspnea, imbalance, diminished strength, limited range of motion, poor posture, fatigue. In our study first report of the reliability and validity of the Tinetti Assessment Tool for evaluating patient with Balance and Gait disorder.

In this study 60 patients participated. Gujarati version of Tinetti Assessment Tool was given twice with 1-week interval to measure the test- retest reliability and to validity. The results of the study showed good

correlation Balance scale and Gait scale(ICC= .986,and .977) (P<0.01) and internal consistency (cronbach's alpha = . 993 and .986).

For content validity equivalence all 6 experts answer were located between mostly agree and strongly agree of Gujarati version of Tinetti Assement Tool for idiomatic equivalence (average= 0.89) semantic equivalence (average = 0.91) and content relevance (average= 0.92). Thus, Gujarati version of Tinetti Balance Scale was content validated for idiomatic equivalence, semantic equivalence , content relevance.

In previous studies, interrater reliability and intrarater reliability of the Korean Tinetti balance scale were(ICC =(0.97 and 0.98) respectively. The interrater reliability and intrarater reliability of the Korean Tinetti balance scale were(ICC =0.94 and 0.96). reliability and validity for gait and balance had high sensitivity and specificity for predicting falls among the patient with PD.[10] In Spanish version the concurrent validity had a high correlation (r = 0.74- 0.93). and inter and intra- rater reliability was between 0.4 to 0.6 and 0.6 to 0.8 The tinetti scale is valid and reliable for Colombian population.[12]

Turkish version of the scale was applied on the participants at 2 week intervals. Test-retest shown good reliability (ICC= 0.94) . interrater and intrarater reliability (ICC=0.86 And 0.90).[9] Turkish version of the POMA-1 scale has been found be a reliable and valid.In Persian version of POMA was applied 7-14 days intervals. Internal consistency (cronbach's alpha= 0.94). test-retest reliability (ICC=0.97). inter-rater reliability (ICC=0.92). Persian shown excellent psychometric properties

It was found Gujarati version of Tinetti Assessment Tool items equivalent to those in original version which is intended by translators involve in this study. The results showed that it was translate this scale into other languags without losing psychometric properties of the original English version

CONCLUSION

The Gujarati version of Tinetti Assessment Tool was cross-culturally adapted and validated for use among the Gujarati-speaking populations. The translated version has acceptable reliability and internal consistency.

SUMMARY

The study is find out the reliability and validity of the Tinetti Assessment Tool in Gujarati language on the elderly people with Balance and Gait disorder in Gujarat. 40 people were chosen with the 40-70 age group participated in the study and they were given Tinetti Assessment Tool was given twice with 1 week interval to measure test-retest reliability and to measure validity. The results showed good correlation and internal consistency and content validity

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CHRONIC NECK PAIN AMONG COLLEGE STUDENTS A CROSS-SECTIONAL STUDY

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ABSTRACT :

Chronic neck pain is most common problem in people nowadays. Chronic neck pain can have causes such as working for hours over computer and mobile phones which eventually causes muscle strains.

BACKGROUND:

To find prevelance, determinants and consequences of chronic neck pain among college going students.

METHODOLOGY:

STEP 1: Selection of suitable participants.

STEP 2: Sending the consent form through e-mail.

STEP 3: Sending the link of questionnaire through e-mail.

STEP 4: Collection of data.

STEP 5: Analysis of the survey.

STEP 6: Statistical Analysis

STEP 7: Result

RESULT: Most of the patient did not had any pain or had miled pain during personel care, lifting heavy weights, reading, headaches, Concentration inactivities, work, driving, Sleeping and Recreational activities.

CONCLUSIONS: From the results it can be concluded that more than half of the population had no pain or mild pain and they didn't feel any issues in dealing with personal care lifting heavy weights reading headaches concentration work driving sleeping and Recreation

KEYWORDS: Chronic neck pain, VAS scale, NDI scale, college students

I. INTRODUCTION

Chronic neck pain is most common problem in people nowadays.1,2The chronic neck pain seems to a have large impact on people's health and hinders with an Individual's day to day activity and work.2

Symptoms

- Pain that's often worsened by holding your head in one place for long periods, such as when driving or working at a computer.
- Muscle tightness and spasms.
- Decreased ability to move your head.
- Headache.
- Neck pain is typically classified as chronic when it persists or regularly recurs for at least 3 months.

Causes of neck pain and problems may include:

- Injury (damage to the muscles, tendons, or ligaments) Herniated disk in the neck.
- Arthritis (such as osteoarthritis, rheumatoid arthritis) Cervical (neck) disk degeneration.
- Congenital (present at birth) abnormalities of the vertebrae and bones.
- Tumors.

Your neck is flexible and supports the weight of your head, so it can be vulnerable to injuries and conditions that cause pain and restrict motion. Neck pain causes include:

- Muscle strain : Overuse, such as too many hours hunched over your computer or smartphone, often triggers muscle strains. Even minor things, such as reading in bed or gritting your teeth, can strain neck muscles.
- Worn joints : Just like the other joints in your body, your neck joints tend to wear down with age. Osteoarthritis causes the cushions (cartilage) between your bones (vertebrae) to deteriorate. Your body then forms bone spurs that affect joint motion and cause pain.

- Nerve compression : Herniated disks or bone spurs in the vertebrae of your neck can press on the nerves branching out from the spinal cord.
- Injuries : Rear-end auto collisions often result in whiplash injury, which occurs when the head is jerked backward and then forward, straining the soft tissues of the neck.
- Diseases : Certain diseases, such as rheumatoid arthritis, meningitis or cancer, can cause neck pain.

Neck pain can cause reduced range of motion due to movement restriction muscles of the neck can become strained due to bad posture habits such as spending excessive time on computer and mobile phones where the neck remains continuously in the same position for a prolonged period of time. Pain in the neck most of the time goes away within a few weeks that being said pain that persist for months could be a sign of underlying problem that needs Observation.4 Chronic Neck pain can have causes such as working for hours over computer and mobile phones which eventually causes muscle strains. Whiplash injuries where the head is forced backward and forward and diseases like cancer.4

REVIEW OF LITERATURE

1. Prevalence , determinants and consequences of chronic neck pain in Finland, By Matti Makela, Markku Heliovaara, Kai Sievers, Olli Impivaara, Paul Knekt, Arpo Aromaa , in 1991.

The distribution, determinants, and consequences of chronic neck pain have hitherto been described inadequately. In the Mini-Finland Health Survey, a representative population sample of 8,000 Finns aged ≥30 years was invited to participate in a comprehensive health examination comprising an interview and a clinical examination; 90.2% complied. Predetermined criteria were used to diagnose major cardiovascular, musculoskeletal, respiratory, mental, and other disorders, regardless of other simultaneous disorders. Chronic neck syndrome was diagnosed in 9.5% of the men and 13.5% of the women. When adjusted for age and sex, the prevalence of the neck syndrome was associated with a history of injury to the back, neck, or shoulder and with mental and physical stress at work. Among those aged 30 to 64 years, overweight and parity were also significant determinants. Other musculoskeletal and mental disorders were associated with neck syndrome, and the association persisted after working conditions, injuries, overweight, and parity were adjusted for. There was some independent association between neck syndrome and disabilities, use of physician services, and use of pain killers.

2. Neck pain among undergraduate medical students in a premier institute of central India: A cross-sectional study of prevalence and associated factors,By Prateek Behera, Anindo Majumdar, G Revadi, John Ashutosh Santoshi, Vivek Nagar, Nitu Mishra in 2020 .

This study aimed to evaluate the prevalence of neck pain and the associated factors including gadget use among undergraduate medical students of a premier medical college in central India.

3. Prevalence of neck pain among under graduate student of Lahore, By Ayesha Malik , M.Umer Pasha , Sadia khalid , Ashfaq ahmad , Syed Amir Gilani , 2017 .

The main intent of this study was to find out the prevalence of neck pain in undergraduates Students. A cross sectional study was conducted which was not derived from experiments. A survey was conducted from the undergraduate students of main universities in lahore city named as Punjab university of Lahore and University of Lahore descriptive statistics focused on bar charts histograms and pie charts were Used. Results concluded that out of 402 respondents (56.7%) were suffering with neck pain while (43.3%) respondents were not having neck pain. No association was found between gender and neck pain (p-value 0.351) additionally, there was weaker relation between age and neck pain (p-value 0.785).Neck pain occurring. In students was mainly sudden in onset & intensity was mild to moderate of the neck pain. Mostly students were taking medications & physiotherapy treatment for reducing the neck pain.

4. Improving knowledge of Text Neck and Neck Pain Using Interactive Smartphone Application for Undergraduate Students in Universiti Sains Malaysia, By Jasni Dolah, Joey Loh Jo Yie, Lilian Lee Shiau Gee , In 2020.

The objective of this study is to determine the level of knowledge and awareness of the text neck among undergraduate students of University Sains Malaysia (USM) and to create an interactive mobile application to reduce the prevalence. The app is ARbased neck exercise gamification that alerts incorrect posture using a smartphone front camera and a built-in sensor. The proposed study will enable people who are suffering from, or at risk of, text neck to have more pleasant and engaging neck exercise experience with a better exercise impact, and may promote regular breakaway from the wrong posture.

5. Effects of neck exercise on sitting posture in patients with chronic neck pain , By Deborah Falla, Gwendolen Jull, Trevor Russell, Bill Vicenzino,Paul Hodges , 2007

This study had 2 purposes: (1) to compare change in cervical and thoracic posture during a distracting task between subjects with chronic neck pain and control subjects and (2) to comparethe effects of 2 different neck exercise regimens on the ability of people with neck pain to maintain an upright cervical and thoracic posture during this task. Fifty-eight subjects with chronic, nonsevere neck pain and 10 control subjects participated in the study.

6. Responses to Vignettes about Students with Chronic Pain in K-12 Public Schools Provide by Current Principals and Assistant Principal BY Kimberly S Payne , In 2020.

This dissertation study addresses a gap in the literature in K-12 public education regarding students who experience chronic pain (CP). While awareness and understanding about the plight of children and adolescents with CP are prevalent in the healthcare and medical realms, evidence of how public schools respond to students' pain

complications as they apply to their education, both in the K-12 setting andbeyond, is scant. Despite this, consequences of ignoring or misunderstanding CP instudents by K-12 schools could be significant: Studies from the healthcare realm indicate that students with CP often become caught in a "downward spiral" of chronic pain-invoked absenteeism resulting in falling behind in academics and low school functioning, thus placing them at risk of poorer eventual outcomes in life. Likewise, family members and school personnel become frustrated by lack of information, communication problems, and the inability to attend to students' needs. Additionally, matters are complicated when K-12 school administrators are required to work within fixed legal frameworks that are not necessarily sensitive to CP issues.

7. Active neck muscle training in the treatment of chronic neck pain in women a Randomized Controlled trial, by Jari Ylinen , Esa-Pekka Takala , Matti Nykänen , in 2003

Patients were randomly assigned to either 2 training groups or to a control group, with 60 patients in each group. The endurance training group performed dynamic neck exercises,which included lifting the head up from the supine and prone positions. The strength training group performed high-intensity isometric neck strengthening and stabilization exercises with an elastic band. Both training groups performed dynamic exercises for the shoulders and upper extremities with dumbbells. All groups were advised to do aerobic and stretching exercises regularly 3 times a week

8. A systematic review of the impact of chronic pain on adolescents' school functioning School personnel responses to managing pain in the schools By Fatimah Alsaggaf, Imelda Coyne , In 2020.

To critically synthesize empirical studies on the impact of chronic pain on adolescents' school functioning and school personnel responses to managing pain in schools.

9. Physical exercises and functional rehabilitation for the management of chronic neck Pain , By Jari Ylinen , in 2007

The aim of this review was to reassess the effectiveness of different exercise methods in relieving pain and improving disability in patients with chronic nonspecific neck pain. Ten andomized controlled or comparative high-quality trials were included in a more detailed analysis using patient oriented primary outcome measures (e.g., patient's rated pain and Disability) as well as pressure pain threshold and functional outcomes (neck strength and range of motion). Findings revealed moderate evidence supporting the effectiveness of both long-term dynamic as well as isometric resistance exercises of the neck and shoulder musculature for chronic or frequent neck disorders. Findings revealed no evidence supporting the long-term effectiveness of postural and proprioceptive exercises or other very low intensity exercises. Clinicians are encouraged to consider these findings and incorporate them into their practice when planning the treatment of patients with chronic neck disorders.

NEED OF STUDY

Currently there are many studies done on chronic neck pain but there is limited research on prevalence ,determinants and consequences of chronic neck pain among college going students. Need for study arises to understand the determinants and prevalence of chronic neck pain in college going students as their neck remains in the same position continuously for longer time while studying and using mobile phones as well as laptops.

OBJECTIVE OF THE STUDY

- To find out whether Myofacial Release (MFR) Technique or Active Release Technique is more effective in treating chronic low back pain.
- To find out whether Myofacial Release (MFR) Technique is superior for treating chronic low back pain.
- To find out whether Active Release Technique is superior for treating chronic low back pain.

HYPOTHESIS

H0 : There is no association between pain and personal care, lifting heavy weights, reading, headaches, concentration in activities, work, driving, sleeping, recreational activities.

H1: There is association between pain and personal care, lifting heavy weights, reading, headaches, concentration in activities, work, driving, sleeping, recreational activities.

METHODOLOGY

STEP 1: Selection of suitable participants.

STEP 2: Sending the consent form through e-mail.

STEP 3: Sending the link of questionnaire through e-mail.

STEP 4: Collection of data.

STEP 5: Analysis of the survey.

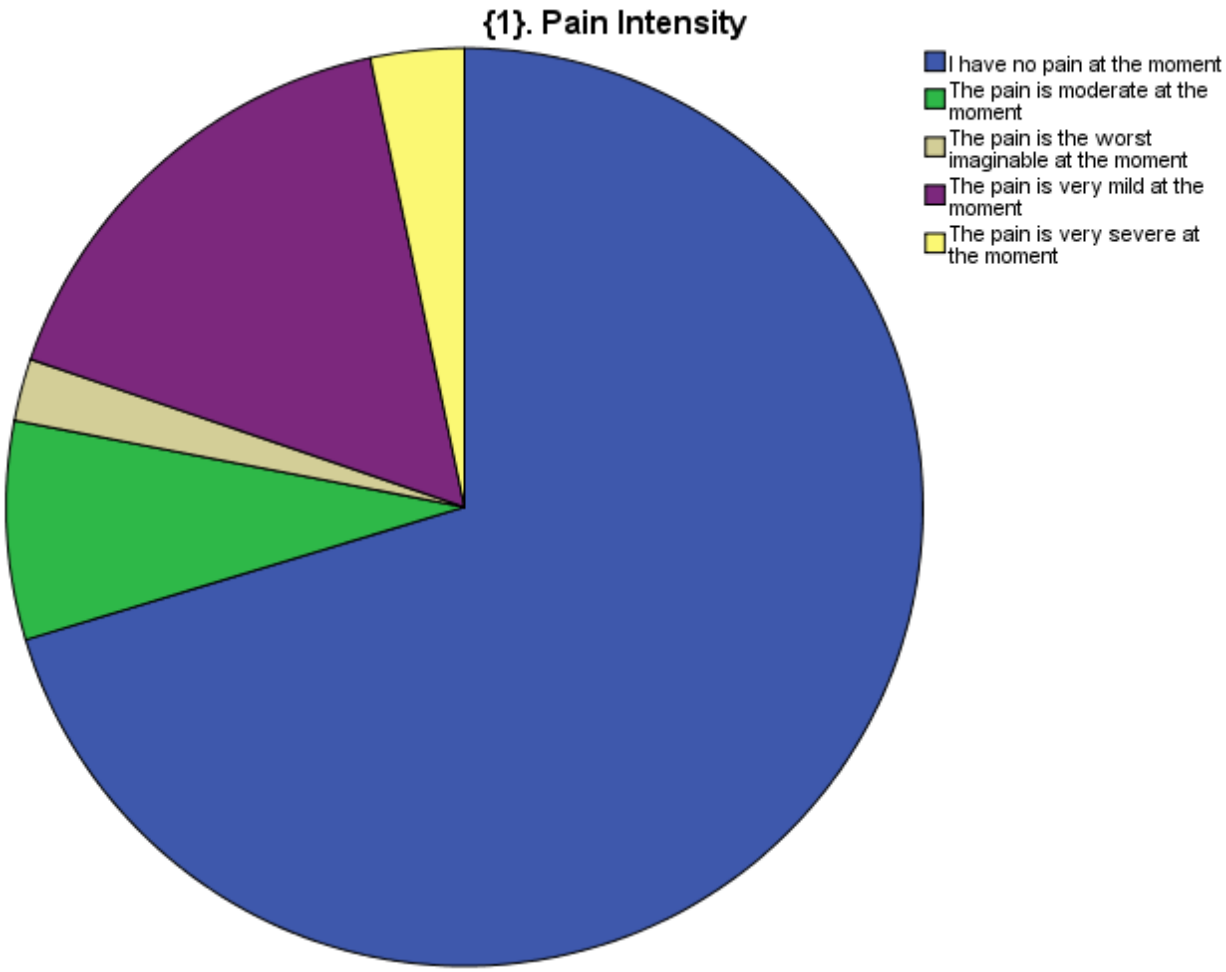
STEP 6: Statistical Analysis

STEP 7: Results

Result

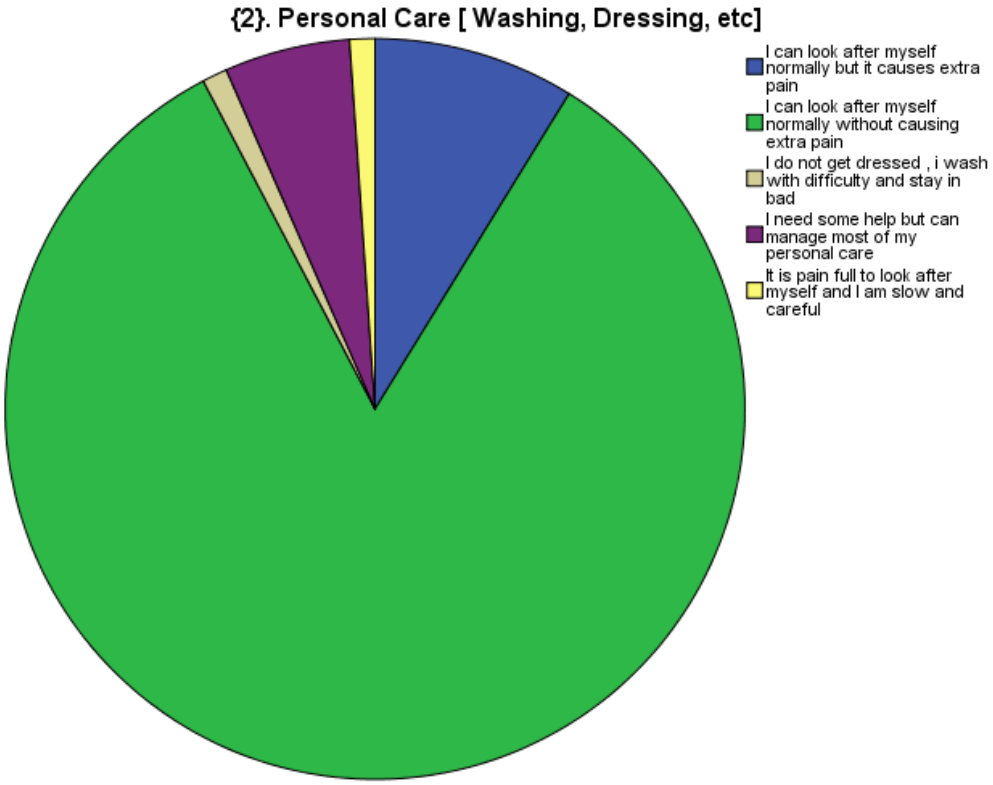
{1}. Pain Intensity

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	I have no pain at the moment	64	70.3	70.3	70.3
	The pain is moderate at the moment	7	7.7	7.7	78.0
	The pain is the worst imaginable at the moment	2	2.2	2.2	80.2
	The pain is very mild at the moment	15	16.5	16.5	96.7
	The pain is very severe at the moment	3	3.3	3.3	100.0
	Total	91	100.0	100.0	

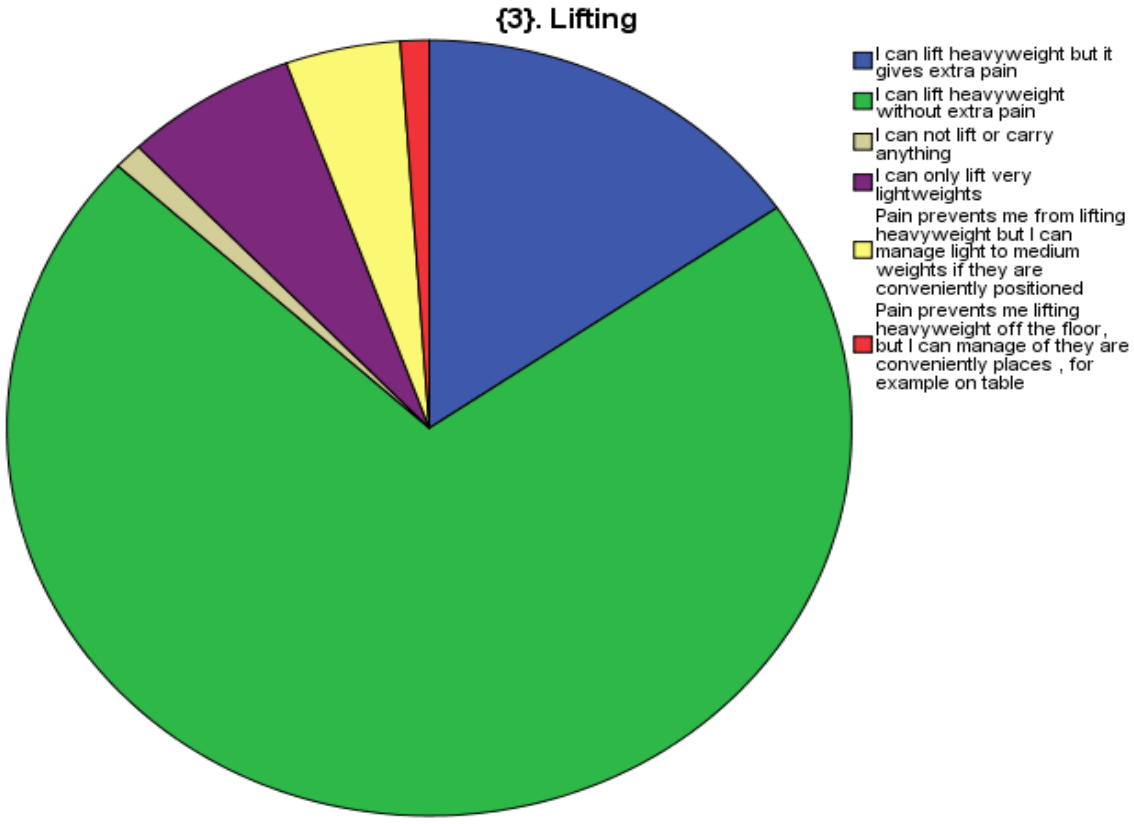


{2}. Personal Care [Washing, Dressing, etc]

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	I can look after myself normally but it causes extra pain	8	8.8	8.8	8.8
	I can look after myself normally without causing extra pain	76	83.5	83.5	92.3
	I do not get dressed , i wash with difficulty and stay in bad	1	1.1	1.1	93.4
	I need some help but can manage most of my personal care	5	5.5	5.5	98.9
	It is pain full to look after myself and I am slow and careful	1	1.1	1.1	100.0
	Total	91	100.0	100.0	

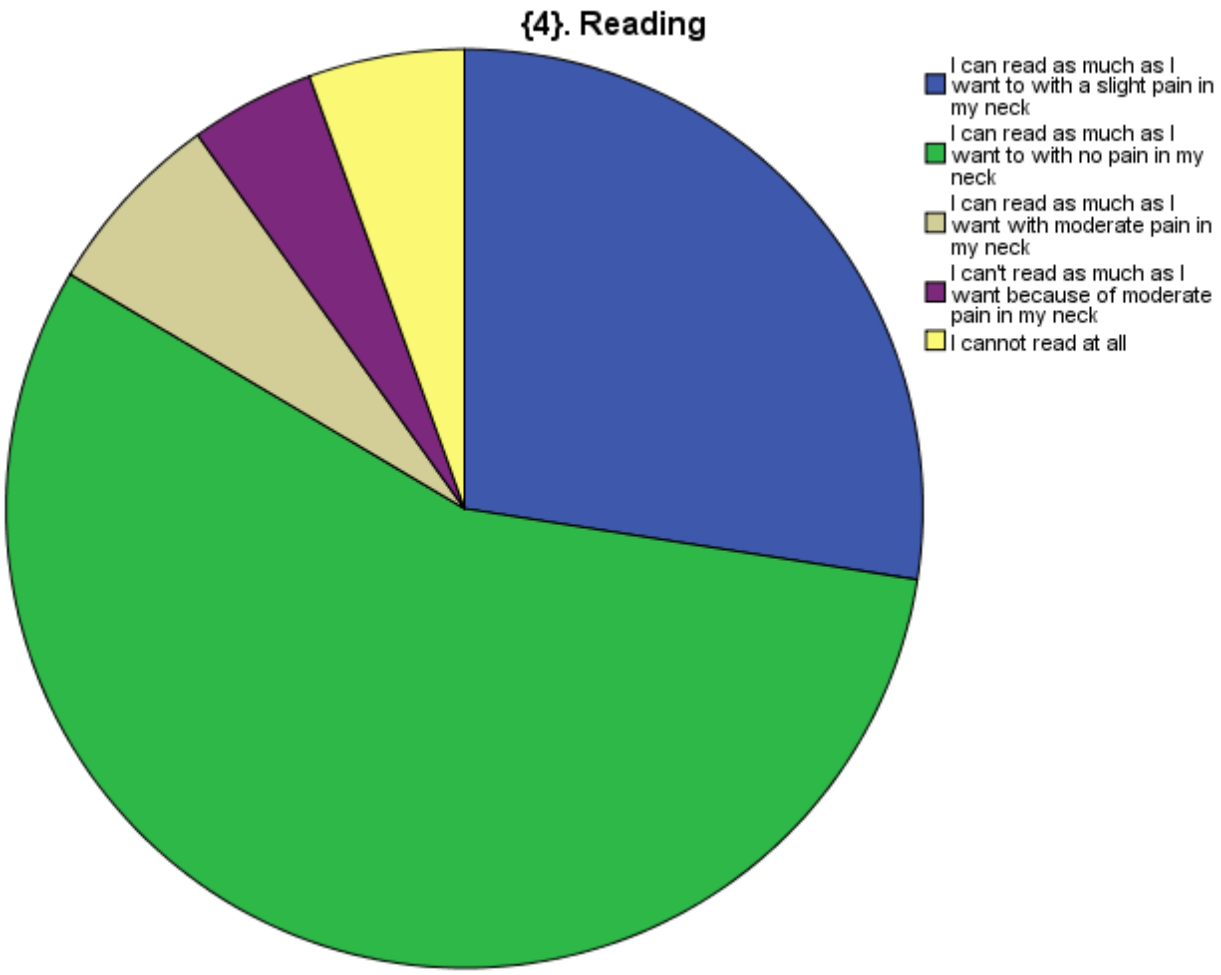


		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	I can lift heavyweight but it gives extra pain	14	15.4	15.4	15.4
	I can lift heavyweight without extra pain	65	71.4	71.4	86.8
	I can not lift or carry anything	1	1.1	1.1	87.9
	I can only lift very lightweights	6	6.6	6.6	94.5
	Pain prevents me from lifting heavyweight but I can manage light to medium weights if they are conveniently positioned	4	4.4	4.4	98.9
	Pain prevents me lifting heavyweight off the floor, but I can manage of they are conveniently places , for example on table	1	1.1	1.1	100.0
	Total	91	100.0	100.0	



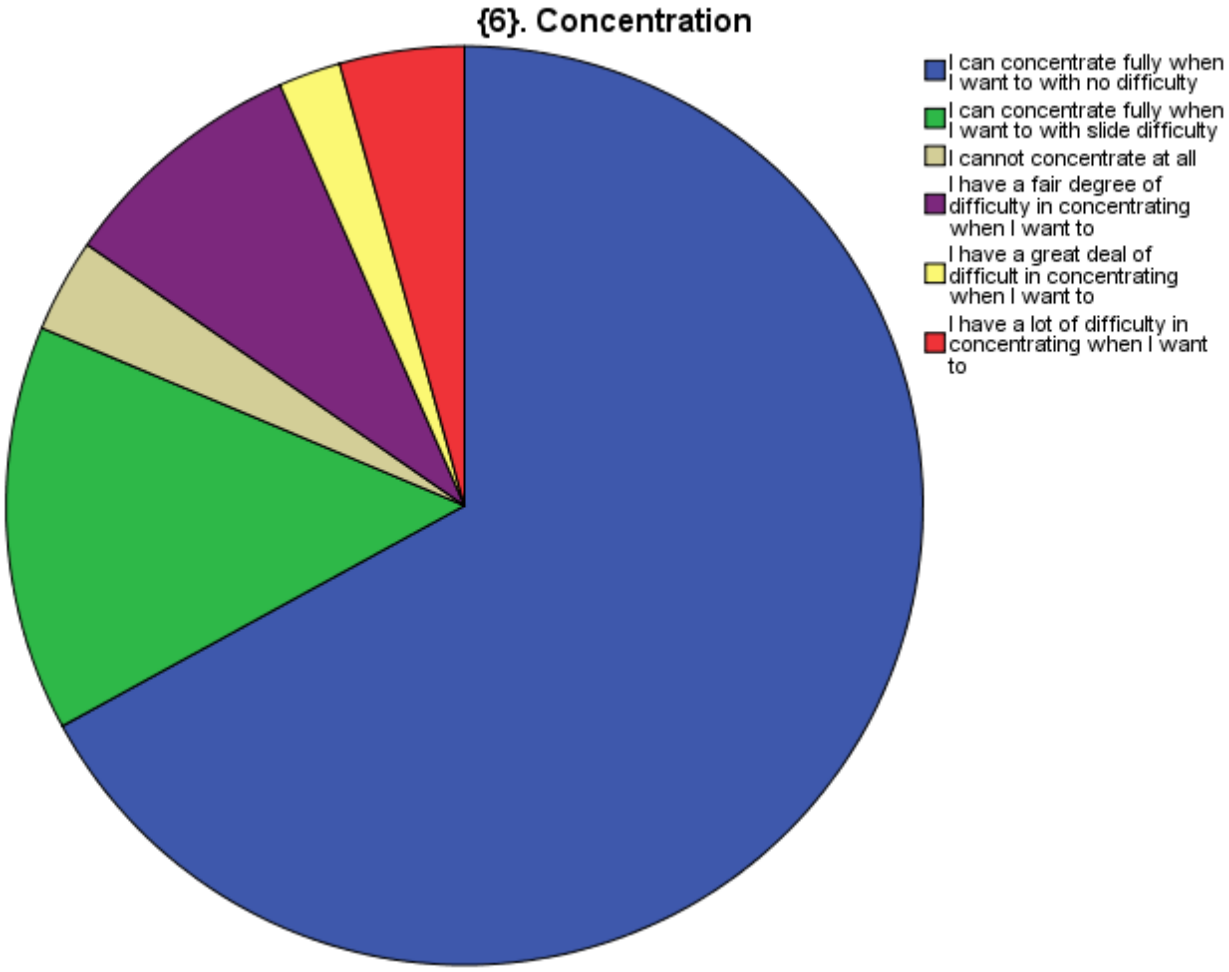
{4}. Reading

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	I can read as much as I want to with a slight pain in my neck	25	27.5	27.5	27.5
	I can read as much as I want to with no pain in my neck	51	56.0	56.0	83.5
	I can read as much as I want with moderate pain in my neck	6	6.6	6.6	90.1
	I can't read as much as I want because of moderate pain in my neck	4	4.4	4.4	94.5
	I cannot read at all	5	5.5	5.5	100.0
	Total	91	100.0	100.0	



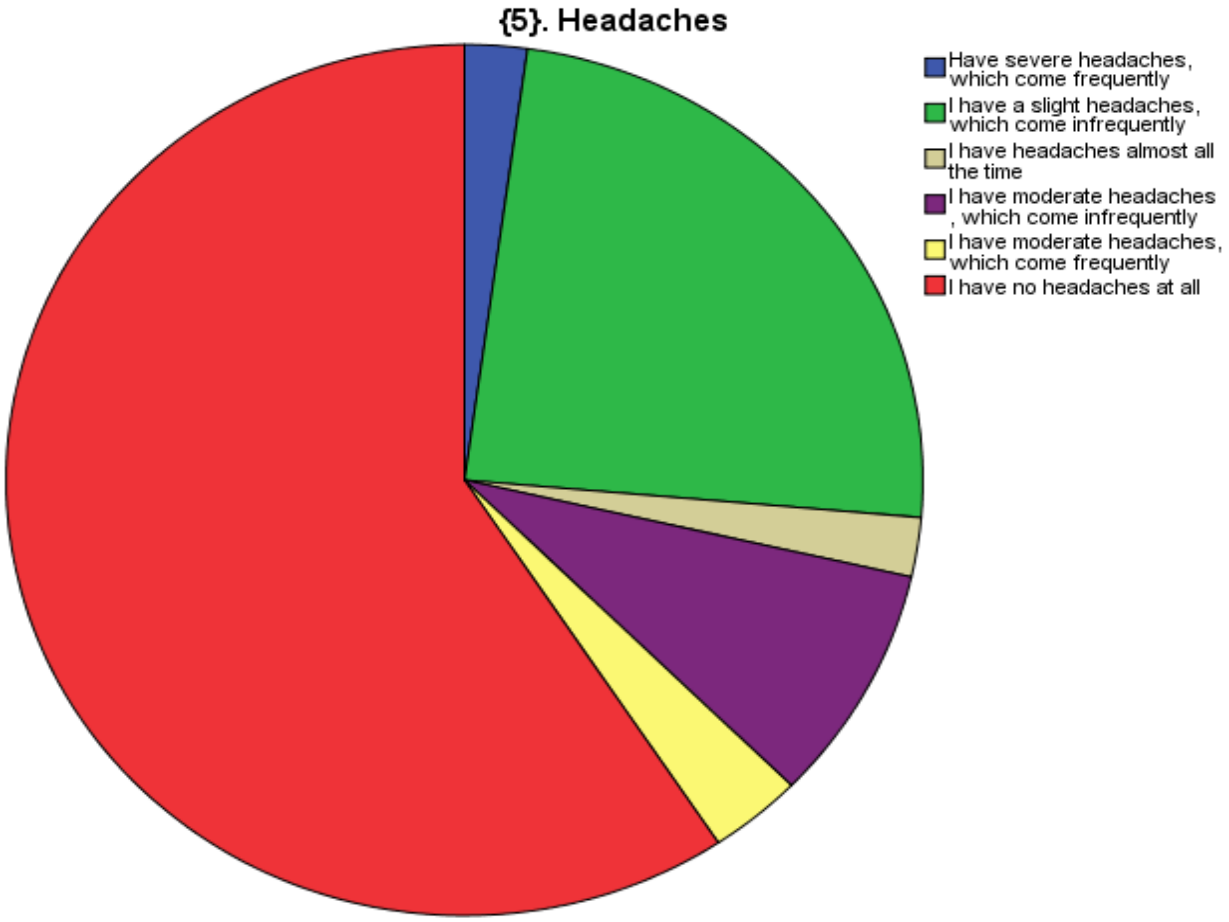
{5}. Headaches

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Have severe headaches, which come frequently	2	2.2	2.2	2.2
	I have a slight headaches, which come infrequently	22	24.2	24.2	26.4
	I have headaches almost all the time	2	2.2	2.2	28.6
	I have moderate headaches , which come infrequently	8	8.8	8.8	37.4
	I have moderate headaches, which come frequently	3	3.3	3.3	40.7
	I have no headaches at all	54	59.3	59.3	100.0
	Total	91	100.0	100.0	



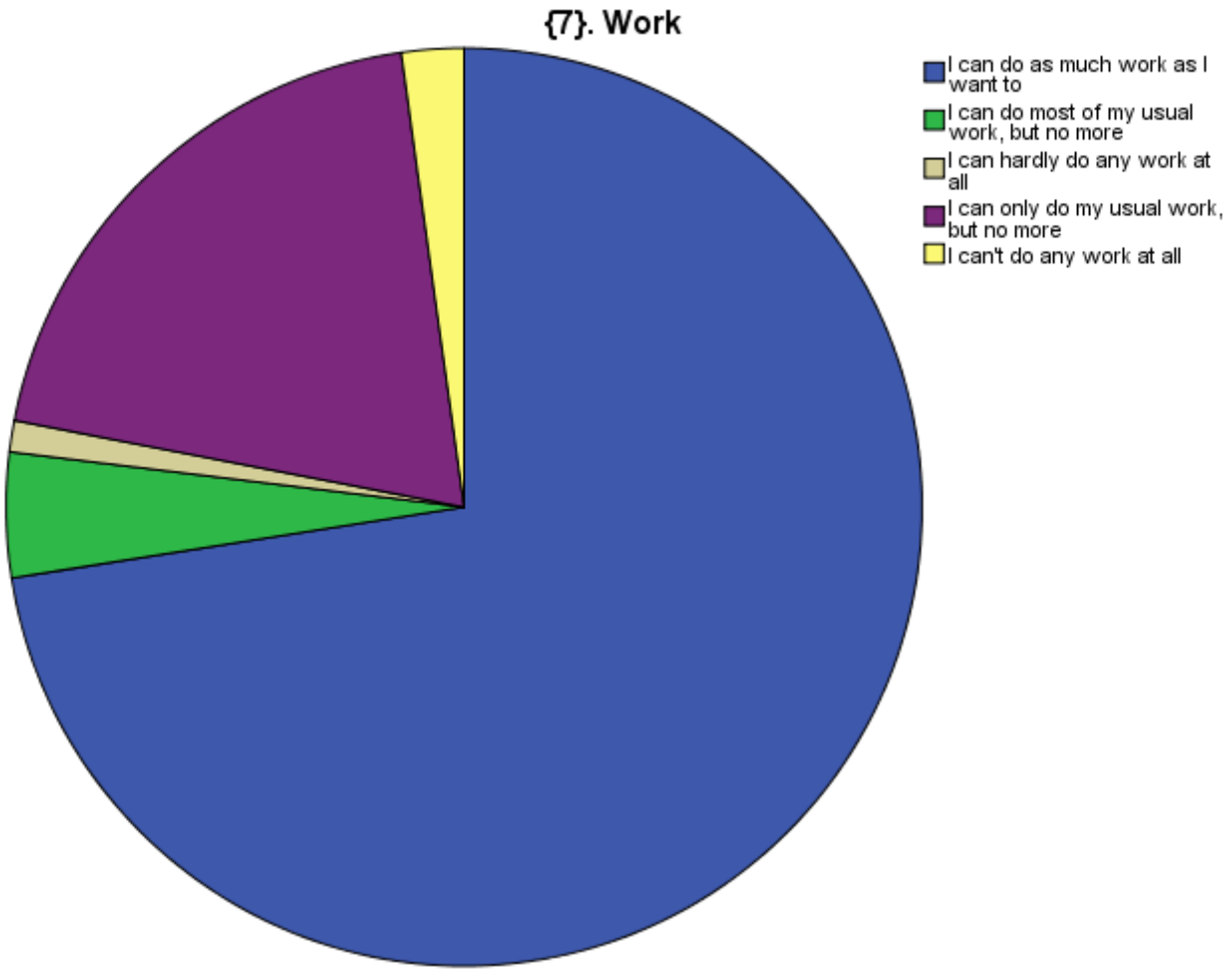
{6}. Concentration

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	I can concentrate fully when I want to with no difficulty	61	67.0	67.0	67.0
	I can concentrate fully when I want to with slide difficulty	13	14.3	14.3	81.3
	I cannot concentrate at all	3	3.3	3.3	84.6
	I have a fair degree of difficulty in concentrating when I want to	8	8.8	8.8	93.4
	I have a great deal of difficult in concentrating when I want to	2	2.2	2.2	95.6
	I have a lot of difficulty in concentrating when I want to	4	4.4	4.4	100.0
	Total	91	100.0	100.0	



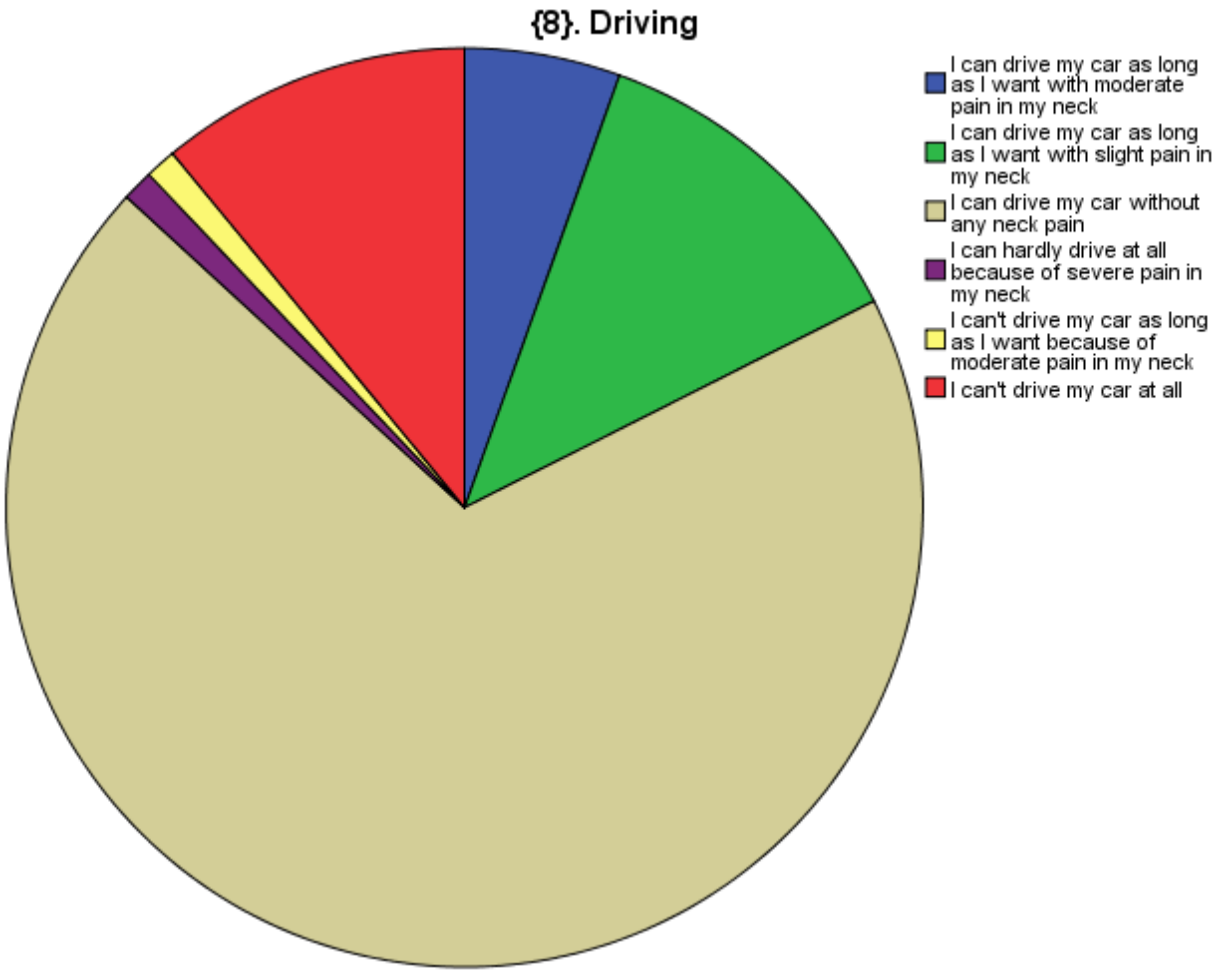
{7}. Work

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	I can do as much work as I want to	66	72.5	72.5	72.5
	I can do most of my usual work, but no more	4	4.4	4.4	76.9
	I can hardly do any work at all	1	1.1	1.1	78.0
	I can only do my usual work, but no more	18	19.8	19.8	97.8
	I can't do any work at all	2	2.2	2.2	100.0
	Total	91	100.0	100.0	



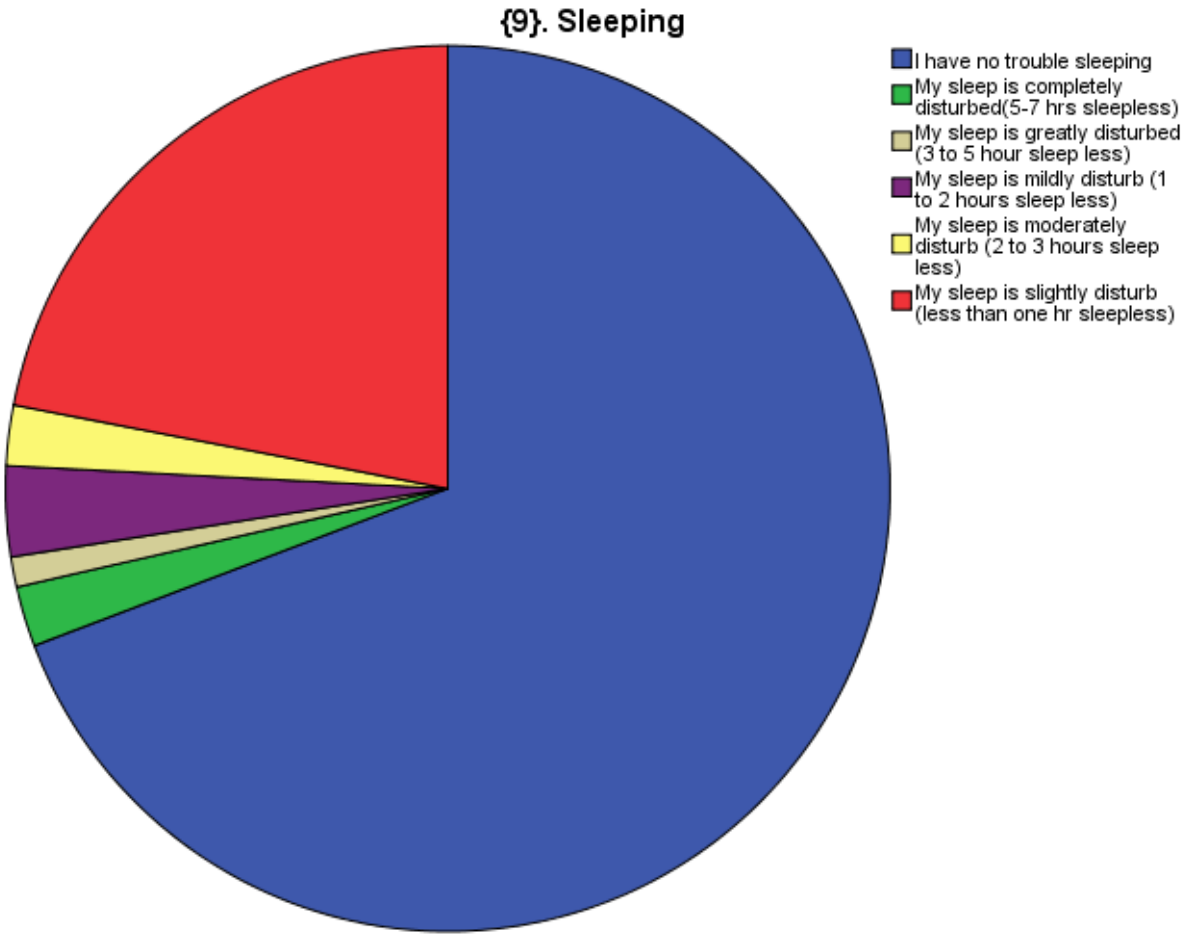
{8}. Driving

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	I can drive my car as long as I want with moderate pain in my neck	5	5.5	5.5	5.5
	I can drive my car as long as I want with slight pain in my neck	11	12.1	12.1	17.6
	I can drive my car without any neck pain	63	69.2	69.2	86.8
	I can hardly drive at all because of severe pain in my neck	1	1.1	1.1	87.9
	I can't drive my car as long as I want because of moderate pain in my neck	1	1.1	1.1	89.0
	I can't drive my car at all	10	11.0	11.0	100.0
	Total	91	100.0	100.0	



{9}. Sleeping

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	I have no trouble sleeping	63	69.2	69.2	69.2
	My sleep is completely disturbed(5-7 hrs sleepless)	2	2.2	2.2	71.4
	My sleep is greatly disturbed (3 to 5 hour sleep less)	1	1.1	1.1	72.5
	My sleep is mildly disturb (1 to 2 hours sleep less)	3	3.3	3.3	75.8
	My sleep is moderately disturb (2 to 3 hours sleep less)	2	2.2	2.2	78.0
	My sleep is slightly disturb (less than one hr sleepless)	20	22.0	22.0	100.0
	Total	91	100.0	100.0	



{10}. Recreation

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	I am able to engage in all my recreation activities with no neck pain at all	68	74.7	74.7	74.7
	I am able to engage in all my recreation activities, with some ne pain in my neck	17	18.7	18.7	93.4
	I am able to engage in most common but not all of my usual recreation activities because of pain in my neck	2	2.2	2.2	95.6
	I can't do any recreation activities at all	4	4.4	4.4	100.0
	Total	91	100.0	100.0	

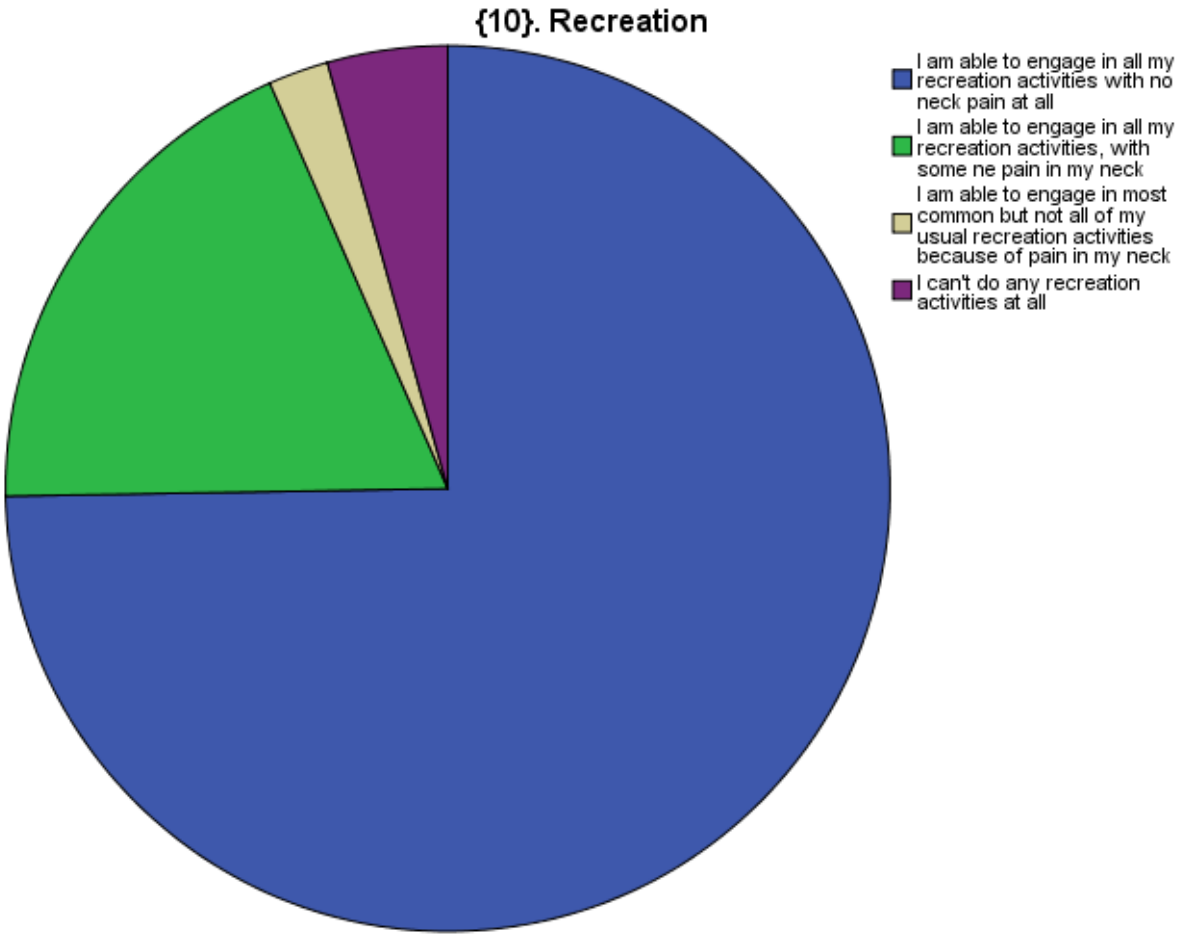


Table 1 : Pain Intensity v/s Personal Care (Washing, Dressing etc.)

Pain Intensity		I have no pain at the moment	The pain is very mild at the moment	The pain is moderate at the moment	The pain is very severe at the moment	The pain is the worst imaginable at the moment
{2}. Personal Care [Washing, Dressing, etc]	I can look after myself normally but it causes extra pain	3	3	1	1	0
	I can look after myself normally without causing extra pain	58	10	6	1	1
	I do not get dressed , i wash with difficulty and stay in bad	1	0	0	0	0
	I need some help but can manage most of my personal care	1	2	0	1	1
	It is pain full to look after myself and I am slow and careful	1	0	0	0	0

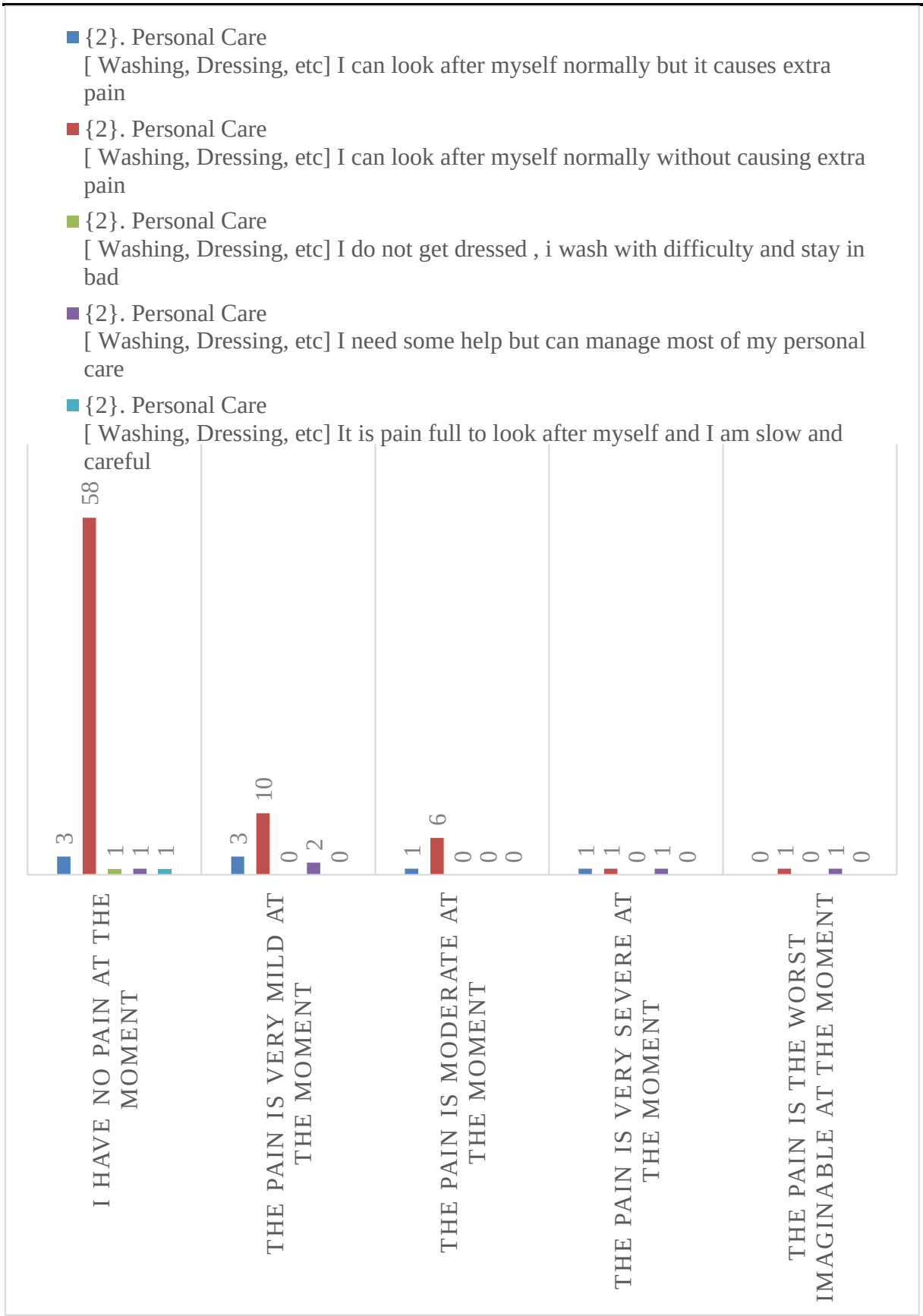

{2}. Personal Care [Washing, Dressing, etc] I can look after myself normally but it causes extra pain
{2}. Personal Care [Washing, Dressing, etc] I can look after myself normally without causing extra pain
{2}. Personal Care [Washing, Dressing, etc] I do not get dressed , i wash with difficulty and stay in bad
{2}. Personal Care [Washing, Dressing, etc] I need some help but can manage most of my personal care
{2}. Personal Care [Washing, Dressing, etc] It is pain full to look after myself and I am slow and careful
3
58
1
1
1
3
10
0
2
0
1
6
0
0
0
1
1
0
1
0
0
1
0
1
0
1
0
I HAVE NO PAIN AT THE MOMENT
THE PAIN IS VERY MILD AT THE MOMENT
THE PAIN IS MODERATE AT THE MOMENT
THE PAIN IS VERY SEVERE AT THE MOMENT
THE PAIN IS THE WORST IMAGINABLE AT THE MOMENT

Table 2 : Lifting Weights v/s Pain Intensity

Pain Intensity		I have no pain at the moment	The pain is very mild at the moment	The pain is moderate at the moment	The pain is very severe at the moment	The pain is the worst imaginable at the moment
{3}. Lifting	I can lift heavyweight but it gives extra pain	2	4	6	2	0
	I can lift heavyweight without extra pain	53	9	1	1	1
	I can not lift or carry anything	1	0	0	0	0
	I can only lift very lightweights	6	0	0	0	0
	Pain prevents me from lifting heavyweight but I can manage light to medium weights if they are conveniently positioned	2	1	0	0	1
	Pain prevents me lifting heavyweight off the floor, but I can manage of they are conveniently places , for example on table	0	1	0	0	0

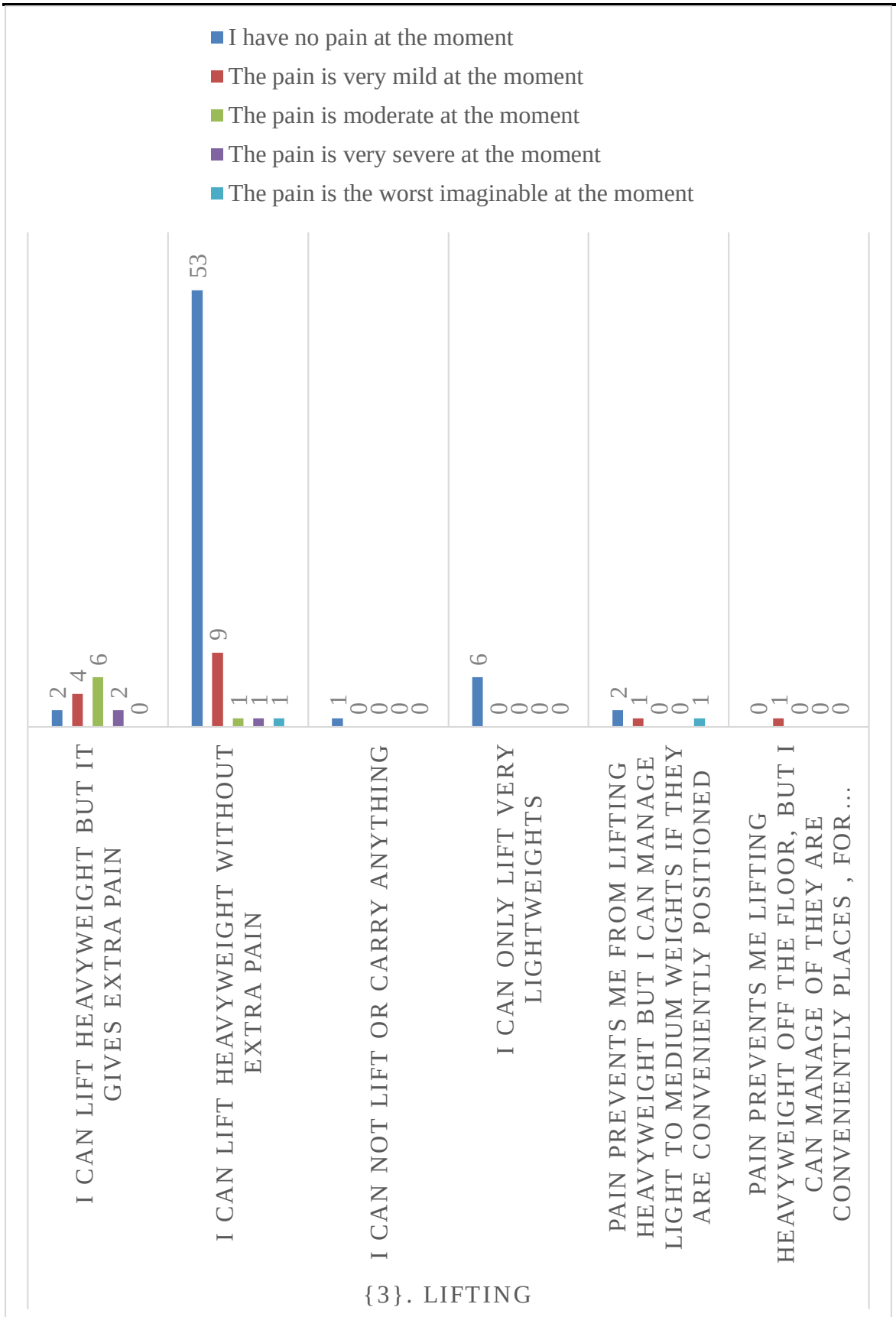

I have no pain at the moment
The pain is very mild at the moment
The pain is moderate at the moment
The pain is very severe at the moment
The pain is the worst imaginable at the moment
2 4 6 2 0
53 9 1 1 1
1 0 0 0 0
6 0 0 0 0
2 1 0 0 1
0 1 0 0 0
I CAN LIFT HEAVYWEIGHT BUT IT GIVES EXTRA PAIN
I CAN LIFT HEAVYWEIGHT WITHOUT EXTRA PAIN
I CAN NOT LIFT OR CARRY ANYTHING
I CAN ONLY LIFT VERY LIGHTWEIGHTS
PAIN PREVENTS ME FROM LIFTING HEAVYWEIGHT BUT I CAN MANAGE LIGHT TO MEDIUM WEIGHTS IF THEY ARE CONVENIENTLY POSITIONED
PAIN PREVENTS ME LIFTING HEAVYWEIGHT OFF THE FLOOR, BUT I CAN MANAGE OF THEY ARE CONVENIENTLY PLACES , FOR...
{3}. LIFTING

Table 3 : Reading v/s Pain Intensity

Pain Intensity		I have no pain at the moment	The pain is very mild at the moment	The pain is moderate at the moment	The pain is very severe at the moment	The pain is the worst imaginable at the moment
{4}. Reading	I can read as much as I want to with a slight pain in my neck	16	6	2	1	0
	I can read as much as I want to with no pain in my neck	44	5	1	1	0
	I can read as much as I want with moderate pain in my neck	1	4	1	0	0
	I can't read as much as I want because of moderate pain in my neck	0	0	2	1	1
	I cannot read at all	3	0	1	0	1

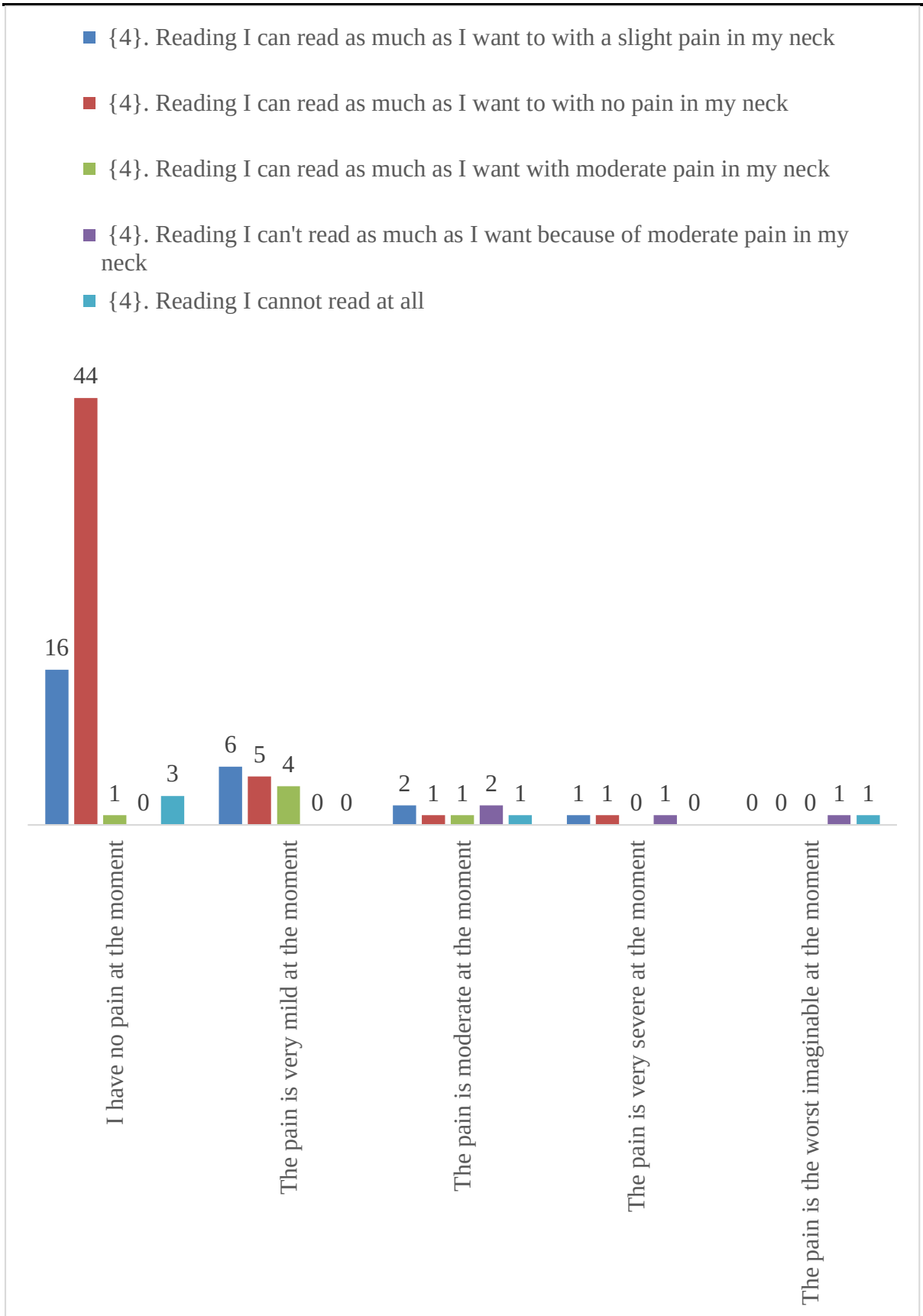

{4}. Reading I can read as much as I want to with a slight pain in my neck
{4}. Reading I can read as much as I want to with no pain in my neck
{4}. Reading I can read as much as I want with moderate pain in my neck
{4}. Reading I can't read as much as I want because of moderate pain in my neck
{4}. Reading I cannot read at all
16 44 1 0 3
6 5 4 0 0
2 1 1 2 1
1 1 0 1 0
0 0 0 1 1
I have no pain at the moment
The pain is very mild at the moment
The pain is moderate at the moment
The pain is very severe at the moment
The pain is the worst imaginable at the moment

Table 4 : Headaches v/s Pain Intensity

Pain Intensity		I have no pain at the moment	The pain is very mild at the moment	The pain is moderate at the moment	The pain is very severe at the moment	The pain is the worst imaginable at the moment
{5}. Headaches	Have severe headaches, which come frequently	0	0	2	0	0
	I have a slight headaches, which come infrequently	14	7	0	0	1
	I have headaches almost all the time	1	0	1	0	0
	I have moderate headaches , which come infrequently	3	3	1	1	0
	I have moderate headaches, which come frequently	2	0	1	0	0
	I have no headaches at all	44	5	2	2	1

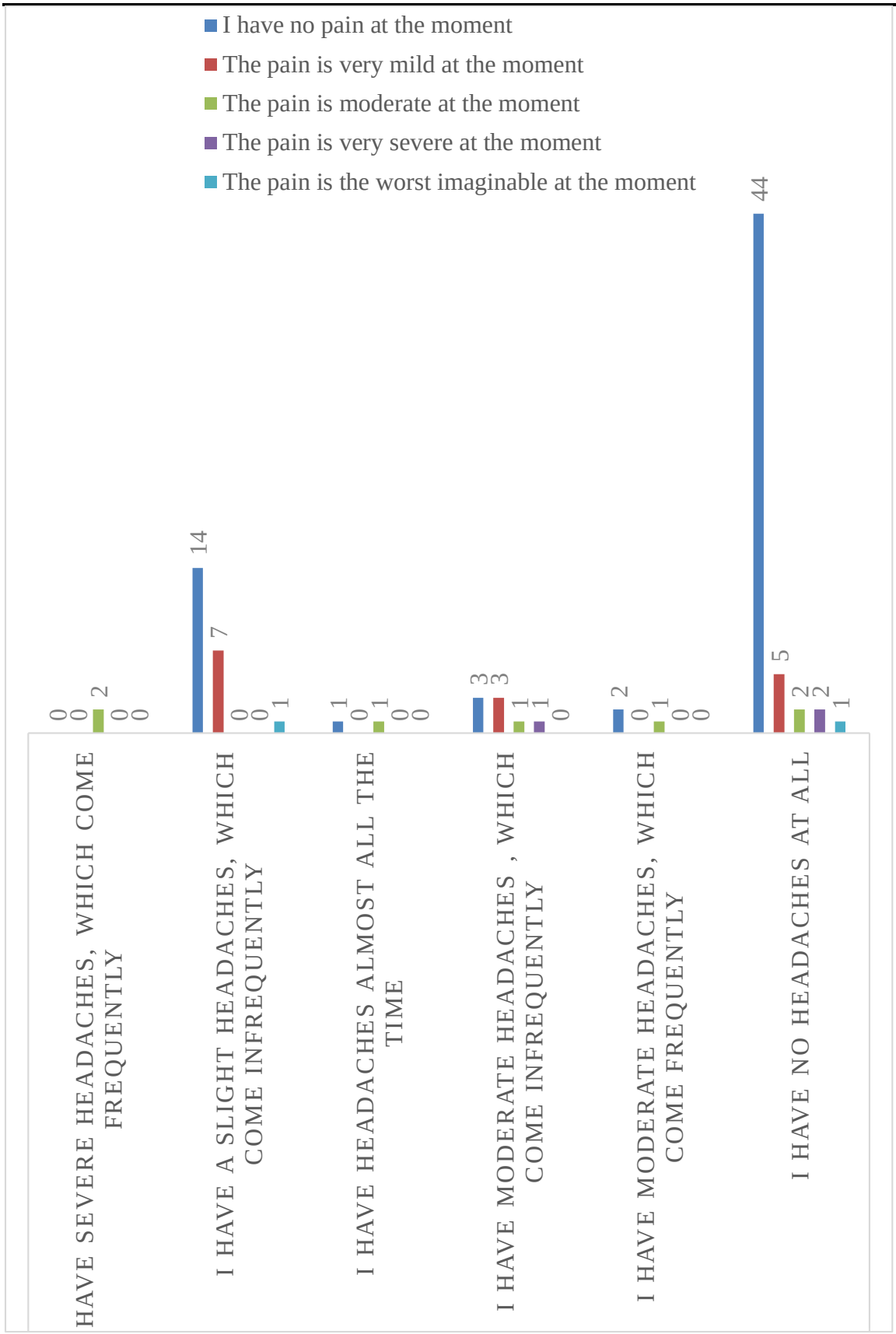

I have no pain at the moment
The pain is very mild at the moment
The pain is moderate at the moment
The pain is very severe at the moment
The pain is the worst imaginable at the moment
HAVE SEVERE HEADACHES, WHICH COME FREQUENTLY
0 0 2 0 0
I HAVE A SLIGHT HEADACHES, WHICH COME INFREQUENTLY
14 7 0 0 1
I HAVE HEADACHES ALMOST ALL THE TIME
1 0 1 0 0
I HAVE MODERATE HEADACHES , WHICH COME INFREQUENTLY
3 3 1 1 0
I HAVE MODERATE HEADACHES, WHICH COME FREQUENTLY
2 0 1 0 0
I HAVE NO HEADACHES AT ALL
44 5 2 2 1

Table 5 : Concentration v/s Pain Intensity

Pain Intensity		I have no pain at the moment	The pain is very mild at the moment	The pain is moderate at the moment	The pain is very severe at the moment	The pain is the worst imaginable at the moment
{6}. Concentration	I can concentrate fully when I want to with no difficulty	52	6	1	1	1
	I can concentrate fully when I want to with slide difficulty	5	6	1	1	0
	I cannot concentrate at all	2	0	1	0	0
	I have a fair degree of difficulty in concentrating when I want to	3	3	2	0	0
	I have a great deal of difficult in concentrating when I want to	1	0	1	0	0
	I have a lot of difficulty in concentrating when I want to	1	0	1	1	1

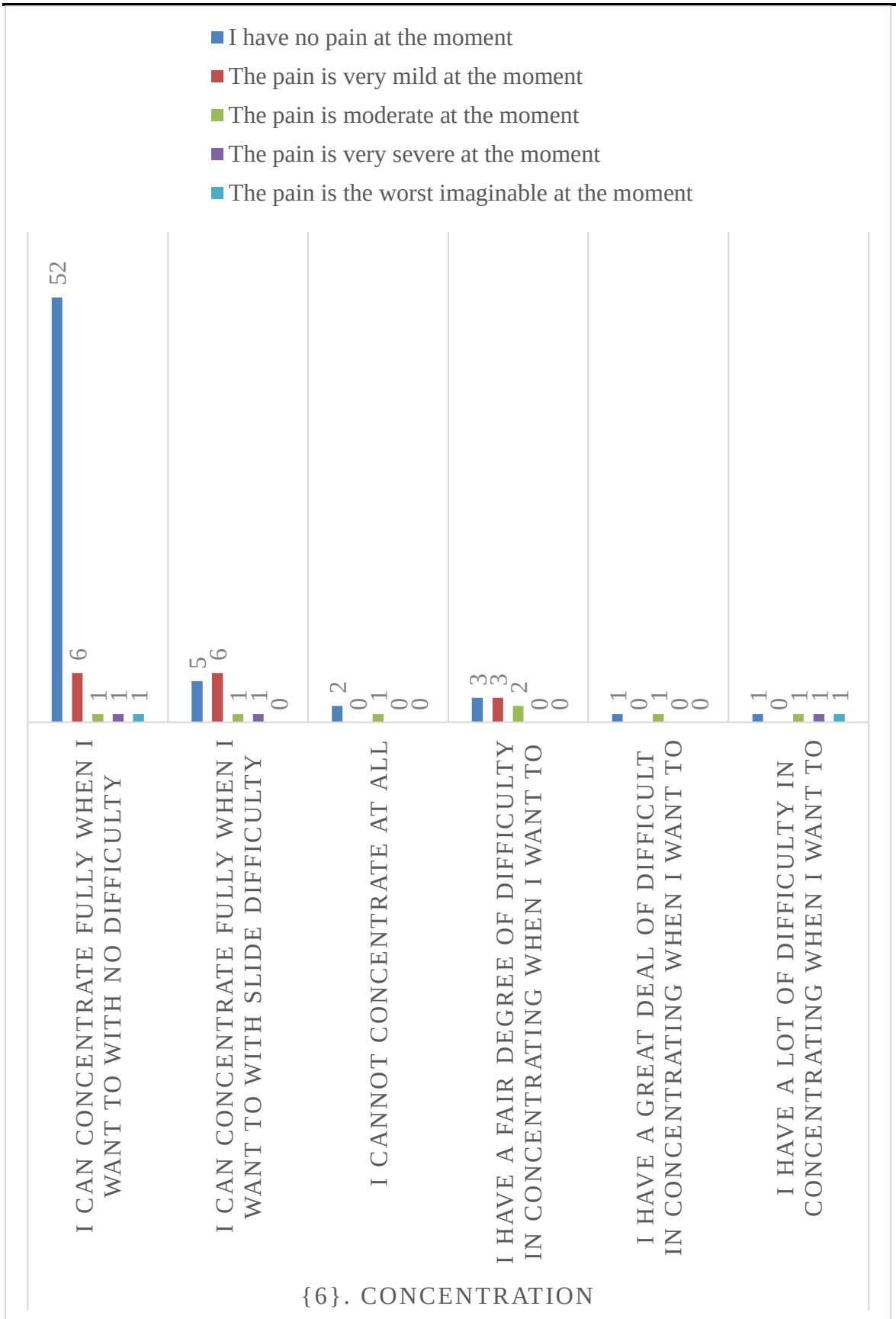

I have no pain at the moment
The pain is very mild at the moment
The pain is moderate at the moment
The pain is very severe at the moment
The pain is the worst imaginable at the moment
52
6
1
1
1
5
6
1
1
0
2
0
1
0
0
3
3
2
0
0
1
0
1
0
0
1
0
1
1
1
I CAN CONCENTRATE FULLY WHEN I WANT TO WITH NO DIFFICULTY
I CAN CONCENTRATE FULLY WHEN I WANT TO WITH SLIDE DIFFICULTY
I CANNOT CONCENTRATE AT ALL
I HAVE A FAIR DEGREE OF DIFFICULTY IN CONCENTRATING WHEN I WANT TO
I HAVE A GREAT DEAL OF DIFFICULT IN CONCENTRATING WHEN I WANT TO
I HAVE A LOT OF DIFFICULTY IN CONCENTRATING WHEN I WANT TO
{6}. CONCENTRATION

Table 6 : Work v/s Pain Intensity

Pain Intensity		I have no pain at the moment	The pain is very mild at the moment	The pain is moderate at the moment	The pain is very severe at the moment	The pain is the worst imaginable at the moment
{7}. Work	I can do as much work as I want to	53	8	3	1	1
	I can do most of my usual work, but no more	0	0	2	2	0
	I can hardly do any work at all	1	0	0	0	0
	I can only do my usual work, but no more	9	7	2	0	0
	I can't do any work at all	1	0	0	0	1

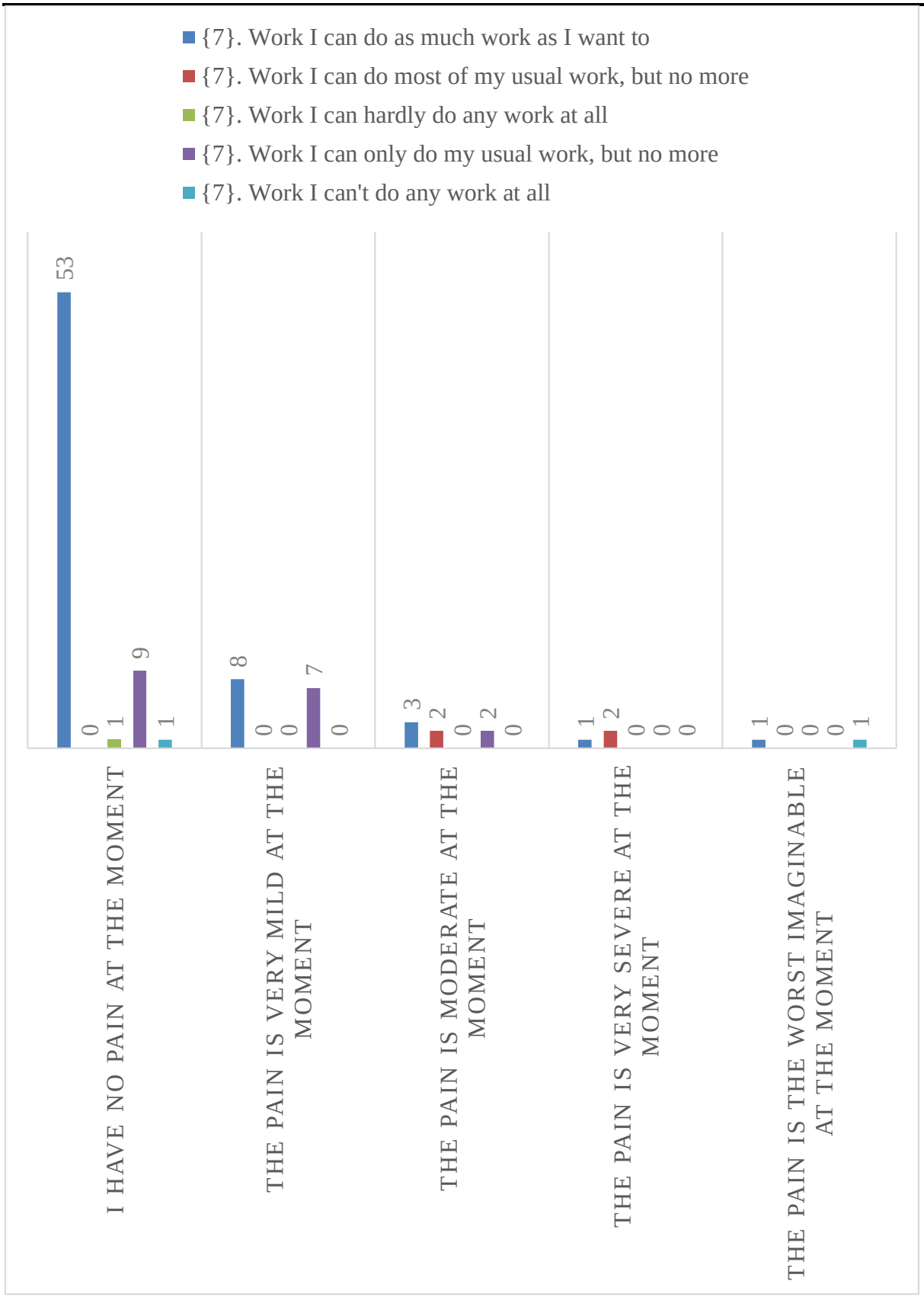
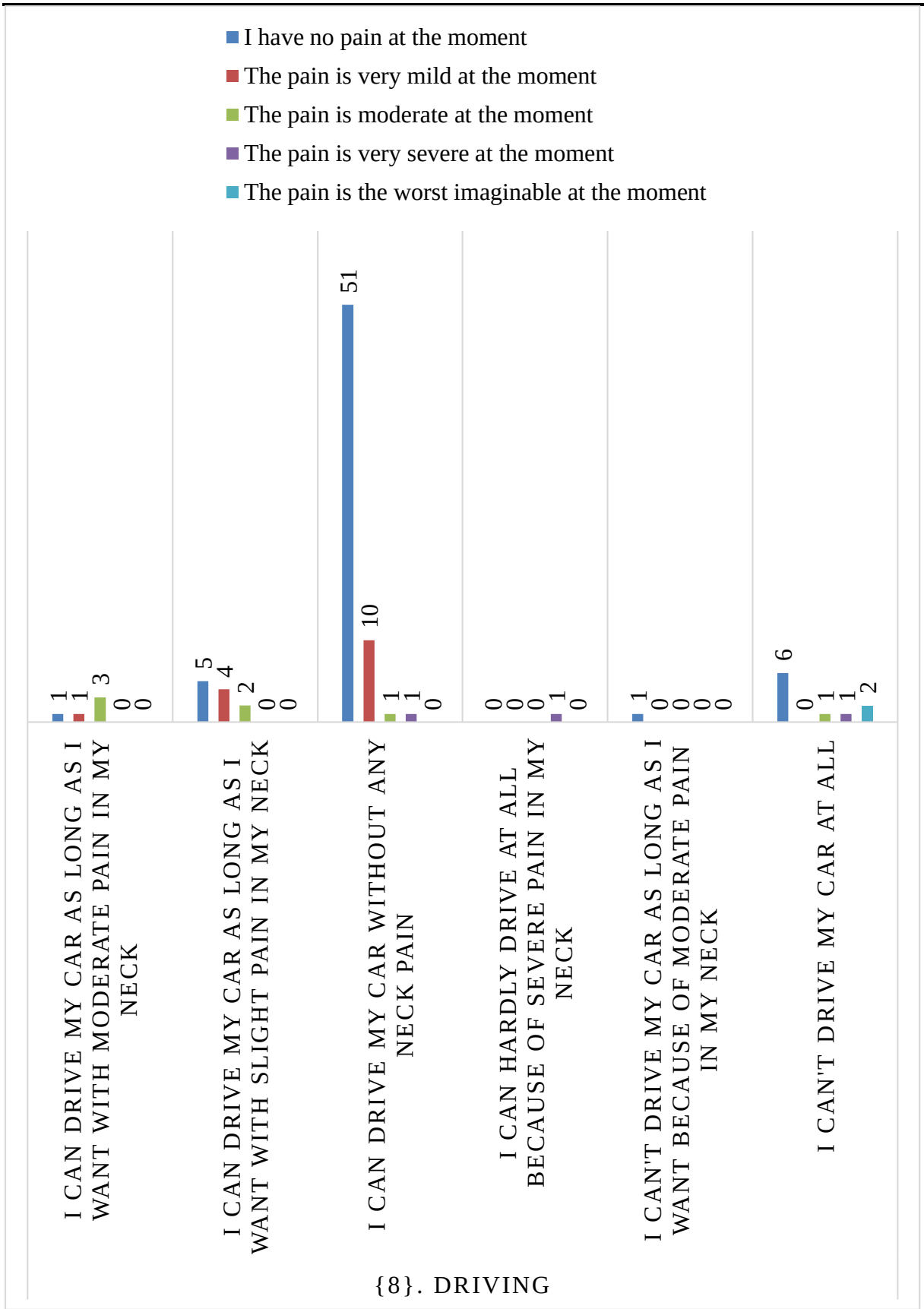

{7}. Work I can do as much work as I want to
{7}. Work I can do most of my usual work, but no more
{7}. Work I can hardly do any work at all
{7}. Work I can only do my usual work, but no more
{7}. Work I can't do any work at all
53
0
1
9
1
8
0
0
7
0
3
2
0
2
0
1
2
0
0
0
1
0
0
0
1
I HAVE NO PAIN AT THE MOMENT
THE PAIN IS VERY MILD AT THE MOMENT
THE PAIN IS MODERATE AT THE MOMENT
THE PAIN IS VERY SEVERE AT THE MOMENT
THE PAIN IS THE WORST IMAGINABLE AT THE MOMENT

Table 7 : Driving v/s Pain Intensity

Pain Intensity		I have no pain at the moment	The pain is very mild at the moment	The pain is moderate at the moment	The pain is very severe at the moment	The pain is the worst imaginable at the moment
{8}. Driving	I can drive my car as long as I want with moderate pain in my neck	1	1	3	0	0
	I can drive my car as long as I want with slight pain in my neck	5	4	2	0	0
	I can drive my car without any neck pain	51	10	1	1	0
	I can hardly drive at all because of severe pain in my neck	0	0	0	1	0
	I can't drive my car as long as I want because of moderate pain in my neck	1	0	0	0	0
	I can't drive my car at all	6	0	1	1	2


I have no pain at the moment
The pain is very mild at the moment
The pain is moderate at the moment
The pain is very severe at the moment
The pain is the worst imaginable at the moment
1 1 3 0 0
5 4 2 0 0
51 10 1 1 0
0 0 0 1 0
1 0 0 0 0
6 0 1 1 2
I CAN DRIVE MY CAR AS LONG AS I WANT WITH MODERATE PAIN IN MY NECK
I CAN DRIVE MY CAR AS LONG AS I WANT WITH SLIGHT PAIN IN MY NECK
I CAN DRIVE MY CAR WITHOUT ANY NECK PAIN
I CAN HARDLY DRIVE AT ALL BECAUSE OF SEVERE PAIN IN MY NECK
I CAN'T DRIVE MY CAR AS LONG AS I WANT BECAUSE OF MODERATE PAIN IN MY NECK
I CAN'T DRIVE MY CAR AT ALL

{8}. DRIVING

Table 8 : Sleeping v/s Pain Intensity

Pain Intensity		I have no pain at the moment	The pain is very mild at the moment	The pain is moderate at the moment	The pain is very severe at the moment	The pain is the worst imaginable at the moment
{9}. Sleeping	I have no trouble sleeping	49	9	1	2	2
	My sleep is completely disturbed(5-7 hrs sleepless)	1	0	1	0	0
	My sleep is greatly disturbed (3 to 5 hour sleep less)	0	0	1	0	0
	My sleep is mildly disturb (1 to 2 hours sleep less)	1	1	1	0	0
	My sleep is moderately disturb (2 to 3 hours sleep less)	1	0	1	0	0
	My sleep is slightly disturb (less than one hr sleepless)	12	5	2	1	0

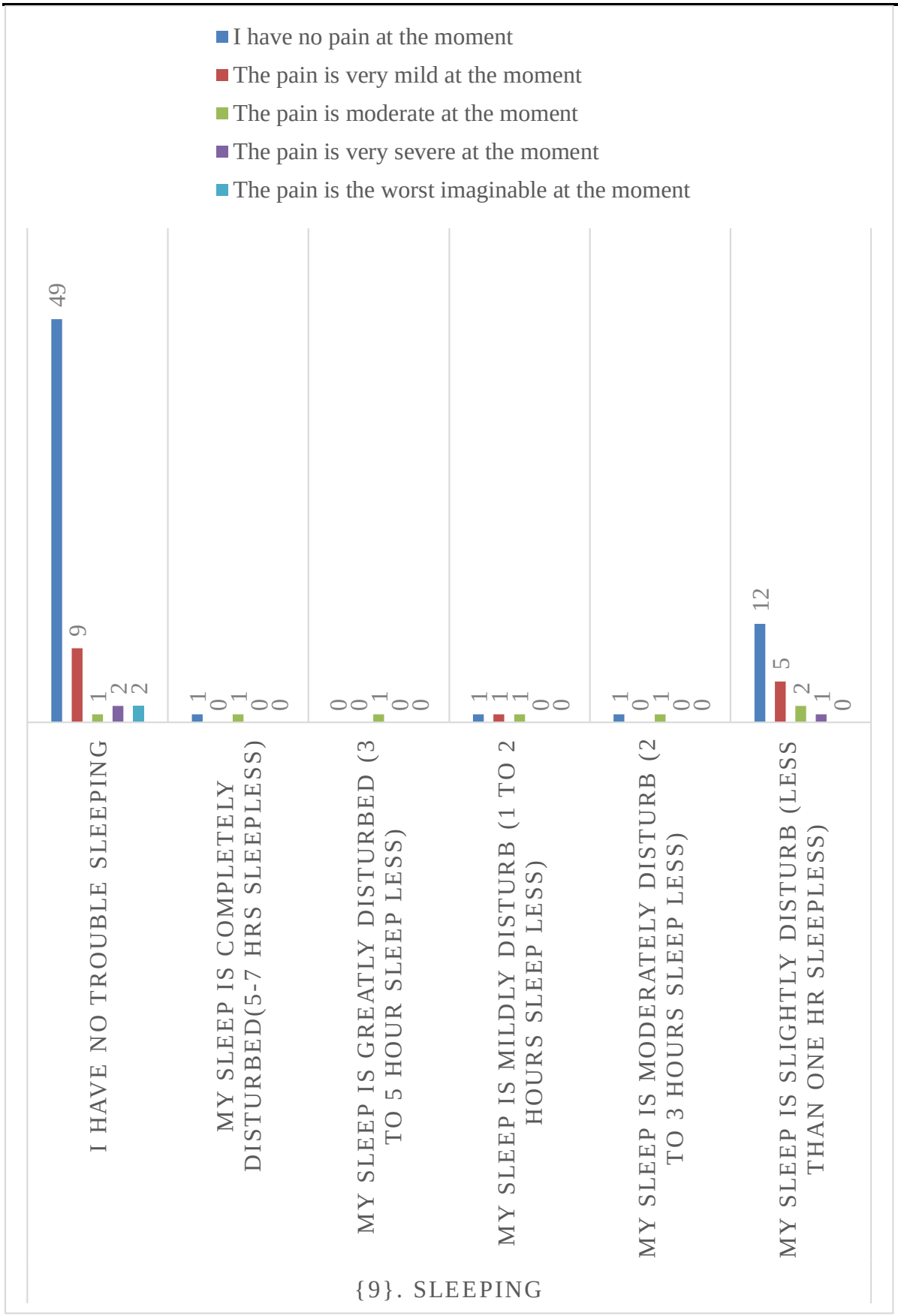
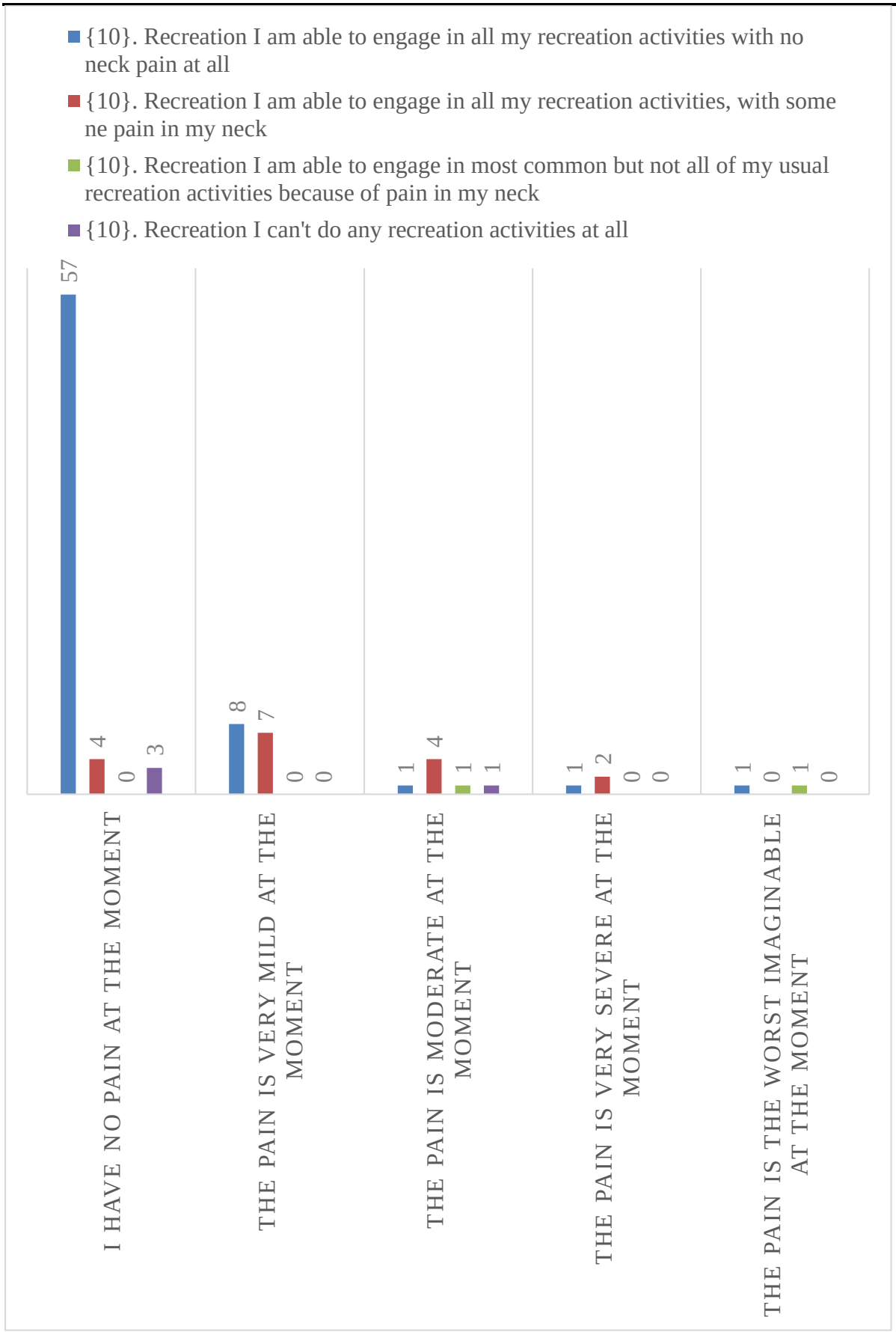

I have no pain at the moment
The pain is very mild at the moment
The pain is moderate at the moment
The pain is very severe at the moment
The pain is the worst imaginable at the moment
49
9
1
2
2
1
0
1
0
0
0
0
1
0
0
1
1
1
0
0
1
0
1
0
0
12
5
2
1
0
I HAVE NO TROUBLE SLEEPING
MY SLEEP IS COMPLETELY DISTURBED(5-7 HRS SLEEPLESS)
MY SLEEP IS GREATLY DISTURBED (3 TO 5 HOUR SLEEP LESS)
MY SLEEP IS MILDLY DISTURB (1 TO 2 HOURS SLEEP LESS)
MY SLEEP IS MODERATELY DISTURB (2 TO 3 HOURS SLEEP LESS)
MY SLEEP IS SLIGHTLY DISTURB (LESS THAN ONE HR SLEEPLESS)
{9}. SLEEPING

Table 9 : Recreation v/s Pain Intensity

Pain Intensity		I have no pain at the moment	The pain is very mild at the moment	The pain is moderate at the moment	The pain is very severe at the moment	The pain is the worst imaginable at the moment
{10}. Recreation	I am able to engage in all my recreation activities with no neck pain at all	57	8	1	1	1
	I am able to engage in all my recreation activities, with some ne pain in my neck	4	7	4	2	0
	I am able to engage in most common but not all of my usual recreation activities because of pain in my neck	0	0	1	0	1
	I can't do any recreation activities at all	3	0	1	0	0


{10}. Recreation I am able to engage in all my recreation activities with no neck pain at all
{10}. Recreation I am able to engage in all my recreation activities, with some ne pain in my neck
{10}. Recreation I am able to engage in most common but not all of my usual recreation activities because of pain in my neck
{10}. Recreation I can't do any recreation activities at all
57
4
0
3
8
7
0
0
1
4
1
1
1
2
0
0
1
0
1
0
I HAVE NO PAIN AT THE MOMENT
THE PAIN IS VERY MILD AT THE MOMENT
THE PAIN IS MODERATE AT THE MOMENT
THE PAIN IS VERY SEVERE AT THE MOMENT
THE PAIN IS THE WORST IMAGINABLE AT THE MOMENT

Results

Using the graphs the following results were obtained:

1. Most of the patients did not had any pain or had mild pain during personal care (washing, dressing, etc).
2. Most of the patients did not had any pain or had mild pain during Lifting heavy weights.
3. Most of the patients did not had any pain or had mild pain during Reading.
4. Most of the patients did not had any pain or had mild pain during slight headaches, which come infrequently.
5. Most of the patients did not had any pain or had mild pain and so they can concentrate in their day to day activities with no/less difficulty.
6. Most of the patients did not had any pain or had mild pain while doing work.
7. Most of the patients did not had any pain or had mild pain while driving.
8. Most of the patients did not had any pain or had mild pain while sleeping or had no trouble sleeping.
9. Most of the patients did not had any pain or had mild pain and so they were able to engage in all their recreational activities with no/mild neck pain.

DISCUSSION

Neck pain can have causes that aren't due to underlying disease. Examples include prolonged straining (looking up or down), sleeping in an uncomfortable position, stress, chiropractic manipulation or wearing heavy necklaces. Chronic neck pain can range from an achy annoyance to shock-like pain that goes into the arm and becomes debilitating. Neck pain is typically classified as chronic when it persists or regularly recurs for at least 3 months.

Drs Ylinen and Häkkinen,Dr Takala ,Dr Nykänen,Dr Mälkiä,Dr Pohjolainen and Ms Karppi,Dr Airaksinen did research in Active neck muscle training in the treatment of chronic neck pain in women: a randomized controlled trial , the results show that the Both strength and endurance training for 12 months were effective methods for decreasing pain and disability in women with chronic, nonspecific neck pain. Stretching and fitness training are commonly advised for patients with chronic neck pain, but stretching and aerobic exercising alone proved to be a much less effective form of training than strength training. [6]

Author Deborah Falla, Gwendolen Jull, Trevor Russell, Bill Vicenzino, Paul Hodges did research in Effect of neck exercise on sitting posture in patients with chronic neck pain, the results show that the This study showed that people with chronic neck pain demonstrate a reduced ability to maintain an upright posture when distracted. Following intervention with an exercise program targeted at training the craniocervical flexor muscles, subjects with neck pain demonstrated an improved ability to maintain a neutral cervical posture during prolonged sitting. [4]

When Jari Ylinen did research in Physical exercises and functional rehabilitation for the management of chronic neck pain ,the results show that Specific moderate and highintensity neck muscle training can reduce neck pain. A decrease in neck pain is associated with reduced pressure pain sensitivity in neck muscles. Intensive regular training will increase neck muscle strength and range of motion, leading to improved function and less disability in patients with chronic neck pain. Training for a few months is commonly recommended, but it has beenshown to produce only transitory improvements. Long-term progressive resistance training for neck and shoulder muscles is therefore recommended. Moreover, effective training can be performed at home with low-cost training equipment.[8]

In this cross - sectional research chronic neck pain among college going students on 90 students from age 18-24 . In this research NDI scale and VAS scale were used to measure pain and disability of students. My research concluded that the there is no disability among college going students.

I did this research because I observed that college going students have to keep their neck constantly in one position whether it was for attending lectures or working on their desk so I wanted to know if they were experiencing any kind of chronic neck pain in their day to day life.

CONCLUSION

From the results it can be concluded that more than half of the population had no pain or mild pain and they didn't feel any issues in dealing with personal care lifting heavy weights reading headaches concentration work driving sleeping and recreation.

SUMMARY

From the results it can be concluded that more than half of the population had no pain or mild pain and they didn't feel any issues in dealing with personal care lifting heavy weights reading headaches concentration work driving sleeping and recreation.

Limitations

- Smallsamplesize.
- Limitedagegroupof18-24years.
- Neckpainprolongedmorethan12weeks.

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ROLE OF YOGA IN PCOD [POLYCYSTIC OVARIAN DISEASE]-A QUASI-EXPERIMENTAL ONE-WAY STUDY

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[1]Swarrnim Startup & Innovation University, Gandhinagar

ABSTRACT

BACKGROUND : Polycystic means many cysts. Polycystic ovarian Disease is a complex disorder of chronic oligoanovulation or oligomenorrhoea and clinical or biochemical hyperandrogegism. Genetic and environmental factors may contribute to this disorder and may affect 14-44 year age of women . This is one of the main reason for infertility. Women affected with this syndrome often have ovulatory dysfunction hormonal disbalance, hyperandrogenemia, obesity and hyper insulinemia.

METHODOLOGY: They were subjected to Yoga therapy for 30-45 mins /day for 3 months with a break after every 6 days. Treatment duration was 3 months. Pre and post outcome measures were taken.

RESULT: . Data was considered statistically significant with $P<0.05$ and highly significant at $p<0.01$. Pre and post mean difference of BMI shows 33.28 ± 26.64 in pre date collection and 28.36 ± 21.77 in post data collection. As $p<0.05$ there is significant difference between groups. Pre and post mean difference values of VMSS shows 2.33 ± 14.67 and 0.93 ± 23.87. This shows a significant difference between two groups.

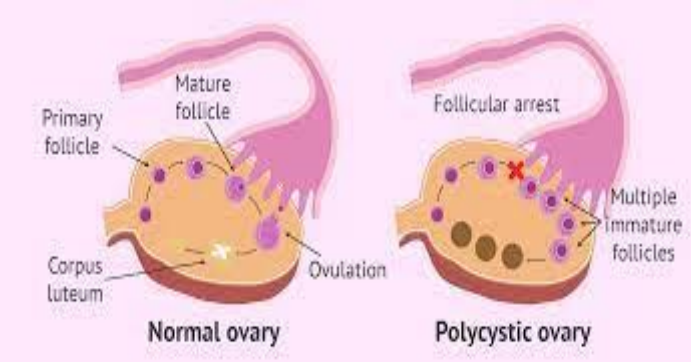
CONCLUSIONS: Daily yoga for 30 minutes with 5 Asanas along with meditation and Shavasana helps in weight reduction and stress management which ultimately stabilize the normal function of hypothalmo-pituitary–ovarian axis and cure PCOD.

KEYWORDS: polycystic ovarian disease, yoga, obesity, Body Mass Index , infertility.

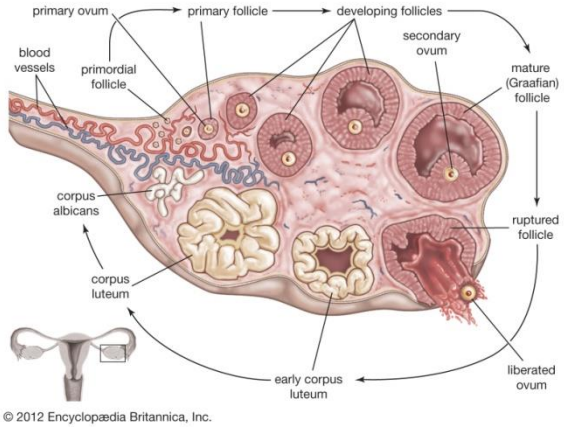
INTRODUCTION

Polycystic means many cysts. Polycystic ovarian Disease is a complex disorder of chronic oligoanovula-tion or oligomenorrhoea and clinical or biochemical hyperandrogegism. Genetic and environ-mental fac-tors may contribute to this disorder and may affect 14-34 age of women .This is one of the main reason for infertility. Women affected with this syndrome often have ovulatory dysfunction hormonal disbalan-ce, hyperandrogenemia, obesity and hyper insulinemia. PCOD has life-long implications with in-creased risk for infertility, metabolic syndrome, type 2 diabetes mellitus, cardiovascular disease and endometrial carcinoma. [1]

Polycystic ovary Disease (PCOD) is a very common endocrine disorder, of uncertain aetiology, that affects an estimated 5–10% of women of reproductive age. PCOD typically presents during adolescence and is a heterogeneous syndrome that classically is characterized by features of an ovulation (amenorrh-ea, oligomenorrhoea) combined with symptoms of androgen excess (Hirsutism, acne, alopecia). [2]



PHOTOGRAPH: 1 NORMAL OVARIES VS PCOD OVARI



PHOTOGRAPH: 2 OVULATION

Polycystic ovary disease (PCOD) is an endocrine disorder associated with metabolic change in women of reproductive age. It is the most common cause of infertility with physical, mental and hormonal imbalances. The prevalence rate of polycystic ovary disease (PCOD) in India is 9.13%.[3]

It is characterized by irregular, short menstruation, depression, obesity, acne, hair fall, cystic ovary, blood sugar imbalance, etc. Various factors responsible for polycystic ovary disease, but also stress and lack of exercise are the most important factor for exaggerating polycystic ovary disease. [3]

Clinical signs of PCOD include elevated luteinizing hormone (LH) and gonadotropin–releasing hormone (GnRH) levels, whereas follicular-stimulating hormone (FSH) levels are muted or unchanged. As a result of the increase in GnRH, stimulation of the ovarian thecal cells, in turn, produces more androgens.[4]

The word yoga is derived from the Sanskrit root yuj, which means to join or yoke. Philosophically, yoga refers to the connection of the individual self with the universal self. Yoga is one of the six branches of classical Indian philosophy and has been practiced for thousands of years.[5]

Yoga is an ancient discipline designed to bring balance and health to the physical, mental, emotional, and spiri- tual dimensions of the individual. Yoga is often depicted metaphorically as a tree and comprises eight aspects, or ‘‘limbs:’’ yama (universal ethics), niyama (individual ethics), asana (physical postures), pranayama (breath control), pratya- hara (control of the senses), dharana (concentration), dyana (meditation), and samadhi (bliss). Long a popular practice in India, yoga has become increasingly more common in Wes- tern society. In a national, population-based telephone survey (n 1⁄4 2055), 3.8% of respondents reported using yoga in the previous year and cited wellness (64%) and specific health conditions (48%) as the motivation for doing yoga.[6]

Yoga is the union of individual self, jeevatma, with the universal self, paramatma. It is the communion of the human soul with the divinity. Simple meaning of Yoga is union. Yoga is the integration and harmony between thoughts, words, and deeds or integration between head, heart and hands. [7]

NEED *OF STUDY*

Many researchers have studied the individual effect of Suryanamaskar and pelvic opening yoga among with diet and life style mordification but there is no research done without a combination of these two and any diet and lifestyle changes. Thus, it is necessary to conduct the study on Effect of Yoga on PCOD.

AIM AND OBJECTIVES OF THE STUDY

AIM OF STUDY:

To evaluate effect of yoga in PCOD.

OBJECTIVES OF STUDY:

1. To assess and compare the changes in BMI in PCOD before & after 3 months of Yoga.
2. To assess and compare the Oligomenorrhea (irregular menstruation) in PCOD. Before and after 3 months of yoga
3. To assess and compare yoga therapy in PCOD before and after 3 months of Yoga therapy.

HYPOTHESIS

1. **Null hypothesis:**
   There will be no significant impact of yoga in management of symptoms of PCOD.

2. **Research hypothesis:**
   There will be significant impact of yoga in management of symptoms of PCOD.

MATERIALS AND METHODS

STUDY DESIGN - A Quasi- experimental one- way study
SOURCE OF DATA - Hospitals (Ahmedabad)
POPULATION - 18-30 adolescent girls
SAMPLING METHOD- convenient sampling
SAMPLE SIZE - 30
DURATION OF THE STUDY - 3 months
TRETMENT DURETION - 6 session per week for 3 months

METHOD OF COLLECTION OF DATA

1.Inclusion criteria:

- Age limitation 18 to 30
- Menstrual irregular symptoms with PCOD
- Dysmenorrhea
- Obesity with symptoms with PCOD

2.Exclusion criteria :

- PCOS
- Infertility
- Patient takes any treatment or therapy

MATERIALS AND TOOLS USED

- Yoga Mats
- Pillow
- Blocks
- Mobile phones

OUTCOME MEASURES

BMI (Body Mass Index)

- It is a measure of body fat based on your weight in relation to your height. It is more of an indicator than a direct measurement of a person's total body fat. As the BMI score increases, so does the
- person's total body fat increases.
- Formula to check BMI is BMI= weight/ [height (m2)
- BMI weight ranges: Less than 18.5 = Underweight , Between 18.5 - 24.9 = Healthy Weight, Between 25 - 29.9 = Overweight, Over 30 = Obese.

VMSS (verbal multimensiona scoring system) [8]

- The Verbal Multidimensional Scoring System (VMDS) measures both pain and related systemic signs and symptoms, while the Visual Analogue Scale measures only pain. Hence, primary dysmenorrhea was measured in different degrees of severity in different studies. Dysmenorrhea or pain during menstruation is commonly seen in young women and largely impacts their quality of life. Pain medications are largely used to tackle this situation; however, they have side effects with regular use.

METHODOLOGY

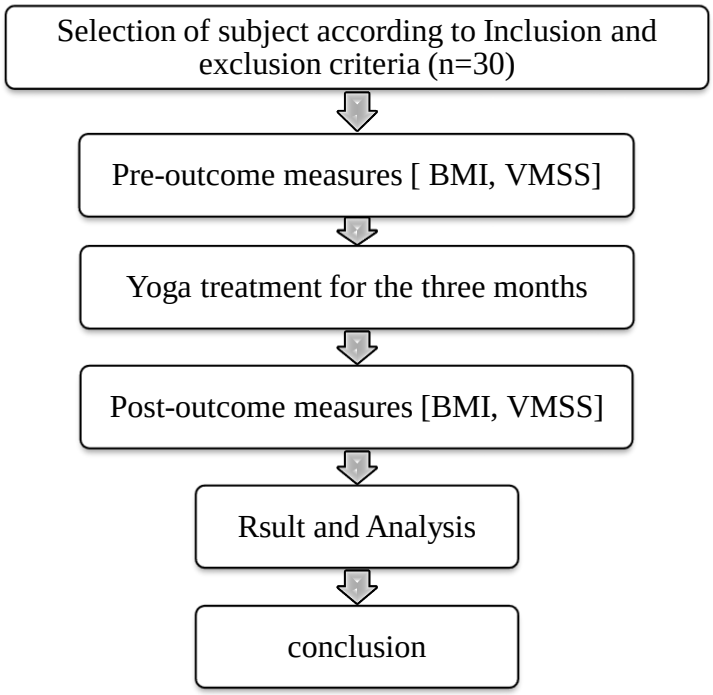


CHART 1: CHART OF STUDY PROCEDURE

The study a quasi -experimental one way study was undertaken by collecting data by convenient sampling of 18-30 age adolescent girls. First of all 30 patients will be selected according to the inclusion and exclusion criteria from the hospitals. Newly diagnosed and a case of PCOD but not under treatment. The patients have already diagnosed dysmenorrhoea severity. All of that patients presenting with complaints of weight gain, irregular periods from several years, lethargy, increased appetite and heaviness in the body.

At the second stage Informed consent was obtained from all the participants. Following which the study was initiated a thorough history was collected using questionnaire in favor of pre outcome measurement.

From all the participants including personal details such as name, age, address and phone number, medical history of any menstrual irregularities (Amenorrhoeal Oligmenorrhoea /menorrhagia) Hyperandrogenism features like (Hirsutism, Acne, Alopecia), history of other exclusion features were collected in detail. As well the Physical examination must be taken in this General examination was done

Height in inch's and weight in kilograms were measured and Body Mass Index (BMI) was calculated as weight/height in meter square; additionally VMSS (verbal multidimensional scoring sysrem) to assessment as concerns to dysmenorrhoea severity. All of that patients presenting with complaints of weight gain, irregular periods from several years , lethargy, increased appetite and heaviness in the body .

After the second stage, all participants will be asked to sign a consent with clear information about the research which will provide a clear understanding of the research project , procedure or treatment and clinical trial. It also includes information of possible risks and benefits, including what the researcher is doing in the field. If a person chooses to take part in the treatment, procedure, trial, or testing, she needs to signs the form to give official consent.

Next stage would be yoga therapy (yoga specific for PCOD along with weight loss) .Therefore for the management of obesity physical exercise, fat reducing medicine and diet is necessary. In this case only Yogasanas were advised without any medicinal treatment and diet management.

Patient prescribes Surya Namaskar, along with pelvic opening asanas. In these yoga package these asanas will include: Suryanamaskar (start with 5 rounds and then slowly increasing the number), Baddhakonasana, Supta baddhakonasana, Ustrasana, Shalabhasana (with 7 repetition) .

These Asanas practiced early in the morning with empty stomach for 45 mins to one hour per day for 3 months. Prior to therapy 6 days of training was given to participant. Participant didn't had any previous experience of yoga practice. Total duration of each asanas during six days training period for three months. While doing these asanas abdomen, thighs and spine are stretched. Stretching helps to reduce extra fat which is accumulated over abdomen, thighs. That's why these Asanas were selected for the study.

PHOTOGRAPH: 3 PATIENTS PERFORMING YOGASANAS

PHOTOGRAPH: 4 PATIENTS PERFORMING YOGASANAS

When patient start practicing yoga, patient was made to perform for 35 mins for seven days of training according to the schedule given in table number 1.

After 7 days yogasana training, duration of asanas was increased. This was followed for 1 hour 15min daily in the morning with empty stomach. Schedule of Yoga therapy practiced for three months by patient as shown in table number 2.

Sr.No.	Yogasanas	Duration	repetition	Rest	Total duration
1	Suryanamaskar	10 min	5	-	10 min
2	Baddhakonasana	30 sec	5	30 sec	3 min
3	Suptabaddhakonasana	30 sec	5	30 sec	3 min
4	Ustrasana	30 sec	5	30 sec	3 min
5	Shalabhasana	30 sec	5	30 sec	3 min

TABLE: 1 YOGA TERAPY FOR SEVEN DAYS

Sr.No.	Yogasanas	Duration	repetition	Rest	Total duration
1	Suryanamaskar	10 min	7	-	10 min
2	Baddhakonasana	30 sec	7	1min	7 min
3	Suptabaddhakonasana	30 sec	7	1min	7 min
4	Ustrasana	30 sec	7	1min	7 min
5	Shalabhasana	30 sec	7	1min	7 min

TABLE: 2 YOGA TERAPY FOR THREE MONTH

In last stage After three months of regular yoga practice history was collected using questionnaire in favor of post outcome measurement from all the participants including personal details such as medical history of any menstrual irregularities (Amenorrhoeal Oligmenorrhoea /menorrhagia). Hyperandrogenism features like (Hirsutism, Acne, Alopecia), history of other exclusion features were collected in detail. In General examination, height and weight were measured in inches and kilograms respectively. In addition physical examination should must be taken and Body Mass Index (BMI) was calculated as weight/height in meter square; additionally VMSS (verbal multidimensional scoring system) to assessment as concerns to dysmenorrheal severity .

RESULT

Study variables were done before starting physiotherapy sessions on group and at the end of the study, study variables include BMI and VMSS.

Data analysis:

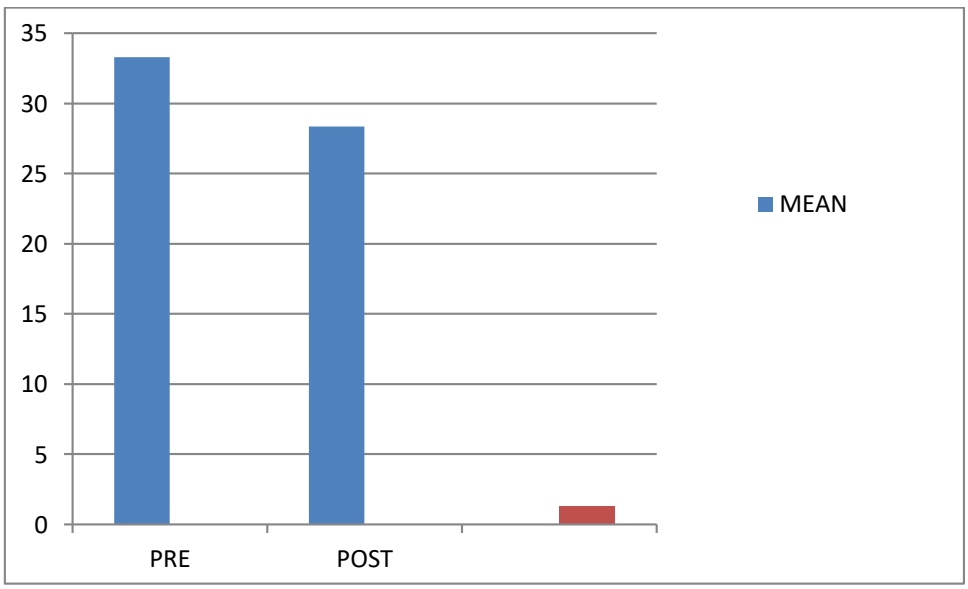
Statistical analysis was performed on the data obtained from 30 patients. Data was analyzed using Social Science statistics. It was a website which working with statistics. Descriptive statistics for all outcome measures were expressed as mean, standard deviations and test of significance such as paired‘t’ test used for comparing within group and comparing between the groups. Data was considered statistically significant with $P<0.05$ and highly significant at $p<0.01$. Pre and post mean difference of BMI shows 33.28 ± 26.64 in pre date collection and 28.36 ± 21.77 in post data collection. As $p<0.05$ there is significant difference between group. Pre and post mean difference values of VMSS shows 2.33 ± 14.67 and 0.93 ± 23.87. This shows a significant difference between two groups.

Group	Mean	Mean Difference	Standard Deviation	"t" Value	"p" Value
Pre Test	33.28	4.29	26.64	4.29812	P<0.05
Post Test	28.36	4.29	21.77		P<0.05

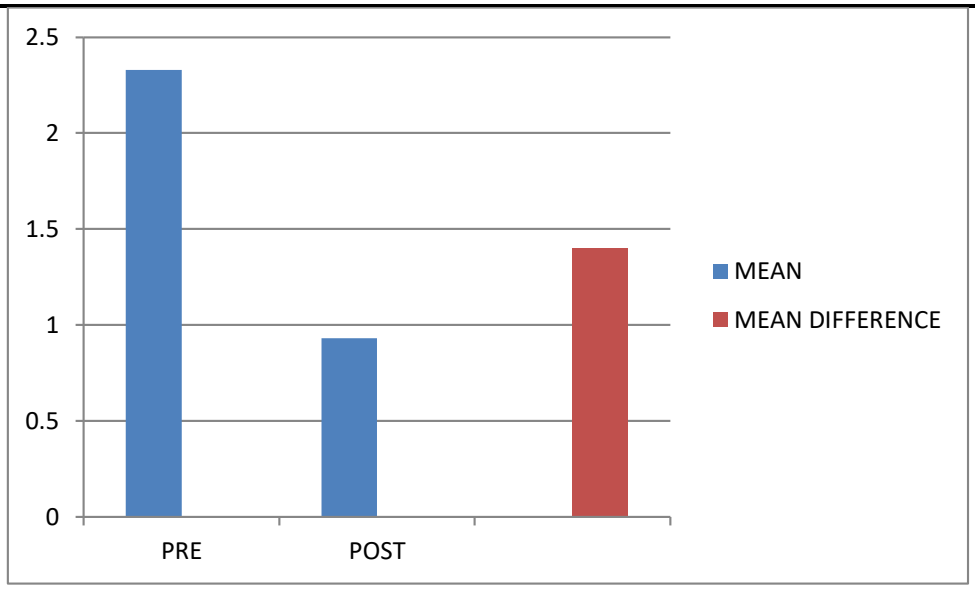
TABLE 3: PAIRED "T" TEST VALUES FOR BMI

Group	Mean	Mean Difference	Standard Deviation	"t" Value	"p" Value
Pre Test	2.33	1.4	14.67	-6.65226	P<0.05
Post Test	0.93	1.4	23.87		P<0.05

TABLE 4: PAIRED "T" TEST VALUES FOR VMSS



GRAPH 1: MEAN VALEUE FOR BMI



GRAPH 2: MEAN VALUE OF VMSS

Outcome Measures	"t" Value	"p" Value
BMI	4.29812	P<0.05
VMSS	-6.65226	P>0.05

TABLE 5: INDEPENDENT "T" TEST VALUES

DISCUSSION

Obesity, hormonal imbalance, mental health problems such as depression, anxiety, stress, etc are among the most common reasons for individuals to seek treatment with Yoga, Asanas and Pranayama. Yoga encourages one to relax, ease the breath and focus on the present,shifting the balance from the sympathetic nervous system and the flight-or-fight response to the parasympathetic system and the relaxation response. It effects are mainly calming and restorative; it lowers breathing and heart rate, decreases blood pressure, lowers cortisol levels, and increases blood flow to the intestines and vital organs.[9]

Yoga calmness of the mind and create a sense of well-being, feelings of relaxation, improved self-confidence, improved efficiency, increased attentiveness, lowered irritability, and an optimistic outlook on life, it also help us treating the symptoms of PCOD such as obesity, stress and hormonal imbalance. It optimizes the body's sympathetic responses to stressful stimuli and restores autonomic regulatory reflex mechanisms associated with stress. The regular practice of Yoga results in lower anxiety, heart rate, respiratory rate, blood pressure, and cardiac output in students practicing yoga and meditation. Consistent yoga practice improves depression and can lead to significant increases in serotonin levels coupled with decreases in the levels of monamine oxidase, an enzyme that breaks down neurotransmitters and cortisol.[9]

Yoga increases blood flow and levels of hemoglobin and red blood cells which allows for more oxygen to reach the body cells, enhancing their function and reducing stress and improving metabolism.Many yoga asanas and postures lowers the resting heart rate, increases endurance, and can improve the maximum uptake and utilization of oxygen during exercise.[9]

The significant positive effects of yoga in reducing stress, anxiety, and depression have been confirmed.

CONCLUSION

Daily yoga for 30 minutes with 5 Asanas along with meditation and Shavasana helps in weight reduction and stress management which ultimately stabilize the normal function of hypothalmo-pituitary–ovarian axis and cure PCOD.

SUMMARY

A study was conducted to evaluate the effect of Yoga therapy on autonomic function and adrenal fatigue in patients with polycystic ovarian disease. 30 PCOD patients were participated in the study & they were given Yoga therapy for 45mins to one hour per day for 3months with 6 days for week. Before and after the therapy, subjects underwent pre and post outcome measurement. The results showed not only a significant reduction in BMI but also regular period cycle per month.

LIMITATION

- Small sample size
- Age group is limited in 18-30 years

FUTURE RECOMMENDATION

Further research can replicate these findings in other variation such as large group or large age group. In addition, comparison between two groups as well as comparison between exercises and yoga. Lastly, yoga therapy with diet plan.

ABBREVIATIONS

- **PCOD:** polycystic ovarian dieses
- **PCOS:** polycystic ovarian syndrom
- **VMSS:** verbal multimensiona scoring system
- **FSH:** follicle Stimulating Hormone
- **LH:** Luteinizing Hormone
- **GnRH:** Gonadotrepin-releasing hormone
- **BIM:** Body Mass Index

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"EFFECTS OF YOGA THERAPY ON PHYSICAL AND PSYCHOLOGICAL QUALITIES OF LIFE IN PERIMENOPAUSAL WOMENS- AN EXPERIMENTAL STUDY"

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ABSTRACT

Background: Perimenopausal period is characterized by a continuous decline in ovarian function due to which women are vulnerable to various physical and psychological symptoms affecting quality of life. Currently these symptoms are managed by hormone replacement therapy. However, hormonal therapy can cause complications including malignancy which has resulted in search for various alternative therapies to improve the quality of life (QOL). Yoga is one such alternative therapy shown to enhance the QOL at all stages of human life associated with the chronic illness. There are very few scientific studies regarding the effect of yoga on perimenopause and in this study, we investigated the effects of yoga therapy on physical and psychological symptoms using the standardized questionnaire.

Objective: To study the effect of yoga therapy on physical and psychological symptoms of perimenopause.

Materials and Methods: It is a prospective non-randomized control study of 56 perimenopausal women with 12 weeks of intervention. The subjects were divided in two groups with either yoga therapy [n = 28] or exercise [n = 28] as the interventional tool. The symptoms control and QOL before and after intervention in both the groups were assessed by using the MENQOL which is standardized questionnaire.

Results: The perimenopausal symptoms in all domains were improved by yoga therapy, thus significantly improving the overall QOL compared to the control group.

Conclusion: This study clearly demonstrates the effectiveness of yoga therapy in managing the distressing perimenopausal symptoms. It is easy, safe, non-expensive alternative therapy helping the well-being of perimenopausal women and must be encouraged in the regular management of perimenopausal symptoms.

Key Words: MENQOL questionnaire, perimenopausal QOL, yoga therapy.

INTRODUCTION

Menopause is an important event in the life of a women when reproductive capacity ceases. During this transitional phase, woman exhibits severe and multiple symptoms. Frequently reported symptoms fall into several categories, including physical disturbances such as hot flushes, psychological complaints such as mood swings, and other changes that may impair personal or social interactions and diminish the overall quality of life.[1] It was seen that in 1990, there were an

estimated 467 million women in this state and this number is expected to increase to 1,200 million by the year 2030. [2]

According to the Indian Menopause Society [3] there will be a large increase in the perimenopausal women in India also. Most women in India over the age of 45 years do not understand the changes taking place in their bodies and spend their valuable years of life battling problems and diseases associated with perimenopause. Hence it becomes very important to develop methods and treatment plans to control perimenopausal symptoms and thereby to improve the quality of life of this large group of women.

DIFFERENCE BETWEEN PERIMENOPAUSE AND MENOPAUSE: Perimenopause is the period of a woman's life shortly before the occurrence of menopause. A women's body will begging the process of menopause meaning the hormone production from the ovaries is beginning to decline.

SYMPTOMS: The common symptoms include

- Irregular menses - As ova production in ovary reduces oestrogen production becomes erratic leading to Irregular menses
- Hot Flashes - Due to blood vessels dilation near the skin as a result of reduced estrogen
- Night sweats - Due to hot flashes
- Weight gain - oestrogen deficiency leads to weight gain
- Mood swings - Perimenopause has increased risk of depression
- Breast tenderness - Due to oestrogen induced water retention
- Alteration of blood cholesterol - Elevated oestrogen favours high density lipoprotein which reduces blood cholesterol
- Low bone density - oestrogen is involved in maintaining equilibrium of calcium in bone

BENEFITS OF YOGA IN PERIMENOPAUSAL WOMEN:

1. It relieves stress: yoga can also help women better manage and support Overall mood
2. A consistent practice may reduce blood pressure: Some research shows blood pressure may increase after menopause due in great part to the hormonal changes that take place in the body. Fortunately, yoga is a traditionally utilized antidote. A consistent practice may help promote better oxygenation and blood circulation throughout the body.
3. Yoga promotes good joint health: Research shows a frequent, and consistent yoga practice may help relieve joint pain Not all menopausal women have arthritis, but the condition does increase with age.
4. Yoga may help lead to fewer hot flashes.

NEED OF STUDY

Yoga, the traditional Indian body-mind science has been used effectively in various health disorders affecting almost all the major organ system including cardiovascular, respiratory, neuroendocrine, gastrointestinal and musculoskeletal system. [12-15] Since perimenopause also affects several organ systems, this study is conducted to evaluate the effects of yoga therapy on menopausal symptoms.

AIM

- To study the effects of Yoga Therapy on Physical and Psychological Quality of Perimenopausal Women

OBJECTIVE

- To study the effects of Yoga Therapy on Physical Quality of Perimenopausal Women
- To study the effects of Yoga Therapy on Psychological Quality of Perimenopausal Women

HYPOTHESIS

1) NULL HYPOTHESIS

There are no significant effects of Yoga Therapy on Physical and Psychological Quality of life Perimenopausal Women.

2) EXPERIMENTAL HYPOTHESIS

There are significant effects of Yoga Therapy on Physical and Psychological Quality of life Perimenopausal Women.

METHODOLOGY

Study Design: An Experimental Study
Source Of Data: Near Ahmedabad
Population: Perimenopausal Women
Sampling Method: Random Sampling
Duration Of Study: 3 Months
Sample Size: 56

Materials and Tools Used:

1. Consent form
2. Pen,
3. Pencil
4. Paper
5. Plinth and
6. Pillow
7. Assessment form

Inclusion Criteria:

1. Aged between 40-50 years,
2. Subjects willing to participate,
3. Subjects able to practice yoga or exercise protocols and,
4. Subjects who are having perimenopausal symptoms.

Exclusion Criteria:

1. Women who were already practicing yoga for a month or more,
2. Women with surgical menopause and receiving any kind of hormone therapy and
3. Active psychological disorders or any other medical disorders.

Outcome Measures:

MENOPAUSE-SPECIFIC QUALITY OF LIFE QUESTIONNAIRE (MENQOL) [13]

The self-administered questionnaire utilized in this study included socio-demographic information with menstrual history and the menopause-specific quality of life questionnaire (MENQOL). MENQOL is a self-administered, 'scaled' 29-item survey questionnaire, designed to measure quality of life in menopausal women and also to measure the extent to which an individual is affected by menopausal symptoms. It comprises the four domains, Vasomotor, Psychosocial, Physical and Sexual, which are graded separately.

Procedure:

This interventional study included 56 perimenopausal women divided into two groups. One group practiced yoga therapy (test group, n = 28) and the other practiced a set of physical exercise (control group, n = 28).

The subjects were from local community and recruited through personal contacts with various women's organizations, clubs and self-help groups. The informed oral consent was obtained from the subjects before starting the intervention.

After taking informed consent patients were divided into 2 groups by simple random sampling method and treatment was given for 3 months.

Group A: Subjects of these group received Yoga therapy.

Group B: Subjects of these group received conventional treatment (Exercise Program).

The intervention program in both groups were started by collecting the baseline data, teaching and practicing the respective protocols for 45 minutes every day, follow-ups and collection of post-interventional data after 12 weeks of practice.

FLOW CHART OF THE STUDY PROCEDURE

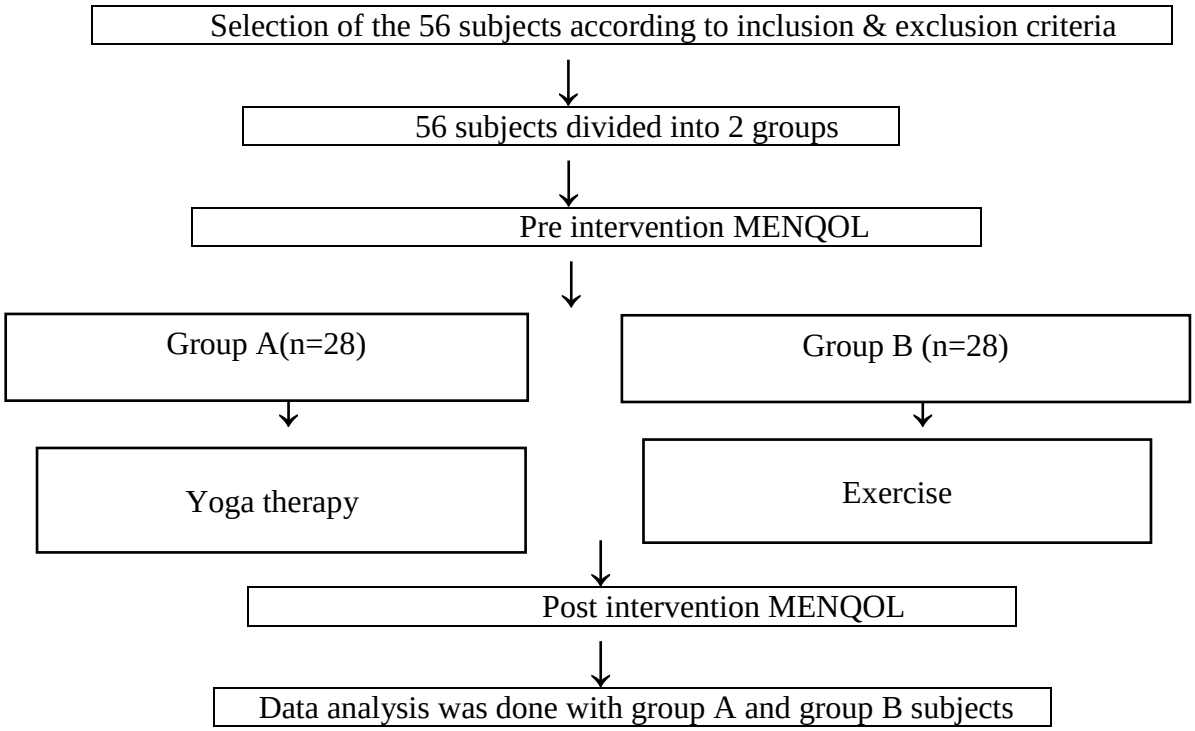

Figure 1: Flow chart of study Procedure

The yoga therapy module used was developed on the basis of Patanjali yoga [16] and Hatha yoga [17] to address the physical, psychological and emotional symptoms with suitable practice of asanas, pranayama and dhyana to result in improvement of overall quality of life. The control group practiced a set of exercise program.[18]

GROUP A: YOGA THERAPY (TEST GROUP)

1. ASANAS (Body postures)

- Sitting: Vajrasana, supta vajrasana Pascimottanasana, Poorvatanasana, Janusirsasana, Upavistakonasana, Baddhakonasana, Vakrasana, Ashvinimudra.
- Standing: Tadasana, Trikonasana, Parshvakonasana.
- Lying on the back (supine): Pavanamuktasana, Padottanasana.
- Lying on the stomach (Prone): Bhujangasana, Shalabhasana, Dhanurasana, Paryankasana.

Figure 2: Asanas

2. PRANAYAMA (Breathing practices)
    - Anuloma-viloma (alternative nostril),
    - Surya bhedana (right nostril),
    - Chandrabhedana (left nostril),
    - Sheetali (through tongue) and
    - Bhramari (honey bee sound during exhalation).

3. Relaxation: Deep relaxation in shavasana (corpse pose).

4. Meditation: 'So Ham' dhyana sitting in meditative postures like swastikasana

GROUP B: EXERCISE INTERVENTION (CONTROL GROUP)

1. Loosening exercises:
    - Sitting: Passive rotation of toes, Toe bending, Ankle bending, Ankle rotation, Knee bending, Knee rotation, Knee cap tightening, Half butterfly, Full butterfly, Neck bending, Neck rotation.
    - Standing: Waist rotation, Wrist rotation, Shoulder rotation.
    - Each one repeated for 10 rounds or 10 rotations.
2. Strengthening exercises (While standing/ Sitting).
    - Wrist — Stretching arms straight in front, make the tight fist, palm facing down, move the fist up and down vigorously from the wrist-10 times.
    - Palms — Holding near the chest bending at the elbow, spread the fingers, and move palms up and down vigorously from the wrist.
    - Fingers — Throwing out the arms in front, give the fingers of both the arms the shape of the hood of cobra, stiffen the entire length of the arms from the shoulder joints to the finger tips till they start trembling-5 times.
    - Elbows — Stretch the arms straight down beside the body, make the tight fist of the palms, and raise the fists forward up to the level of the shoulder with a jerk-10 times.
    - Arms — Make the fists of hands with thumb tucked in, bend the elbow and raise the forearms till they parallel to the ground, push both the arms forward forcefully and vigorously to the level of the shoulder-10 times.

Figure 3: Strengthening Exercise of wrist

- Back — Spreading the legs apart as far as possible, place the hands on the hips bend backward from the waist as far as possible and then forward without bending the knees till head reaches the ground-5 times.
- Thighs — Stretch out the arms facing down straight in front at the shoulder heights, inhaling bend the knees till thighs come parallel to the ground, and then come up exhaling-5 times.
- Calves — Stretch out the arms facing down straight in front at the shoulder heights, inhaling squat and go down as far as possible-5 times. Supine rest 5 to 10 minutes.

RESULT

Statistical analysis

All pre and post data were analyzed by using SPSS Version 16. The individual variables were evaluated to determine the changes in two groups after 12 weeks. The pre and post data of MENQOL questionnaire was analyzed.

The effectiveness was calculated as 'within the group' (yoga and control group), 'between the groups' (yoga vs. control).

Sr. No.	Variables	Yoga	Control
1	Age	47.03 ± 2.56	47.54 ± 2.17
2	BMI	26.08 ± 3.07	26.89 ± 3.45
3	Menstruation regular	6	8
4	Menstruation irregular	13	11
5	No Menstruation	9	9

Table 1: Demographic Data

The largest categories of women were between 46 and 50 years of age. No significant difference was observed between the groups regarding body mass index and menstrual history is shown in Table 1. There was no significant difference between the groups ($P > 0.05$). In the psychosocial domain, large number of women from both the groups (72% to 79%) complained experiencing poor memory as the most prevalent symptom followed by feeling of anxiety, loneliness, depression and impatience. Two of the questions in this domain that is being dissatisfied with personal life and accomplishing less what I used to do were recorded more significantly by control group compared to the yoga group ($P < 0.05$) while other attributes from this domain were all comparable ($P > 0.05$). All the symptoms in the physical domain except for flatulence and muscles and joint pains were comparable in both groups without any significant difference.

Groups	Within group analysis	Mean Difference	Standard Deviation	"t" Value	"p" Value
Group A	Pre-Test Post Test	-1.59	0.64	-8.9	P<0.05
Group B	Pre-Test Post Test	-0.68	0.18	-7.09	P<0.05

Table 2: Paired "t" test values for MENQOL

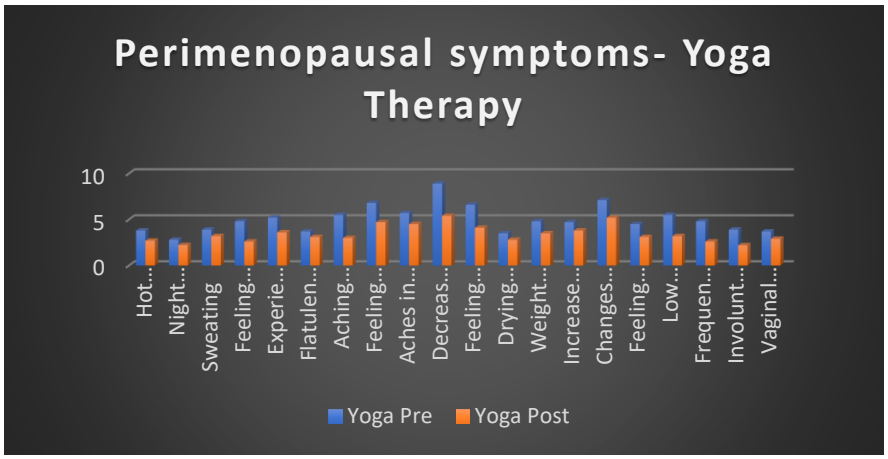

Figure 4: Yoga therapy and effect on Perimenopausal symptoms

The results of effect of yoga therapy (test group) and exercise (control group) on the symptoms of all the two domains are presented in Table 2. In the psychosocial domain, yoga therapy resulted in the significant difference in all the symptoms while exercise therapy resulted in the improvement of four symptoms but failed to provide relief for the remaining symptoms. All the symptoms in the physical domain were significantly improved in yoga group. In control group, highly significant ($P < 0.05$) decrease was observed only in one symptom and moderate in other six symptoms. The symptom of aching in muscles and joints was relieved somewhat after physical exercise and no significant change was observed in the remaining symptoms.

Outcome Measures	"t" Value	"p" Value
MENQOL	-3.48	P<0.05

Table 3: Independent "t" test values

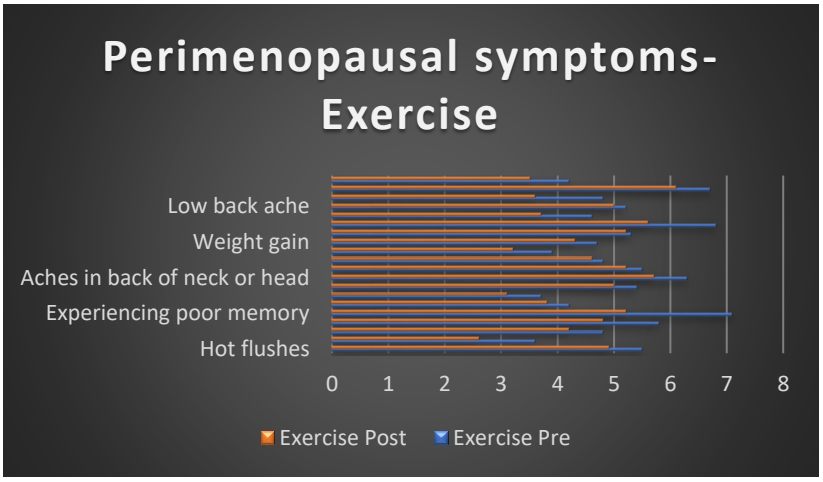

Figure 5: Exercise and effect on Perimenopausal symptoms

The effect size' was greater in yoga therapy group in all domains compared to the control group. 'Between the group effect', there was significant difference between the groups in all domain ($P = 0.53$) [Table 3]. The overall quality of life is measured by the mean of overall scores of each domain and yoga therapy group showed a very significant improvement ($P < 0.05$) compared to control group.

DISCUSSION

The present study thus clearly documents the significant presence of various perimenopausal symptoms in the local population severely affecting the quality of life. Many of these women expressed their distress and helplessness regarding these symptoms, which were seriously interfering in their day-to-day living. Thus, there is a need to search and develop a cost-effective, simple, community-based therapeutic tool to provide symptom relief and to improve health status, and in this perspective yoga has emerged as the appropriate system to deal effectively with issues related to perimenopause.

The present study clearly demonstrates the clinical utility of yoga in significantly reducing the perimenopausal symptom in all domains and thereby improves the overall quality of life. Asanas, pranayama and dhyana, the components of yoga therapy, seem to improve the symptom profile in the all domains through several physiological and biochemical mechanisms. The improvement in physical strength and fitness caused by yoga seems to be related to several factors like muscular strength and endurance, flexibility, cardiorespiratory fitness, body composition and pulmonary function.[19] The intense stretching and muscle conditioning associated with attaining and holding yoga postures increases the skeletal muscle oxidative capacity and decrease glycogen utilization, possibly caused by increased vascularization, increased intramuscular oxygen and glycogen stores or by increased numbers of mitochondria.[20] Yoga practice also may increase the absorption of the calcium from the intestine, stimulate bone remodeling and maintain the load bearing capacity of the bone; reduces the pain in the back of the head, neck, lower back and headache by influencing limbic system modulation of endogenous pain control system.[21]

This impact of yoga seems to be due to its effect on the functioning of nervous system leading to increase in alpha rhythm, intra hemispheric coherence and homogeneity in the brain [22,23] and increase in P 300 phase amplitude [19] all of which seems to enhance the cognitive processes. Menopausal anxiety can be a very difficult symptom to manage, but yoga therapy showed significant improvement compared to physical exercise. Several mechanisms like altered neurotransmitters, changed brain blood flow and brain metabolism and sympathetic activation seems to be responsible for this improvement brought by yoga practice. [24]

Compared to physical exercise group, yoga showed most significant effect in managing the symptoms of vasomotor domain. All the three symptoms in this domain, that is, hot flushes, night sweats and sweating were significantly reduced in the yoga group while no improvement was observed in any of the symptoms in control group. Especially, the improvement in hot flushes through yoga was very rewarding, since this is most difficult symptom to manage and affects the overall quality of life. The vasomotor symptom improvement brought about by yoga intervention seems to be due to its effect in modulating autonomous nervous system with special attention to decreased sympathetic nervous system activation [25] which in turn seems to affect the thermoregulation resulting in vasodilatation and sweating.[26]

The yoga postures used in this study are known to improve the tone of the muscles of pelvic region and enhance the blood circulation to the urogenital area.[27] Thus, yoga improved most of the symptom profile thus contributing significantly in the improvement of overall quality of life. Yoga is relatively simple to learn and is economical, non-invasive with multiple collateral lifestyle benefits. Group and individual practice may also help to improve lifestyle choices and health-related attitudes in part, by enhancing psychological well-being and thereby contributing significantly to chronic disease protection and health promotion.

Though most of the clinical effects of yoga are probably brought about by vagal stimulation and parasympathetic activation, the complete mechanisms underlying the reported benefits remain poorly understood. Clearly, additional high-quality research is warranted to confirm and further explore the putative beneficial effects of yoga in perimenopausal women.

CONCLUSION

This study clearly demonstrates the effectiveness of yoga therapy in managing the distressing perimenopausal symptoms. It is easy, safe, non-expensive alternative therapy helping the well-being of perimenopausal women and must be encouraged in the regular management of perimenopausal symptoms.

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"EFFECT OF PILATES EXERCISE VERSUS MYOFASCIAL RELEASE IN PATIENTS WITH CHRONIC LOW BACK PAIN - A COMPARATIVE STUDY"

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ABSTRACT

BACKGROUND: Chronic low back pain is defined as pain, muscle tension or stiffness localized below the costal margin and above the inferior gluteal folds, persists for 12 weeks or more. For treating Chronic Low back pain various techniques are available. Basic aim is to compare the effect of Pilates exercise and MFR technique in patients with chronic low back pain.

METHODOLOGY: After taking informed, written consent patients were divided into 2 groups by simple random sampling method. Group A received Pilates exercise plus conventional treatment and Group B received MFR technique plus conventional treatment. Both groups received treatment 4 sessions per week for 4 weeks. Pre and post intervention NPRS were measured. Data were analyzed with both groups.

RESULT: As the data followed normal distribution, parametric tests were used. Paired t test was applied to analyze pre and post outcome measures between both groups. Both the groups showed significant improvement in NPRS scores in within group analysis ($p<0.05$) but there was no statistically significant difference found in NPRS at the end of 4 weeks in between groups analysis ($p>0.05$).

CONCLUSIONS: The present study concludes that Pilates exercise along with conventional treatment and MFR technique along with conventional treatment, both are equally effective in reducing pain in patients with Chronic Low Back Pain.

KEY WORDS: Pilates exercise, MFR technique, Chronic low back pain.

INTRODUCTION

Chronic low back pain is defined as a pain, muscle tension or stiffness localized below the costal margin and above the inferior gluteal folds, which persists for 12 weeks or more[1] Exercise training has collectively been shown to be effective in reducing pain when compared with non-exercise training-based treatments in adults. [2] Risk factor of chronic low back are female sex, middle age, sedentary lifestyle as well as strenuous physical activity, occupational overload, smoking and obesity. [3]

Pilates exercise used for the core strengthening, posture and breathing pattern also. These exercises aim to improve static and dynamic stability, posture and ADLs. [4] The use of specialized Pilates exercise requirements are spring resistance, such as reformer has also recommended for Chronic Low Back Pain (CLBP) patients. [5] It has recommended in management of people with CLBP, this type of exercise helpful to strengthen deep and stabilizing muscle which support to the lumbar spine (transverse abdominis muscle). The muscles are inhibited in people with CLBP. [6]

Myofascial release (MFR) used for manual medicine which include the application of low-load, long duration of stretch to the myofascial complex with intent to restore optimal length of fascia-tissue, reduce pain and improve functional ability. Applied combined intervention of MFR with other therapeutic appear like muscular energy, soft tissue, high velocity-low amplitude thrust and cranial sacral techniques. [7]

Advance stage of research includes the progression towards more functional task giving to the patient to activate of deep muscle and global trunk muscles. [8] In recent years, increased interest in the issues fascia, which until recently was neglected in the etiology of LBP. At the same time as term is defined as fascial system- a network that has ability to transfer forces, where separate elements manually interact and form complex involved in traversing.

Those patients which suffering from long time CLBP gives rise to, restrictions within the fascial tissues. The combination of different structures of the complex lumbar-pelvic- hip joint may cause the source of pain is a considerable distance from the origin of pain. [9] Long standing limitation of motion occurring in people with risk factors for development of LBP, it's cause restrictions within the fascial tissue. Restrictions can cause abdominal tension which lead to an increase in excitability of receptors located in the fascia, bone structures involve in wrong direction, thus leading to excessive compression in the intervertebral joints. As a result, dysfunction and pain.[10]

NEED OF THE STUDY:

According to research done in past the Myofascial release and Pilates both methods individually when given shown beneficial effects but no studies were compared these methods. Both methods are individually effective in low back pain according to the previous research article but which one is more beneficial to reduce pain is not shown till now. Our need of the study is to compare both treatments so it is helpful in clinical practice for better treatment outcome.

AIM AND OBJECTIVES:

AIM: - To compare effects of Pilates exercise and MFR in people with CLBP.

OBJECTIVES: -

1. To find out the effects of Pilates exercise in CLBP on pain

2. To find out the effects of MFR in CLBP on pain

3. To compare effects of Pilates exercise and MFR on pain

HYPOTHESIS:

1. NULL HYPOTHESIS:

- There is no significant difference between effect of MFR and Pilates in chronic low back pain patients.

2. **ALTERNATIVE/ RESEARCH HYPOTHESIS:**

- There is significant difference between effect of MFR and Pilates in chronic low back pain patients.

METHODOLOGY:

STUDY DESIGN**:** A Comparative study

SOURCE OF DATA: OPD of Venus Institute of Physiotherapy

POPULATION: Chronic low back pain patient (Age between 30 to 50 years)

SAMPLING METHOD: Simple random sampling

DURATION OF STUDY: 4 weeks

TREATMENT DURATION**:** 4 sessions per week for 4 weeks

SAMPLE SIZE**:** 30 (Calculated via following formula) [11]

$N = 4\,\Sigma^2\,(Z_\alpha + Z_\beta)^2 / D^2$

N = Sample size

Σ = Standard Deviation

Z_α = Level of desired significance (1.96)

Z_β = Desired Power (0.84 for 80% power)

D = Effect size (Mean difference)

A) Group A: 15

B) Group B: 15

METHOD OF SELECTION OF SUBJECTS: -

INCLUSION CRITERIA:

- Patient's willingness to participate
- Both males and females
- Age group between 30-50 years
- Patient having chronic low back pain with more than 3 months
- Without identifiable specific anatomical/neurological factors

EXCLUSION CRITERIA:

- Any orthopedic or neurological condition of lumbar spine

- Patient with previous spinal injury
- Spondylolisthesis
- Past history of vertebral fractures
- Cancer of spine
- Tuberculosis of spine

MATERIALS AND TOOLS REQUIRED: -

1. Consent form
2. Pen, pencil, paper
3. Plinth and Pillow
4. Pilate mat
5. Transcutaneous electrical nerve stimulation (TENS) unit with gel, cotton and
6. Micro-pore

OUTCOME MEASURES: -

NUMERICAL PAIN RATING SCALE (NPRS): [12]

- The NPRS for pain is a Uni-dimensional measure of pain intensity in adults. Similar to visual analogue scale (VAS), the NPRS is anchored by describing pain severity extremes. The NPRS can be administered verbally on graphically for self-completion.
- A 11-point numeric scale with 0 representing one pain extreme (e.g., no pain), and 10 representing the other pain extreme (e.g., "pain as bad you can imagine" and "worse pain imaginable"). The patient is asked to indicate the numeric value on the segmented scale that best describes their pain intensity. Scores range from 0-10. Higher scores indicate greater pain intensity.
- Reliability: High test-retest reliability has been observed in both literate and illiterate patients with rheumatoid arthritis (r=0.96 and 0.95, respectively) before and after medical consultation.
- Validity: For construct validity, the NPRS was shown to be highly correlated to the VAS in patients with rheumatic and other chronic pain conditions (pain>6 months) range from 0.86 to 0.95.

CLINICAL INTERVENTIONS: -

All the participants/ patients of the study were advised to continue their normal routine activities but they should not take any pharmacological agents or other form of treatment Other than the designed protocol, during the period of study. After taking informed consent patients were divided into 2 groups by simple random sampling method and treatment was given 4 sessions per week for 4 weeks.

Group A: Patients of these group received Pilates exercise plus conventional treatment.

Group B: Patients of these group received MFR technique plus conventional treatment.

Conventional therapy for both groups:

Patients received conventional therapy in the form of Transcutaneous Electrical Nerve Stimulation [Pulse width - 50-300 µs, Frequency - 150 Hz, Pulse shape - rectangular shape, Intensity - 0 to 60 mA (Milliamps) (It can be varying from patient to patient), Duration - 10 minutes], hamstrings and calf stretching, cat and camel exercise, extension of trunk (cobra pose), static glutes and static back exercise for 4 days a week for 4 weeks.

FLOW CHART OF THE STUDY PROCEDURE

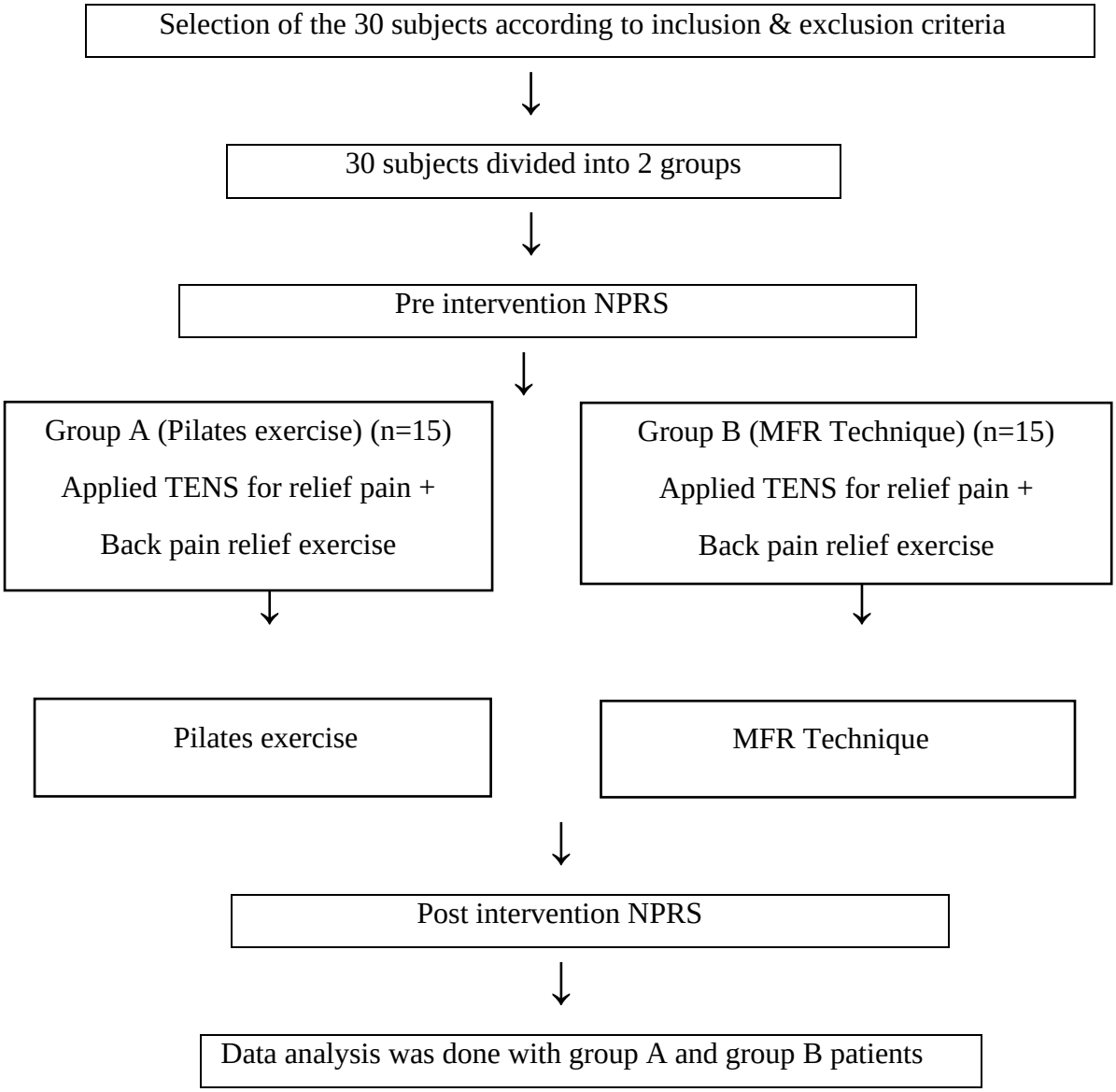

Figure 1: Flow chart of study Procedure

■ **<u>Group A [Pilates exercise plus conventional treatment]</u>:**

Pilates exercise: -

(1) <u>CURL-UPS</u>:

- Patient position: supine with knee semi-flexed
- First instruct the patient to perform the contraction of abdominal muscles and then lift the head. Progress by lifting the shoulders until the scapula and thorax clear the mat, keeping the arms horizontal.
- Hold this position as much as patient can (maximum 10 seconds) and then relax. 10 repetitions with 3 second interval.

(2) <u>BRIDGING</u>:

- Patient position: hook-lying position
- Have the patient press upper back and feet into the met, elevate the pelvis and extend the hips.
- Hold this position for 10 seconds and then relax. 10 repetitions with 3 second interval.

(3) KNEE TO CHEST:

- Patient position: supine
- Gently pull one knee up to chest until feel a stretch in lower back. Bring the knee as close to your chest as comfortably possible. Keep the opposite leg relaxed in a comfortable position, either with knee bent or with leg extended. Hold for about 5 seconds and then relax. 10 repetitions with 3 second intervals.

(4) BILATERAL STRAIGHT LEG RISING:

- Patient position: supine
- Bend the knee of one leg at 90-degree angle, planting the foot flatly on the floor. Stabilize the muscles on straight leg by contracting the quadriceps.
- Inhaling slowly, lift the straight leg at least 6 inches off the ground. Hold for 3 seconds then relax. 10 repetitions with 3 seconds interval.

(5) BIRD DOG EXERCISE:

- Patient position: Quadruped
- Place patient's knees under their hips and their hands under the shoulders. Maintain a neutral spine by using an abdominal muscles. Raise right arm and left leg, keeping shoulders and hips parallel to the floor. Hold this position for the few seconds, then lower back down to the starting position. Raise opposite arm and leg (left arm and right leg), holding this position for a few seconds. Return to the starting position. This is 1 round. Repeat this 10 times with 2 sets and each round 3 second interval time.

■ **Group B [MFR technique plus conventional treatment]:**

❖ **MFR technique: -**

- Myofascial release is a hands-on soft tissue technique that facilitates a stretch into the restricted fascia. A sustained pressure is applied into the tissue barrier, after 60 to 90 seconds. The tissue will undergo histological length changes allowing the first release to be felt. The therapist Follows the release into a new tissue barrier and holds. After a few releases the tissue will become softer and more pliable.
- Patient position: prone
- Therapist stands contra lateral to the side to be treated, at the level of patient's iliac crest. The therapist's superior hand is positioned thinner sided adjacent to the lumbar spine with extensive contact at the TFL at the level of L1 to L4 and acts as a palpation hand.
- The superior hand work as a palpation hand and initiates a direct stretch of the fascia laterally to a noticeable tissue resistance. The therapist follows the creep of myofascial tissue to initiate further stretching of the TFL and piriformis muscle. The applied force on the tissue is only moderate in the direction of the abdominal muscles.
- The duration of entire technique is 60 to 90 seconds at the same place of the lower back. [NOTE: The therapist contact (which could involve thumb, finger, knuckle or elbow) moves longitudinally along muscle fibers, distal to the proximal.]

RESULT:

Data analysis: Statistical analysis was performed on the data obtained from 30 patients. Data was analysed using SPSS (Version 16). Descriptive statistics for all outcome measures were expressed as mean, standard deviations and test of significance such as paired 't' test used for comparing data within each group and independent 't' test for comparing between the groups. Data was considered statistically significant with P<0.05. Pre and post mean difference of pain (NPRS) shows 1.46 ± 2.12 in group A and 1.73 ± 1.22 in group B. Independent "t" test values chronic LBP shows not significant difference between both groups.

Table 1: Paired "t" test values for Chronic LBP (NPRS)

Groups	Within group analysis	Mean	Mean Difference	Standard Deviation	"t" Value	"p" Value
Group A	Pre-Test Post Test	5.46 4	-1.46	2.12	-3.8977	P<0.05
Group B	Pre-Test Post Test	6.33 4.6	-1.73	1.22	-5.49	P<0.05

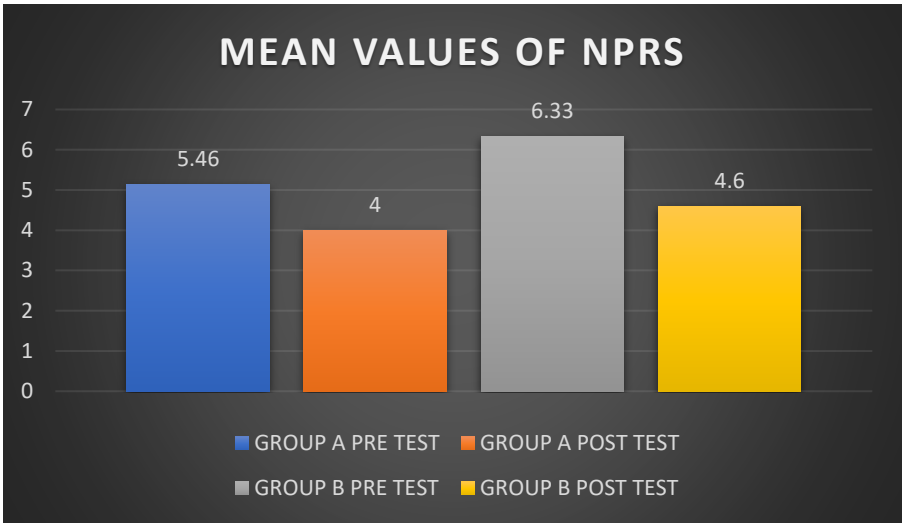

Figure 2. Mean Values of NPRS

Table 2: Independent "t" test values chronic LBP

Outcome Measures	"t" Value	"p" Value
NPRS	-1.16	0.1267

DISCUSSION:

The present study was designed to study effects of Pilates exercise and MFR technique in patients with chronic low back pain. Total 30 patients with low back pain more than 3 months were included in the study with the age group of 30 to 50 years and according to the inclusion and exclusion criteria.

After taking informed, written consent subjects were divided into two groups by simple random Sampling method. Group A received Pilates exercises plus conventional treatment and group B received MFR technique plus conventional treatment. Both groups were assessed before and after treatment duration to determine the extent of reduction of pain using Numerical pain rating scale taken as outcome measures.

At the end of 4 weeks, patients in both groups showed reduction in pain and improvement in NPRS scores on statistical analysis. The result showed that there was no statistically significant difference of effectiveness of pain between Both groups (group A and group B).

So here, both groups were improved after intervention. By comparing NPRS measure group A showed statistically significant improvement in pain equal to the group B. The mean difference of NPRS is almost equal to the both groups. So, Pilates exercise along with conventional treatment and MFR technique along with conventional treatment both are equally effective in reducing pain in patients with Chronic Low Back Pain.

CONCLUSION:

The present study concludes that Pilates exercise along with conventional treatment and Myo Fascial Release technique along with conventional treatment both are equally effective in reducing pain in patients with Chronic Low Back Pain.

LIMITATIONS

- In this study age limit is 30-50 years.
- MFR technique only assessed in chronic low back pain patients.
- Long term follow up is not taken.

FURTHER RECCOMENDATION

- Study can be done with chronic low back pain patients with other age groups.
- MFR technique effectiveness can also be determined for acute low back pain patients.
- Long term follows up of the patients can be taken to compare sustainability of treatment.

ABBREVIATIONS

- **CLBP** = Chronic low back pain
- **MFR** = Myofascial release
- **LBP** = low back pain
- **ADLs** = Activities of daily living
- **TENS** = Transcutaneous electrical nerve stimulation
- **TFL** = Tensor fascia late
- **SLR** = Straight leg raise
- **NPRS** =Numerical pain rating scale
- **VAS** = Visual Analogue Scale

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ATTITUDE AND BELIEF TOWARDS PHYSICAL ACTIVITY AND EXERCISE IN PATIENTS WITH CHRONIC LOW BACK PAIN A LITERATURE REVIEW

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INTRODUCTION

Chronic pain is a major public health problem all over the world.[1] The chronic low back pain is define as the chronic lower back pain is established by the persistence of pain beyond 3 month of symptoms.[1] CLBP can have a debilitating effect on patient's lives, resulting in disability and reducing their ability to carry out activities of daily living.[1] Acute low back pain is pain remains for less than 6 months.[2] Sub-acute back pain is back pain for between 6weeks and 3moths.[2]

Low back pain can affect all age and genders.[2] back pain is then further categorized into specific or non-specific back pain. Non-specific back pain refers to a pain is diagnosed when the cause of back pain is unknown. And specific back pain refers to a specific cause

for the pain, for example an infection or a fracture.[3] back pain is a major health issue in western countries and 60%-80% of adults are likely to experience low back pain[4]. Chronic pain is a significant health problem that leads to major consequences for the individuals afflicted, their families, and society.[4] Chronic pain can lead to various disabilities. Currently, there are in general no curative options for chronic pain, so treatments focus on reducing pain and disability.[4]

Physical activity and physical exercise are commonly prescribed as treatment for chronic pain. Physical activity is defined as any bodily movement produced by skeletal muscles that results in energy expenditure[5]. Physical exercise is described as a subset of physical activity characterized by planned, structured, and repetitive physical activities with an objective to maintain or improve physical fitness.[5] Because the terms physical activity and physical exercise are often used 3 interchangeably in the literature, the term physical activity and exercise (PA&E) is used in this study[6]. PA&E interventions for chronic pain patients can include aerobic exercises, strength exercises, and motor control exercises[6]. PA&E as treatment has shown significant improvements (up to medium effect sizes) for pain intensity, physical disability, and psychological distress in chronic neck pain, chronic low back pain.[6]

WHO defines physical activity as any bodily movement produced by skeletal muscles that requires energy expenditure – including activities undertaken while working, playing, carrying out household chores, travelling and engaging in recreational pursuits.[7] An increase in physical activity is one of the measures that is said to have the greatest positive effect on public health.[7] Physical activity plays an important role in the prevention and treatment of chronic musculoskeletal pain, but chronic pain may implicate a poor rehabilitation outcome.[7] PA increases the blood flow to the back which is important for the healing process of the soft tissues in the back.[7] Physical activity can reduce the risk of chronic disease including cancer, depression, cardiovascular diseases.[8] physical activity is reduced in the people who is suffered from chronic pain.[8]

Activity has been identified as the most important health-related behavior to change, the patients ask health care staff for support in making lifestyle changes.[8] Physical activity increases the blood flow to the back which is important for the healing process of the soft tissues in the back.[8]

The term "physical activity" should not be confused with "exercise", which is a subcategory of physical activity that planned, structured, repetitive, and aims to improve or maintain one or more components of physical fitness.[8] Physical activity to increase aerobic capacity and muscular strength, especially of the lumbar extensor muscles, is important for patients with CLBP in assisting them to complete activities to daily living.[8]

Pain is a subjective and personal experience, and its presence in the chronic form brings not only biological changes but emotional, cognitive and also behavioral changes.[8] The Back Pain Attitudes Questionnaire (Back-PAQ) was developed following these Interviews with people experiencing acute and chronic LBP. It aims to assess beliefs which underlie common attitudes about back pain[9]. Evidence showed that patients with chronic pain that had depression, anxiety and anguish have reported higher intensity of pain and disability.[10] A considerable body of research, based on cognitive-behavioral theory, has established the importance of individuals' pain-related cognitions and coping responses in their adaptation to chronic pain.[11] Beliefs and attitudes influence the acceptance, the results and the satisfaction

with treatment, also impacting the capacity of individuals to build an active and satisfactory life, despite the pain.[12]

For the beliefs facing pain, the Brief Pain Inventory (BPI-brief) was used, validated for the Portuguese language in 2006.[12] The purpose of this instrument is to evaluate the attitudes and beliefs facing pain in patients with non-oncologic chronic pain[12]. It has 30 items corresponding to seven domains: solicitude, emotion, medical cure, control, disability, physical damage, and medication.[12]

The "solicitude" domain relates to how much the patient believes that his/her family and other people should be more solicitous during the pain episodes. "Emotion" relates to the belief of the emotional effects, good or bad, in the painful experience."Medical Cure" relates to how much the patient believes in medicine to cure his/her pain. "Control" relates to how much the patient believes that he/she has control over his/her pain. "Disability" relates to how much the patient believes that the pain has disabled him/her. "Physical Damage" relates to how much, in the patient's point of view, the pain hurts him/herself, and because of it, exercises should be avoided."Medication" relates to how much the patient believes that drugs are the best treatment for chronic pain.[12]

Beliefs are culturally learned certainties; they are each individual's notion concerning its own reality, of the others and of the space, which interferes with the behavior[12]. Beliefs have been described as 'a cognitive process resulting in a concrete cognition of how we think things are'.[13] Attitudes are organized in affective arrangements, relatively stable, that reflect the trend to respond positively or negatively to something or some event. Both are formed from personal experiences[14]. Attitudes are 'a more complex cognitive state involving beliefs and feelings as well as values and predispositions to act in a certain way'.[15] Beliefs and attitudes influence the acceptance, the results and the satisfaction with treatment, also impacting the capacity of individuals to build an active and satisfactory life, despite the pain.[16]

Beliefs about a stressor such as pain, and in particular, appraisals of threat, influence an individual's coping responses (Lazarus, 1993). Coping has been defined as `constantly changing cognitive and behavioral efforts to manage specific external 6 and/or internal demands that are appraised as taxing or exceeding the resources of the person'[17]

Review question

- **What is the attitude and belief towards physical activity in chronic low back pain?**

- **What is the most appropriate treatment to cure the chronic low back pain?**

NEED OF STUDY

NEED OF STUDY

- To understand determinants of belief and attitude towards physical activity and exercise in patients with chronic low back pain.

OBJECTIVE OF REVIEW

OBJECTIVE OF REVIEW

- To identify attitude and belief towards physical activity and exercise in chronic pain.
- To identify attitudes and beliefs about LBP in the general population to analyse their association with individual characteristics and the belief that exercise is an effective treatment for LBP.

HYPOTHESIS

- ***Null Hypothesis(H0):***

There will be no effect or zero pain relief in patient with chronic low back pain.

- ***Alternative Hypothesis(H1):***

There will be significant effect or progress in pain relief in patient with chronic low back pain.

METHODOLOGY

- **KEYWORDS USED FOR SEARCH :**
  - Chronic low back pain, Attitude and belief towards physical activity and exercise

- **SEARCH STRATEGY :**
  - For the literature review, we used standard search strategies involving the querying of online databases MEDLINE (pub med) , Google scholar using key words followed by relevant articles. We included articles in overview.
  - Eligible criteria for the articles were :

Eligible criteria for the articles were:

- Duration of publication : 2013 Onwards
- Article should be in English language
- Age criteria : 45 – 65 years
- Article that assess the physical attitude and the need of exercise
- Exclusion criteria for the articles were :
- Unpublished articles
- Article which published in another language

➢ **DATA SEARCHED** :

- To identified potentially relevant articles in the medical
- Literature, we searched MEDLINE (PUBMED), Google scholar, Sci-hub data bases

➢ **DATA SYNTHESIS :**

- Narrative synthesis of data will be done.

Prisma chart:

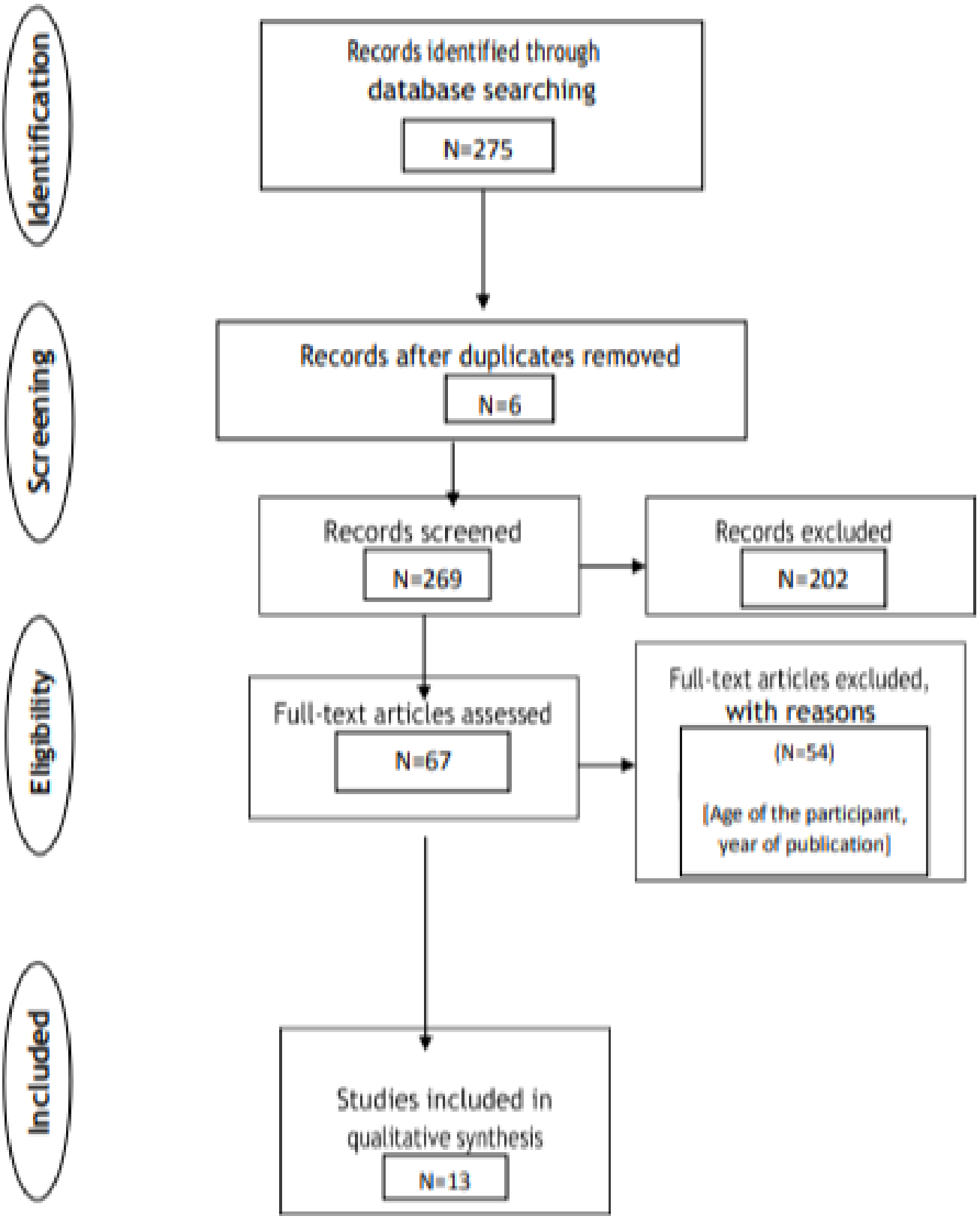

Table-1:

Sr.No..	1
AUTHORS	Anil Chankara mangala m Mathew, Rowther Shamna Safar, Thazhuth ekudiyil Sathyam Anithade vi, Moosa Saira Banu, Singanall ur Lakshma nan ,Ravi Shankar, Beliyur Krishna Dinakar Rai Thomas Vengail Chacko
YEAR	2013
STUDY DESIGN	A cross sectional study
AIM & OBJECTIVE	The aim of this study was to estimate the prevalence of low back pain and its association with height, fat distribution, reproductive history and socioeconomic influence.
OUTCOME	HEIGHT ,WEIGHT,BMI ,WEIST CIRCUM FARANCE, WEST HIP RATIO
REMARKS	The Back Pain Attitudes Questionnaire (Back-PAQ) was developed following these interviews with people experiencing acute and chronic LBP. It aims to assess beliefs which underlie common attitudes about back pain.
Sr.No.	2
AUTHORS	GARIMA GUPTA and NUPUR NANDINI
YEAR	2014
STUDY DESIGN	A cross sectional study
AIM& OBJECTIVE	The purpose of the study was to evaluate the prevalence of low back pain in non- working rural housewives w. also an attempt has been made to determine thew impact of social burden on low back pain.
OUTCOME	Nordic Musculoskeletal Questionnarie– NMQ, Oswestry Disability Index – ODI, and Zarit Burden Interview – ZBI
REMARKS	The findings of the present study suggest that 83% of the non working rural housewives have low back pain and activity restriction due to their pain
Sr.No.	3
AUTHORS	Rebecca gordon and Saul Bloxham
YEAR	2016
AIM&	This paper explores the impact of back pain on society and the role of physical

OBJECTIVE	activity for treatment of non-specific low back pain.
REMARKS	Exercise intervention programmes involving either muscular strength, Flexibility, aerobic, fitness is beneficial for NSCLBP but not acute low back pain. Non- specific acute low back pain patients recover in 4–6 weeks with or without a treatment , and exercising should be avoided to reduce the swelling of the affected area.
Sr.No.	4
AUTHORS	Linn Karlsson Björn Gerdle Esa- Pekka Takala Gerhard Andersso n Britt Larsson
YEAR	2018
STUDY DESIGN	Qualitative interview study
AIM& OBJECTIVE	The purpose of this study was to describe how patients with chronic pain experience physical activity and exercise (PA&E).
OUTCOME	International Physical Activity Question naire (IPAQ) Hospital, Anxiety and Depressio n Scale (HADS), Pain Self- Efficacy Questionnarie (PSEQ), Fear Avoidance Beliefs Questionnarie(FABQ), Psychological.
REMARKS	Physical activity was highly valued in daily life although experiences of PA&E were characterized by difficulties and failure. A will to engage in desired PA&E was apparent, but it was seldom successful even though the participants tried a variety of strategies. This intention– behavior gap identified might be related to the pain condition as well as to motivational aspects, self- efficacy, and action-control, a conclusion that requires careful analysis and support when PA&E is applied as treatment for chronic pain.
Sr.No.	5
AUTHORS	Gerthi Persson, Annika Brorsson , Eva Ekvall Hansson, Margaret a Troein and Eva Lena Strandber g.
YEAR	2013
STUDY DESIGN	Qualitative study
AIM& OBJECTIVE	The aim of the study was to explore and understand the meaning of prescribing physical activity from the general practitioner' s perspective
REMARKS	There is uncertainty about using PAP as a treatment since physicians lack education in non- pharmaceutical methods. the GPs do not regard the written refferal as a prioritized task and rather refer to other professionals in the health care system to prescribe PAP.
Sr.No.	6
AUTHORS	Monica Joelssona , Susanne Bernhard ssona and Maria E. H.

YEAR	2017
STUDY DESIGN	Qualitative study
AIM& OBJECTIVE	The objective of this study was to describe the experiences of and thoughts about receiving a prescription for physical activity of people with chronic Musculoskeletal pain.
REMARKS	This study suggests that patients with chronic musculoskeletal pain have a greater need for information and extra support to overcome existing barriers, before or when physical activity is prescribed.
Sr.No.	7
AUTHORS	Fernanda Martins Barbosa, Érica Brandão de Moraes Vieira , JoãoBatista Santos Garcia
YEAR	2018
STUDY DESIGN	Cross sectional study , Quantative study
AIM& OBJECTIVE	The objective of this study was to evaluate the behavior of beliefs and attitudes inchronic low back pain and to correlate them with the intensity of pain, disability, anxiety, and depression
OUTCOME	NPRS, BPI, ODI, HADS
REMARKS	It was observed in this study that patient with chronic low back pain often present dysfunctional beliefs in relation to pain and that such beliefs showed, in many cases, an association with the intensity of pain, anxiety, depression and mainly disability, with probable consequences in the therapeutic management of these patients.
Sr.No.	8
AUTHORS	D.W. Griffin a, D.C. Harmon b, N.M. Kennede
YEAR	2012
STUDY DESIGN	Systemic review
AIM & OBJECTIVE	The aim of this systematic review was to determine, based on the current body of evidence, if patients with chronic low back pain have a lower level and/or alteredpattern of physical activity compared with asymptomatic,healthy individuals.
OUTCOME	Newcastle Ottawa Scale (NOS)
REMARKS	There is no conclusive evidence that patients either CLBP are less active than healthy individuals. based on limited number of studies , there is some evidence that the distribution of activites over the course of a day is different between patients with CLBP and controls.

Sr.No.	9
AUTHORS	Janet K. Freburge rGeorge M. Holmes, Robert P. Agans, Anne M. Jackman, Jane D. Darter, Andrea S. Wallace, Liana D. Castel, William D. Kalsben and Timothy S. Carey,
YEAR	2009
STUDY DESIGN	Cross sectional , telephone survey
AIM& OBJECTIVE	The objective of this study was to determine whether the prevalenceof chronic LBP, and the demographic, health- related, andcare- seeking characteristi cs of individuals with the condition have changed over the past 14 years.
REMARKS	The prevalence of chronic, impairing LBP has risen significantly in NC, with continuing high levels of disability and care utilization. A substantial portion of the rise in LBP care costs overthe past two decades may be related to this rising prevalence.
Sr.No.	10
AUTHORS	Elin Dysvik, Torill Christine Lindstrøm, Ole- Johan Eikeland, and Gerd Karin Natvig
YEAR	2004
STUDY DESIGN	Survey design
AIM& OBJECTIVE	The present study focused on HRQL as measured by the Medical Outcomes Survey- Short Form (SF-36) and addressed possible relationship s between pain beliefs as measured by the Pain Beliefs and Perceptions Inventory (PBAPI).
OUTCOME	.VAS, SF-36, PBAPI, HRQL
REMARKS	According to CBT altering pain beliefs and improving coping skills may modified the pain experiences and there by improve the health related quality of life.
Sr.No.	11
AUTHORS	Tom Mayer, Robert J. Gatchel, and Trent Evans
YEAR	2000

STUDY DESIGN	Prospective cohort study
AIM& OBJECTIVE	To assess the association between age and objective psychosocio economic treatment outcomes for work- related spinal disorders undergoing functional restoration
OUTCOME	VAS, DALLAS BACK PAIN INVENT ORY
REMARKS	Age does not affect additional surgery rates, subsequent injuries, or delays in settling financial disputes.
Sr.No.	12
AUTHORS	Ivan P.J. Huijnen a,*, Jeanine A. Verbunt a,b,c, Madelon L. Peters d, Philippe Delespau l e,Hanne P.J. Kinderm ans d , Jeffrey Roelofs d, Marielle Goossens d,Henk A.M. Seelen
YEAR	2000
STUDY DESIGN	Cohort study
AIM& OBJECTIVE	This study evaluates whether patients with Chronic Low Back Pain (CLBP) who are more depressed and/or report more pain indeed have a lower objectively assessed daily life activity level or whether they only perceive their activity level as lower
OUTCOME	Roland Disability Question naire (RDQ) Baecke Physical Activity Question naire (BPAQ) VAS Beck Depressio n Inventory II (BDI- II)
REMARKS	The patients with CLBP, who had a higher level of depression, underestimated their daily activity level, although their actual activity level did not differ
Sr. No.	13
AUTHORS	Judith A. Turnera, Mark P. Jensenb, Joan M.Romanao
YEAR	1999
STUDY DESIGN	Cross sectional study
OUTCOME	NPRS
REMARKS	This result of the study confirm that beliefs, coping, and catastrophizing would each be associated significantly with physical disability and depression in patients beginning a multidisciplinary pain treatment program.
Sr. No.	14

AUTHORS	Gur Prasad Dureja, Paraman and N. Jain ,Naresh Shetty, Shyama Prasad Mandal, Ram Prabhoo, Murlidhar Joshi, Subrata Goswami, Karthic Babu, Natarajan, Rajgopalan Iyer, D. Tanna ; Pahari Ghosh Ashok Saxena, Ganesh Kadhe, Abhay A Phansalkar
YEAR	2013
STUDY DESIGN	Epidemiological telephonic survey
AIM& OBJECTIVE	The present epidemiological study identified point prevalence of chronic pain in India, impact on individual's QoL, unveiling current pain treatment practices, and levels of satisfaction with treatment.
REMARKS	A significant population of India suffers from chronic pain, and their QoL is affected leading to disability. A proportion of respondents receiving pain treatment were taking nonprescription medications with a majority of respondents on NSAIDs. A very few were consulting pain management specialists.
Sr. No.	15
AUTHORS	S. Slade, S. Patel, M. Underwo od,J. Keating
YEAR	2015
STUDY DESIGN	Systematic review
AIM& OBJECTIVE	To identify and synthesize qualitative empirical studies that explored what peoplewith non-specific chronic low back pain believe about exercise therapy and physical activity or training for the management of their condition and make recommendations for clinical practice and research.
REMARKS	People are likely to prefer and participate in exercise or training programs and activities that are designed with consideration of their preferences, circumstances, fitness levels and exercise experiences. In the area ofexercise and low back pain research there is a paucity of qualitative data.
Sr.No.	16
AUTHORS	Geneen LJ, Moore RA, Clarke C, Martin D, Colvin LA, Smith BH
YEAR	2020
STUDY DESIGN	Cochrain review
AIM& OBJECTIVE	To provide an overview of Cochrane Reviews of adults with chronic pain to determinethe eIectiveness of diIerent physical activity and exercise intervention s in reducing pain severity and its impact on function, quality of life, and healthcare use & the evidence for any adverse eIects or harm associated with physical activity and exercise interventions.
OUTCOME	NPRS,SF36

REMARKS	There is limited evidence of improvement in pain severity as a result of exercise. Thereis some evidence of improved physical function and a variable effect on both psychological function and quality of life. physical activity and exercise is an intervention with few adverse events that may improve pain severity and physical function, and consequent quality of life. physical activity and exercise is an intervention with few adverse events that may improve pain severity and physical function, and consequent quality of life.
Sr.No.	17
AUTHORS	Melda Soysal,Bi lge Kara, M. Nuri Arda2
YEAR	2012
AIM& OBJECTIVE	To investigate physical activity level in patients with chronic low back and neck pain
OUTCOME	Oswestry Disability Index (ODI), Physical Activity Question naire (IPAQ), (SF-36), Sleep Quality Index (PSQI) , Beck Depressio n Inventory
REMARKS	Physical activity modification was found in patients with chronic low back and neck pain. Physical activity level, disability, sleep, depression and quality of life scores of preoperative patients with low back pain more affected than neck patients.
Sr.No.	18
AUTHORS	Tania Gardner, Kathryn Refshaug e , Lorraine Smith , James McAuley c,Markus Hübscher c, Stephen Goodall
YEAR	2017
STUDY DESIGN	SYSTEMATIC REVIEW
AIM& OBJECTIVE	What influence do physiotherapist' s beliefs and attitudes about chronic low back pain have on their clinical management of people with chronic low back pain
OUTCOME	PABS-PT SCORE FEAR AVOIDANCE
REMARKS	Both quantitative and qualitative studies showed a relationship between treatment orientation and clinical practice. The inclusion of qualitative studies captured the influence of patient factors in clinical practice in chronic low back pain. There is a need to recognize that both beliefs and attitudes regarding treatment orientation of physiotherapists, and therapist-patient factors need to be considered when introducing new clinical practice models, so that the adoption of new clinical practice is maximised

Sr.No.	19
AUTHORS	Tomoko Fujii, Hiroyuki Oka, Kenichir o Takano2, Fuminari Asada3, Takuo Nomura4 , Kayo Kawamat a1,Hiros hi Okazaki5 , Sakae Tanaka6 and Ko Matsudai
YEAR	2015
STUDY DESIGN	Cross sectional study
AIM& OBJECTIVE	High prevalence of low back pain (LBP) in nurses has been reported globally. Ergonomic factors and work- related Psychosocial factors have been focused on as risk factors.
OUTCOME	Fear- Avoidanc e Beliefs Question naire (FABQ), Kessler Psycholo gical Distress Scale (K-6)
REMARKS	A small number of nurses had chronic disabling LBP that interfered with their work. In the nurses who had any type of LBP, high FABs were significantly associated with experiencing chronic disabling LBP. FABs about physical activity might be a potential target for LBP management in nurses.
Sr.No.	20
AUTHORS	Wing S. Wong and Richard Fieldingy
YEAR	2011
STUDY DESIGN	Cross sectional study
AIM& OBJECTIVE	prevalence of chronic pain in the general population of Hong Kong; evaluate the relationship of chronic pain with sociodemographic and life-style factors;
OUTCOME	NPRS, HADS, SF-36
REMARKS	chronic pain is common in the general population of Hong Kong, and the prevalence is highest among women and middle-aged adults.
Sr.No.	21
AUTHORS	Ben Darlow, Meredith Perry, James Stanley, FionaMathieso n,Markus Melloh, G David Baxter, Anthony Dowell
YEAR	2014
STUDY DESIGN	Cross sectional study
AIM& OBJECTIVE	To explore the prevalence of attitudes and beliefs about backpain in New Zealand and compare certain beliefs based on back pain history or health professional exposure.

OUTCOME	.Back Pain Attitudes questionnaire (Back- PAQ).
REMARKS	A large proportion of respondents believed that they needed to protect their back to prevent injury; we theorise that this belief may result in reduced confidence to use the back and contribute to fearavoidance. Uncertainty regarding what is a safe level of activity during an episode of back pain may limit participation
Sr.No.	22
AUTHORS	Corinna Leonhard t,Dirk Lehr,Judi th Luckman n,Heinz-Dieter Basler Erika Baum,Mi chael Pfingsten Jan 36ildebran dt Michael M. Kochen, Annette Becker
YEAR	2009
STUDY DESIGN	Across- lagged panelanalysis
AIM& OBJECTIVE	The assumption that low back pain (LBP) patientssuffer from "disuse" as a consequence of high fear avoidance beliefs is currently Corinna Leonhardt Dirk Lehr under debate
OUTCOME	International physical activity questionnaire, FBQ
REMARKS	study demonstrate demonstrated that a fear- avoidance based physical therapy only showed beneficial effectsin patients who scored high on a FAB- scale at the beginning
Sr.No.	23
AUTHORS	Jeanine A. Verbunt, Klaas R. Westerter p, Geert J. van der Heijden, Henk A. Seelen, Johan W. Vlaeyen, J. Andre Knottnerus
YEAR	2001
STUDY DESIGN	Cross sectional study
AIM& OBJECTIVE	To evaluate disuse (ie, a decreased Daily physical activity level) in patients with chronic low Back pain(LBP) and to evaluate the construct validity of accelerometrv 36inesio phobi physical activity in daily life
OUTCOME	Roland Disability Questionnaire (RDQ), scoring low back disability, Tampa Scale for 36inesio phobia (TSK), VAS
REMARKS	Decrease physical activity levels in this sample of chronic LBP patients was not confirmed. The tracmor is a valid instrument for measuring daily activity in LBP patients.
Sr.No.	24
AUTHORS	Richard MH Evering, Marit GH van Weering, Karin CGM Groothui s-

	Oudshoo rn,Miria
YEAR	2010
AIM& OBJECTIVE	To give an overview of the physical activity level of patients with chronic fatigue syndrome in comparison with asymptomatic controls.
OUTCOME	IPAQ
REMARKS	Patients with chronic fatigue syndrome appear to be less physically active compared with asymptomatic controls. There is no difference in variation of physical activity levels between patients with chronic fatigue syndrome and healthy control subjects, butthe validity and reliability of some methods of measuring Physical activity is questionable or unknown.
Sr.No.	25
AUTHORS	R A Iles, M Davidson , N F Taylor
YEAR	2008
STUDY DESIGN	Systematic review
AIM& OBJECTIVE	To identify psychosocia l predictors of failureto return to work in non-chronic (lasting less than3 months) non-specific low back pain (NSLBP)
REMARKS	To predict work outcome in non-chronic NSLBP, psychosocial assessment should focus on recovery expectation and fear avoidance.The importance of fear avoidance beliefs in chronic pain has been established and it appears these beliefs and behaviours also play an important role in the non-chronic phase of NSLBP and can assist in predicting work outcome.

RESULT

RESULT

275 records were identified using databases searching. Duplicates screening was performed and 6 articles were removed in duplicates screening and than 3 reviews independently scanned the abstract and title or both and determined which studies were to be assessed further and if there were any discrepancies it were then further remove by the supervisor. Prisma flowchart was adapted for the study selection. Following it 275 studies were screened after the duplicates were removed out of which 6 studies were screened after the duplicates were removed. Furthermore excluded as full texts of 67 articles were screened out of which studies were excluded due to many reasons as mentioned in prisma flowchart of study selection. At last we included 13 studies in our data synthesis. The detail of study used in the data synthesis were be mentioned I the data extraction table which include the following detailed: author and year of publication, study design, aim and objective, outcome measure and remarks.

In this study we have observed that chronic low back pain often present dysfunction belief and attitude in relation to pain and that such belief showed in many cases, an association with intensity of pain anxiety and depression. A large proportion of respondents believed that they needed to protect their back to prevent injury; we theorise that this belief may result in reduced confidence to use the back and contribute to fear avoidance. People experiencing back pain may benefit from more targeted information about the positive prognosis. The provision of clear guidance about levels of activity may enable confident participation in an active recovery. According to cognitive behavior therapy altering pain beliefs and improving coping skills may modified the pain. experiecnces and thereby improve the health related quality of life

A very high proportion of respondents believed they should stay active when they have back pain. Among from all the people who are suffering from chronic low back pain, women are having a increasing complain of low back pain in compare of men. If we look most specifically than we found that age group of 41-50 years are those who are suffering from chronic low back pain. In addition to that smoking in men had no significant relationship with low back pain, because those who were found positive chronic low back pain where non smoker. The assosiation of low back pain with reproductive history is found significantly. According to that those women who has history of caesarean section more prone to have a low back pain later a time. Even those who have history of sterilization.

Some study also shows that both men and women who where household and in lower socio economical status reported more back pain than those who were in higher socio economic status. We have found that low back pain in ruler housewifes is around 83%, out of those more than 50% of housewife have severe disability with low back pain. They have also significant impact of social burden on their daily life.

Chronic fatigue syndrome is characterized by severe, disabling chronic fatigue lasting for at least six months. Other symptoms can include musculoskeletal pain, sleep disturbances, impaired concentration and headaches. Patients with chronic fatigue syndrome appear to be less physically active compared with asymptomatic controls.

There is no difference in variation of physical activity levels between patients with chronic fatigue syndrome and healthy control subjects, but the validity and reliability of some methods of measuring physical activity is questionable or unknown.

DISCUSSION

DISCUSSION

The present review was intended to understand determinants of belief and attitude towards physical activity and exercise in patients with chronic low back pain. Main aim of the review was to identify what are the multiple dimension bother the patient to perform physical activity and exercise in chronic low back pain[1]. As well as the review suggests belief may result in reduced confidence to use the back and contribute to fear avoidance[2].

We have found that the prevalence of chronic low back pain more common in aged population (41-50years). In general the prevalence of LBP was higher in women (52.9%) compared to men (28.4%). The alterations in sleep due to the chronic low back pain are very common results and show the impact of this painful syndrome on the quality of life and disability of the individual[4]. Study has also showed that a reduce the level of basic activity in patient with chronic low back pain, whereas increased their sportive and leisure time activities.

There are several studies that conform to the pattern that height is not correlated with the occurrence of low back pain in women, though in men many studies reported a positive correlation[15,17,18]. This study has also examined the association between low back pain and weight. The results conform to the pattern wherein weight does not correlate with the occurrence of low back pain and is consistent with previous studies.[24] These findings provide no evidence that a greater body mass index and waist-hip ratio is associated with an increased risk of low back pain.

The current review found that treatment orientation and fear avoidance beliefs of the physiotherapist had an influence on clinical practice and advice given to patients. A therapist with higher biomedical orientation and fear avoidance beliefs towards chronic low back pain was associated with advice to restrict return to work duties and restrict return to activity, a higher perception of risk associated with work or activity, and increased certification of sick leave. Healthcare professionals' beliefs about chronic low back pain have been shown to have an influence on patient beliefs.

The findings of the present study suggest that 83% of the non working rural housewives have low back pain and activity restriction due to their pain. They have significant impact of social burden on their low back pain. High prevalence (83%) of low back pain among rural housewives is an alarming sign for our society. Better health-care measures to enhance rural housewives education about good posture, ergonomic measures, health schemes, health awareness, and activity pacing could help rural housewives.

In this study, women who have undergone caesarean section or sterilization reported more low back pain than who have not undergone these procedures. This may be due to the sedentary life style after the caesarean section. Nevertheless, it was also observed that women who have occupation described as “Physically demanding” also have higher risk of low back pain suggesting that extremes of activity are probably not ideal.

CONCLUSION

CONCLUSION

Majority of available literature review suggest that patient with chronic low back pain often present dysfunctional beliefs and attitude in relation to pain. A large population subjects believed that they need to protect their back to prevent injury: Which shows that this belief may result in reduce confidence to use the back and contribute to fear avoidance.

Key findings of this literature review are:

- The reason for chronic low back pain are multi factorial which include reduce physical activity, food habit, occupation, under lying disease.
- Patient with low back pain often present that dysfunctional belief and attitude in relation to pain.
- Chronic pain often may lead to disability.

LIMITATIONS

Limitations

- Our review includes limited number of articles so some of the causes of attitude and belief might be missed
- Number of article were very less

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ANNEXURE

	AUTHORS	YEAR	STUDY DESIGN	AIM & OBJECTIVE	OUTCOME	REMARKS
1	1. Anil Chankaramangalam Mathew, Rowther Shamna Safal, Thazhuthekudiyil Sathyam Anthadan, Moosa Saira Banu, Singanallur Lakshmanan, Ravi Shankar, Bellyur Krishna Dinakar Rai, Thomas Vengall Chacko	2013	A cross sectional study	The aim of this study was to estimate the prevalence of low back pain and its association with height, fat distribution, reproductive history and socioeconomic infl uence.	HEIGHT WEIGHT BMI WEIST CIRCUMFARANCE, WEST HIP RATIO	The Back Pain Attitudes Questionnaire (Back-PAQ) was developed following these interviews with people experiencing acute and chronic LBP.23 It aims to assess beliefs which underlie common attitudes about back pain.
2	2. GARIMA GUPTA and NUPUR NANDINI	2014	A cross sectional study	The perpose of the study was to evaluate the prevalence of low back pain in non-working rural housewivwsw. also an attempt has been made to determine thew impact of social burden on loe back pain.	Nordic Musculoskeletal Questionnaire – NMQ, Oswestry Disability Index – ODI, and Zarit Burden Interview – ZBI	The findings of the present study suggest that 83% of the non working rural housewives have low back pain and activity restriction due to their pain
3	6. Rebecca gordon and Saul Bloxham	2016	Systematic Review	This paper explores the impact of back pain on society and the role of physical activity for treatment of non-specific low back pain.		Exercise intervention programmes involving either muscularstrength,flexibility, aoraeroic, fitness is beneficial for NSCLBP but not acute low back pain. Non-specific acute low back pain patients recover in 4–6 weeks with or without a treatment , and exercising should be avoided to reduce the swelling of the affected area.
4	4. Linn Karlsson Björn Gerdle Ewa-Pekka Takala Gerhard Andersson Britt Larsson	2018	qualitative interview study	The purpose of this study was to describe how patients with chronic pain experience physical activity and exercise (PASE).	International Physical Activity Questionnaire (IPAQ) Hospital Anxiety and Depression Scale (HADS), Pain Self-Efficacy Questionnaire (PSEQ), Fear Avoidance Beliefs Questionnaire (FABQ), Psychological Inflexibility in Pain Scale (PIPS)	Physical activity was highly valued in daily life although experiences of PASE were characterized by difficulties and failure. A will to engage in desired PASE was apparent, but it was seldom successful even though the participants tried a variety of strategies. This intention–behavior gap identified might be related to the pain condition as well as to motivational aspects, self-efficacy, and action-control, a conclusion that requires careful analysis and support when PASE is applied as treatment for chronic pain.
5	5.Gerthi Persson,Annika Brörsson , Eva Ekvall Hansson,Margareta Troein and Eva Lena Brandberg	2013	qualitative study	The aim of the study was to explore and understand the meaning of prescribing physical activity from the general practitioner's perspective		There is uncertainty about using PAP as a treatment since physicians lack education in non-pharmaceutical methods, the GPs do not regard the written referral as a prioritized task and rather refer to other professionals in the health care system to prescribe PAP
7	6.Monica Joessona , Susanne Bernhardssona and Maria E. H. Larsson.	2017	qualitative study	The objective of this study was to describe the experiences of and thoughts about receiving a prescription for physical activity of people with chronic musculoskeletal pain		There is uncertainty about using PAP as a treatment since physicians lack education in non-pharmaceutical methods, the GPs do not regard the written referral as a prioritized task and rather refer to other professionals in the health care system to prescribe PAP
8	7.Fernanda Martins Barbosa, Erica Brandão de Moraes Vieira , João Batista Santos Garcia	2018	cross-sectional , quantitative study	The objective of this study was to evaluate the behavior of beliefs and attitudes in chronic low back pain and to correlate them with the intensity of pain, disicability, anxiety, and depression	NPRS, BPI, CDI, HADS	This study suggests that patients with chronic musculoskeletal pain have a greater need for information and extra support to overcome existing barriers, before or when physical activity is prescribed.
9	8.D.W. Griffin a, D.C. Harmon b, N.M. Kennede	2012	systematic review	The aim of this systematic review was to determine, based on the current body of evidence, if patients with chronic low back pain have a lower level and/or altered pattern of physical activity compared with asymptomatic, healthy individuals.	Newcastle Ottawa Scale (NOS)	there is no conclusive evidence that patients eith CLBP are less active than health individuals, based on limited number of studies , there is some evidence that the distribution of activites over the course of a day is different between patients with CLBP and controls.
10	9.Janet K. FreburgerGeorge M. Holmes, Robert P. Agans, Anne M. Jackman, Jane D. Darter, Andres S. Wallace, Liana D. Castel, William D. Kaiser and Timothy S. Carey,	February, 2009	cross-sectional, telephone survey	The objective of this study was to determine whether the prevalence of chronic LBP, and the demographic, health-related, and care-seeking characteristics of individuals with the condition have changed over the past 14 years.		The prevalence of chronic, impairing LBP has risen significantly in NC, with continuing high levels of disability and care utilization. A substantial portion of the rise in LBP care costs over the past two decades may be related to this rising prevalence
11	10.Elin Dysvik, Torill Christine Lindstrøm, Ole-Johan Eikeland, and Gerd Karin Natvig	2004	survey design	The present study focused on HRQL as measured by the Medical Outcomes Survey-Short Form (SF-36) and addressed possible relationships between pain beliefs as measured by the Pain Beliefs and Perceptions Inventory (PBAPI).	,VAS, SF-36, PBAPI, HRQL	according to CBT altering pain beliefs and improving coping skills may modified the pain exeperiences and there by improve the health related quality of life.
12	12.Ivan P.J. Huijnen a,*, Jeanine A. Verbunt a,b,c, Madelon L. Peters d, Philippe Delespaul e,Hanne P.J. Kindermans d , Jeffrey Roelofs d, Marielle Goossens d,Henk A.M. Seelen	2010	cohort study	This study evaluates whether patients with Chronic Low Back Pain (CLBP) who are more depressed and/or report more pain indeed have a lower objectively assessed daily life activity level or whether they only perceive their activity level as lower	Roland Disability Questionnaire (RDQ) Baecke Physical Activity Questionnaire (BPAQ) VAS Beck Depression Inventory II (BDI-II)	the patients with CLBP, who had a higher level of depression, underestimated their daily activity level, although their actual activity level did not differ.
13	13.Judith A. Turnera, Mark P. Jensenb, Joan M. Romanoa	October 1999			NPRS	This result of the study confirm that beliefs, coping, and catastrophizing would each be associated significantly with physical disability and depression in patients beginning a multidisciplinary pain treatment program.
14	14.Gur Prasad Dureja, Paramanand N. Jain,Naresh Bhatty,Bhyana Prasad Mandal, Ram Prabhoo Murallidhar Joshi, Subrata Goswami, Karthic Babu Natarajan, Rajagopalan Iyer, D. Tahina, Pahari Ghosh Ashok Saxena, Ganesh Kadhe, Abhay A. Phansalkar	2013	epidemiological telephonic survey	The present epidemiologic study identified point prevalence of chronic pain in India, impact on individual's QoL, unveiling current pain treatment practices, and levels of satisfaction with treatment.		A signiTcant population of India suffers from chronic pain, and their QoL is affected leading to disability. A proportion of respondents receiving pain treatment were taking nonprescription medications with a majority of respondents on NSAIDs. A very few were consulting pain management specialists.
15	15.S. Slade, S. Patel, M. Underwood J. Keating	May, 2015	systmetic review	To identify and synthesize qualitative empirical studies that explored what people with non-specific chronic low back pain believe about exercise therapy and physical activity or training for the management of their condition and make recommendations for clinical practice and research.		People are likely to prefer and participate in exercise or training programs and activities that are designed with consideration of their preferences, circumstances, fitness levels and exercise experiences. In the area of exercise and low back pain research there is a paucity of qualitative data
16	16.Geneen LJ, Moore RA, Clarke C, Martin D, Colvin LA, Smith BH	2020	cochrain review	To provide an overview of Cochrane Reviews of adults with chronic pain to determine the effectiveness of different physical activity and exercise interventions in reducing pain severity and its impact on function, quality of life, and healthcare use & the evidence for any adverse effects or harm associated with physical activity and exercise interventions.	NPRS, SF-36	There is limited evidence of improvement in pain severity as a result of exercise. There is some evidence of improved physical function and a variable effect on both psychological function and quality of life. physical activity and exercise is an intervention with few adverse events that may improve pain severity and physical function, and consequent quality of life. physical activity and exercise is an intervention with few adverse events that may improve pain severity and physical function, and consequent quality of life.
17	17.Melda Boysal,Bilge Kara, M. Nuri Arda2	2012		To investigate physical activity level in patients with chronic low back and neck pain.	Oswestry Disability Index (ODI), Physical Activity Questionnaire (IPAQ), (SF-36), Sleep Quality Index (PSQI) , Beck Depression Inventory	Physical activity modification was found in patients with chronic low back and neck pain. Physical activity level, disability, sleep, depression and quality of life scores of preoperative patients with low back pain more affected than neck patients.
18	18.Tania Gardner, Kathryn Refshauge , Lorraine Smith , James McAuley c,Markus Hübscher c, Stephen Goodall	2017	systmetic review	What influence do physiotherapists' beliefs and attitudes about chronic low back pain have on their clinical management of people with chronic low back pain	FABB-PT SCORE FEAR AVOIDANCE	Both quantitative and qualitative studies showed a relationship between treatment orientation and clinical practice. The inclusion of qualitative studies captured the influence of patient factors in clinical practice in chronic low back pain. There is a need to recognise that both beliefs and attitudes regarding treatment orientation of physiotherapists, and therapist-patient factors need to be considered when introducing new clinical practice models, so that the adoption of new clinical practice is maximised.
19	19.Tomoko Fujii, Hiroyuki Oka, Kenichiro Takano2, Fuminori Asada3, Takuo Nomura4, Kayo Kawamata1, Hiroshi Okazaki5, Sakae Tanaka6 and Ko Matsudaira	June 2015	cross-sectional study	High prevalence of low back pain (LBP) in nurses has been reported globally. Ergonomic factors and work-related psychosocial factors have been focused on as risk factors.	Fear-Avoidance Beliefs Questionnaire (FABQ), Kessler Psychological Distress Scale (K-6)	A small number of nurses had chronic disabling LBP that interfered with their work. In the nurses who had any type of LBP, high FABs were significantly associated with experiencing chronic disabling LBP. FABs about physical activity might be a potential target for LBP management in nurses.
20	20.Wing S. Wong and Richard Fielding	Feb 2011	cross-sectional study	prevalence of chronic pain in the general population of Hong Kong; evaluate the relationship of chronic pain with sociodemographic and life-style factors;	NPRS, HADS, SF-36	
21	21.Ben Darlow,Meredith Perry, James Stanley, Fiona Mathieson,Markus Melloh, G David Baxter, Anthony Dowell	2014	cross-sectional study	To explore the prevalence of attitudes and beliefs about back pain in New Zealand and compare certain beliefs based on back pain history or health professional exposure.	Back Pain Attitudes Questionnaire (Back-PAQ).	A large proportion of respondents believed that they needed to protect their back to prevent injury; we theorise that this belief may result in reduced confidence to use the back and contribute to fear avoidance. Uncertainty regarding what is a safe level of activity during an episode of back pain may limit participation
22	22.Corinna Leonhardt,Dirk Lehr, Judith Luckmann,Heinz-Dieter Basler Erika Baum,Michael Pfingsten Jan Hildebrandt Michael M. Kochen,Annette Becker	2009	Across-lagged panelanalysi	The assumption that low back pain (LBP) patients suffer from "disuse" as a consequence of high fear avoidance beliefs is currently Corinna Leonhardt Dirk Lehr under debate	international physical activity questionnaire, FBQ	study demonstrate demonstrated that a fear-avoidance based physicaltherapyonlyshowedbeneficialeffectsinpatients who scored high on a FAB-scale at the beginning

21 Ben Darlow,Meredith Perry, James Stanley, Fiona Mathieson,Markus Mellish, G David Baxter, Anthony Dowell	2014	cross-sectional study	To explore the prevalence of attitudes and beliefs about back pain in New Zealand and compare certain beliefs based on back pain history or health professions exposure.	Back Pain Attitudes Questionnaire (Back-PAQ).	A large proportion of respondents believed that they needed to protect their back to prevent injury; we theorise that this belief may result in reduced confidence to use the back and contribute to fear avoidance. Uncertainty regarding what is a safe level of activity during an episode of back pain may limit participation
22 Corinna Leonhardt,Dirk Lehr,Judith Luckmann,Heinz-Dieter Basler Erika Baum,Michael Pfingsten,Jan Hildebrandt Michael M. Kochen,Annette Becker	2009	Across-lagged panelanalysi	The assumption that low back pain (LBP) patients suffer from 'disuse' as a consequence of high fear avoidance beliefs is currently Corinna Leonhardt Dirk Lehr under debate	International physical activity questionnaire, FBQ	study demonstrate demonstrated that a fear-avoidance based physicaltherapyonlyshowedsomebeneficialeffectsinpatients who scored high on a FAB-scale at the beginning
23 Jeanine A Verbunt, Klaas R. Westerterp, Geert J. van der Heijden, Henk A. Seelen, Johan W. Vlaeyen,J. André Knottnerus	Jun 2001	cross-sectional study	To evaluate disuse (ie, a decreased daily physical activity level) in patients with chronic low back pain (LBP) and to evaluate the construct validity of accelerometry formeasuring physical activity in daily life.	Roland Disability Questionnaire (RDQ), scoring low back disability, Tampa Scale for Kinesiophobia (TSK), VAS	Decrease physical activity levels in this sample of chronic LBP patients was not confirmed. the tracmor is a valid instrument for measuring daily activity in LBP patients.
24 Richard MH Bleijenberg, Marit GH van Weering, Karin CGM Groothuis-Oudshoorn,Miriam MR Vollenbroek-Hutten	Jun 2010	systmetic review	To give an overview of the physical activity level of patients with chronic fatigue syndrome in comparison with asymptomatic controls.	IPAQ	Patients with chronic fatigue syndrome appear to be less physically active compared with asymptomatic controls. There is no difference in variation of physical activity levels between patients with chronic fatigue syndrome and healthy control subjects, but the validity and reliability of some methods of measuring physical activity is questionable or unknown.
25 R A Iles, M Davidson, N F Taylor	April 2008	systmetic review	To identify psychosocial predictors of failureto return to work in non-chronic (lasting less than3 months) non-specific low back pain (NSLBP)		To predict work outcome in non-chronic NSLBP, psychosocial assessment should focus on recovery expectation and fear avoidance.The importance of fear avoidance beliefs in chronic pain has been established and it appears these beliefs and behaviours also play an important role in the non-chronic phase of NSLBP and can assist in predicting work outcome.

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Association Of Physical And Mental Health During Covid-19 In College Going Students

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Abstract

Background:
Exercise is an important component of healthy lifestyle to reduce a person's risk of developing the disease and subsequent disability. Stress, anxiety, and depression are overwhelmingly prevalent across the globe during this COVID-19 pandemic, and multiple factors can influence the rate of mental health conditions. Our factorial analysis showed notable associations and manifestations of stress, anxiety, and depressive symptoms. In Corona pandemic one can easily understand that new world order has established and many things changed drastically but importance of physical activity is still at utmost importance so one shouldn't neglect importance of same.

Objectives:
To find out the association of physical activity and mental health in college going student's and to know their mental health status.

Methodology:
This study involved 150 participants between the ages of 18 to 25 years college going students. This survey based study was conducted via mail incitation.

Results:
Self-reported PA was lower post-COVID among participants reporting being previously active (mean change: - 32.3% [95% CI: - 36.3% to - 28.1%]) but largely unchanged among previously inactive participants (+2.3% [- 3.5% to +8.1%]). Decreased PA and increased screen time were associated with worsening in depression, anxiety and stress.

Conclusion:
The current findings strongly support the mental health benefits of implementing measures that promote physical activity.

Key-words:
COVID-19, physical impact, psychological impact, university students.

INTRODUCTION

COVID-19 outbreak: As per World Health Organization (WHO) - Coronavirus disease (COVID-19) is an infectious disease caused by a newly discovered coronavirus. Most people who fall sick with COVID-19 will experience mild to moderate symptoms and recover without special treatment. It was caused by a novel coronavirus, which originated from a wet market in Wuhan, China, and has spread worldwide, earning the pandemic status by WHO on March 11, 2020.[1] As of the 3rd week of July, India has emerged as the third hardest-hit country with 10, 40,980 confirmed cases of COVID-19 and 25,602 deaths and the numbers are still increasing. According to WHO, the most common symptoms: are fever, dry cough, and tiredness. Less common symptoms: aches and pains, sore throat, diarrhoea, conjunctivitis, headache, loss of taste or smell, a rash on skin, or discoloration of fingers or toes. Serious symptoms: difficulty breathing or shortness of breath, chest pain or pressure, loss of speech or movement, Seek immediate medical attention if you have serious symptoms.[2]

Owing to COVID 19, prolonged home stay may lead to increased sedentary behaviours such as spending excessive amounts of time sitting, reclining, or lying down for screening activities (playing games, watching television, using mobile devices); reducing regular physical activity (hence lower energy expenditure); or engaging in avoidance activities that consequently, lead to inactivity and contribute to anxiety and depression and stress, which in turn can lead to a sedentary lifestyle known to result in a range of chronic health conditions. Maintaining regular physical activity and routinely exercising in a safe home environment is an important strategy for healthy living during the coronavirus crisis as an improvement in mental health status of college going students. Mental health is a state of well-being in which an individual realizes their abilities and to cope up with daily stresses of life and able to do productive work and to contribute to society.[3]

Mental health has core symptoms such as anxiety, depression and stress lead to disturbance in mental health. For accurate analysis of depression, anxiety, stress standard scale is DASS-21 (Depression, Anxiety, and Stress Scales – 21) this scale was developed by Lovibond. The three-dimensional self-reporting scales assess the presence and intensity of affective states of depression, anxiety, and stress. And to measure physical Activity standard scale is IPAQ (International physical activity questionnaire) it comprises a set of 4 questionnaires, long (5 activity domains asked independently) and short (4 generic items) versions for use by either telephone or self-administered methods are available.[4]

METHODOLOGY

Research Design: Cross-sectional Survey

Study setting: Online mode

Sampling Method: Convenient Sampling

Sample size: 150

Inclusion criteria:

- Indian college-going students between 18-25
- Able to read, write and understand English language
- Has Internet facility with e-mail

Exclusion criteria:

- Mini-mental scale less than 24
- Any systemic illness (musculoskeletal, cardiovascular, degenerative, and neurological)

Data collection tool:

- Physical activity assessed by: International Physical Activity Questionnaire (IPAQ)
- Mental health assess by DASS-21 (Depression, anxiety, stress scale)

Procedure:

The study was conducted among the college-going students of the Indian population between the ages of 18 to 25 years. Participants entered into the study from different fields of education. A random selection of the participants was used. Firstly, the Google form was created and circulated on an online platform via mail. The online consent form was taken from all the participants before they answered the questions. Secondly, with respective permission, they entered into the online survey of the DASS-21 and IPAQ along with consent and demographic details. Google form consisted of three pages and a total of 28 questions. The first page was about consent and the demographic detail of the participants. The second page was about the depression anxiety, stress scale which consisted of 21 questions and the rating scale was from 0 to 3. Whereas, 0 means did not apply at all and 3 means apply to very much and most of the time. After fillip in the second page, they entered the third page of the survey form. The third page was about the international physical activity questionnaire which consisted of 7 subparts the physical activity in different circumstances. They filled the form with tangible self-experience. The distribution of the survey form was extended to the whole country, however mostly in Gujarat where the majority of students belong. Then we waited for two days for survey collection. Initially, we received 100 responses from the first circulation. After that, we did follow up with the college-going students again via calls and messages. Moreover, we sent a new invitation to other students of the colleges. Then again we waited for the 2 days for more responses. Eventually, at the end of the survey collection, we received more than 160 responses. After the collection of the sample size, we started statistical analysis of the online survey.

DATA ANALYSIS

- Descriptive analysis was done for demographic details.

- Pearson correlation coefficient was to find out the association between physical activity and mental health of college-going students.

RESULT:

160 responses were received, out of which 10 responses were incomplete and hence excluded. The final sample size was 150. The participants were of age group 18 to 25 years with an average age of 21.6 ± 2.15 years.

Table 1: Number the participants according to Gender and Educational Status

Variables	Subgroups	No of Participants	%
Gender	**Male**	79	51.97
	Female	73	48.03
Educational Status	**Bachelor's Degree**	140	92.10
	Master's Degree	11	7.23
	PhD	1	0.65

Table 2: DASS-21 Score for number the participants

	Depression	Anxiety	Stress
Normal	89	72	108
Mild	17	13	14
Moderate	27	23	15
Severe	6	21	8
Extremely Severe	13	23	7

Table 3: IPAQ Analysis for the participants

Type of Activity	Average Days/Weeks	Average Minute/Weeks
Vigorous Physical Activity	3.85	62.5
Moderate Physical Activity	4.33	53.29
Walking	3.85	63.71
Travelling	2.88	67.38
Bicycling	4.17	43.17
Leisure Time	4.68	27.15

DISCUSSION

This research presents a timely investigation of changes in physical activity, sitting time, and screen time as a result of COVID-19 public health restrictions, and their associations with mental health in students. The current findings indicate: (1) large reductions in physical activity and increases in sedentary time across the population and particularly among previously physically active and self-isolated/quarantined individuals; (2) consistent associations between reductions in physical activity and increases in screen time with higher negative mental health and lower positive mental health; and, (3) more severe anxiety and depressive symptoms for those in self-isolation compared to less restrictive situations, which were not moderated by changes in physical activity or sedentary behaviour. We found that females were 1.7 times more likely to be present with depressive symptoms, 2.6 times as likely to show symptoms of anxiety, and twice as likely to show stress symptoms when compared to males but when adjusted for other confounding factors, females were quadruple times as likely as males to have depression and 3.5 times as likely as males to have anxiety. Our results are similar to previous studies conducted during the SARS and COVID-19 pandemic in Italy and China, where the prevalence of psychological disorders was steadily associated with the female gender[4, 5, and 6]. This trend was noted in India before the outbreak too where the prevalence of depression and anxiety disorders was more in females than males. There was no significant association between gender and the likelihood of stress which is in accordance with studies conducted during earlier epidemic/pandemic situations[7]. Gender-specific help and counselling should be offered to mitigate the psychological strain on the population. An interesting finding in our study was the variation in the association between age and depression, anxiety, and stress. Educational status influences the occupation and income of the individual, which are in turn associated with psychosocial wellbeing. The economic crisis due to lockdown might put the individuals without formal education at a higher risk of developing anxiety. Counselling, guidance, or any form of mental health help should include verbal or pictorial representations to aid this group population.

CONCLUSION

The current findings strongly support the mental health benefits of implementing measures that promote physical activity during periods of societal modification due to a pandemic. Potentially effective methods to do so may be through enhanced telehealth or public broadcasting time devoted to the promotion/implementation of home-based physical activity.

LIMITATIONS

- This cross-sectional design precludes inference of causality and the sample is predominantly well-educated.
- In particular, as this study sample is not representative of the entire Indian population, generalizations should be limited based on the sample characteristics.
- All behaviours and currently followed public health guidelines were self-reported and included a recall of pre-COVID-19 activity, which is potentially subject to misreporting. The self-selection and convenience sampling of participants to complete the survey may also affect the results, although a >70% completion rate for those who began the survey is high.

FUTURE RECOMMENDATIONS

Future research should replicate these findings in other large samples, investigate potential cross-national differences, longitudinally assess dynamic relationships between these factors, and integrate device-based measures.

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Effect of Zumba Exercise on Low Back Pain in Obese People: An Experimental Study

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Abstract

Background
Physical inactivity is a commonly observed cause of increasing incidence of lifestyle diseases like obesity which has increased the incidence of low back pain. As dancing is a physical activity that can be tailored to fit a target population's age and culture therefore, Zumba is becoming a global dance fitness activity to reduce lifestyle disease epidemic. It has a mixture of popular entertaining music, different dance styles and aerobic exercises which improves the health of all age groups. Thus, physiological effects of Zumba can be used as adjuncts to conventional medicine for prevention of various lifestyle diseases e.g., diabetes and obesity. Zumba incorporates movement of large muscle groups for aerobic endurance, strength training and flexibility thereby contributing in reducing obesity and thus decreasing back pain in all ages, especially in the geriatric population. Various researchers have also recorded the positive effect of Zumba on weight, BMI, body fat mass. To summarize, these findings reflect that Zumba intervention can be explored further as a therapeutic tool in complementary and alternative medicine for improving low back pain in obese people.

Methodology
An experimental study with a pre-test/post-test design. 30 obese participants between the ages of 18 to 45 years with low back pain were included. We evaluated changes over time (pre-test to post- test) in all outcome measures. Paired t-tests were used to analyze pain and BMI.

Result
Statistically significant improvements were seen in the Pain ($p = 0.0000005$) and BMI ($p = 0.0000002$).

Conclusion
Conclusion the current finding strongly support that Zumba has health benefits and it reduces lower back pain in obese people.

Keywords
ZUMBA, Low back pain, Obesity, Life style disease.

INTRODUCTION

Low back pain is a symptom not a disease, and can result from several different known or unknown abnormalities or diseases. It is defined by the location of pain, typically between the lower rib margins and the buttock creases. It is commonly accompanied by pain in one or both legs and some people with low back pain have associated neurological symptoms in the lower limbs. For nearly all people presenting with low back pain, the specific nociceptive source cannot be identified and those affected are then classified as having so-called non-specific low back pain. People with low back pain often have concurrent pain in other body sites, and more general physical and mental health problems, when compared with people not reporting low

back pain. The combined effect on individuals of low back pain and co-morbidity is often more than the effect of the low back pain or the co-morbidity alone and results in more care, yet typically a poorer response to arrange of treatments.[1]

Obesity is one of the co morbidity which has been associated with low back pain. Obesity is defined by waist circumference was associated with increased incidence of radiating low back pain after adjustment for age, gender, educational status, occupational status, and smoking status.[2] Scientifically, obesity is caused by consuming more calories than needed by the body, they are not burnt through physical activity / exercise. One of the diseases of inactivity is obesity or overweight. Lack of physical work such as sitting for long periods will give a negative effect on health and can lead to obesity, therefore Physical exercise is vital for a healthy life and has several positive influences on the body.[3] Despite this evidence, many clinicians consider obesity to be a self-inflicted condition of little medical significance. It is thus important to focus on obesity which can decrease the incidence of low back pain immensely.[4]

In an effort to reduce rates of obesity Zumba Exercise has deliberately chosen, for reasons that it can be made in the form of weight-bearing exercise program that is homogeneous in an attempt to lose weight by exercise in the right dose. Lately, Zumba dance workout has been highly in demand by the women and young mothers, as it is evident from the increasing amount of participation in gym. In such case, it appears that high moving motivation overtake fatigue and directly influence the reduction of body fat.[3]

Zumba can be used as a physical activity which provides a large calorie burn through aerobic activities done with interval training. The average person will burn around 600 to 1,000calories in a single Zumba class. It Burn an excessive amount of calorie in compared to cardio workout and improves coordination as it is needed when you grow old. It is a full body workout besides this it help you reach your target heart rate, 145 beats per minute which can help in increasing the cardiovascular endurance.[5]

This study is necessary because the prevalence of low back pain is very high in obese people and this study will help to find the effectiveness of Zumba exercise in low back pain in obese people.

METHODOLOGY

Study Design: Experimental Study

Study setting: Community

Sampling Method: Convenient Sampling

Sample size: 30

Inclusion criteria:

- Age- 18 to 45years
- BMI- 30 or higher
- Low Back Pain

Exclusion criteria:

- Age- Below 18 years and above 45 years.
- People with active lifestyle.
- People suffering from cardiovascular, neurological and musculoskeletal conditions.

Outcome Measure:

- Numeric Pain Rating Scale (NPRS).
- Modified Oswestry low back pain disability questionnaire (MODQ)
- Body Mass Index (BMI)

Procedure:

Identification of subjects were done according to the inclusion criteria. Each of them was explained about the study and its benefits and written consent was obtained from each individual. Subjects who fulfilled inclusion and exclusion criteria along with BMI scoring were recruited and assigned into group: **Zumba Exercise group**. Each individual's weight, pain and disability level i.e. BMI, NPRS and MODQ score were taken Pre and Post Intervention.

Exercise group:

30 subjects were taken into the group for 4 weeks, each session was of 45minutes.

The Zumba Exercise schedule consists of:

a) Warm-up session- 5-10minutes

• Upper limb stretching

• Lower limb stretching

• Trunk stretching

b) Zumba exercise - 30minutes

c) Cool-down - 10minutes

• Slowly decrease the intensity of exercise

• Stretching

DATA ANALYSIS

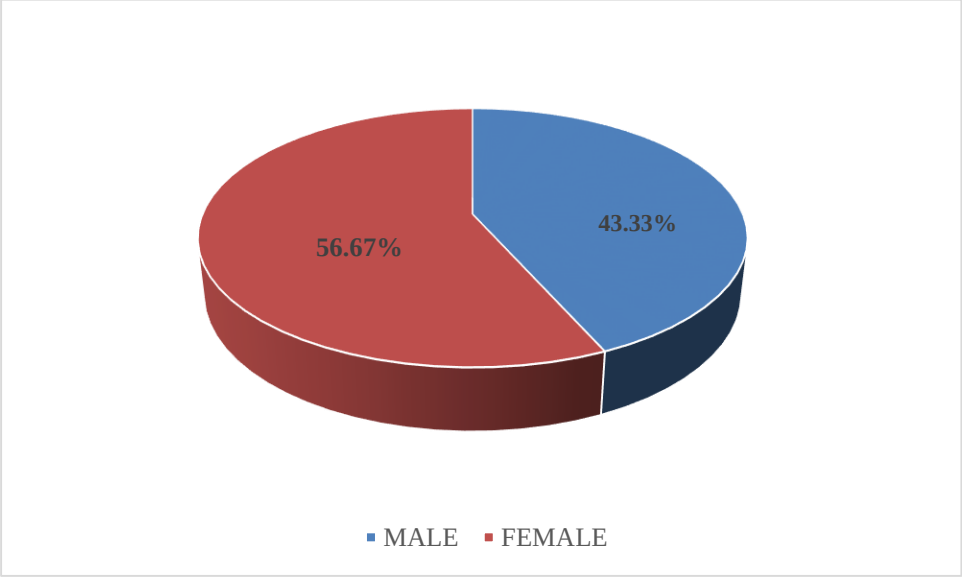
Data were analysed using SPSS statistical software using an intention-to-treat approach. Prior to all hypothesis testing, independent sample t-tests were conducted to examine whether significant mean differences existed in demographic, MODQ, BMI, NPRS scale variables among the group at baseline. We examined whether outcomes changed differentially from baseline to post intervention.

RESULT:

Demographic Profile:

1. GENDER DISTRIBUTION:

There were total 30 participants among which 17 were females and 13 were males.

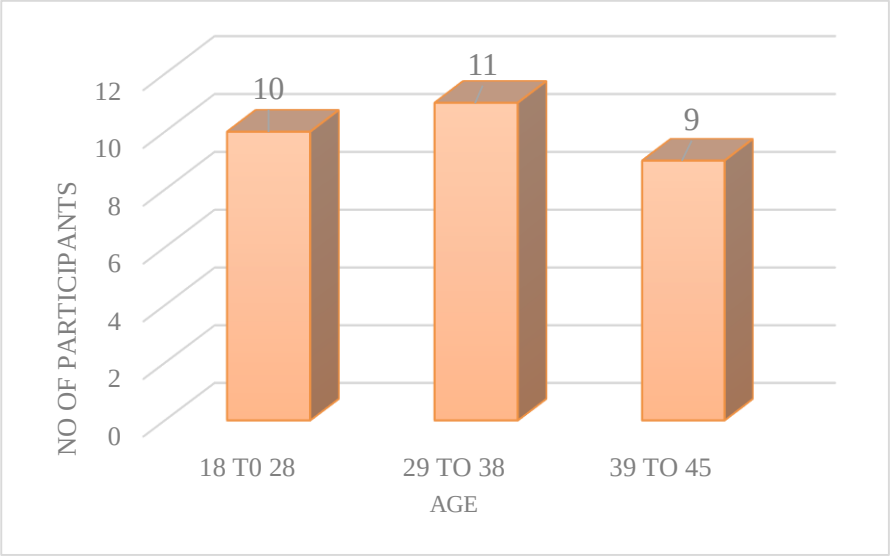


GRAPH 1: GENDER DISTRIBUTION

2. AGE DISTRIBUTION:

MEASURES	MEAN
GROUP	32

TABLE No. 1: Mean of Age Distribution within group



GRAPH 2: AGE DISTRIBUTION

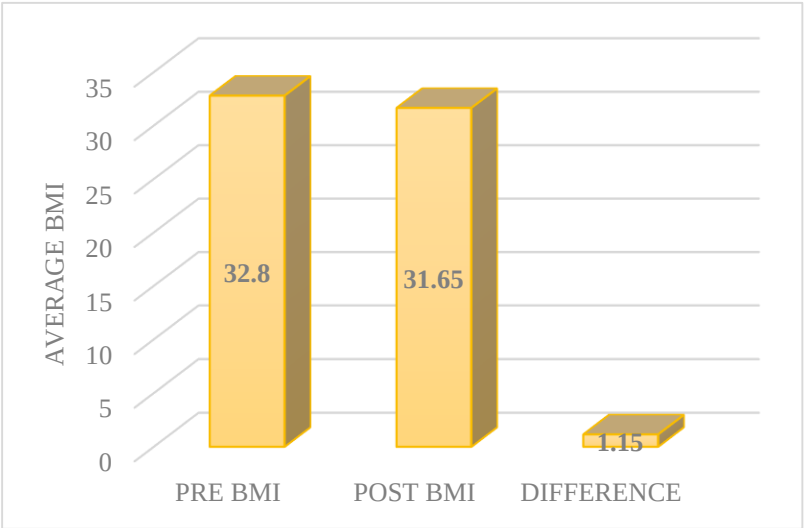
The above given age chart depicts the information about the number of participants taken in different age groups. It is apparent that the highest participant are in the age group of 29 to 38 which is 11, whereas in the age group of 18 to 28 there are 10 participants. In the age group of 39 to 45 there are 9 participants which is the lowest among all.

Clinical Parameters:

3. BMI:

MEASURES	BMI		DIFFERENCE	T-VALUE	P-VALUE
	PRE	POST			
GROUP (comparison within group)	32.70±2.86	31.65±2.39	1.05	0.00000000421308	< 0.01

TABLE No. 2: Comparison of within Groups for BMI



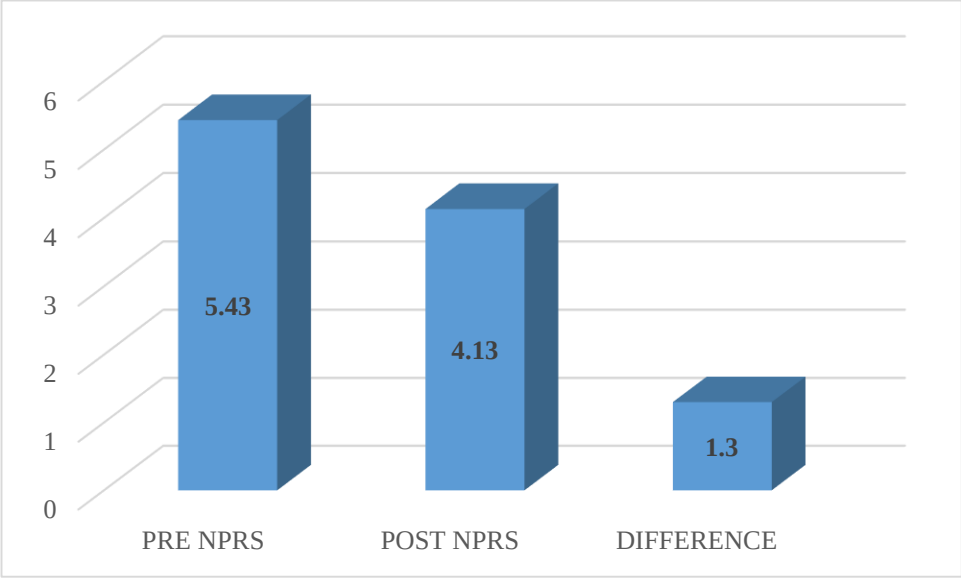
GRAPH 3: Comparison of within Groups for BMI

The above given graph shows the comparison of BMI within the groups. The average BMI were taken before the treatment and it seemed to be 32.8, whereas when the post BMI were taken it had decreased up to 31.65, hence the difference between both turns out to be 1.05.

4. NPRS (NUMERIC PAIN RATING SCALE)

MEASURES	NPRS (NUMARIC PAIN RATING SCALE)		DIFFERENCE	T-VALUE	P-VALUE
GROUP (comparison within group)	PRE	POST	1.3	0.00000000421308	< 0.01
	5.43	4.13			

TABLE No. 3: Comparison of within Groups for NPRS (NUMERIC PAIN RATING SCALE)



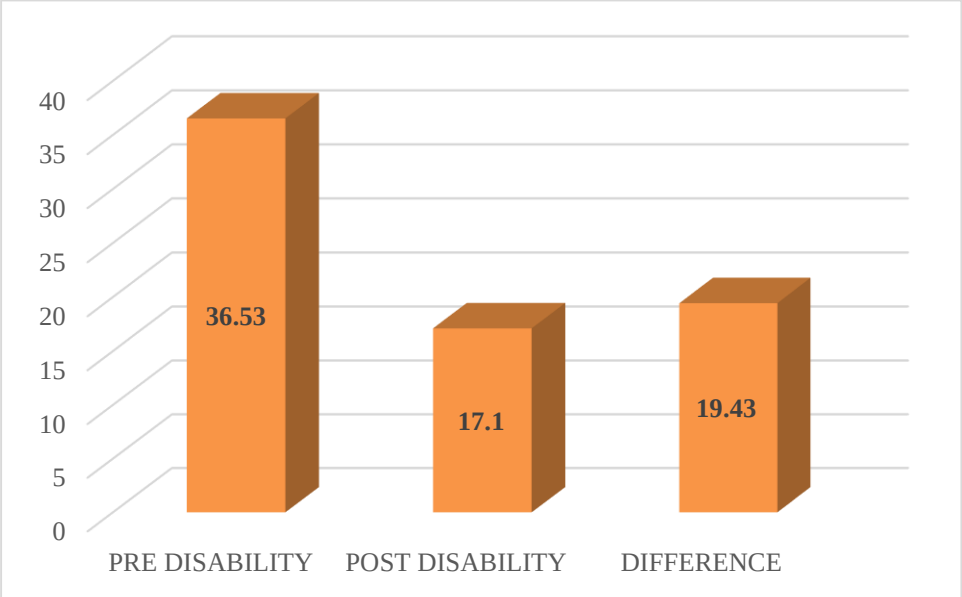
GRAPH 4: Comparison of within Groups for NPRS (NUMERIC PAIN RATING SCALE)

The above given chart shows the comparison of NPRS between the pre and post group. The pre NPRS was noted to be 5.43, however the post NPRS which was taken after the treatment was up to 4.13, hence the difference was noted to be 1.3.

5. MODIFIED OSWESTRY LOW BACK PAIN DISABILITY QUESTIONNAIRE (MODQ).

MEASURES	MODQ		DIFFERENCE	T-VALUE	P-VALUE
GROUP	PRE	POST	19.43	0.00000000000000589	< 0.01
	36.53	17.1			

TABLE No. 4: Comparison of within Groups for MODQ



GRAPH 5: Comparison of within Groups for MODQ.

The above given disability chart illustrates comparison of MODQ within the groups. The number of disability points seem to be high in pre-treatment part which is 36.53, nevertheless after the treatment a drastic change was noted and it dropped at 17.1 in the post phase of treatment, hence the difference seems to be 19.43.

DISCUSSION

The results of the study support the use of effectiveness of Zumba among obese people in low back pain. The findings obtained suggest that 4 weeks of Zumba exercise (five, forty five minute sessions a week) shows significant differences in Disability, Pain, and BMI on Obese individual.

Excessive body weight is directly related to several conditions of the spine, including the number of lumbar discs with degeneration, progression of disc disease, increased likelihood of radicular pain and neurologic symptoms and a higher prevalence of lumbar facet osteoarthritis. There are known postural changes with obesity that are likely contributing factors to an increase in mechanical load to the spine that include:

- A more flexed trunk posture leading to a decrease in flexion motion of the thoracic and thoracolumbar segments.
- An increased lordosis and decreased lateral bending of the lumbar spine.
- An increased hip joint movement.
- An increased anterior pelvic tilt.
- An increased hip-to-bench ratio for table-top work activities (a person has to stand further back from the table due to the size of the abdomen and reach farther forward). This limited spinal mobility has a negative impact on disc nutrition by limiting fluid movement and rehydration. The discs and facet joints are also affected directly by increased inflammatory responses generated by the adipose cells in the form of cytokines and acute-phase reactants.[6]

Despite these proposed and known theories of the effects of obesity on the spine, the role of obesity in directly causing LBP is still being confirmed. A review by Leboeuf-Yde of 56 research studies between 1965 and 1997 led to a conclusion that increased body weight may be a possible weak risk factor for LBP, but there were insufficient data to link it as a clear causative factor.[7]

Snow et al. randomized 54 obese patients (mean BMI 42.6 kg/m2) with musculoskeletal pain as measured by VAS (0–10 points) >5 to a physical therapy treatment program versus control group prior to a weight-loss program. The group receiving physical therapy experienced a significant reduction in VAS to 2.3 with the weight-loss program.[8]

The most recent study of nonsurgical weight loss in 46 adults with LBP and a mean BMI of 44.7 kg/m2 used a 52-week multidisciplinary program. This program included liquid meal replacements for 12 weeks (phase 1) followed by supervised caloric restriction from weeks 13–52 (phase 2). Study participants went to weekly educational meetings and group therapy sessions for the first 26 weeks, and monthly group meetings for the Second 26 weeks. During the second 26 weeks, they also participated in 60–90 min of physical activity. Over the year-long study, mean BMI was reduced to 39.6 kg/m2 (mean decrease of 5.1 kg/m2 [11.4%]) and ODI improved significantly from 31.9 to 27.1, and Numerical Pain Score (NPS) showed improvement (3.3 at baseline; 2.6 at 1 year). Weight, BMI, NPS and ODI all showed the most improvement during the initial 13 weeks of liquid meal replacements, and as the mean weight and BMI decreased, the NPS and ODI scores also decreased.[9]

Many health-associated problems are caused by the increased body fat mass and overweight. Given the global prevalence of overweight, using an accurate method is necessary to decrease overweight. Although Zumba is currently used to lose weight, this type of sport is rarely addressed in practical research as a weight loss method. Thus through this study it can be said that Zumba can be used as a conservative management to reduce weight which significantly decreases low back pain and Disability.

CONCLUSION

The current findings strongly support that Zumba exercise benefits the people having low back pain and who are suffering from obesity.

LIMITATIONS

- Small sample size.
- Limited age group of 18-45 years.
- The self-selection and convenience sampling of participants to complete the study may also influence on the result.

FUTURE RECOMMENDATIONS

- Future research should replicate these findings in other large samples, take larger age groups
- Investigate relationship between Pain and Obesity.

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Job and Career Satisfaction among Physiotherapists of Gujarat State - A Prevalence Study

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Abstract

Background:
Job and career satisfaction is an integral part of an individual's professional life. It affects job performance, consequently influencing growth of the profession. This study aims to assess the level of job and career satisfaction among physiotherapists of Gujarat State.
Methodology:
A cross-sectional survey was done with a self-administered e-questionnaire. 467 surveys collected were subjected to descriptive statistical analysis.
Result:
Overall job satisfaction is 39.83% (3.14±1.20) and career satisfaction is 42.84% (3.18±1.23).
Conclusions:
The majorities of physiotherapists were not satisfied with their jobs and moderately satisfied with their careers. It is essential to incorporate favourable factors in the workplace that promote professional satisfaction and there is a need to enhance opportunities for continued medical education.
Keywords:
Job satisfaction, Career satisfaction, Physiotherapists, Gujarat

INTRODUCTION

Work plays a prominent role in our lives. It occupies more time than any other single activity and provides the economical basis for our life style. Therefore, job satisfaction is a key research area for numerous specialists and is one of the most frequently studied work attitudes.[1]

Health services are affected by many factors such as human resources, delivery system and health infra structures. Among these human resources is a vital component in delivering health services. Job satisfaction of the health workers is highly important in building up employee motivation and efficiency as higher job satisfaction determine better employee performance and higher level of patients' satisfaction. Job satisfaction in health care workers has a great impact on quality, effectiveness and work efficiency and at the same time on health-care costs. Besides its importance for patients and health care system as a whole, professional satisfaction in health care workers is directly connected with absence from work, human relations and organization of work.[2, 3, 4]

Job satisfaction is how an individual feels about his or her job.[5] Job satisfaction, or dissatisfaction, not only depends on the nature of the job, but also on the individual's expectations from the job, and relies on the degree of motivation an employee has. The most common predictors for job satisfaction are leadership, interpersonal relationships, salary and promotion.[6]

Job satisfaction is under the influence of a series of factors such as: The nature of work, Salary, Advancement opportunities, Management, Work groups and Work conditions. [7] Job satisfaction is an important factor in increasing the level of work performance

and career aspirations. It is noted in the literature that there is high correlation between job satisfaction, commitment and better performance.[8, 9.]

One common research finding is that job satisfaction is correlated with life satisfaction. This correlation is reciprocal, meaning people who are satisfied with life tend to be satisfied with their job and people who are satisfied with their job tend to be satisfied with life. However, some research has found that job satisfaction is not significantly related to life satisfaction when other variables such as non-work satisfaction and core self-evaluations are taken into account.[10, 11]

There are important reasons why the researcher should be concerned with job satisfaction the first is that the people deserve to be treated fairly and with respect. Job satisfaction to some extent is a reflection of good treatment. It can also be considered as an indicator of emotional wellbeing or physiological health. The second reason is that job satisfaction can lead to behaviour of employees that affects organizational functioning .Furthermore job satisfaction can be a reflection of organizational functioning. Differences among organizational units in job satisfaction can be diagnostic of potential trouble spots.[12] Dissatisfied workers are more likely to provide inferior services, the physical and mental status and the social functioning of these workers can be affected substantially by the level of their job satisfaction.[13]

In recent years the scope of physiotherapy is also expanding to outside of medical institutions. So, that physiotherapist is increasingly expected to practice according to the social needs.[14] this necessitates practitioners to improve their quality of treatment. In order to deliver high quality of physiotherapy service it is necessary for the physiotherapist to have a firm commitment to their work, awareness of themselves as a professional & motivation & ambition to apply present and past learning and work experience to their future work.[15] One of the premises for quality treatment is job satisfaction, and this, in turn, influences employee retention in the work field, decreases absenteeism, improves work productivity and enhances performance.[16]

Knowledge about Physiotherapists job satisfaction will indirectly influence career choice and professional preferences in students for choosing Physiotherapy as a profession. One of the premises for quality treatment is job satisfaction, and this, in turn, influences employee retention in the work field, decreases absenteeism, improves work productivity and enhances performance.[17] Knowledge about Physiotherapists job satisfaction will indirectly influence career choice and professional preferences in students for choosing Physiotherapy as a profession.[18]

METHODOLOGY

Study design: A cross sectional survey study

Source of data: Physiotherapy colleges of Gujarat, Hospitals and Private Clinics of Gujarat, Social Media (Google, Facebook, Instagram, LinkedIn, and Whatsapp)

Population: Physiotherapists with more than 6 months of experience

Method of collection of data: Online survey form

Sample size: Convenient

Duration of study: 1 year

Inclusion criteria:

- Physiotherapists working in Physiotherapy Colleges of Gujarat.
- Physiotherapists having private practice or working at hospitals of Gujarat
- Physiotherapists having postal and/or email address.
- Physiotherapists having more than 6 months of work/teaching experience.

Exclusion criteria:

- Physiotherapists not willing to participate in the study.
- Physiotherapists not replying to the questionnaire in the fixed time period.
- Physiotherapists having less than 6 months of work/teaching experience.

Procedure:

The questionnaire was constructed with closed questions pertaining to job and career satisfaction. Job satisfaction included a set of questions on knowledge, work ethics, qualification, remuneration, rewards, communication among co-workers, and opportunities provided at the workplace. Career satisfaction included a set of questions on professional status, opportunities, immigration, career path, contribution, and research activity. It also covered basic demographics such as age, gender, years of experience and qualification (i.e. master‘s/bachelor‘s degree). Only the responses of individuals with more than 6 months of experience were included. The questionnaire was developed on Google Forms and consisted 15 closed questions, equally distributed on job and career satisfaction, eight of which focused on job satisfaction, and seven on career satisfaction.

STEP: 1

Identifying eligible candidates according to the inclusion criteria

STEP: 2

Selecting suitable candidates

STEP: 3

Sending consent form

STEP: 4

Sending survey form after receiving consent form

STEP: 5

Collection of data

STEP: 6

Assessment of collected data

STEP: 7

Statistical data analysis

STEP: 8

Result

DATA ANALYSIS

Statistical analysis was carried out with SPSS (v.26). Convenience sampling was used and descriptive statistics was performed. Mean, standard deviation and percentage were used and the level of satisfaction for each question was expressed in percentage. Finally, overall combined job and career satisfaction was calculated in percentage.

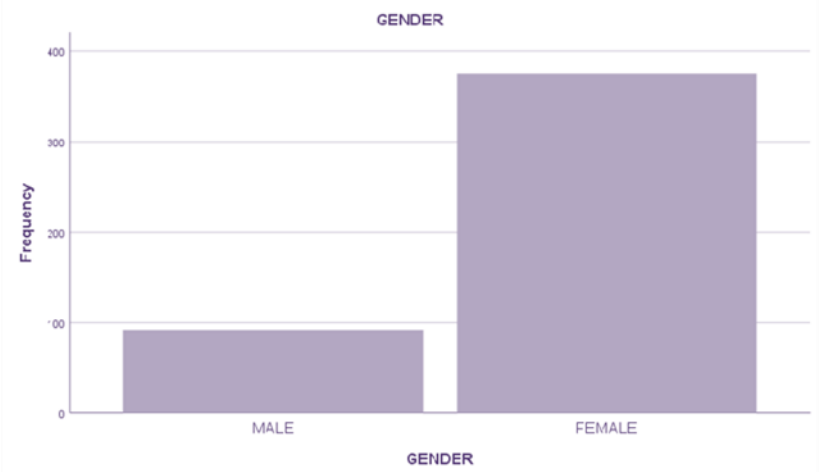
RESULT:

The demographic detail of the respondents is shown in the tables below. There were a total of 467 responses.

GENDER					
		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	**Male**	92	19.7	19.7	19.7
	Female	375	80.3	80.3	100.0
	Total	467	100.0	100.0	

TABLE.1

As shown in the table 1, out of total number of respondents, 92 were male and 375 were female.

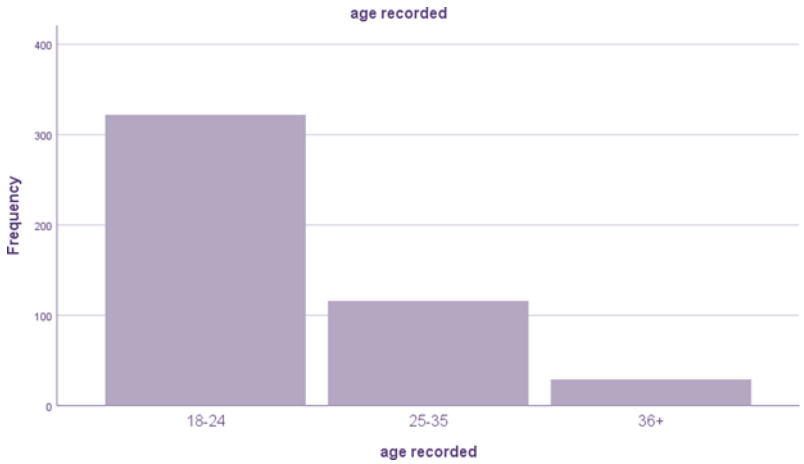


GRAPH.1

AGE RECORDED					
		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	**18-24**	322	69.0	69.0	69.0
	25-35	116	24.8	24.8	93.8
	36+	29	6.2	6.2	100.0
	Total	467	100.0	100.0	

TABLE.2

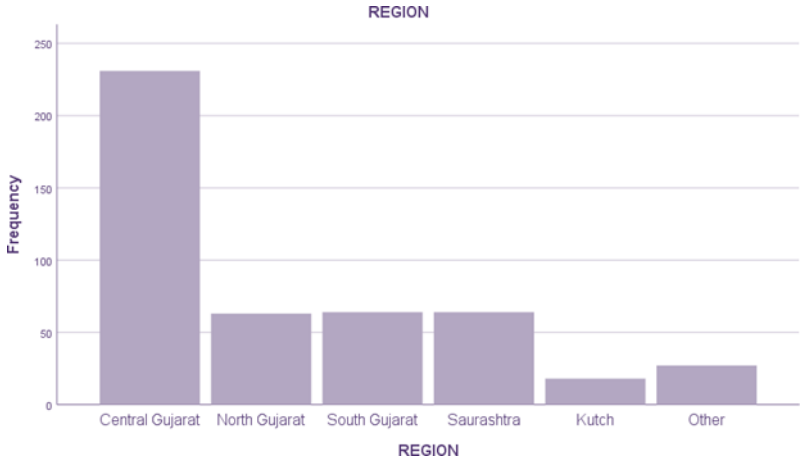
As shown in the table 2, 322 respondents were of age group ranging from 18-24 years, 116 respondents were of age group ranging from 25-35 years and 29 respondents were of age group ranging from 36-45 years.



GRAPH.2

REGION					
		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	**Central Gujarat**	231	49.5	49.5	49.5
	North Gujarat	63	13.5	13.5	63.0
	South Gujarat	64	13.7	13.7	76.7
	Saurashtra	64	13.7	13.7	90.4
	Kutch	18	3.9	3.9	94.2
	Other	27	5.8	5.8	100.0
	Total	467	100.0	100.0	

TABLE.3



GRAPH.3

As shown in the table 3, from the respondents, 231 were from Central Gujarat, 63 were from North Gujarat, 64 were from South Gujarat, 64 were from Saurashtra, 18 were from Kutch and 27 were from other regions of Gujarat.

WORK EXPERIENCE					
		Frequency	**Percent**	**Valid Percent**	**Cumulative e Percent**
Valid	**6 months to 12 months**	288	61.7	61.7	61.7
	1 year to 5 years	135	28.9	28.9	90.6
	More than 5 years	44	9.4	9.4	100.0
	Total	467	100.0	100.0	

TABLE.4

As shown in the table 4, from the respondents 288 were having 6-12 months of experience, 135 were having 1-5 years of experience, 44 were having more than 5 years of experience

GRAPH.4

The tables below represent the statistical analysis (frequency, percentage) of the responses of all the questions asked in the survey which were rated on 5 point likert scale by the respondents

LOJS1					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Extremely dissatisfied	37	7.9	7.9	7.9
	Moderately dissatisfied	63	13.5	13.5	21.4
	Neither satisfied nor dissatisfied	138	29.6	29.6	51.0
	Moderately satisfied	138	29.6	29.6	80.5
	Extremely satisfied	91	19.5	19.5	100.0
	Total	467	100.0	100.0	

TABLE.5

LOJS2					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Extremely dissatisfied	19	4.1	4.1	4.1
	Moderately dissatisfied	27	5.8	5.8	9.9
	Neither satisfied nor dissatisfied	173	37.0	37.0	46.9
	Moderately satisfied	185	39.6	39.6	86.5
	Extremely satisfied	63	13.5	13.5	100.0
	Total	467	100.0	100.0	

TABLE.6

LOJS3					
		Frequency	Percent	Valid Percent	CumulativePercent
Valid	Extremely dissatisfied	55	11.8	11.8	11.8
	Moderately dissatisfied	46	9.9	9.9	21.6
	Neither satisfied nor dissatisfied	138	29.6	29.6	51.2
	Moderately satisfied	146	31.3	31.3	82.4
	Extremely satisfied	82	17.6	17.6	100.0
	Total	467	100.0	100.0	

TABLE.7

LOJS4					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Extremely dissatisfied	64	13.7	13.7	13.7
	Moderately dissatisfied	45	9.6	9.6	23.3
	Neither satisfied nor dissatisfied	90	19.3	19.3	42.6
	Moderately satisfied	157	33.6	33.6	76.2
	Extremely satisfied	111	23.8	23.8	100.0
	Total	467	100.0	100.0	

TABLE.8

LOJS5					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Extremely dissatisfied	83	17.8	17.8	17.8
	Moderately dissatisfied	63	13.5	13.5	31.3
	Neither satisfied nor dissatisfied	156	33.4	33.4	64.7
	Moderately satisfied	119	25.5	25.5	90.1
	extremely satisfied	46	9.9	9.9	100.0
	Total	467	100.0	100.0	

TABLE.9

LOJS6					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Extremely dissatisfied	82	17.6	17.6	17.6
	Moderately dissatisfied	117	25.1	25.1	42.6
	Neither satisfied nor dissatisfied	148	31.7	31.7	74.3
	Moderately satisfied	46	9.9	9.9	84.2
	Extremely satisfied	74	15.8	15.8	100.0
	Total	467	100.0	100.0	

TABLE.10

LOJS7					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Extremely dissatisfied	46	9.9	9.9	9.9
	Moderately dissatisfied	118	25.3	25.3	35.1
	Neither satisfied nor dissatisfied	184	39.4	39.4	74.5
	Moderately satisfied	36	7.7	7.7	82.2
	Extremely satisfied	83	17.8	17.8	100.0
	Total	467	100.0	100.0	

TABLE.11

LOJS8					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Extremely dissatisfied	91	19.5	19.5	19.5
	Moderately dissatisfied	110	23.6	23.6	43.0
	Neither satisfied nor dissatisfied	156	33.4	33.4	76.4
	Moderately satisfied	46	9.9	9.9	86.3
	Extremely satisfied	64	13.7	13.7	100.0
	Total	467	100.0	100.0	

TABLE.12

LOCS9					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Extremely dissatisfied	100	21.4	21.4	21.4
	Moderately dissatisfied	18	3.9	3.9	25.3
	Neither satisfied nor dissatisfied	118	25.3	25.3	50.5
	Moderately satisfied	139	29.8	29.8	80.3
	Extremely satisfied	92	19.7	19.7	100.0
	Total	467	100.0	100.0	

TABLE.13

LOCS10					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Extremely dissatisfied	80	17.1	17.1	17.1
	Moderately dissatisfied	82	17.6	17.6	34.7
	Neither satisfied nor dissatisfied	208	44.5	44.5	79.2
	Moderately satisfied	97	20.8	20.8	100.0
	Total	467	100.0	100.0	

TABLE.14

LOCS11					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Extremely dissatisfied	73	15.6	15.6	15.6
	Moderately dissatisfied	54	11.6	11.6	27.2
	Neither satisfied nor dissatisfied	110	23.6	23.6	50.7
	Moderately satisfied	100	21.4	21.4	72.2
	Extremely satisfied	130	27.8	27.8	100.0
	Total	467	100.0	100.0	

TABLE.15

LOCS12					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Extremely dissatisfied	56	12.0	12.0	12.0
	Moderately dissatisfied	18	3.9	3.9	15.8
	Neither satisfied nor dissatisfied	127	27.2	27.2	43.0
	Moderately satisfied	147	31.5	31.5	74.5
	Extremely satisfied	119	25.5	25.5	100.0
	Total	467	100.0	100.0	

TABLE.16

LOCS13					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Extremely dissatisfied	55	11.8	11.8	11.8
	Moderately dissatisfied	74	15.8	15.8	27.6
	Neither satisfied nor dissatisfied	162	34.7	34.7	62.3
	Moderately satisfied	120	25.7	25.7	88.0
	Extremely satisfied	56	12.0	12.0	100.0
	Total	467	100.0	100.0	

TABLE.17

Locs14					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Extremely dissatisfied	74	15.8	15.8	15.8
	Moderately dissatisfied	36	7.7	7.7	23.6
	Neither satisfied nor dissatisfied	156	33.4	33.4	57.0
	Moderately satisfied	146	31.3	31.3	88.2
	Extremely satisfied	55	11.8	11.8	100.0
	Total	467	100.0	100.0	

TABLE.18

Locs15					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Neither satisfied nor dissatisfied	15	3.2	3.2	3.2
	Moderately satisfied	422	90.4	90.4	93.6
	Extremely satisfied	30	6.4	6.4	100.0
	Total	467	100.0	100.0	

TABLE.19

The tables below represent the statistical analysis (mean, standard deviation) of the responses of all the questions asked in the survey which were rated on 5 point likert scale by the respondents.

Statistics						
		LOJS1	LOJS2	LOJS3	LOJS4	LOJS5
N	Valid	467	467	467	467	467
	Missing	0	0	0	0	0
Mean		3.3919	3.5268	3.3298	3.4411	2.9615
Std. Deviation		1.17310	.93847	1.21614	1.31933	1.22326

TABLE.20

Statistics						
		LOJS6	LOJS7	LOJS8	LOJS9	LOJS10
N	Valid	467	467	467	467	467
	Missing	0	0	0	0	0
Mean		2.8137	2.9829	2.7473	3.2248	2.6895
Std. Deviation		1.28610	1.19895	1.26541	1.39080	.98702

TABLE.21

Statistics						
		LOJS11	LOJS12	LOJS13	LOJS14	LOJS15
N	Valid	467	467	467	467	467
	Missing	0	0	0	0	0
Mean		3.3426	3.5460	3.1028	3.1542	4.0321
Std. Deviation		1.39833	1.24797	1.16555	1.21410	.30908

TABLE.22

Table 23 represents the level of job satisfaction among PTs. The results reflected that the majority of PTs were satisfied with their job in all aspects measured.

Table 23. Level of job satisfaction among physiotherapists				
	Questions	**Mean**	**Std. deviation**	**Level of satisfaction (%)**
QI	**Are you satisfied with the opportunities provided at your workplace to improve and update your knowledge and clinical skills?**	3.3919	1.17310	49.1%
Q2	**What is your level of satisfaction with the communication between your co- workers and supervisors in workplace?**	3.5268	0.93847	53.1%
Q3	**What is your level of satisfaction with work ethics at your workplace?**	3.3298	1.21614	48.9%
Q4	**Are you satisfied with your qualification matching the designation?**	3.4411	1.31933	57.4%
Q5	**Are you satisfied with remuneration for the service you provide?**	2.9615	1.22326	35.4%
Q6	**Are there regular increments in your salary in the organization/hospital you are working in?**	2.8137	1.28610	25.7%
Q7	**Are you satisfied with the criteria implemented in your organization/hospital for promotion?**	2.9829	1.19895	25.5%
Q8	**Are you satisfied with the rewards received for your performance (excluding timely promotion)?**	2.7473	1.26541	23.6%
	Overall job satisfaction	3.1493	1.2025	39.8375%
20–40% dissatisfied; 41–60 moderately satisfied; 61–80 satisfied; >80 highly satisfied				

The results were as follows for satisfaction with:

- Opportunities provided in the workplace to improve knowledge and skill level: 49.1% (3.39± 1.173)
- Communication among co-workers: 53.1% (3.526± 1.216)
- Work ethics: 48.9% (3.32±1.216)
- Qualification matching with designation: 57.4% (3.44±1.319)
- Remuneration: 35.4% (2.96 ±1.223)
- Rewards at workplace: 25.5% (2.98±1.198)
- Overall job satisfaction among physiotherapists: 39.83% (3.14± 1.202).

Table 24. Results demonstrating level of career satisfaction among physiotherapists				
		Mean	**Std deviation**	**Level of career satisfaction (%)**
Q9	**Are you satisfied with your professional status in the community and social life?**	3.224	1.39080	49.5%
Q10	**Are you satisfied with the opportunities available in India for continued professional education?**	2.6895	0.98702	20.8%
Q11	**Are you satisfied with the career path you chose?**	3.3426	1.3983	49.2%
Q12	**Are you satisfied with your contribution towards the growth of the physiotherapy profession in India?**	3.5460	1.2479	57%
Q13	**Are you satisfied with opportunities provided for research activity at your work place?**	3.1028	1.1655	37.7%
	Overall career satisfaction	3.180	1.237	42.84%
20–40% dissatisfied; 41–60 moderately satisfied; 61–80 satisfied; >80 highly satisfied				

Table 25. Results regarding qualification/income and immigration				
		Mean	**Std. Deviation**	**Level of agreement**
Q14	**Your qualification (1/2/PhD) influences your income**	3.1542	1.21410	43.1%
Q15	**Indian PTs are immigrating for better prospects**	4.0321	.30908	96.8%
20–40% disagree; 41–60% moderately disagree; 61–80% agree; >80% highly agree				

Table 24 and Table 25 represent career satisfaction level among physiotherapists

The results were as follows for satisfaction with:

- Satisfaction with professional status: 49.5% (3.224±1.390)
- Opportunities for continued medical education: 20.8% (2.68±0.987).
- Satisfied with the career path chosen: 49.2% (3.76±1.363)
- Contribution to the profession: 57% (3.546 ±1.247).
- Opportunities at work: 37.7% (3.10±1.165)
- Qualification level influences the income: 43.1% (2.74±1.439),
- Physiotherapists emigrating for better prospects: 96.8% (4.032±0.309).
- Overall career satisfaction among physiotherapists: 42.84% (3.18±1.137).

DISCUSSION:

In this state level survey, it was found that most physiotherapists surveyed were moderately dissatisfied with their job and career. The authors were unable to find literature on career satisfaction among Physiotherapists of Gujarat State.

Job satisfaction

Workplace opportunities, communication, ethics, and qualification-matching designation:

Physiotherapy is a skill-based profession where most of the techniques require a hands-on approach. Therefore, it is important for individual physiotherapists to have periodic training to update their skills and knowledge within their workplaces based upon international standards. Developing countries like India lack such opportunities. However, this study reveals that the majority of the

individual surveys were happy about the current opportunities provided to them. Interpersonal relationships, which affect communication among co-workers, is another sensitive area that has an impact on professional development[19]. The survey within this study showed that 53.1% of the physiotherapists were satisfied with their communication with co-workers and supervisors. One of the important aspects of job satisfaction is having an appropriate designation based on an individual's qualification. This is the indirect way of keeping workers effective at work. Depending on their designation, their remuneration and work responsibilities can change. In this study, 57.4% of physiotherapists were happy with their designation based on their qualification. Work ethics is also one of the important factors, which determines employee satisfaction on. This study shows that the majority of the employees reported being satisfied with their organization's work ethics.[20]

Career satisfaction

Professional status, qualification influence on income, and immigration:

In the current study, 49.5% of the physiotherapists were satisfied with their professional status in the community. The majority of the participants agree that physiotherapists are immigrating to other places for better prospects. This indirectly states that the majority of them are dissatisfied working in Gujarat, and it is presumed to be the same in other developing countries. Since this survey has been able to reach only a few of the PTs in Gujarat, however, this statement cannot be generalized. There is a need for extensive research regarding this aspect.

Remuneration, salary increments, organizational criteria and rewards:

Remuneration is another important element of job satisfaction. This survey reveals that only 35.4% of physiotherapists were happy with the remuneration they receive for the work they do. This provides some insight into the situation in India where it appears physiotherapists feel they are underpaid. Motivating the employee to improve their performance in the workplace is necessary, as is rewarding them periodically for their performance.[21]

In the current survey, 25.5% of the respondents was satisfied with the rewards they received for their work performance.

Career choice, contribution to the profession and opportunities for research activity:

The most encouraging aspect of this survey is that the majority of the participants were happy about the career they have chosen. It is essential to keep ourselves updated with recent information in order to provide safe, effective and quality care for our patients. Of the population in the current study, 79.2% expressed dissatisfaction towards the opportunities provided for continued professional education.

CONCLUSION

The majority of physiotherapists in the current study were not satisfied with their job and moderately satisfied with their career in the state of Gujarat. This study represents the scenario in state of Gujarat in India, providing insight into the situation in developing countries and also provides a global outlook when compared with developed countries.

LIMITATIONS

- Convenient sample size. Responses were collected from the physiotherapists whose contacts were possible either through email or social media.
- The main limitation of the study was the participation in the survey. As the survey was sent electronically, the response rate was solely dependent on participants 'motivation.
- The major drawback of the study was that it could only reach the major cities in Gujarat, and those who used networks. This should be a consideration for future study.
- This was a preliminary survey which does not represent the entire population; hence, a detailed study should be carried out with large sample size in order to be able to generalize the results.

FUTURE RECOMMENDATIONS:

- Other factors affecting job satisfaction can be considered.
- Individual factor for job satisfaction can be studied.
- Inclusion of all the physiotherapists in Gujarat.
- Job satisfaction of Physiotherapists can be compared with other health care professionals.
- Job satisfaction among Physiotherapists working in different health care settings can be studied.

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Find Prevalence Of Osteoarthritis In Young Working Professionals A Cross-Sectional Study

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ABSTRACT

BACKGROUND AND OBJECTIVES :

This study was conducted to find the prevalence of osteoarthritis of knee in young people age between 21 to 30 years having sitting or standing work profession. The purpose of the study was to find prevalence ratio of OA in young people. Osteoarthritis (OA) is defined as a heterogeneous group of conditions that lead to joint symptoms and signs associated with a defective articular cartilage and related changes in bone morphology. It is considered the most common type of arthritis, as well as one of the most significant health problems that pervades our modern world. In 2019, it was estimated that 43 million adults suffered from arthritis. Of those, 26.9 million adults aged 25 years or older had OA. One in four people is expected to develop symptomatic OA in his or her lifetime.

INTRODUCTION :

Arthritis is a common joint problem usually associated with older adults. And there are very less study/,research Conducted on osteoarthritis in young age. According to the National Library of Medicine (NLM)Trusted Source, most people show symptoms of osteoarthritis by the time they are 70 years old, but there are also potential chances of osteoathritis in young age. So, this research helps to determine the Prevalence rate in various conditions. So this study may help to determine the prevalence ratio of OA in young people.

METHODOLOGY:

Research will be done on around 100 subjects age between 21 to 30 years with having sitting or standing profession to find Prevalence ratio for OA in young people.

Prevalence rate will be calculated by below formula.
* Prevalence percentage = OA will be found for given
Criteria / OA Will be not found for given criteria (Number of sub.) * 100 %

An observational study was conducted by using the convenient sample method. One hundred working professionals of ahmedabad and nearby area participated in this study by performa validated assessment form and clinical measures.

RESULT:

The prevalence of OA varies according to the definition of OA, the specific joint(s) under study, and the characteristics of the study population. The age standardized prevalence of radiographic knee OA in given subjects age between 21-30 years was only 5% among the all participants. Out of 100 subjects only 5 subjects primarily suspected of having OA of knee. Out of 100 subjects there was 56 female and 44 male subject in this survey. And OA was found in 3 female and 2 male subject after assessing clinical measures.

So, the prevalence percentage of OA of knee in young people age between 21 to 30 years having prolonged sitting or standing work profession would be as below:

$$\text{Prevalence percentage} = \frac{\text{OA will be found for given Criteria}}{\text{OA Will be not found for given criteria}} \times 100$$

PREVALENCE PERCENTAGE = 5/95 * 100% = **5.2631%**

A sum of 100 working professionals responded answering the questionnaire. An analysis was done by excel & calculation was done by chi square test calculator. The chi- square statistics found as **0.1695.** The p value is **0.918761**. The result is not significant at **p < .01**.

Keywords : Osteoarthritis , Prevalence , Young working professionals

Introduction

●Osteoarthritis (OA) is a common chronic condition resulting in pain, fatigue, functional limitations, increased healthcare utilization and high economic costs to society. The burden of OA is projected to increase, due in part to obesity and population aging.
●While the prevalence of OA increases with age, there is a growing recognition that OA affects people at younger ages.
●Recent US data demonstrated that half of people with symptomatic knee OA are diagnosed by age 55.

• Osteoarthritis (OA) is one of the most devastating chronic conditions that affect people around the world.
• Although the usual population associated with the condition is the elderly, who are mostly inactive, athletes and younger individuals are also susceptible.
• Depending on the population, the etiology may differ; injuries, occupational activities, and obesity appear to be the most common
causes of OA in young and athletic populations. [1]

Fig 1.1 X-RAY FINDING OF KNEE OA

Left) In this x-ray of a normal knee, the space between the bones indicates healthy cartilage (arrows). (Right) This x-ray of an arthritic knee shows severe loss of joint space.

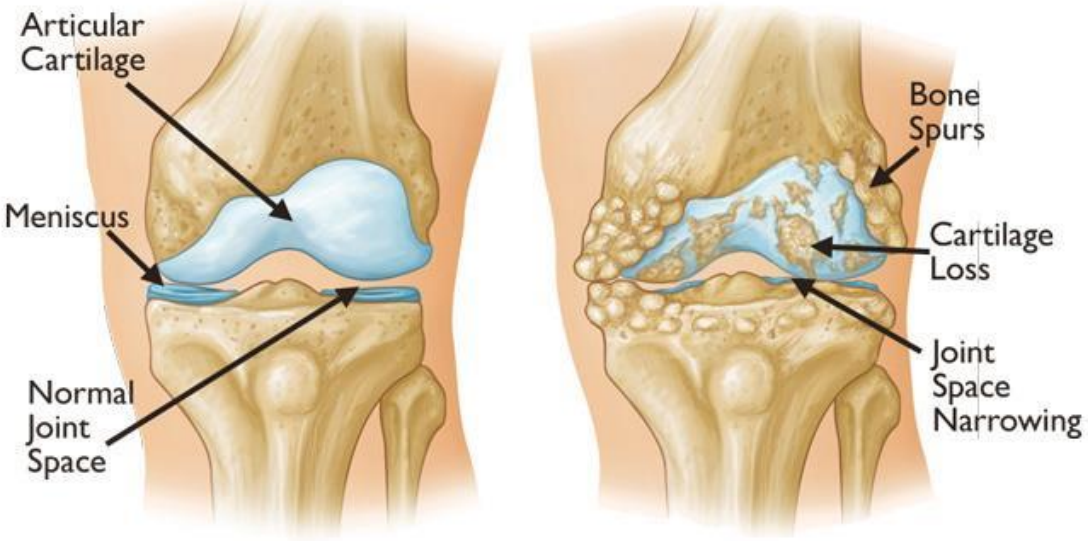


Fig 1.2 NORMAL KNEE VS OA KNEE

Osteoarthritis often results in bone rubbing on bone. Bone spurs are a common feature of this form of arthritis.

Stage 0 represents a normal joint.

- Stage 1 represents very minor wear and tear on a joint, but pain is unlikely.
- Stage 2 represents mild osteoarthritis, which is when most will typically begin experiencing pain and discomfort.
- Stage 3 is designated moderate, where there is obvious cartilage erosion. This may come with joint stiffness, more severe pain, and the experience of popping or snapping sounds.
- Stage 4 osteoarthritis is severe, where the joint space between the bones is considerably reduced. This creates greater friction, which generates more pain and discomfort.

What Are the Symptoms of Osteoarthritis?

• Symptoms of osteoarthritis most often develop gradually and include:
• Joint aching and soreness, especially with movement
• Pain after overuse or after long periods of inactivity
• Stiffness after periods of rest
• Bony enlargements in the middle and end joints of the fingers

(which may or may not be painful)

• Joint swelling
Some Of Potential Causes That Can Develop OA In Young People.
• There are several factors that increase a person's chances of developing osteoarthritis. These include:

• **Heredity**. Some people have an inherited defect in one of the genes responsible for making cartilage. This causes defective cartilage, which leads to more rapid deterioration of joints.
•People born with joint abnormalities are more likely to develop osteoarthritis, and those born with an abnormality of the spine (such as scoliosis or curvature of the spine) are more likely to develop osteoarthritis of the spine.[3]

• **Obesity** . Obesity increases the risk for osteoarthritis of the knee, hip, and spine. Maintaining ideal weight or losing excess weight may help prevent osteoarthritis of these areas or decrease the rate of progression once osteoarthritis is established.

• **Injury**. Injuries contribute to the development of osteoarthritis. For example, athletes who have knee-related injuries may be at higher risk of developing osteoarthritis of the knee. In addition, people who have had a severe back injury may
be predisposed to develop osteoarthritis of the spine. People who have had a broken bone near a joint are prone to develop osteoarthritis in that joint.[3]

• **Joint overuse**. Overuse of certain joints increases the risk of developing osteoarthritis. For example, people in jobs requiring repeated bending of the knee are at increased risk for developing osteoarthritis of the knee.
• Other diseases. People with rheumatoid arthritis, the second most common type of arthritis, are more likely to develop osteoarthritis. In addition, certain rare conditions, such as iron overload or excess growth hormone, increase the chance of developing OA.[3]

•OA isn’t restricted to older adults. Younger adults can also experience symptoms that may signify OA, including:

• morning joint stiffness
• aching pain
• tender joints
• limited range of motion
• Most often pathology develops in women but found in men.
Usually it is detected when it has already happened to
fracture, especially of the femur, which is considered the
most serious and life-threatening.[4]

• After pain, stiffness was identified as a significant
symptom that…
• impacted daily life. Other impactful symptoms included:

• - functional, walking and standing limitations
• - loss of flexibility
• - sleep disturbance
• - fatigue
• - grating (bone on bone) sensation
• - joint swelling
• - disfigurement
• - other numbness and instability (OA VOP 2017)[4]

• Diagnosing OA in athletes and young individuals is sometimes challenging because of their increased pain tolerance. However, the treatment of OA in these populations does not differ from its management in the general population.
• Several considerations need to be taken into account when choosing a treatment modality. The purpose of this review is to address OA in athletes and younger individuals and to discuss its presentation, diagnosis, and treatment.[4]

Clinical Findings for OA

X-Rays – Cartilage loss, a tell-tale sign of osteoarthritis, appears as a narrowing of the space between bones in the joint. While an X-ray image will not show the cartilage itself, your doctor can use this bone proximity to provide a diagnosis. An X-ray can also show bone spurs around a joint, which may cause pain and tenderness.

MRI – A magnetic resonance imaging test, or MRI, can produce detailed images of bone and soft tissues. This includes cartilage. This test is not typically needed for an initial diagnosis, but it can provide more information about the disease's progression.

Blood tests – Certain blood tests can help rule out other causes of joint pain, like rheumatoid arthritis, narrowing your doctor's field of potential diagnoses.

Joint fluid analysis – In this test, your doctor will use a syringe to draw fluid from the affected joint. They then test the fluid to determine whether the inflammation is caused by an infection or gout, homing in on a definitive diagnosis.

Epidemiology

●Osteoarthritis (OA) of the knee is the most common form of joint disease and prevalence of both radio graphically evident and symptomatic. The females having higher prevalence than males (11.4% vs 6.8%).

●The gender difference in prevalence has recently been emphasized in a meta-analyses, which provides evidence for a greater risk in females for prevalent and
incident knee OA.

●The meta-analysis also reported that females tend to have more severe knee OA radio graphically assessed than males and that the gender differences increase with
age > 55 years. The prevalence of OA will increase as the population of the kingdom ages, especially if the incidence of obesity remains at over 50% in the 45+ age.

• OA in adults is frequently accompanied by comorbidities that
• contribute to decreased quality of life:
• - obesity or being overweight (90 percent)
• - hypertension (40 percent)
• - depression (30 percent)
• Osteoporosis at a young age is very rare, so at the first manifestations should be sure to look for the causes of the disease.[2]
• Activity Limitation: • Arthritis limits the activities of 23.7 million US adults. Around 44% of adults with doctor-diagnosed arthritis had arthritis attributable activity limitations in 2013–2015.
• Leading Cause of Work Disability
• Arthritis and other rheumatic conditions are a leading cause of work disability among US adults.3
• In all US states, 1 in 25 working-age adults aged 18 to 64 years face work limitations they attribute to arthritis; among those with arthritis, at least 1 in 4 have work limitations. The prevalence of work limitations due to arthritis varies by state.
•Risks of revision surgery are especially pronounced in the younger patient, who may be more physically active and, consequently, subject to multiple revision surgeries over a lifetime. (DR.S.Bhandari 2012)[5]

NEED OF STUDY

• Arthritis is a common joint problem usually associated with older adults. And there are very less study/research Conducted on osteoarthritis in young age. According to the National Library of Medicine (NLM)Trusted Source, most people show symptoms of osteoarthritis by the time they are 70 years old, but there are also potential chances of osteoathritis in young age. So, this research helps to determine the Prevalence rate and percentage of OA in young working professionals who have prolonged sitting ans standing work profession. So this study may help to determine the prevalence ratio of OA in young people.

OBJECTIVE OF THE STUDY

• To find prevalence of OA in young people(Age between 21 to 30 years) having prolonged sitting or standing work profession in ahmedabad and gandhinagar area.

• *REVIEW OF LITERATURE*

1. Prevalence of osteoarthritis of knee joint among adult population in a rural area of Kanchipuram District, TN [Venkatachalam.J, Natesan.M, Bharath Z] Year -2018.[9]

•A total of 1986 adult respondents were interviewed out of which 27.1% had OA of knee. Age more than 50 years, female gender, tobacco usage, illiteracy, lower socioeconomic class, positive family history of OA, diabetes, and hypertension were found to be associated with OA knee ($P < 0.05$).

• Conclusion: The burden of osteoarthritis knee was high in this region. Hence, effective preventive strategy has to be taken to minimize this burden.

2. Osteoarthritis Affects Younger People, Too by ILANA N. ACKERMAN, PT, PhD (Article published in 2019)[10]

●Conclusion of this study

• In this article researcher found that In younger people presenting with persistent joint pain and transitory stiffness (particularly those who have sustained a previous traumatic joint injury), the early signs of OA should be suspected. Routine imaging is not indicated for the diagnosis of uncomplicated knee or hip OA.
•While X-rays are inexpensive, radiographic findings are not well correlated with symptoms and are unlikely to alter the management plan or predict future disease progression. Magnetic resonance imaging can detect early OA changes that may be useful in a research context,but the clinical significance of these changes is questionable. Overuse of MRI is costly for health systems and may lead to unwarranted surgical interventions.

• These include activity-related joint pain and either no joint-related morning stiffness or morning stiffness lasting no longer than 30 minutes.Atypical features (eg, a hot swollen joint, prolonged morning stiffness, or rapid worsening) warrant investigation, as they may indicate other diagnoses, including inflammatory or septic arthritis, or malignancy.

3. Hip and knee osteoarthritis In young age (ADAM G. CULVENOR, PT, PhD), RANA S. HINMAN, PT, PhD(Vol 2. Feb. 2017)[11]

• Hip and knee OA is not restricted to older age groups and can profoundly affect quality of life and work participation among younger people. Knee joint injury is a strong risk factor for subsequent knee OA, and early signs and symptoms may present in the decade following injury or reconstructive surgery.

•Thorough physical examination can identify key impairments, and PROMs are valuable tools for tracking changes in pain, function, and well-being. Nonsurgical management approaches relevant to younger patients include education and self-management support, physical therapist–prescribed exercise programs, and weight management.

4. Epidemiology of osteoarthritis: state of the evidence. Kelli D. Allen, Yvonne M. Golightly [2019].[12]

• This study concludes the Risk factors with strong evidence for osteoarthritis onset and/or progression include age, sex, socioeconomic status, obesity, family history, joint injury, joint alignment, and occupational joint loading.Traditional epidemiologic studies and mining of large health administrative databases show a large and increasing impact of osteoarthritis.

5. Risk Factors for Osteoarthritis and Contributing Factors to Current Arthritic Pain in South Korean Older Adults.Kyoung Min Lee, Chin Youb Chung, Ki Hyuk Sung, Seung Yeol Lee, Sung Hun Won, Tae Published online 2014 Dec 10.[13]

• The Fourth Korean National Health and Nutrition Examination Surveys was conducted in 2009. Therein, 720 males and 1008 females aged between 25 years to 45 years older were included. Comprehensive data on habitual, socioeconomic, medical, nutritional, and psychological factors were collected along with the presence of osteoarthritis and arthritic pain. After univariate analysis, binary logistic regression analysis was performed to identify risk factors for osteoarthritis and contributing
factors to current arthritic pain. And the study conclude that higher BMI, lack of weekly moderate intensity activity, and unfavorable subjective health status were significant factors contributing to current arthritic pain. More attention needs to be paid to psychiatric effects on osteoarthritis and joint related pain.

6. What Are the common risk factors that cause OA in younger athletes (Whittaker.J 2015)[14]

This study concludes some major and most common risk factors that cause OA in younger athletes that mentioned as below.

• Five common athletic injuries have been identified as placing patients at greater risk of developing post-traumatic OA:

• - anterior cruciate ligament (ACL) ruptures
• - meniscus tears (the second most common structure damaged in athletes)
• - shoulder dislocation
• - patellar dislocation
• - ankle instability (the most commonly injured joint in the body)

7.Osteoarthritis in Young, Active, and Athletic Individuals. *Adae O Amoako(2018)*[10]

This study concludes several risk factors associated with OA. In the athlete or young individual, injury, occupational activities, and obesity are the main factors that contribute to OA. Diagnosis of OA in the athlete is often delayed and difficult

because of high tolerance to pain, as well as the athlete's preference for expedited return to play. History, physical examination, laboratory tests, and radiographic findings may be used to make a definite diagnosis of OA. Exercise remains the recommended initial treatment for OA in all populations. NSAIDs, braces, and surgery are other treatment modalities for OA. The treatment of OA in the athlete or young individual should be patient specific, with consideration for the patient's expectations and the period of absence from sports activities.

8. Workplace policies and prevalence of knee osteoarthritis: the Johnston County Osteoarthritis Project. J-C Chen, L Linnan, L F Callahan, E H Yelin, and J B Renner, J M Jordan [2007 Jun 13]

The negative associations between KOA and workplace policies raise concerns about possible employment discrimination or beneficial effects of workplace policies.

Longitudinal studies are needed to clarify the dynamic complexities of KOA risks and outcomes in relation to workplace policies.

Studies on the interrelations of work and osteoarthritis (OA) remain an active area of research because of their profound implications for clinical practice and public policy. As indicated in recent reviews of epidemiological literature on the relationship between occupational factors and risks of knee OA (KOA),[1,2] both case–control and prospective cohort studies have shown the positive associations between KOA and physical exposures in the workplace, and the strength of scientific evidence is moderate.

Specifically, previous studies have shown that certain occupational activities (e.g., kneeling, squatting or climbing) increase the risk of KOA,[3,4,5,6] presumably due to increased biomechanical loads on knee joints.

However, most of the previous studies were primarily focused on individual-level attributes; very little data are available to examine the potential link between KOA and organisation-level workplace characteristics (e.g., workplace policies, employers' commitment), many of which play an important role in occupational health and safety.

HYPOTHESIS

NULL HYPOTHESIS :

There's no correlation find between knee OA and young people (Age between 21 to 30 years) having prolonged sitting or standing work profession. That's why prevalence rate is difficult to find and result is not significant.

RESEARCH HYPOTHESIS :

There's some correlation find between knee OA and young people (Age between 21 to 30 years) having prolonged sitting or standing work profession. Hens prevalence

rate can be find and significance can be find through this research.

METHODOLOGY

MATERIALS AND METHODOLOGY :-

STUDY DESIGN : Cross-sectional study

SOURCE OF DATA : Hospitals and Offices

POPULATION : Young Working professionals having age between 21 to 30 years who have prolonged sitting or standing work profession.

SAMPLING METHOD : Convenient Sampling Method

DURATION OF STUDY : 1 month

SAMPLE SIZE : 100

•Method of selection of data:

Research will be conducted on young people age between 21 to 30 years having prolonged standing or sitting work profession. An observational study was conducted by using the convenient sample method. One hundred working professionals of ahmedabad and nearby area participated in this study by perform validated assessment form and clinical measures.

• *INCLUSION CRITERIA*

• Subject having age between 21 to 30 Years.

• Both male and female subject.

• Subject who having prolonged sitting or standing work profession (Ex: Nurse, Teacher/Professor, Petrol filler man).

• *EXCLUSION CRITERIA*

• Subject having diabetes, hyperthyroidism, hypertension, osteoporosis, rickets and various type of muscular disorders.

• Subject having autoimmune disease.

• Subject with previous history OA surgery.

• Subject with history of any other neurological and cardio-thoracic conditions.

• Subject having OA of hip, wrist or hand and feet.

• OUTCOME MEASURES

• Clinical assessment forms

• Patient's X-ray, and other radiological reports

• Clinical Measures

• Excel sheet

• The Visual Analogue WOMAC 3.0 scale & VAS scale

• Goniometer

RESULT :

PROCEDURE OF RESEARCH:

Survey of the working professionals

Data collection by using the questionnaire

Data analysis

Data Interpretation

Result

Conclusion

A sum of 100 working professionals responded answering the questionnaire. An analysis was done by excel & calculation was done by chi square test calculator. The chi- square statistics found as 0.1695. The p value is 0.918761. The result is not significant at $p < .01$.

RESULTS			
	NONE	MILD	MODERATE
MALE	42 (41.80) [0.00]	1 (1.32) [0.08]	1 (0.88) [0.02]
FEMALE	53 (53.20) [0.00]	2 (1.68) [0.06]	1 (1.12) [0.01]

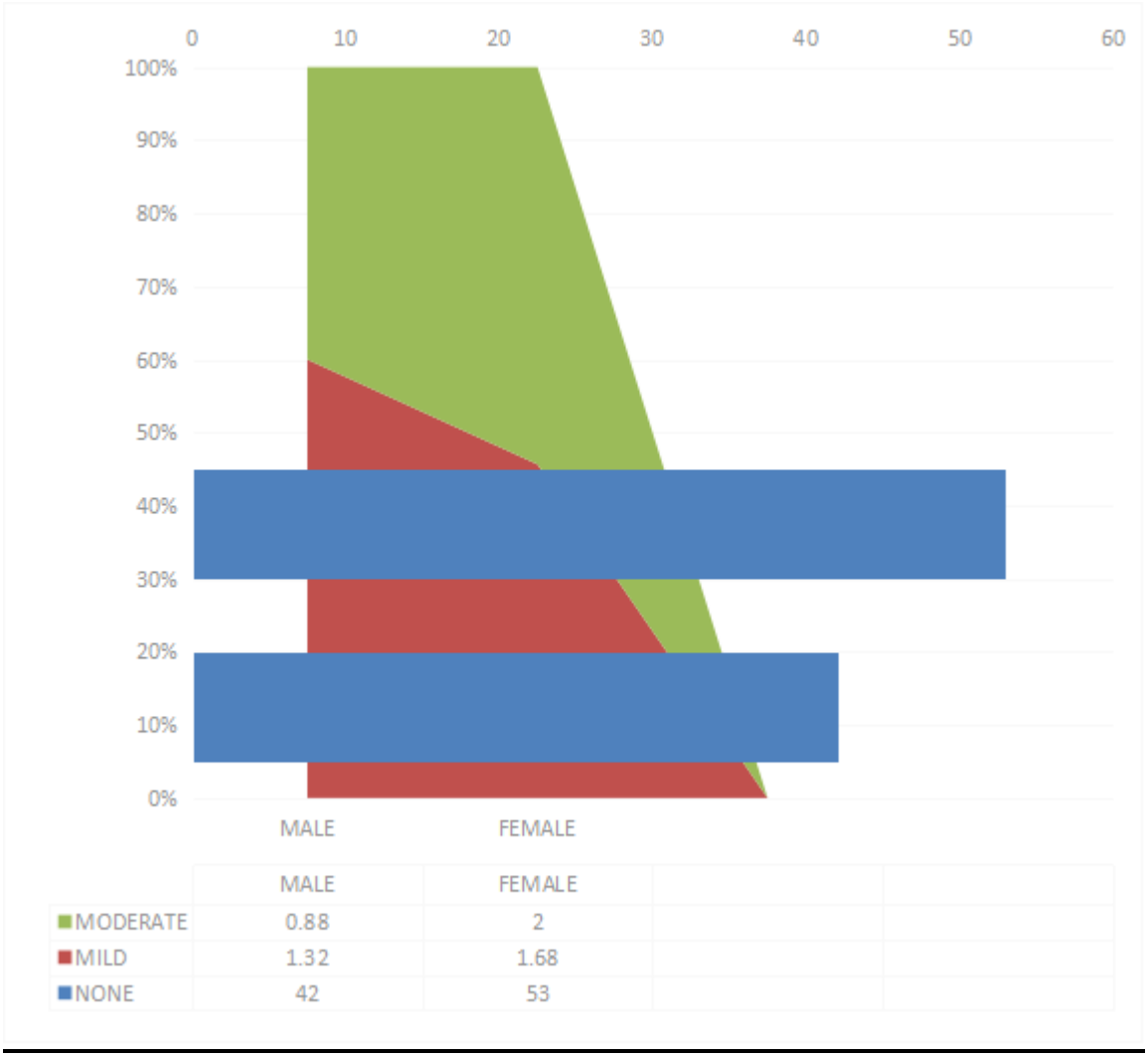
1.1 RESULT TABLE WITH P VALUE AND CHI SQUARE DATA

The prevalence of OA varies according to the definition of OA, the specific joint(s) under study, and the characteristics of the study population. The age standardized prevalence of radiographic knee OA in given subjects age between 21-30 years was only 5% among the all participants. Out of 100 subjects only 5 subjects primarily suspected of having OA of knee. Out of 100 subjects there was 56 female and 44 male subject in this survey. And OA was found in 3 female and 2 male subject after assessing clinical measures.

So, the prevalence percentage of OA of knee in young people age between 21 to 30 years having prolonged sitting or standing work profession would be as below:

Prevalence percentage = OA will be found for given Criteria **DEVIDED BY** OA Will be not found for given criteria **INTO 100%**

TOTAL PREVALENCE PERCENTAGE = **5.2631%**
PREVALANCE PERCENTAGE IN MALES = **2.10%**
PREVALANCE PERCENTAGE IN FEMALES = **3.15%**

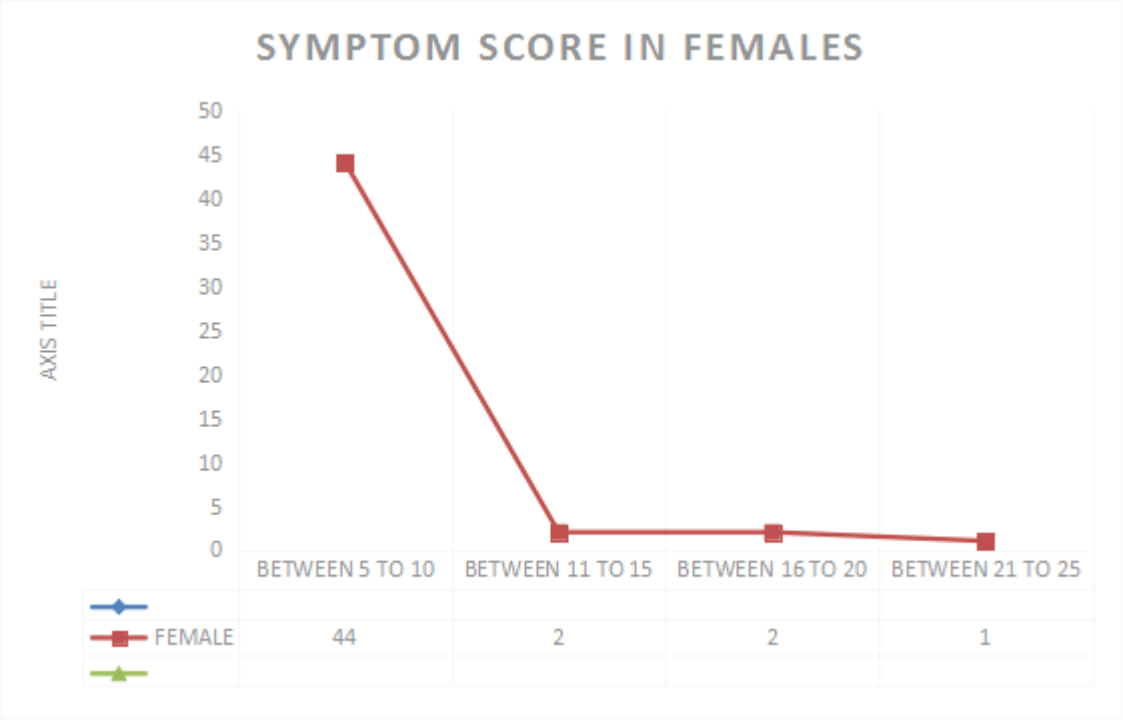


GRAPH 1.1 CHI SQUARE

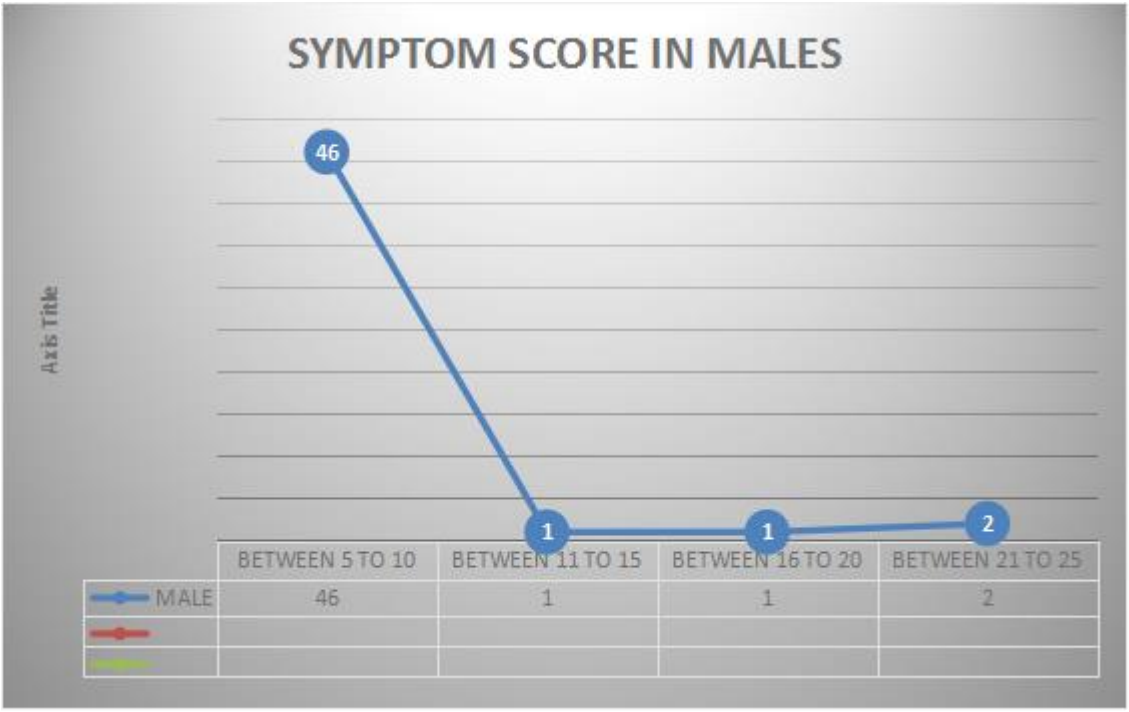
➡ ***CHI SQUARE STATISTICS WITH PREVALANCE DATA***

A chi-squared test (also chi-square or χ^2 test) is a statistical hypothesis test that is valid to perform when the test statistic is chi-squared distributed under the null hypothesis, specifically Pearson's chi-squared test and variants thereof. Pearson's chi-squared test is used to determine whether there is a statistically significant difference between the expected frequencies and the observed frequencies in one or more categories of a contingency table.

Symptoms - These questions should be answered thinking of your knee symptoms during the **last week**

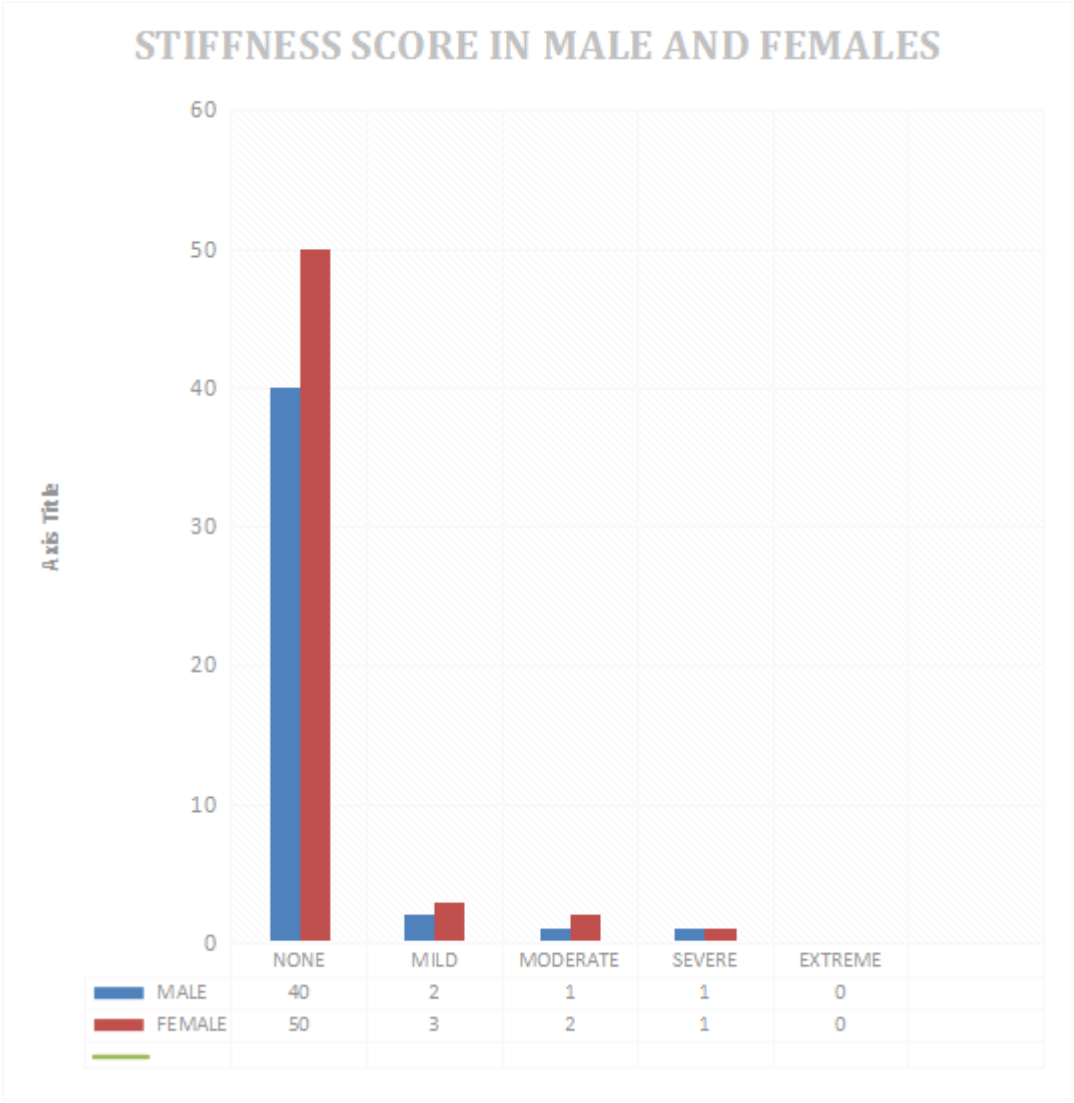


GRAPH 1.2

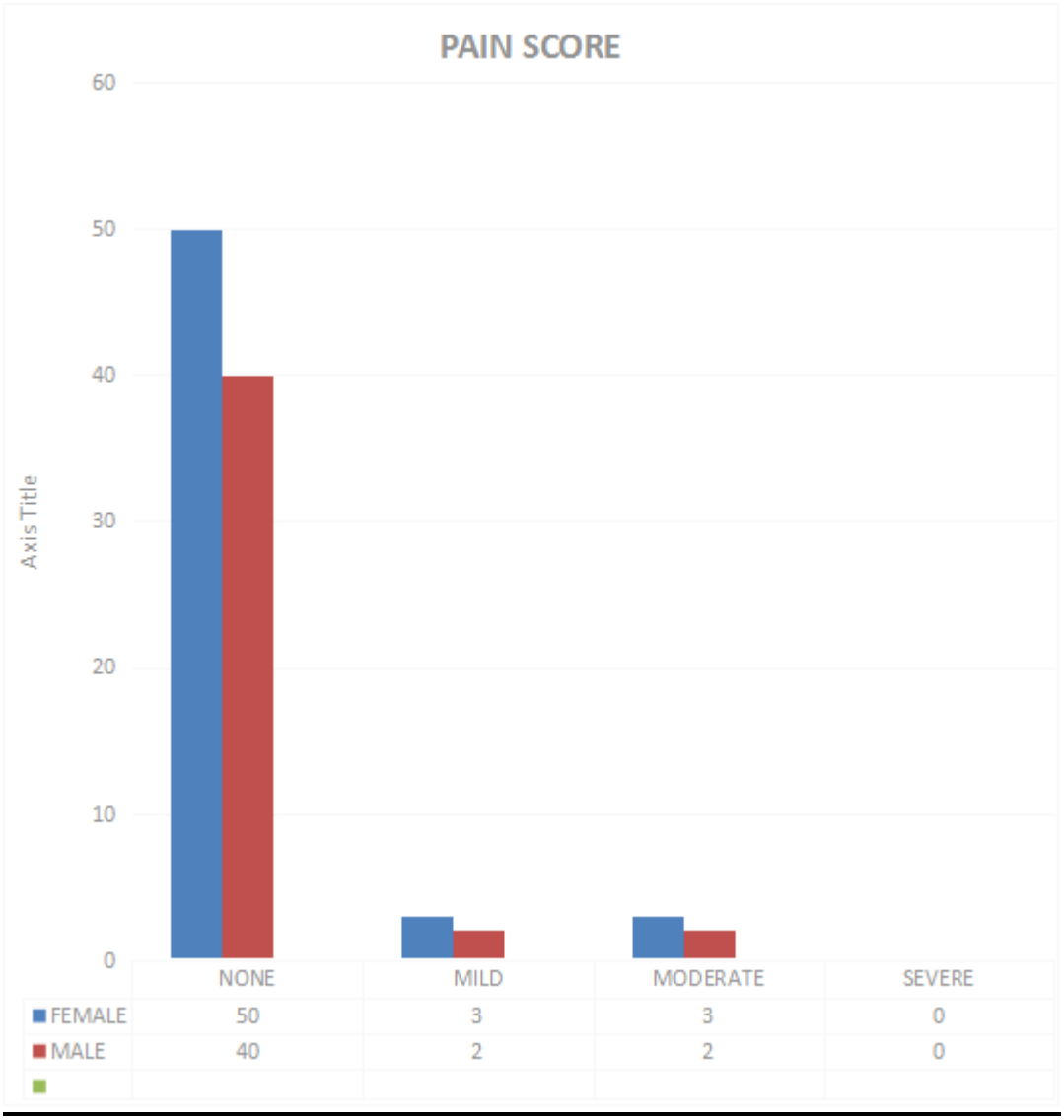


GRAPH 1.3

Stiffness - The following questions concern the amount of joint stiffness you have experienced during the **last week** in your knee. Stiffness is a sensation of restriction or slowness in the ease with which you move your knee joint.

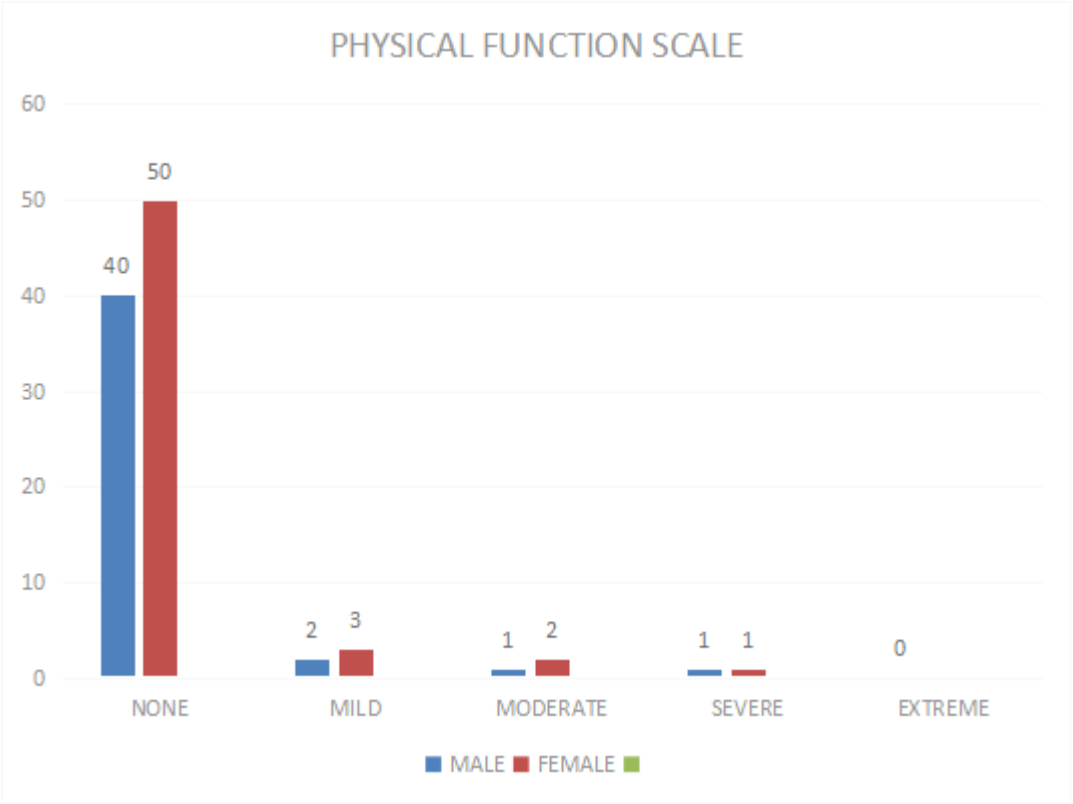


GRAPH 1.4


PAIN SCORE
60
50
40
30
20
10
0
Axis Title
NONE
MILD
MODERATE
SEVERE
FEMALE
50
3
3
0
MALE
40
2
2
0

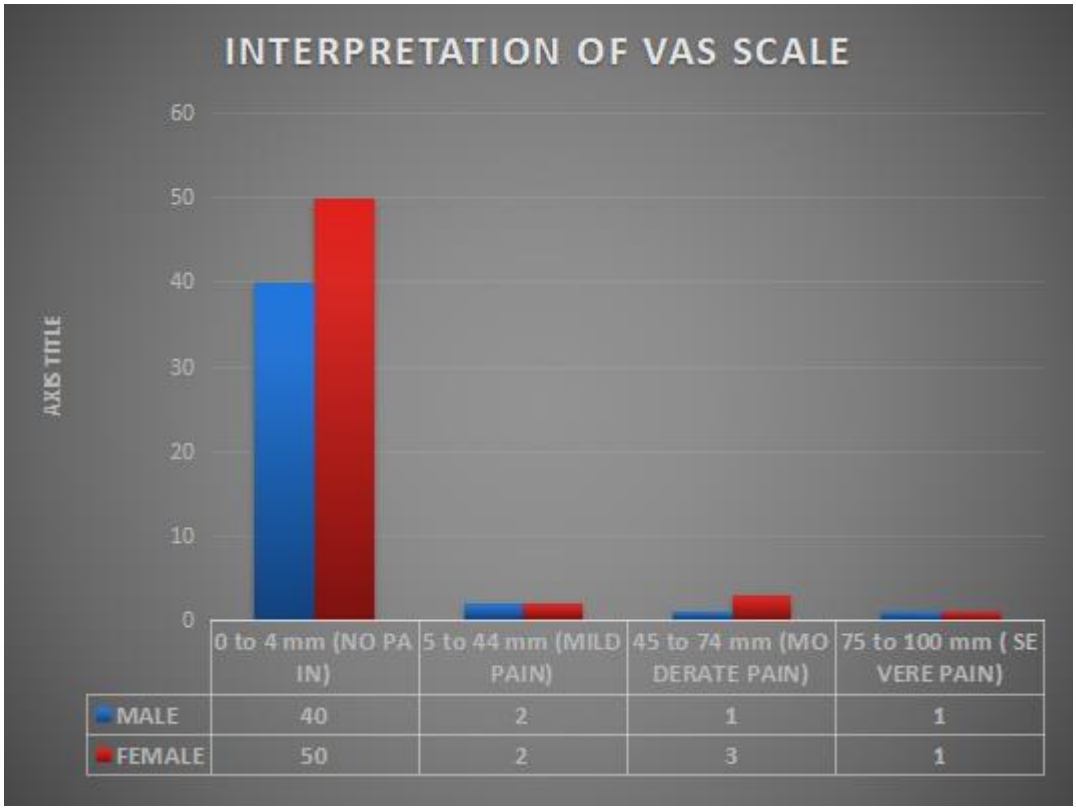
GRAPH 1.4

Function, daily living - The following questions concern your physical function. By this we mean your ability to move around and to look after yourself. For each of the following activities please indicate the degree of difficulty you have experienced in the last week due to your knee



GRAPH 1.5

VAS SCALE RESULTS



GRAPH 1.7

DISCUSSION :

The present study was carried out to find prevalence of osteoarthritis in young people (Age between 21 to 30 years) having prolonged sitting and standing profession. This study was performed in the ahmedabad and nearby areas. any damage to the joints cannot be reversed, the symptoms of osteoarthritis can be managed, allowing sufferers to live as normal a life as possible.

Treatments for osteoarthritis include lifestyle advice, medications, orthobiologics and surgery.

Lifestyle changes include taking steps to lose weight if necessary and doing low impact exercise, such as yoga, to help strengthen muscles around the joint to stabilise it. Your doctor may refer you to a physiotherapist if your job or choice of physical activity is causing your symptoms. They may also recommend topical treatments or the use of hot or cold compresses.

Osteoarthritis typically affects people over the age of 50, but young people can be affected as well.[2] The CDC estimates that about 7% of the U.S. population aged 18–44 had been diagnosed with OA from 2013–2015.

Younger people who are active in sports or other physically demanding activities, or who have sustained an injury such as a torn meniscus—a tear in the cartilage of the knee—may be more prone to developing the condition earlier in life.

Over 32 million people across the U.S. live with osteoarthritis.[3] While this condition can affect any joint, it typically affects the knees, hips, back, hands, and neck. Symptoms such as pain or swelling may not occur right away and can worsen over time.

This study was conducted to find the prevalence of osteoarthritis of knee in young people age between 21 to 30 years having sitting or standing work profession. The purpose of the study was to find prevalence ratio of OA in young people. Osteoarthritis (OA) is defined as a heterogeneous group of conditions that lead to joint symptoms and signs associated with a defective articular cartilage and related changes in bone morphology. It is considered the most common type of arthritis, as well as one of the most significant health problems that pervades our modern world. In 2019, it was estimated that 43 million adults suffered from arthritis. Of those, 26.9 million adults aged 25 years or older had OA. One in four people is expected to develop symptomatic OA in his or her lifetime.

SUMMARY & CONCLUSION

The prevalence of OA varies according to the definition of OA, the specific joint(s) under study, and the characteristics of the study population. The age standardized prevalence of radiographic knee OA in given subjects age between 21-30 years was only 5% among the all participants. Out of 100 subjects only 5 subjects primarily suspected of having OA of knee. Out of 100 subjects there was 56 female and 44 male subject in this survey. And OA was found in 3 female and 2 male subject after assessing clinical measures.

A sum of 100 working professionals responded answering the questionnaire. An analysis was done by excel & calculation was done by chi square test calculator. The chi- square statistics found as 0.1695. The p value is 0.918761. The result is not significant at $p < .01$.

This study concludes that prevalence of osteoarthritis is very less in young working professionals that's why we can conclude that young people is not very prone for OA.
But there are some potential chances for having OA is present like lifestyle, genetic factors and other factors that can cause OA in young age.

LIMITATION & FUTURE RECOMMENDATION

1. Small sample size.
2. Limited research area.
3. The self selection and convenient sampling of participates to complete the study may also influence the result.
4. Very limited access to clinical measures.
5. Very small subject group.

FUTURE RECOMMENDATION

- Future research should replicate these findings in other large samples , take larger age groups to find most accurate prevalence of OA in young working professionals.

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ANNEXURE A

Clinician's name (or ref) **Patient's d.o.b :**

INSTRUCTIONS: This survey asks for your view about your knee. This information will help us keep track of how you feel about your knee and how well you are able to do your usual activities.

Answer every question by ticking the appropriate box. If you are unsure about how to answer a question, please give the best answer you can.

Symptoms - These questions should be answered thinking of your knee symptoms during the **last week.**

S1. Do you have swelling in your knee?

○ Never ○ Rarely ○ Sometimes ○ Often ○ Always

S2. Do you feel grinding, hear clicking or any other type of noise when your knee moves?

○ Never ○ Rarely ○ Sometimes ○ Often ○ Always

S3. Does your knee catch or hang up when moving?

○ Never ○ Rarely ○ Sometimes ○ Often ○ Always

S4. Can you straighten your knee fully?

○ Never ○ Rarely ○ Sometimes ○ Often ○ Always

S5. Can you bend your knee fully?

○ Never ○ Rarely ○ Sometimes ○ Often ○ Always

Stiffness - The following questions concern the amount of joint stiffness you have experienced during the **last week** in your knee. Stiffness is a sensation of restriction or slowness in the ease with which you move your knee joint.

S6. How severe is your knee joint stiffness after first wakening in the morning?

○ None ○ Mild ○ Moderate ○ Severe ○ Extreme

S7. How severe is your knee stiffness after sitting, lying or resting **later in the day?**

○ None ○ Mild ○ Moderate ○ Severe ○ Extreme

Pain[1]

P1. How often do you experience knee pain?

○ Never ○ Monthly ○ Weekly ○ Daily ○ Always

What amount of knee pain have you experienced the **last week** during the following activities?

P2. Twisting/pivoting on your knee

○ None ○ Mild ○ Moderate ○ Severe ○ Extreme

P3. Straightening knee fully

○ None ○ Mild ○ Moderate ○ Severe ○ Extreme

P4. Bending knee fully

○ None ○ Mild ○ Moderate ○ Severe ○ Extreme

P5. Walking on flat surface

○ None ○ Mild ○ Moderate ○ Severe ○ Extreme

P6. Going up or down stairs

○ None ○ Mild ○ Moderate ○ Severe ○ Extreme

P7. At night while in bed

○ None ○ Mild ○ Moderate ○ Severe ○ Extreme

P8. Sitting or lying

○ None ○ Mild ○ Moderate ○ Severe ○ Extreme

P9. Standing upright

○ None ○ Mild ○ Moderate ○ Severe ○ Extreme

Function, daily living - The following questions concern your physical function. By this we mean your ability to move around and to look after yourself. For each of the following activities please indicate the degree of difficulty you have experienced in the **last week** due to your knee.

Al. Descending stairs				
○ None	○ Mild	○ Moderate	○ Severe	○ Extreme

A2. Ascending stairs				
○ None	○ Mild	○ Moderate	○ Severe	○ Extreme

For each of the following activities please indicate the degree of difficulty you have experienced in the **last week** due to your knee.

A3. Rising from sitting				
○ None	○ Mild	○ Moderate	○ Severe	○ Extreme

A4. Standing				
○ None	○ Mild	○ Moderate	○ Severe	○ Extreme

A5. Bending to floor/pick up an object				
None	Mild	Moderate	Severe	Extreme

A6. Walking on flat surface				
○ None	○ Mild	○ Moderate	○ Severe	○ Extreme

A7. Getting in/out of car				
○ None	○ Mild	○ Moderate	○ Severe	○ Extreme

A8. Going shopping				
○ None	○ Mild	○ Moderate	○ Severe	○ Extreme

A9. Putting on socks/stockings				
○ None	○ Mild	○ Moderate	○ Severe	○ Extreme

A10. Rising from bed				
○ None	○ Mild	○ Moderate	○ Severe	○ Extreme

A11. Taking off socks/stockings

○ None ○ Mild ○ Moderate ○ Severe ○ Extreme

A12. Lying in bed (turning over, maintaining knee position)

○ None ○ Mild ○ Moderate ○ Severe ○ Extreme

A13. Getting in/out of bath

○ None ○ Mild ○ Moderate ○ Severe ○ Extreme

A14. Sitting

○ None ○ Mild ○ Moderate ○ Severe ○ Extreme

A15. Getting on/off toilet

○ None ○ Mild ○ Moderate ○ Severe ○ Extreme

For each of the following activities please indicate the degree of difficulty you have experienced in the **last week** due to your knee

A16. Heavy domestic duties (moving heavy boxes, scrubbing floors, etc)

○ Never ○ Rarely ○ Sometimes ○ Often ○ Always

A17. Light domestic duties (cooking, dusting, etc)

○ Never ○ Rarely ○ Sometimes ○ Often ○ Always

Thank you very much for completing all the questions in this questionnaire.

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ACUTE EFFECT OF SCAPULAR PROPRIOCEPTIVE NEUROMUSCULAR FACILITATIONS TECHNIQUE VERSUS CLASSIC SHOULDER EXERCISES IN ADHESIVE CAPSULITIS

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ABSTRACT

BACKGROUND:

Frozen Shoulder Is An Idiopathic Diseases Characterized By Fibrosis, Decrease Volume Of The Glenoid Capsule, And Progressive Pain With Loss Of ROM.

SCAPULAR PNF TECHNQUES :

PNF Is A Treatment Concept With Four Theoretical Mechanisms, Referred To As Autogenic Inhibition, Reciprocal Inhibition, Stress Relaxation, And The Gate Control Theory, That Enhance ROM And Muscle Activation. PNF Has An Positive Effect On Pain, Muscle Strength.

CLASSIC SHOULDER EXERCIES :

- **Strengthening exercises :**

- Codman Pendulum exercises.
- Wand (stick) exercises.
- Pulley exercises.

- Finger walk.
- Resisted Exercise With Theraband

- **OBJECTIVES:**

- To Determine The Acute Effect Of Scapular PNF Techniques With Tens In Patients With Adhesive Capsulitis.
- To Determine The Acute Effect Of Classic Shoulder Exercises With Tens In Patients With Frozen Shoulder.
- To Compare The Acute Effect Between The Scapular PNF Techniques With Tens And Classic Shoulder Exercises With Tens In Patients With Adhesive Capsulitis.

METHODOLOGY:

30 Patients are Allocate To 2 Groups Scapular PNF Exercise And Tens, Classic Exercise And Tens. The Intervention Were Apply In A Single Session. The Visual Analog Scale(Vas), Lateral Scapular Slide Test, Range Of Motion And Simple Shoulder Test Were Evaluate Before And After The Intervention. All The Participants Of The Study Were Be Given Treatment According To The Group For 4 Weeks.

Subjects – 30 Subjects

Groups – 2 Groups

Sampling Method – Randomized Sampling Method

	Group 1	Group 2
Treatment Method	Scapular PNF With TENS	Classic Shoulder Exercise With TENS
Subjects	15	15
Duration: 4x/W/4 Weeks	4x/W/4 Weeks	

Inclusion Criteria:

- Having A Painfull Stiff Shoulder For At Least 3 Months, And Diagnosed As Frozen Shoulder.

- Having Limited Rom Of Shoulder Joint(Rom Losses Of 25% Or Greater Compared With The Non Involved Shoulder In At Least 2 Of The Following Shoulder Motion; Glenohumeral Flexion, Abduction.

Exclusion Criteria:

- Diabetes Mellitus
- A History Of Surgery On The Particular Shoulder
- A Pain Full Stiff Shoulder After A Severe Trauma
- Fracture Of The Shoulder Complex
- Rheumatoid Arthritis
- Rotator Cuff Rupture
- Tendon Calcification

Analysis:

- Between group analysis of obtained data were be done by using Unpaired T- test.
- Within the same group analysis (pre and post) of obtain data were be done by using paired T-test.

RESULT & CONCLUSIONS:

During The Course Of The Study It Has Been Concluded That Scapular PNF Techniques And Classic Shoulder Exercises Both Are Improved Pain, Scapular Dyskinesis And Functional Impairment The Patients With Adhesive Capsulitis. There Is Significant Increase In Both Scapular PNF Techniques And Classic Shoulder Exercises After 4-Week Treatment Duration In Both Groups. But Group Receiving Scapular PNF Techniques Showed More Power Full Improvement In Pain, Scapular Dyskinesis And Functional Improvement.

INTRODUCTION

INTRODUCTION

Adhesive capsulitis, Describes The common Shoulder condition Characterized By Painful And Limited Active And Passive Range of Motion(Rom). Individuals With Primary Adhesive capsulitis Are Commonly

Between 40 and 65 Years And The Incidence Appears Higher In Females Than Males.(1)

- The Term Adhesive capsulitis Were BE Used, Because It Encompasses Both Primary Adhesive Capsulitis And Secondary Adhesive Capsulitis Related to Systemic Diseases And Extrinsic or Intrinsic Factors, Excluding Cerebral Vascular Accident, Proximal humeral #, And Causative Rotator Cuff or Labral Pathology.(1)

(FIG 1: ADHESIVE CAPSULITIS)

Adhesive capsulitis IS Estimated To Affected 2% Of The General Population, With A Cumulative Incidence Between Of 2.4 Per 1000 Person-Years. It Is Rare Before The Age Of 40,With A Peak Incidence Between 40 and 60 And Is Unsual In Patient Over 70 Years (Except Secondary Traumatic Adhesive Capsulitis) And In Manual Workers. It Affects Women Slighly More Often Than Men. The Economic Impact Of The Condition Is Underscored By Its Predilection For Adults Of Working Age(8.2% For Men And 10.1% For Women).(2)

Diabetes Mellitus Is The Common Condition Most Commonly Associated With Adhesive Capsulitis. The Combined Prevalence Of A Diabetic Predisposition And Adhesive Capsulitis Is Estimated To Be As High As 71.5% Diabetics Have A 10% to 20% Lifetime Risk Of Developing A Adhesive Capsulitis, With A 4% Point Prevalence, And A Two To Four Times Greater Risk Than The General Population.(2)

The Glenohumeral joint Is An Incongruous, Ball & Socket Triaxial Joint With A Lax Joint Capsule. Its Supported By The Tendons Of The Rotator Cuff And The Glenohumeral (Suprior, Middle, Inferior) And Coracohumeral Ligaments.(3)

ANATOMY OF SHOULDER JOINT

PRESENTOR :DR.B.VAMSHIKIRAN

(FIG 2: NORMAL SHOULDER ANATOMY)

The Coracohumeral Ligament Originated From The Base And Lateral Border Of The Coracoid Process And Runs Transversely To The Grater Tuberosity. Its Anterior Border Is Distrincts Medially And Merges Laterally. Whereas Its Posterior Border Is Indistinct. it's a Primary Restraint To The Long Head Of Biceps Tendon.(4)

Causes:

The Causes are mainly idiopathic and are due to fibrosis following chronic inflammation. This could be due to:

1}Primary shoulder

2}Secondary Non-shoulder

1 Primary shoulder cause problems directly related to shoulder joint which can give rise to adhesive capsulitis :

tendinitis of rotator cuff

bicipitaltenditis

and dislocation around the shoulder

2 Secondary Non shoulder causes problems not related to shoulder joint like

Diabetes

Hyperthyroidism

Reflex sympathetic dystrophy

Frozen hand syndrome

Complication of Collis's fracture can all leads to adhesive capsulitis.

The reason could be prolonged immobilization of the shoulder joint due to reffered pain, Etc.(5)

Classification:

The Classification System By Including Disease Such As Diabetes Mellitus, Myocardial Infraction Or Various Neurological Disorder Under Secondary Frozen Shoulder Classification Scheme Where, **Primary Adhesivecapsulitis**And Idiopathic Adhesive capsulitis Are Considered Identical And Non AssociatedWith A Systemic Condition Or History Of Injury.

1. Secondary Adhesive capsulitis Was Defined By 3 Subcategories Extrinsic Secondary Adhesive capsulitis Includes Patients Whose Pathology Is Not Directly Related To The Shoulder, And Intrinsic Secondary Adhesive capsulitis Describes Patients With A Known Pathology Of The Glenohumeral Joint Soft Tissues Or Structures. Specific Causes Of Secondary Adhesive capsulitis May Influence Prognosis. For Instance, Individuals With Secondary Adhesive capsulitis Related To Insulin-Dependent Diabetes Are More Likely To Have A More Protracted And Difficult Clinical Course.(6)

Stage Of Adhesive Capsulitis

Stage 1

- Duration Of Symptoms: 0 To 3 Months.
- Pain With Active And Passive Rom.
- Pathologic Changes: Hypertrophic, HypervascularSynovitis, Rare Inflammatory Cell
- Infiltrates, Normal Underlying Capsule.

Stage 2: Freezing stage

- Duration Of Symptoms: 3 To 9 Months
- Chronic Pain With Active And Passive Rom
- Significant Limitation Of Forward Flexion, Abduction, Internal Rotation, External Rotation
- Pathologic changes: hypertrophic, hypervascularsynovitis with perivascular and subsynovialscar ,fibroplasias and scar formation in the underlying capsule.

Stage 3: Frozen Stage

- Duration Of Symptoms: 9 To 15 Months.
- Minimal Pain Except At End Rom.
- Significant Limitation Of Rom With Rigid End Feel.
- Pathologic Changes: “Burned-Out” SynovitisWithout Significant Hypertrophy Or Hypervascularity. Underlying Capsule Shows Dense Scar Formation.

Stage 4: Thawing Phase

- Duration Of Symptoms: 15 To 24 Months.
- Minimal Pain.
- Progressive Improvement In Rom.(1)

Common Structural and Functional Impairments

- Night Pain And Disturbed Sleep During Acute Flares.
- Pain On Motion And Often At Rest During Acute Flares.
- Mobility: Decreased Joint Play And ROM, Usually Limiting External Rotation And Abduction With Some Limitation Of Internal Rotation And Elevation In Flexion.
- Posture: Possible Faulty Postural Compensations With Protracted And Anteriorly Tilted Scapula, Rounded Shoulders, And Elevated And Protected Shoulder.
- Decreased Arm Swing During Gait.

- Muscle Performance: General Muscle Weakness And Poor Endurance In the Glenohumeral Muscles With Overuse Of The Scapular Muscles Leading To Pain In The Trapezius, LevatorScapulae, And Posterior Cervical Muscles.
- Substitution For Limited Glenohumeral Motion With Increased Scapular Motion, Especially Elevation.(3)

Common Activity Limitation And Participation Restriction

- Instability To Reach Overhead, Behind Head, Out To The Side, And Behind Back; Thus, Having Difficulty Dressing (Putting On A Jacket Or Coat Or In The Case Of Women, Fastening Undergarments Behind Their Back), Reaching Hand Into Back Pocket Of Pants (To Retrieve Wallet), Reaching Out A Car Window (To Use An ATM Machine), Self-Grooming (Combing hair, Brushing Teeth, Washing Face), And Bringing Eating Utensils To The Mouth.
- Difficulty Lifting Weighted Objects, Such As Dishes Into A Cupboard.
- Limited Ability To Sustain Repetitive Activities.

Scapular Dyskinesis:

- The Scapula Is The Large Triangular-Shaped Bone At The Back Of Your Shoulder Frequency Known As The Shoulder Blade. Its Only Attachment To The Rest Of The Skeleton Is Throught The Collarbone At The Acromioclavicular Joint. Therefore, The Bone Is Primarily Held In Place By The Attached And Surrouding Muscles. Many Muscle Use The Large Area Of The Scapula For Attachment and They Enable The Vast Range Of Shoulder Motion.(7)
- At The Order Edge Of The Scapula A Shallow Socket Form And Is Where The Humeral Heads Sits Forming The Shoulder Joint. Proper Positioning And Movement Of The Scapula Is Critical For Full And Normal Shoulder Range Of Motion.(7)
- We Use The Acronym **SICK(Scapular Malposition, Inferior Medial Border Prominence, Coracoid Pain And Malposition, And Dyskinesis Of Scapular Movement)** To Refer to An Injury Resulting From Overuse And Fatigue Of The Muscle That Stabilize And Provide Motion For The Scapula.(7)

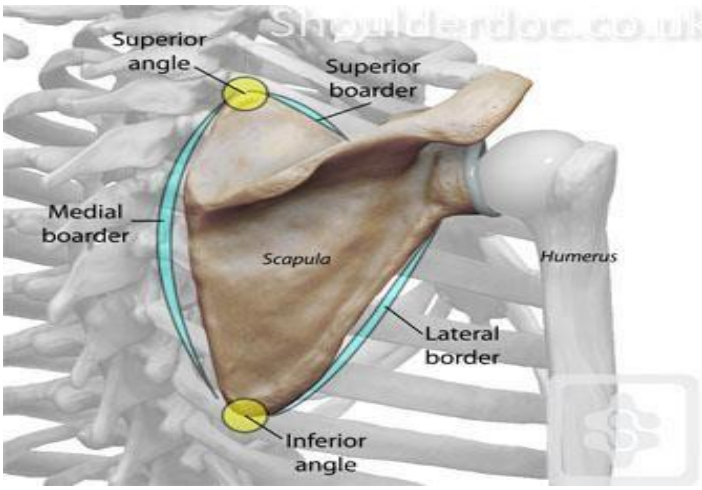


FIG 3: SICK SCAPULA

Risk Factors

- Intense, Repetitive Overhead Activity (Throwing, Tennis, Volleyball)
- Overuse Fatigue.
- Injury To Other Structure Of The Shoulder.
- Direct Trauma
- Muscle Strain
- Tense Pectoralis Major Possibly Resulting From Unbalanced Weight Training(7)

Signs And Symptoms

- Affected Shoulder Appears Dropped Or Lower Than Unaffected Shoulder
- Medial Scapular Protrusion
- Noticeable Hitches And Jumps In Scapular Motion During Arm Movements.
- Scapular Pain
- Pain At The Front, Back, Or Top Of The Shoulder.
- Pain On The Outside Of Your Upper Arm.(7)

Scapular Dyskinesis Classification System(8,9)

- **Type 1: Inferior Border**
- At Rest, The Inferior Medial Scapular Border May Be Prominent Dorsally. During Arm Motion. The Inferior Angle Tilts Dorsally And The Acromion Tilts Ventrally over The Top Of The Thorax.
- The axis Other Rotation Is In The Horizontal Plane.

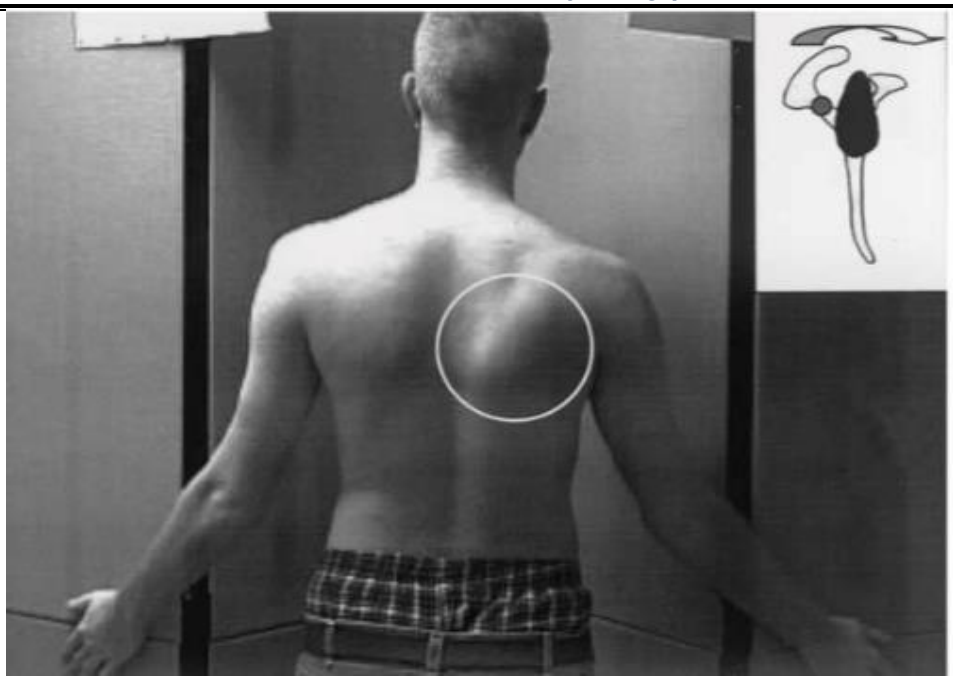


FIG 4: INFERIOR BORDER SCAPULA DYSKINESIS

TYPE 2: MEDIAL BORDER

- At Rest, The Entire Medial Border May Be Prominent Dorsally. During Arm Motion, The Medial Scapular Border Tilts Dorsally Off The Thorax. The Axis Of The Rotation Is Vertical In The Frontal Plane.

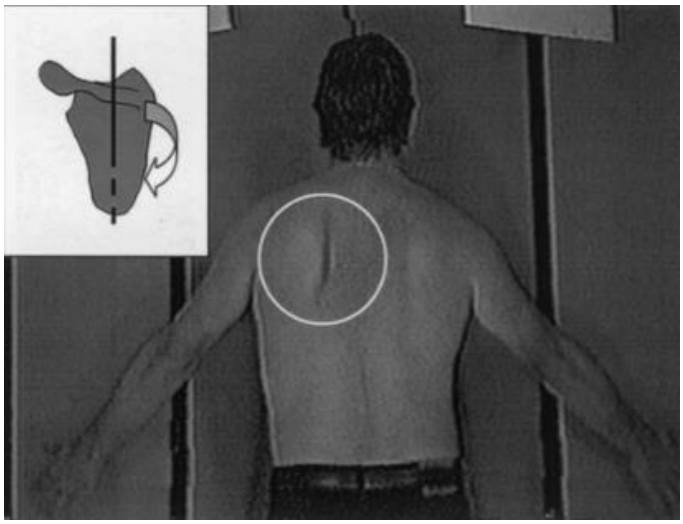


FIG 5: MEDIAL BORDER OF SCAPULAR DYSKINESIS

TYPE 3 : Superior Border

- At Rest, The Superior Border Of The Scapula May Be Elevated And The Scapula Can Also Be Anteriorly Displaced. During Arm Motion, A Shoulder Shrug Initiates Movement Without Significant Winging OF The Scapula Occurring. The Axis Of This Motion Occurs In The Sagittal Plane.

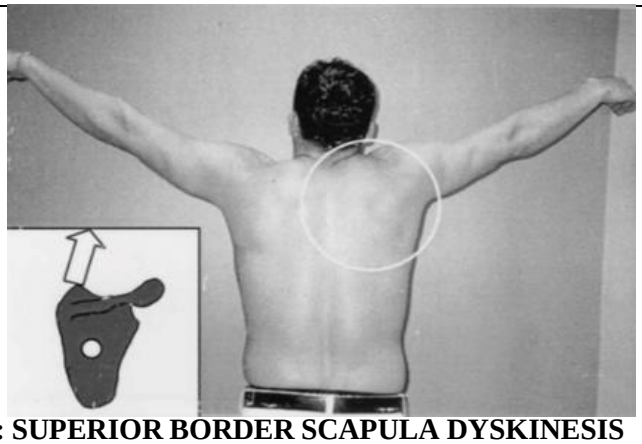


FIG 6: SUPERIOR BORDER SCAPULA DYSKINESIS

Type 4 : Symmetric Scapulohumaral

- At Rest, The Position Of Both Scapula Are Relatively Symmetrical, Taking Into Account That The Dominant Arm May Be Slightly Lower. During Arm Motion, The Scapulae Rotate Symmetrically Upward Such That The InferiorAngles Translate Laterally Away From The Midline.

FIG 7: SYMMETRIC SCAPULOHUMERAL

The Studies Cited Have Shown That Various Forms Of Exercise Are Effective In Reducing The Motion Restriction And Pain Of Patients With Adhesive Capsulitis. Physical Therapists, As Specialists Dealing With Exercise And Movement Dysfunction, Play A Major Role In Restoring Function To These Persons. After Performing The Necessary Tests To Confirm The Diagnosis Of Adhesive Capsulitis Ascertain The Current Status Of The Condition, And Identify Causative Factors, A Physical Therapist Is Prepared To Design A Treatment Program. Each Individual Case Were Dictate Whether Physical Therapy Is To Be Used Alone Or In Conjunction With Other Medical Or Surgical Treatment.

A Combination Of Exercise And Physical Modalities Helps Accomplish This Objective. Activate And Active-Assistive Exercises Such As Pedulum, Wand , And Physiologic ROM Should Be Performed For At Least One Half-Hour Three Times A Day. Passive Exercise Has Multiple Benefits. Gentle Passive Movement, Short Of Pain And The Pathological limit Of Motion, Reduces Pain. Often, Reflex Muscle Spasm Prevents A Patient From Performing Active Exercise, Whereas A TherapistCan Passively Guide The Lime Further Into The Range Without Eliciting Spasm Or A Stretch Reflex. Also , Because Many Patients Are Reluctant Psychologically To Perform Regular, Appropriate Active Exercise, Passive Exercise Becomes The Treatment Of Choice(10).

Evaluation Of The Position Of The Scapula Is Very Important In The Pathologies Of The Shoulder Because These Pathologies Are Responsible For The Second And Third most Common Causes Of Musculoskeletal Pain. Abnormal Changes In The Position Of The Scapula At Different Angles Of The Shoulder Indicate A Disturbance Of The ScapulohumeralRhythm(11,12).

Even Though Scapular Alterations Have Been Assessed In Patients With Frozen Shoulder, Treatment Programs Were Focused On Pain Relief And Improvement In ROM. Scapular Exercises Were Not Included In The Programs

Even Though The Scapula Plays Several Roles In Facilitating Optimal Shoulder Funcation(13).

SCAPULAR PNF TECHNQUES :

PNF Is A Treatment Concept With Four Theoretical Mechanisms, Referred To As Autogenic Inhibition, Reciprocal Inhibition, Stress Relaxation, And The Gate Control Theory, That Enhance ROM And Muscle Activation.(14,15)

PNF Has Been Reported To Be Effective In Relieving Pain And Improving Functional Abilities. PNF Methods, Particularly Those Involving Reciprocal Activation Of The Agonist And Antagonist To The Desired Motion, Provide The Greatest potential For Muscle Functioning.(16,17)

Among Therapeutic Approaches, Joint Mobilization Using PNA Has A Positive Effect On Pain, Muscle Strength, And ROM. Proper Function Of The Upper Extremities Requires Both Motion And Stability Of The Scapula.(19,20)

The Scapula Patterns Defined In PNF Are Activated Within The Upper Extremity Patterns And Scapular Motion Together(21). The Effects Of The Shoulder Have Been Investigated In Some Studies(22-29). However, No Previous Study Has Investigated The Effects Of Scapular PNF Exercises In AC Rehabilitation.

CLASSIC SHOULDER EXERCIES :

- **Strengthening exercises :**
- Codman Pendulum exercises.
- Wand (stick) exercises.
- Pulley exercises.
- Finger walk.
- Resisted Exercises With Theraband(30).
- Therefore, The **Aim Of This Study** Was To Compare The Acute Effects Of Scapular PNF Techniques And Classic Shoulder Exercises With TENS On Pain, Scapular Dyskinesis, Shoulder ROM, And Functionality In Patients With AC.
- In This Study, Pain, Scapular Dyskinesis And Shoulder Function Were Be Measured Using Visual Analogue Scale(VAS), Lateral Scapular Slide Test (LSST) And Simple Shoulder Test.

REVIEWOF LITERATURE

1. **Positional stretching of the coracohumeral ligament on a patient with adhesive capsulitisJose Orlando Ruiz Et Al(2009)** Performed A Study On Positional Streching Of Coracohumeral Ligament On A Patient With Adhesive Capsulitis And Concluded That the Coracohumeral Ligament Streching Is An Effective Therapeutic Strategy To Help Reduce Loss Of Joint Mobility And Function.(31)

2. **Adhesive shoulder capsulitis : Does the timing of manipulation influence outcome ?Olivia Flannery Et Al (2007)** Conducted A Study On The Adhesive Shoulder Capsulitis. In Their Study They Mentioned That Duplay Was The First To Describe A Painful, Stiffening Condition Of The Shoulder, Which He Termed **Peri** – Arthritis Scapula Humerale And Codman In 1934 Named The Condition **Adheshive Capsulitis** Conclued That It Was Characterized By Slow Onset, Pain near The Insertion Of The Deltoid, Instability To Sleep On The Affected Side, Painful And Restricted Elevation And Term **Adheshive Capsulitis** Was Introducted By Neviaser In 1945, Based Upon His Finding Of Synovial Changes In The Gleno - Humeral joint.(32)

3. **The Pathology Of Frozen ShoulderG.C.R. Hand Et Al (2007)** Studies The Pathology Of Adhesive capsulitis. Twenty Two Subjects, Diagnosed As Primary Adhesive capsulitis Was inclued In Their Study Biopsies Were Taken From This Site And Histological And Immunocyto -chemical Analysis Was Performed To Identify The Type Of Cell Present. The Tissue Was Characterized By The Presence Of Fibroblast, Profiferating, Fibroblast And Chronic Inflamatory Response With Fibroblastic Proliferation Which May be Immune Modulated(33).

4. **J.Mobilization Techniques In Subjects With Frozen Shoulder Syndrome: Randomized Multiple-Treatment Trial. PhysTher 2007 Oct;87(10):1307-15. Epub 2007 Aug 7.Jing – Ian Yang (2007)** Did A Randomized Multiple Treatment Trial Of Mobilization Technique In Subject With Adhesive capsulitis Syndrome And The Results Concluded End Range Mobilization And Movement With Mobilization Are More Effective, Than Mid Range Mobilization In Increasing Mobility And Functional Ability In Patients With Adhesive capsulitis.(34)

5. **Adhesive Capsulitis : Does The Timing Of Manipulation Infulence Outcome. AetaOrthop. Belg, 2007,73,21-25.Oliva Flannery, HanamMullett Et Al(2007)** Performed A Study On Adhesive Shoulder capsulitis. In Their Study Used VAS For The Assessment Of Pain In The Shoulder In Subjects Suffering from Adhesive capsulitis And They Concluded That VAS Was Significant To Assess Pain In The Affected Shoulder(35).

6. **Non Operative Management Of Idiopathic Adhesive Capsulitis Journal Of Shoulder And Elbow Surgery 2006.569-573.Wereiam N> Levine Et Al (2006)** Performed A Study On Non Operative Management Of Idiopathic Adhesive capsulitis. In Their study They Said That This Condition Was First Describe By Duplay In 1872 And Named As **FROZEN SHOULDER** In 1934 And Is Characterized By Pain And Restriction Of Both Active and Passive ROM. They Concluded That the Pathology Is Anatomy Was First Describe For Frozen shoulder.(36)

7. **Frozen Shoulder Richard Dias Et Al (2005)** Performed A Study On The Clinical Review Of Frozen Shoulder. They Studied The Incidence, Clinical Presentation, Diagnosis And Treatment Modalities In Adhesive capsulitis. Regarding The Incidence They Concluded That The Onset Of This Condition Before The Age Of 40 Is Very Uncommon. The Peak Age Is 56 Yrs And The Condition Occurs Slightly More Often In Women Than Men. In 6-17% Of Patients, The Other Shoulder Becomes Affected. The Non Dominant Shoulder Is Slightly More Likely To Be Affected.(37)

8. **Acromiohumeral distance in a seated position in persons with impingement syndrome Hebert LJ Et Al(2003)** Had Done A Prospective Cohort Study To Identify The Bestindicators Of The Current Disability Of Patients With Shoulder Impingement Syndrome(Sis)And The Strongest Predictors Of 3 Months SIS-Related Disability. The SPADI Score ALBaseline And The Presence Of Sis On The Dominant Side,Among Other Variables Predicted86% The Variance Of The SPADI At 3 Months And Concluded That Variables That BestExplain The Current Disability Level And Predictors Of Short-Term Leval Of DisabityShould Be Considered In SIS Treatment Planning As Well As For Establishing Prognosis.(38)

9. **Influence of Comorbidity on Self-Assessment Instrument Scores of Patients with Idiopathic Adhesive Capsulitis Jennifer Moriatis Wolf And Andrew Green(2002)** Did A Study To Determine The"Influence Of Co- Morbidity On Self - Assessment Instruments Scots Of Patients With Adhesive Capsulitis. Phase 2 Adhesive Capsulitis Were Prospectively Evaluated With The Use Of VAS And They Found That The Score On VAS Can Be Applied To The Evaluation Of The Patient And May Help To Identify Patients Who Potentially Require A Longer Treatment Course Or Those Outcome WereBe Less Satisfactory.(39)

10. **End-range mobilization techniques in adhesive capsulitis of the shoulder joint: A multiple-subject case report VermeulenHM Et Al (2000)** Did A Study On Effectiveness Of End Range Mobilization Technique In Adhesive

    Capsulitis Of Shoulder Joint In 45 Subjects And The Results Concluded End Range Mobilization Technique To Be Beneficial In Improving Joint Mobility.(40)

11. **Idiopathic adhesive capsulitis. A prospective functional outcome study of nonoperative treatment Griggs Et Al (2000)**Reported That Following A Physical Therapy Program Consisting Of Passive Stretching Exercises (Forward Elevation, External Rotation, Horizontal Adduction And Internal Rotation) At A Mean Follow - Up Of 22 Months, Patients Demonstated A Reduction In Pain Score From 1-57 To 1 -16 In Range From One To Five Points Improvements in Active Range Of Motion, And 64 Patients (20%) Reported A Satisfactory Outcome.(42)

12. **Reliability of goniometric measurements Boone DC, Azen SP Et Al(1987)** Conducted A Study To Determine The Intra - Tester And Inter-Tester Variability And Reliability Of Goniometric Measurement Taken By Four Physical Therapists On Upper And Lower Extremity Motions. Their Findings Indicated The Necessity For Using The Same Lester When Effects Of Treatment Are Evaluated.(43)

NEEDOF STUDY

NEEDOFSTUDY

NEEDOFSTUDY

- There Are Lots Of Study Available Which Suggest The Treatment Of Adhesive Capsulitis Which Includes Scapular PNF Techniques , Classic Shoulder Exercises, Strengthning Exercises , Mobilization Techniques Etc. But There Are Lack Of Evidence Which Compare The Acute Effect Of Scapular PNF Techniques And Classic Shoulder Exercises With TENS In The Effectiveness Between These Treatment Groups For Adhesive Capsulitis Patients.

OBJECTIVESOFTHESTUDY

OBJECTIVES OFTHESTUDY

OBJECTIVEOFTHESTUDY

To Determine The Acute Effect Of Scapular PNF Techniques With Tens In Patients With Adhesive Capsulitis.

To Determine The Acute Effect Of Classic Shoulder Exercises With Tens In Patients With Frozen Shoulder.

To Compare The Acute Effect Between The Scapular PNF Techniques With Tens And Classic Shoulder Exercises With Tens IN Patients With Adhesive Capsulitis.

HYPOTHESIS

HYPOTHESES

HYPOTHESIS

- **Null Hypothesis :**

  There Is No Significant Difference In Effect Of Scapular PNF Techniques And Classic Shoulder Exercises With Tens In The Patients With Adhesive Capsulitis.

- **Alternate hypothesis :**

  There Is Significant Difference In Effect Of Scapular PNF Techniques And Classic Shoulder Exercises With Tens In The Patients With Adhesive Capsulitis.

METHODOLOGY

Participants Were Allocate To Treatment Groups Using Sealed, Opaque Envelopes. The Envelopes Contained Stickers Denoting 1 Or 2. Subjects Who Picked 1 Were Included In The Groups 1 (scapular PNF techniques) And The Subjects Who Picked 2 Were Included In Group 2 (classic shoulder Exercises). Following This, Demographic Information were Conducting. Duration Of Symptoms And Side Affected Noted And Initial Evaluation Of Pain Profile Was Done Using Visual Analogue Scale (VAS).
Functional Performance Were Assessing Using The simple shoulder test scale (SST), And Lateral Scapular Slide Test (LSST).

Group 1 : Subjects Received scapular PNF techniques.
Group 2 : Subjects Received classic shoulder Exercises.

PROCEDURE:

The Purpose And The Procedure Of The Study were Explain In Details To The Patients Who Satisfied The Inclusion Criteria Both The Treatment Groups Completed With Written Informed Consent Form. Patients were Allocate To Treatment Groups Using Sealed, Opaque Envelopes. The Envelopes Contained Stickers Denoting 1 Or 2. Then Both Treatment Groups Of Each Patients Completed 2 times (Pre & Post) VAS, SST, LSST.

The Patients were Collect Along With The Routine Evaluation With Emphasis On; Pain Scores Using VAS Where A Horizontal Line (10cm Long) Was Drawn On A Paper And Patients Were Ask To Mark A Ponton The Line That Beat Defined The Present PAIN Level, Where – 0 Indicated No Pain And – 10 Indicated Severe Pain, Functional Performance were Assessed Using SST Scale. Outcome Measure Were Taken On Day 1 And After Completion Of Treatment Protocol I.E. After 4 Weeks.

SUBJECTS AND METHODS

This Study wereDesign As Randomized Control Trial. Thirty Subjects (Females, Males) Shoulder Exercises Groups And TENS (N=15),Simple Randomization And A Random-Number Table Were Used As The Method Of Sequence Generation For Patients.Same Therapist Evaluated All The Patients, While Another Therapist Applied The Intervention Methods The Therapist Who Applied The Interventions Was Experienced In Ac Treatment And Also Had A PNF Certificate.
All Patients Received An Explanation About The Purpose And Test Procedures Involved In The Study Before Enrollment. Each Patient Was Informed About The Study And Gave Written Informed Consent To Patient

GROUP 1 :

- **SCAPULAR PNF TECHNIQUES :**

In the PNF groups, scapular PNF was applied by a therapist in two diagonals, anterior elevation and posterior depression and posterior elevation and anterior depression with 20 repetitions. Patients lay on the unaffected side while the therapists stood in the line of desired motion. Firstly, the therapist gave preparatory instructions. In the beginning of the
Pattern, the therapist pulled the scapula to the elongated position and then gave instructions for the desired movement. Rhythmic initiation and repeated contractions facilitation techniques were applied in all patterns. These techniques are the best matchedmatched scapular facililation techniques of the PNF agonistic techniques.

GROUP 2 :

In the **classic Shoulder exercise group,** TENS were applied using the same procedure as describe above. After the TENS, strengthening exercises with Theraband and dumbbells were assigned to the patients. One set of want , finger walk , pulley and Codman pendulum exercises scapular elevation adduction (posture), and scapular stabilization exercises were also performed with 20 repetitions for each exercise.
wereRecruite For This Study Form The Near by Clinics In Kalol.
Subjects Werebe Randomly Allocated To Two Groups :SCAPULAR PNF TECH. And TENS (N=15), Classic

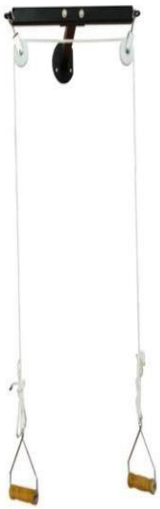
Materials & Tools Used:

1. Inform Consent Form.
2. Pen ,Pencil ,Eraser ,Sharpener ,Stapler
3. Pillow , Plinth ,High Stool

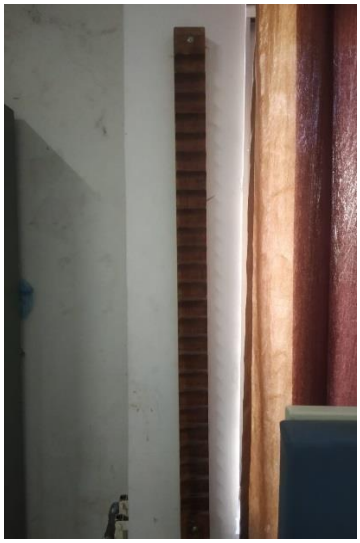
.

4. Pulley.
5. Measure Tape.
6. Dumbbells.
7. Theraband.
8. Finger walk
9. TENS.
10. Goniometer

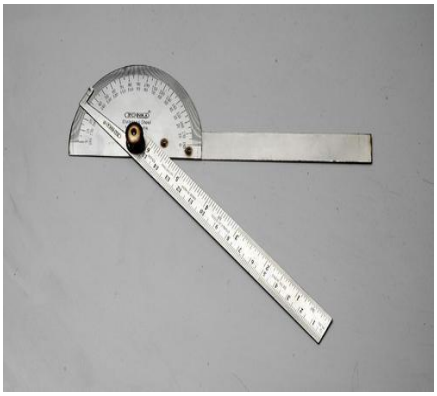
TENS



PULLY



FINGER WALK



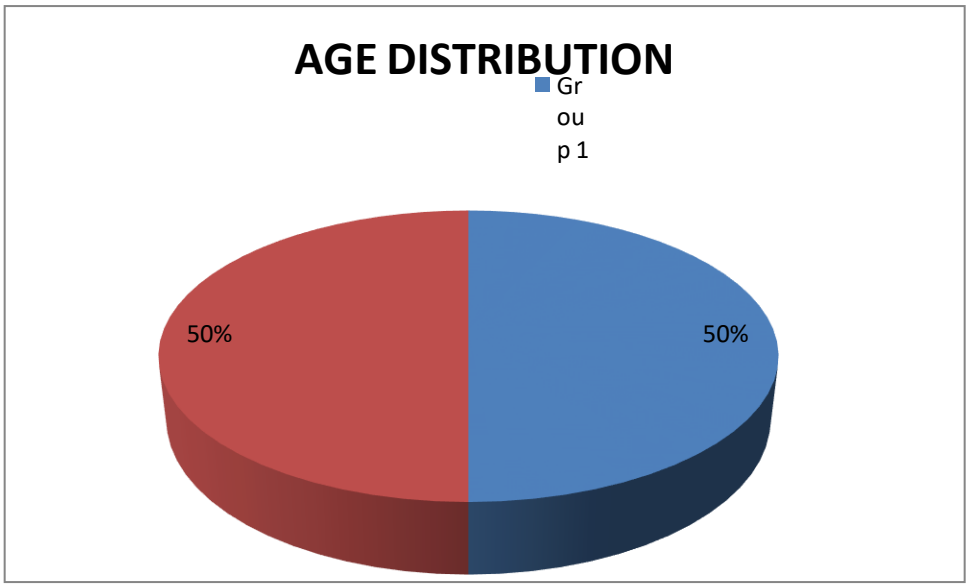
GONIOMETER

MEASURETAPE

RESULT

Table 1: Age Distribution Of Both Groups

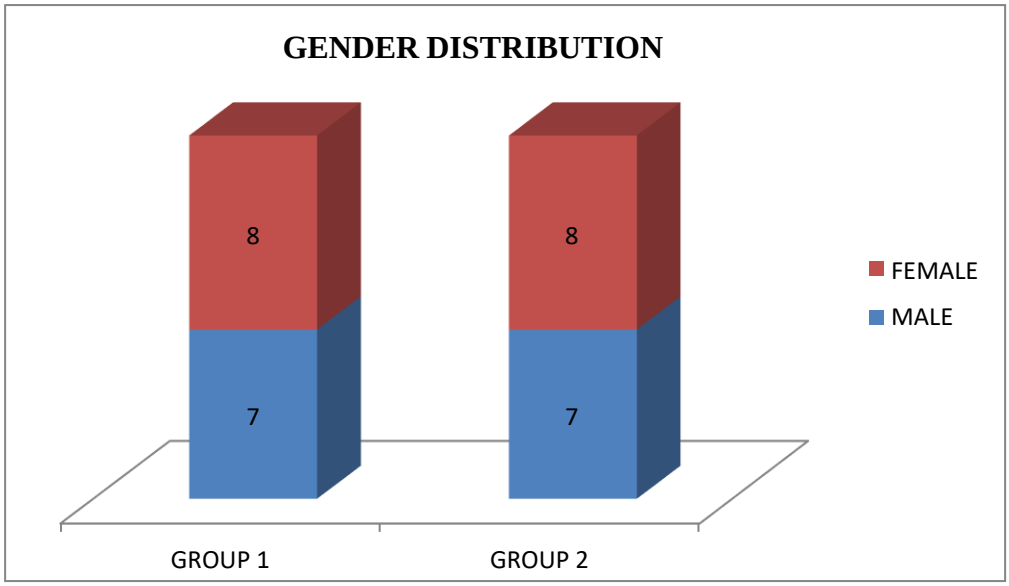
	NO OF PATIENT	MEAN AGE	SD
GROUP 1	15	52.06667	5.612062
GROUP 2	15	51.2	4.443294



(FIG 8: AGE DISTRIBUTION OF BOH GROUPS)

Table 2: Gender Distribution In Both Groups

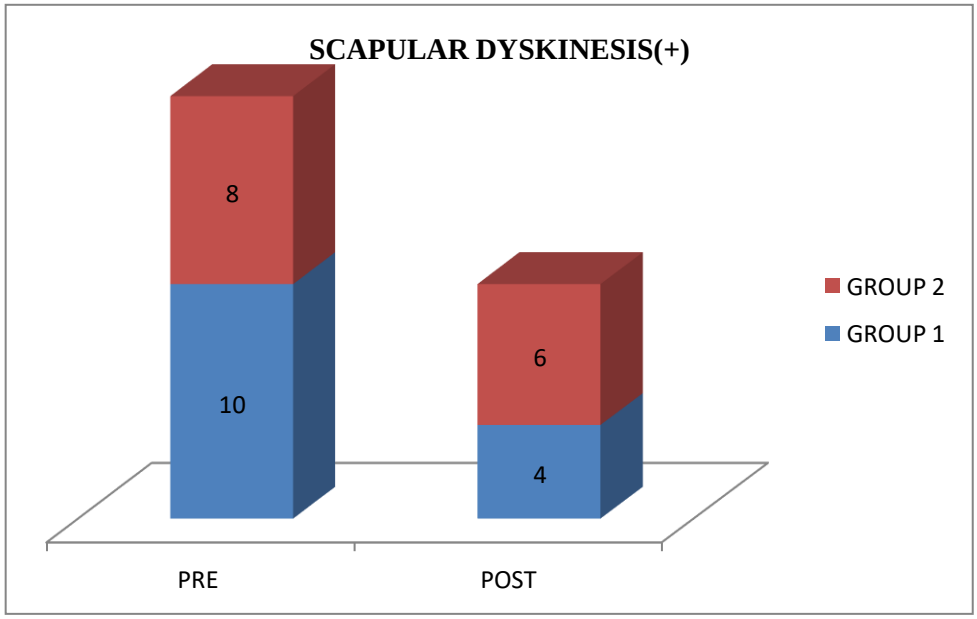
GENDER	MALE	FEMALE	TOTAL
GROUP 1	7	8	15
GROUP 2	7	8	15



(FIG 9: GENDER DISTRIBUTION IN BOTH GROUPS)

Table 3: Comparison Of Pre And Post Scapular Dyskinesis (+) In Both Groups

	PRE	POST
GROUP 1	**10**	**4**
GROUP 2	**8**	**6**

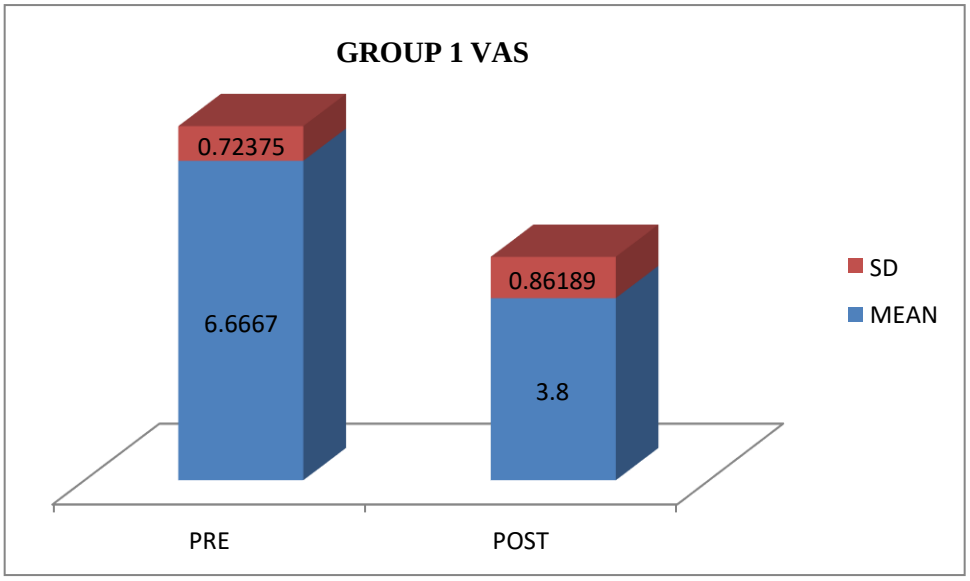


(FIG 10: COMPARISION OF PRE AND POST SCAPULAR DYSKINESIS IN BOTH GROPUPS)

Table 4: Comparison Of Pre And Post VAS In Group 1

GROUP 1 VAS					
TIME	**MEAN**	**SD**	**DF**	**t-value**	**p-value**
PRE	**6.66667**	**0.72375**	**14**	**14.938**	**0.0001**
POST	**3.800000**	**0.86189**			

Here Paired Test Was Used For Analysis And P- Value< 0.0001 Between Pre And Post, Hence, It Shows Highly Significant Difference.

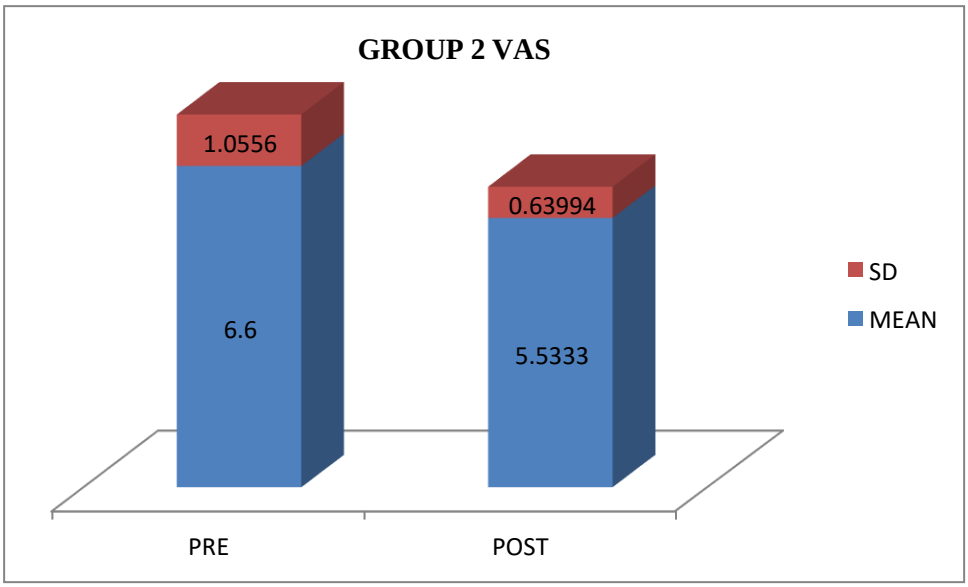


(FIG 11: COMPARISON OF PRE AND POST VAS IN GROUP 1)

Table 5: Comparison Of Pre And Post VAS In Group 2

GROUP 2 VAS					
TIME	**MEAN**	**SD**	**DF**	**t-value**	**p-value**
PRE	**6.6000**	**1.05560**	**14**	**4.298**	**0.0001**
POST	**5.5333**	**0.63994**			

Here Paired Test Was Used For Analysis And P- Value< 0.0001 Between Pre And Post, Hence, It Shows Highly Significant Difference.

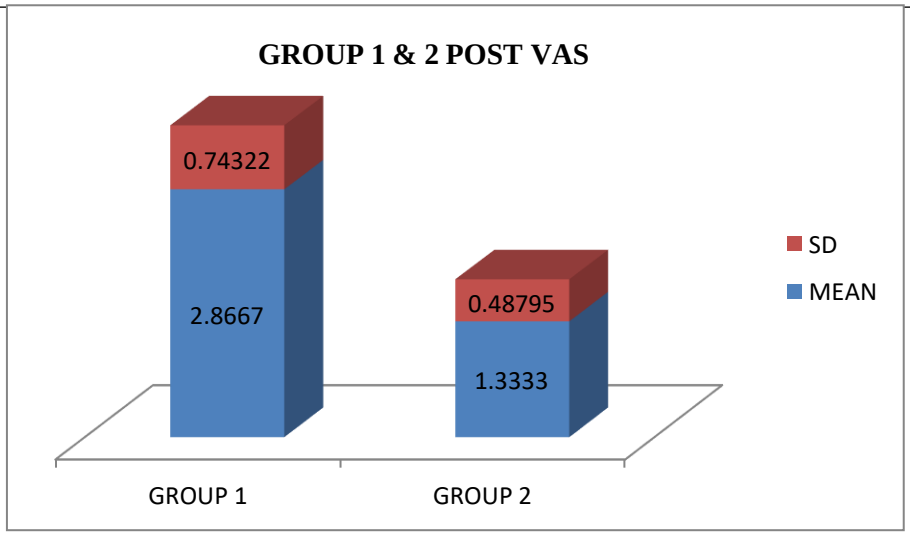


(FIG 12: COMPARISON OF PRE AND POST VAS IN GROUP 2)

Table 6: Comparison Of Difference Between Post VAS Group 1 And Group 2

POST VAS GROUP 1 & 2					
	MEAN	**SD**	**DF**	**t-value**	**p-value**
GROUP 1	**2.8667**	**0.74322**	**28**	**6.679**	**0.0001**
GROUP 2	**1.3333**	**0.48795**			

Here Independence t-Test Was Used For Analysis And P- Value< 0.0001 Between Group 1 And Group2. Hence, It Shows Highly Significant Difference.

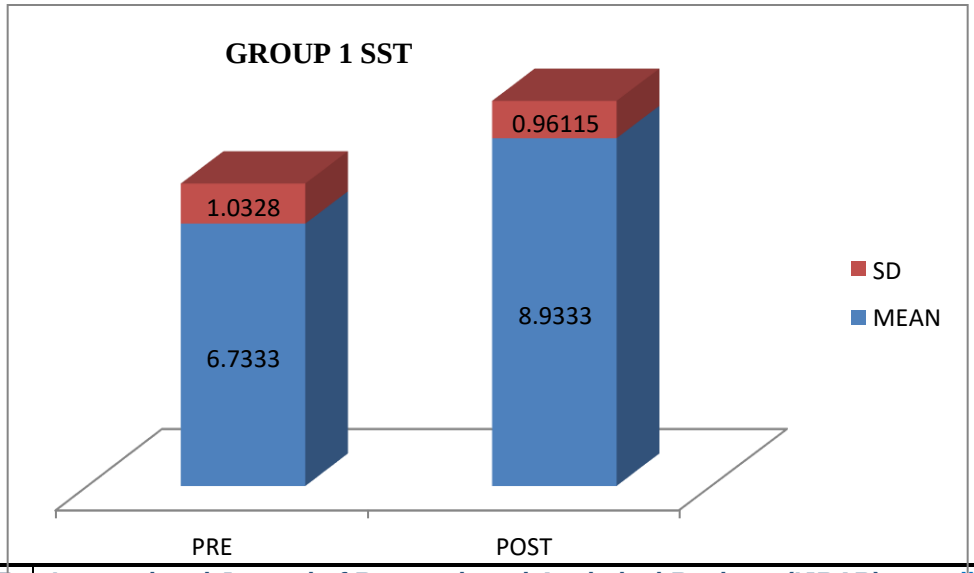


(FIG 13: COMPARISON OF DIFFERENCE BETWEEN POST VAS IN GROUP 1 AND 2)

Table 7: Comparison Of Pre And Post SST In Group 1

GROUP 1 SST					
TIME	**MEAN**	**SD**	**DF**	**t-value**	**p-value**
PRE	**6.7333**	**1.03280**	**14**	**12.602**	**0.0001**
POST	**8.9333**	**0.96115**			

Here Paired Test Was Used For Analysis And P- Value< 0.0001 Between Pre And Post, Hence, It Shows Highly Significant Difference.

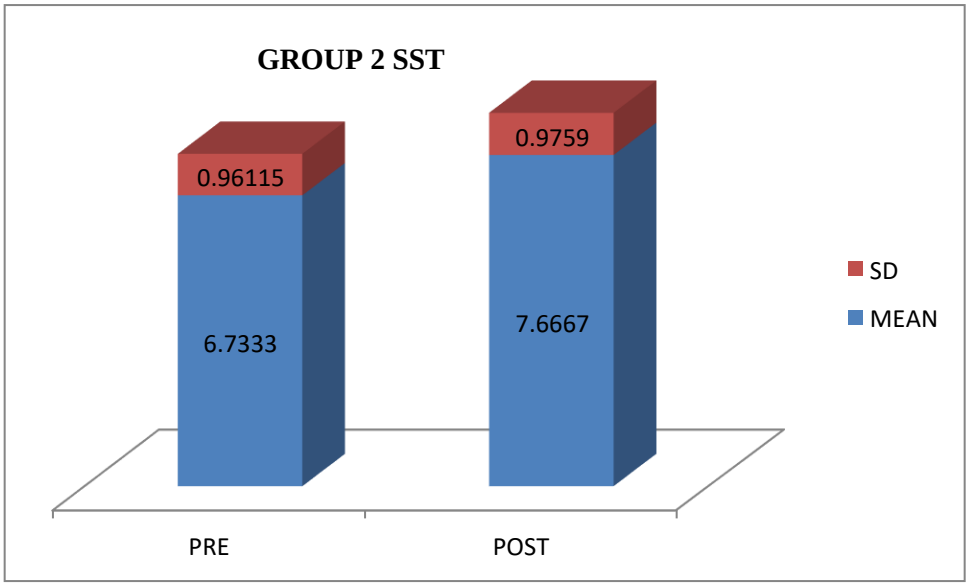


(FIG 14: COMPARISION OF PRE AND POST SST IN GROUP 1)

Table 8: Comparison Of Pre And Post SST In Group 2

GROUP 2 SST					
TIME	**MEAN**	**SD**	**DF**	**t-value**	**p-value**
PRE	**6.7333**	**0.96115**	**14**	**4.090**	**0.0001**
POST	**7.6667**	**0.9759**			

Here Paired Test Was Used For Analysis And P- Value< 0.0001 Between Pre And Post, Hence, It Shows Highly Significant Difference.



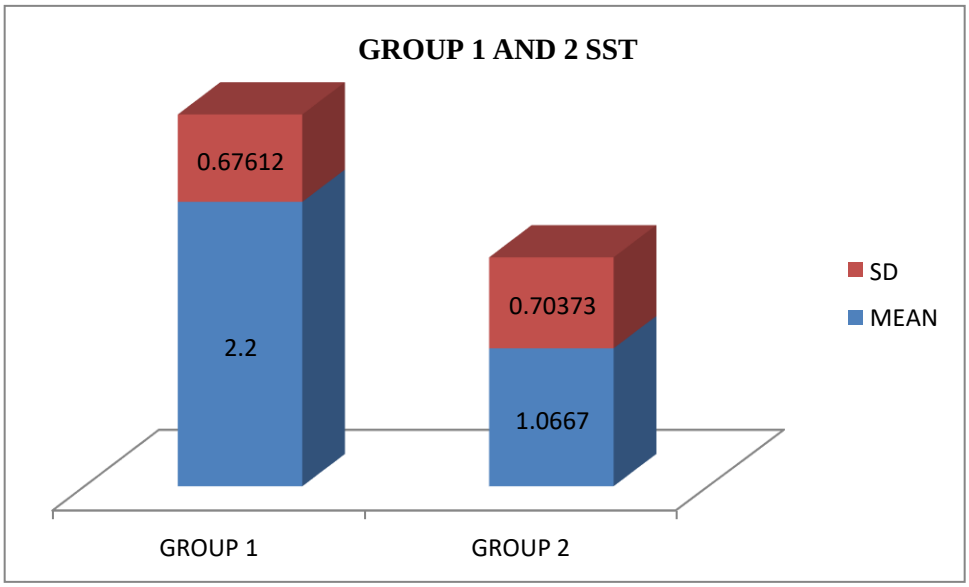
(FIG 15: COMPARISION OF PRE AND POST SST IN GROUP 2)

Table 9: Comparison Of Difference Between Post SST Group 1 And Group 2

POST SST GROUP 1 & 2					
	MEAN	**SD**	**DF**	**t-value**	**p-value**
GROUP 1	**2.2000**	**0.67612**	**28**	**4.498**	**0.0001**
GROUP 2	**1.0667**	**0.70373**			

Here Independence t-Test Was Used For Analysis And P- Value< 0.0001 Between Group 1 And Group2. Hence, It

Shows Highly Significant Difference



(FIG 16: COMPARISION OF DIFFERENCE BETWEEN POST SST IN GROUP 1 AND GROUP 2)

DISCUSSION

DISCUSSION

DISCUSSION

Adhesive Capsulitis Is Characterized By Painful Stiffness Of Shoulder That May Persist For Several Years. It Is A Common Disorder; With An Estimated Annual Incidence Of 3% To 5% In The General Population (Bridgman 1972, Pal Et Al 1986). Advocated Treatments Include Rest And Analgesics, Corticosteroid Injections, Acupuncture, Physical Therapy, Manipulation Under Anesthesia, And Arthroscopic Or Open Surgery. There Is No General Acceptance Of One Standard Treatment.

Adhesive Capsulitis Is A Contracture Of The Capsule And Depending On How Severe The Contracture Is (For It Varies In Intensity From Patient To Patient) The Treatment Is Decided. The First Objective In The Treatment Of Patients With Adhesive Capsulitis Is Pain Relief. This Is Essential, For It Permits Patients To More Readily Participate In An Exercise Program Aimed At Restoring Motion And Recovering Function.

The Primary Mode Of Treatment For Adhesive Capsulitis Is Prevention. Avoiding Prolonged Immobilization Of The Shoulder After Trauma Or When Shoulder Pain Develops Is Key. The Overall Goal Of Treatment Is To Relieve Pain, Restore Motion, And To Restore Function. Although Adhesive Capsulitis Is Generally Considered To Be A Self- Limiting Condition That Can Be Treated With Physical Therapy, The Best Treatment Has Been The Subject Of Extensive Investigation. A Variety Of Different Treatments Have Been Recommended.

CONCLUSIONANDSUMMARY

CONCLUSION &SUMMARY

CONCLUSION

The Study Rejects The Null Hypothesis – There Is No Significant Effect Of Scapular PNF Techniques And For Improving Pain, Scapular Dyskinesis And Functional Impairments The Patients With Adhesive Capsulitis And Accept The Experimental Hypothesis – There Is **Highly Significant Effect Of Scapular PNF Technique** And For Improving Pain, Scapular Dyskinesis And Functional Impairments The Patients With Adhesive Capsulitis .

During The Course Of The Study It Has Been Concluded That Scapular PNF Techniques And Classic Shoulder Exercises Both Are Improved Pain, Scapular Dyskinesis And Functional Impairments The Patients With Adhesive Capsulitis. There Is Significant Increase In Both Scapular PNF Techniques And Classic Shoulder Exercises After 4-Week Treatment Duration In Both Groups. But Group 1 Receiving **Scapular PNF Techniques Showed More Power Full Improvement In Pain, Scapular Dyskinesis And Functional Improvement.**

LIMITATIONS

LIMITATIONS

Limitations

- Sample Size Was Limited.
- There Is No Control Group.
- No Follow Up

Futurerecommendation

- The Same Study Can Be Done With Large Group.
- The Same Study Can Be Done With A Longer Follow- Up.
- The Same Study Can Be Done With Control Group.

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ANNEXURE A

સંમતીપત્રક :

વ્યક્તિનું નામ :

જાતી - સ્ત્રી / પરુષઉંમર _____

:

વ્યક્તિનું સરનામું

: _____

હું હ

કદારસુંશોધનપ્રોજક્ટે ટ

ત્લનાત્મકઅભ્યાસ

હું પણતમામપરીક્ષણોની નઆક્રમણઅનેકોઈઆડઅસરવગરછકે સમજાવીકરવામાું આવીછે.

મારાવય્યાત્મકક્ષમતાઅનેઆરોગ્ય કારણીહાથધરવામા ેજ વયવપરક્ષણવશવગતવારસમજાવયેલ સથતીવગેરકરવામાું આવીછે. ું આવેશક

હું અભ્યાસમાું સહયોગસ્વેછણછેજસમજવાઅનેતહું અસરથઈરહી.

મારાત ીક ીકાળજીઅથવાકાનૂનીઅધકારવગરકોઈકારણઆપ્યાવગર,
હું કોઈપણસમયેપાછીખેંચીમ્કતછું .

હું અભ્યાસદ્વારામેળવીમાહતીસુંશોધનપેપરપ્રકાશનમાટે ઉ મજછેએનહું પણમારીઓળખતતીયપક્ષ પયોગકરીશકાયછેજસ ુરજૂ અ

થવાપ્રકાશીતકોઈપણમાહીતીજાહેરકરવામાટેઆવશેનાહકે અમજછે.

હસ્તાક્ષર (અથવાઅંગૂઠાનીછાપ)

વ્યક્તની_____

કાયદાકીયરીતેસ્વીકાયતનીઘી :_____ સાક્ષીનીસહી :_____

તપાસનારનીસહી :____

સાક્ષીનુંનામ :_____ તારીખ : _____

PATIENTINFORMATIONFORM

What Cause Your Shoulder To Hurts?

Please Rate Your Pain on The Following Scale (circle one)

None Slight After Unusual activity

Moderate Marked Complete Disability

Do you Have Shoulder Pain At Night? YES/NO

Do You Take Pain Medicine? YES/NO

Name: _____

How Much Per Day? _____

Does Your Shoulder Feel Stiff? YES/NO

Does Your Shoulder Feel Loose Or Unstable? (if any) _____ What

Is The Hardest Thing That You Do At Work Or Home?

Please Rate Your Ability To Perform The Following Tasks Your Affected Shoulder.

Rating Scale 4=normal
3=mild compromise
2=difficulty
1=only with aid
0=unable

A_____Use back pocket H_____Dress your self

B_____Perineal care I_____Sleep on affected sideC

_____Wash opposite axilla

D_____Eat with utensil

E_____Comb hair

_____Use hand with arm at Shoulder level

G_____Cary 10-15 lbs with arm At side

J_____Pulling

K_____Use hand overhead

L_____ThrowingF

M_____Lifting

N_____Do usual work

O_____Do usual sport

Study Tittle: **Acute effect of scapular proprioceptive neuromuscular facilitations technique versus classic shoulder exercises in adhesive capsulitis**

I Mr/Mrs_____Exercise My Free Power Of Choice; Here By Give My Consent To Include My Self As A Subject. In The Study And To Publish The Data Obtain. I Have Been Diagnosed As Having Adhesive Capsulitis. I Have Been Informed To My Satisfaction By The Attending Physiotherapist. The Purpose And Method Of The Study As Any Time During The Course Of The Study Without Giving Reason To Do So I Agree To Adhere To The Physiotherapist's Instruction And Co-operate Fully With Those Conducting The Study And Inform Them If My Condition Deteriorates Or If I Experience Any Unwanted Symptoms.

Patient's Name:_____ **Date:**_____

Sign: _____

Physiotherapist Name:_____

Sign: _____

.

ANNEXURE C

DATA COLLECTION SHEET

GROUP: ☐ DATE: _____

NAME OF PATIENT: _____

OPD No: _____

Age: _____

Sex: _____

BMI:_____ Weight:_____Kg Height:_____cms

Address & Contact No:

_____

_____

_____

_____

Affected Side: _____

Signature of the Investigator

AjaydeepsinhVaghela

ANNEXURE D

ASSESSMENT SHEET

DEMOGRAPHIC DATE:

NAME:
AGE:
GENDER:
OCCUPATION:
ADDRESS:
REFFERRED BY:
CONTACT NO:
HAND DOMINENCY:

CHIEF COMPLAIN:

HISTORY:

HISTORY OF PRESENT ILLNESS:

PAST HISTORY:

PERSONAL HISTORY:
SOCIO-ECONOMIC STATUS:

MEDICAL HISTORY:

ON OBSERVATION:

POSTURE:
DEFORMITY.
SWELLING:
EXTERNAL AIDS;
TROPICAL CHANGES:

ON PALPITAION:

TRIGGER POINT:
TENDERNESS:
SPASM:
WARMTH:
SENSATION:
SOFT TISSUE PALPITAION:

BONY PALPITAION;
ACCESSORY
MOVEMENT:0

ON EXAMINATION:

ROM:
MMT:
GIRTH MEASUREMENT:

PAIN ASSESSMENT:

TYPE OF PAIN:
SITE OF PAIN:
AGGRAVATING FACTOR:
RELIEVING FACTOR:

- **Pain assessment by VAS(cms)**

  a. Pre treatment VAS

  0 _____ 10 Score ☐

  b. Post treatment VAS

  0 _____ 10 Score ☐

- **Scapular dyskinesis using a measure tape:**

  Scapular dykineis

  PRE :

POST;

ANNEXURE E

Name:_____ Date:_____

Simple Shoulder Test

Answer each question by circling "Yes" or "No"

If you do not normally do the activity, try to imagine if you could. Would your shoulder restrict you. If the activity causes no pain, or rarely produces pain, then answer "Yes". If your shoulder hurts sometimes, often or always when you do the netivity, answer "No"

1.Is your shoulder comfortable with your arm at rest by your side?	Yes	No
2.Does your shoulder allow you to sleep comfortably?	Yes	No
3.Can you reach the small of your back to tuck in your shirt?	Yes	No
4.Can you place your hand behind your head with the elbow straight out to the side?	Yes	No
5.Can you place a coin on a shelf at the level of your Shoulder Without bonding your albow?	Yes	No
6.Can you lift one pound (full pint container) to the level at your shoulder without bending your elbow?	Yes	No
7.Can you lift eight pound (full gallon container) to the level of your shoulder without bending your elbow?	Yes	No
8.Can you carry twenty pounds at your side with the affected extremity?	Yes	No
9.Do you think yon can toss a softball under- hand twenty yards with the affected extremity?	Yes	No
10.Do you think you can toss a softball over hand twenty yards with the affected extremity?	Yes	No

11.Can you wash the back of your opposite shoulder with the affected extremity? Yes No

12.Would your shoulder allow you to work full-time at your regular job? Yes No

ANNEXURE F
MASTER CHART

GROUP 1								
SR NO:	AGE	GENDER	VAS		SST		VAS DIFFERENT	SST DIFFERNT
			PRE	POST	PRE	POST		
1	45	F	6	4	6	9	2	3
2	47	M	7	5	6	7	2	1
3	50	F	6	3	7	9	3	2
4	46	F	7	4	8	9	3	1
5	60	M	6	3	8	10	3	2
6	57	M	7	4	5	8	3	3
7	60	F	8	4	6	9	4	3
8	47	F	7	5	7	9	2	2
9	57	M	6	4	8	10	2	2
10	46	F	6	3	7	9	3	2
11	55	M	7	4	5	7	3	2
12	47	M	8	4	6	9	4	3
13	59	F	7	5	8	10	2	2
14	51	F	6	2	7	10	4	3
15	54	M	6	3	7	9	3	2

GROUP 2								
SR NO:	AGE	GENDER	VAS		SST		VAS DIFFERENT	SST DIFFERNT
			PRE	POST	PRE	POST		
1	48	F	7	6	7	9	1	2
2	51	M	7	5	5	7	2	2
3	50	F	4	5	7	8	1	1
4	49	F	8	6	8	9	2	1
5	54	M	6	5	7	8	1	1
6	56	F	6	5	8	8	1	0
7	47	M	7	6	6	7	1	1
8	50	F	8	6	6	8	2	2
9	59	M	8	6	7	7	2	0
10	56	F	6	5	7	8	1	1
11	54	F	7	5	7	9	2	2
12	56	M	6	5	8	8	1	0
13	47	F	6	5	5	6	1	1
14	43	M	6	7	7	6	1	1
15	48	M	7	6	6	7	1	1

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"COMPARISON OF ULTRASOUND AND SHOCKWAVE THERAPY IN TENDINOPATHY- AN EVIDENCE BASED STUDY"

Physiotherapy

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ABSTRACT

Background: Tendinopathy is a failed healing response of the tendon, with haphazard proliferation of tenocytes, intracellular abnormalities in tenocytes, disruption of collagen fibres, and a subsequent increase in non-collagenous matrix. There is always remains controversy regarding effectiveness of different treatment techniques for tendinopathy and aim of present study is to find and justify better treatment modality for management of tendinopathy. **Purpose:** To study the evidences regarding effect of Shock wave therapy versus Ultrasound therapy in tendinopathies. **Methodology:** This Evidence based study was conducted from June 2017 to June 2022. Search engines used to find appropriate articles were: PubMed, Google Scholar, PEDro, ResearchGate, ScienceDirect and Embase. Key words used were: Ultrasound, Shock wave Therapy and Tendinopathy. Articles were assessed via 2 scales: Centre for Evidence-Based Medicine's (CEBM's) Levels of Evidence and PEDro scale. **Results:** Total 156 articles were found, out of which 12 articles were relevant and from those 6 articles were included in this evidence-based study. From 6 studies, 1 Meta-analysis (Level of evidence 1a), 2 Randomized controlled trails (Level of evidence 1b) and 3 Comparative studies (Level of evidence 2b). **Conclusion:** There are moderate to strong evidences suggests the Shock wave therapy has more effect on Achilles, Gluteal, Rotator cuff and Lateral Elbow tendinopathies when compared to ultrasound.

KEYWORDS

Ultrasound, Shock wave Therapy and Tendinopathy

INTRODUCTION

Tendinopathy is a degenerative tendon disorder associated with chronic pain, swelling, and impaired physical function. Tendons are susceptible to injury as they undergo high forces during loading activities, receive little vascular blood supply, have low elasticity and decreased metabolism. Tendinopathy is thought to be caused by repetitive tendon microtrauma and subsequent failed healing responses, characterized by neovascularization, incidence of calcium deposits or calcification and increased tendon thickness or swelling.[1]

Histologically, tendinopathy is characterized by the absence of inflammatory cells, poor healing, non-inflammatory intratendinous collagen degeneration, collagen fiber disorientation and thinning, hypercellularity with high concentrations of glycosaminoglycans and proteoglycans, and neovascularization. [2][3]Although inflammatory cells are typically present in tendinopathy, tendon cell degeneration rather than inflammation is considered the pathological hallmark of the disorder, leading to the adoption of the term tendinopathy rather than the previously used diagnosis of tendinitis.

A variety of therapeutic techniques have been proposed for the appropriate management of patients with tendinopathy including exercise, orthotics, manual therapy, passive modalities, acupuncture or a combination of them. However, the effectiveness of each treatment option remains debatable.

Extracorporeal shockwave therapy is a popular method in the management of common tendinopathies and has been proposed as an effective supplement to other noninvasive therapies. The ultrasound is a commonly used modality for tendinosis. It Improves microcirculation, migration and synthesis of collagen fibers to the tendon [4]. There is growing evidence from in vitro and animal-based models that low intensity pulsed ultrasound (LIPUS) may also have beneficial effects on non-mineralized tissues, such as ligaments and tendons. For instance, using these models low intensity pulsed ultrasound (LIPUS) has been found to accelerate knee medial collateral ligament healing [5][6][7], augment tendon repair [8] and modulate tendon cell activity. Alexander et al showed that higher doses of ultrasound energy improved pain in individuals with shoulder calcific tendinitis. In contrast, Warden et al. found that lower doses of ultrasound was no better than placebo for the treatment of individuals with patellar tendinopathy.

So, there is always remains controversy regarding effectiveness of different treatment techniques for tendinopathy and aim of present study is to find and justify better treatment modality for management of tendinopathy.

METHODOLOGY

Study Design: This is an Evidence Based Study, which was conducted according to PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-analysis) guidelines. (Figure 1).

Literature Search:

A specified literature search was performed from June 2017 to June 2022 (Last 5 years). Literature was searched using following search engines: Google Scholar, PEDro, PubMed, ResearchGate, ScienceDirect, Embase

Key Words Used For The Search Were:

Ultrasound, Shock wave Therapy and Tendinopathy

METHOD OF SELECTION OF ARTICLES:

Inclusion Criteria:

(1) Studies involving any type of Tendinopathy from June 2017 to June 2022 (Last 5 years), (2) Studies which compared Ultrasound or Shockwave Therapy in any type of Tendinopathy, (3) Articles on tendinopathy having study design of Systematic reviews, Meta-analysis and RCTs, (4) Articles published in English, (5) Studies done on Human participants.

Exclusion Criteria:

(1) Articles on tendinopathy having study design of Case Control and Cohort (2) Studies done on animals.

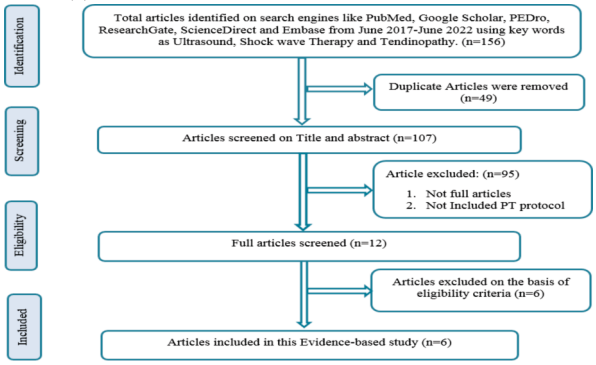

Figure 1: Preferred Reporting Items for systematic reviews and Meta-analysis (PRISMA)

Table 1: Characteristics of Included Studies

SR NO.	TITLE	Study design & Duration	Articles Or Sample Size	Outcome Measures	Pedro And Level Of Evidence
1	Analgesic Effect of Extracorporeal Shock-Wave Therapy in Individuals with Lateral Epicondylitis: A Randomized Controlled Trial [9]	A Randomized Controlled Trial (5 sessions)	40	VAS, Taiwan Version of DASH and Dynamometer	8/10 1b
2	Achilles tendinopathy: Comparison between shockwave and ultrasound therapy [10]	A comparative study (4 weeks)	130	The University of Peloponnese Pain, Functionality and Quality of life Questionnaire - the UoP-PFQ'	4/10 2b
3	Comparison of Radial Extracorporeal Shock Wave Therapy and Traditional Physiotherapy in Rotator Cuff Calcific Tendinitis Treatment [11]	A comparative study (4 weeks)	80	Age, height, Weight, BMI, VAS, Goniometer (Internal and external rotation ROM) and QuickDASH	4/10 2b
4	Comparison of Radial Extracorporeal Shockwave Therapy versus Ultrasound Therapy in the Treatment of Rotator Cuff Tendinopathy [12]	A comparative study (4 weeks)	115	The University of Peloponnese Pain, Functionality and Quality of life Questionnaire - the UoP-PFQ'	4/10 2b
5	Focused extracorporeal shock wave therapy for greater trochanteric pain syndrome with gluteal tendinopathy: a randomized controlled trial [13]	A randomized controlled trial (3 weeks)	50	NPRS, LEFS	7/10 1b
6	A comparative study of the efficacy of ultrasonics and extracorporeal shock wave in the treatment of tennis elbow: a meta-analysis of randomized controlled trials [14]	A meta-analysis	5 articles involving 117 participants	-	- 1a

Assessment of Methodological Quality:
Data was assessed using 2 parameters: (1) Centre for Evidence-Based Medicine's (CEBM's) Levels of Evidence and (2) PEDro scale (Appendix 1 & 2)

RESULTS

Evidences were reviewed and analysis was done on the basis of PEDro score and CEBM's Level of Evidence Scale. Risk of bias is also assessed.

Total 156 articles were found, out of which 12 articles were relevant and from those 6 articles were included in this evidence-based study and other articles were excluded as per Inclusion and Exclusion criteria.

From total 6 studies, there is 1 meta-analysis on efficacy of ultrasonics and extracorporeal shock wave in the treatment of tennis elbow and their result shown that Extracorporeal shock wave Therapy is a superior adjuvant therapy for tennis elbow compared to Ultrasound. Its level of evidence was 1a. 5 out of 6 studies (2 Randomized controlled trials and 3 Comparative studies) were shown that Shock wave (Either Extracorporeal or Radial) was effective treatment for reducing pain and improving disability in subjects with Achilles, Lateral elbow, Gluteal, Rotator cuff tendinopathies when compared to Ultrasound. Their Level of evidence was 1b and 2b.

DISCUSSION

Total 6 studies (1 Meta-analysis, 2 Randomized controlled trials and 3 comparative study) were included in this evidence-based study. The methodological qualities of included studies were moderate to high. The sample size varied from 40-117 subjects.

There are 1 strong evidence (Meta-analysis) which suggest that shock wave therapy is an effective treatment for reducing pain and disability in patients with Lateral elbow tendinopathy when compared to Ultrasound.

There are 2 moderates to high quality of evidences (2 Randomized Controlled Trials) which suggest that shock wave therapy alone or can be adjunct to other conventional treatment provide significant benefits in reducing pain and dysfunctions in patients with Lateral elbow and Gluteal tendinopathies. Total study duration varied from 3 to 5 weeks.

Furthermore, there are 3 low to moderate quality of evidences (3 Comparative Studies) having small to large sample size which compares Ultrasound with Shockwave therapy and their results confirms that Shock wave therapy effectively reduces pain and promotes healing in Rotator cuff and Achillies Tendinopathy. Total Study duration was 4 weeks.

Haupt proposed four possible phase mechanisms of ESWT effects on tissue: physical, physicochemical, chemical and biological. In the physical phase, shockwave pressures cause absorption, refection, refraction and transmission of energy into cells. These tensile forces induce cavitation, increasing cell membrane permeability and activating cell signaling pathways. These include mechano-transduction pathways and those that regulate a variety of gene expressions. In the physicochemical phase, cells release molecules such as adenosine triphosphate (ATP), activating cell signaling pathways. In the chemical phase, ion channels in cell membranes are altered allowing cell calcium mobilization. The biological phase plays host to a plethora of identified biological responses due to tissue and cell stimulation.

Tissue-healing responses are mediated by release of vascular endothelial growth factor (VEGF), endothelial progenitor cells, endothelial nitric oxide synthase (eNOS), insulin-like growth factor (IGF1) proliferating cell nuclear antigen (PCNA) and various other functional proteins.

Cellular modulation is activated by upregulation and downregulation of proteins which promotes processes such as neovascularization, anti-inflammation, anti-apoptosis, chondroprotective effects angiogenesis and regeneration of bone and tendon tissue. [15]

It should be noted that there were no any adverse effects reported from Shockwave Therapy from included articles.

CONCLUSION

From this Evidence based study, it can be concluded that there are moderate to strong evidences suggests the Shock wave therapy has more effect on Achilles, Gluteal, Rotator cuff and Lateral Elbow tendinopathies when compared to ultrasound.

Conflict Of Interest : There is no conflict of interest.

Abbreviations
RCTs: Randomized controlled Trials, VAS: Visual Analogue Scale, VAS-FA: VAS foot and ankle, eNOS: Endothelial Nitric Oxide Synthase, VEGF: Vascular Endothelial Growth Fact, PCNA: Proliferating Cell Antinuclear Antigen, ESWT: Extracorporeal Shockwave Therapy, F-SWT: Focused Shockwave Therapy, R-SWT: Radial Shockwave Therapy, LIPUS: Low Intensity Pulsed Ultrasound, TUS: Therapeutic Ultrasound. PEDro: Physiotherapy Evidence Database, CINAHL: Cumulative Index of Nursing and Allied Health Literature, CEBM: Center of Evidence Based Medicine, PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-analysis, DASH: Disability of Arm, Shoulder and Hand, ROM: Range of Motion, BMI: Body Mass Index, NPRS: Numerical Pain Rating Scale, LEFS: Lower Extremity Functional Scale, GTPS: Greater Trochanteric Pain Syndrome, ATP: Adenosine Triphosphate, OVID: Offshore Vessel Inspection Database, EMBASE: Excerpta Medica Database, IGF1: Insulin-Like Growth Factor1

Ethical Approval
Ethical approval was not required.

Appendix 1- CEBM's Level of Evidence
It assesses quality based on study design, which categorize the studies

in a scale ranging from 1 to 5 with further subdivision for 5each.

Level	Definition
1a	Systematic reviews of randomized controlled trials
1b	Individual randomized controlled trials
1c	All-or-none studies
2b	Systematic reviews of cohort studies
2b	Individual cohort studies or low-quality randomized controlled trials
2c	Outcome research
3a	Systematic reviews of case-control studies
3b	Individual case-control studies
4	Case series, poorly designed cohort or case-control studies
5	Animal and bench research, expert opinion

Appendix 2-PEDro Scale

It assesses methodological quality and consists of a checklist of 11 criteria, 10 of which are scored. For each criterion the study met, 1 point was awarded. The points were tallied and presented as a score out of 10. The scale applies only to experimental studies. For this review, investigations with PEDro scores of 6 to 10 were considered high quality, of 4 to 5 were considered moderate quality, and of 0 to 3 were considered low quality.

No.	Description	Yes/No
1	Eligibility criteria were specified (No points awarded)	
2	Subjects were randomly allocated to groups	
3	Allocation was concealed	
4	The groups were similar at baseline regarding the most important prognostic indicators	
5	There was blinding of all subjects	
6	There was blinding of all therapists who administered the therapy	
7	There was blinding of all assessors who measured at least one key outcome	
8	Measure of at least one key outcome were obtained from more than 85% of the subjects initially allocated to groups	
9	All subjects for whom outcome measures were available received the treatment or control condition as allocated	
10	The result of between group comparisons are reported for at least one key outcome	
11	The study provides both point measures and measures of variability for at least one key outcome	

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VALIDATION OF THE GUJARATI VERSION OF THE NORTHWICK PARK NECK PAIN QUESTIONNAIRE.

Physiotherapy

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ABSTRACT

Background: Neck pain is becoming increasingly common throughout the world. It has a considerable impact on individuals and their families, communities, health-care systems, and businesses. There is substantial heterogeneity between neck pain epidemiological studies, which makes it difficult to compare from different studies. The prevalence of neck pain in the general population ranges between 0.4% and 86.8% (mean: 23.1%); point prevalence ranges from 0.4% to 41.5% (mean: 14.4%); and 1 year prevalence ranges from 4.8% to 79.5% (mean: 25.8%). Northwick Park Neck Pain Questionnaire is one of the most commonly used scales that has been used by physical therapists worldwide. Also, it has already been translated into many languages such as Turkish, Indonesian, Spanish and Swedish. We would like to translate this scale into Gujarati language. Because it is more beneficial for the patient to understand the Gujarati scale and it is also helpful for the Gujarati physiotherapist. **Methodology:** The study was carried out on people aged more then 18 years in Gujarat, India. Those peoples who have knee injury.100 patients who fulfilled inclusion criteria were selected. Initially scale was translated to Gujarati by forward backward translation and patients were instructed to fill the scale at 1 week interval. **Result:** 100 patients participated. Gujarati version of The Northwick Park Neck Pain Questionnaire was given twice with 1- week interval to measure the test- retest reliability and validity. The results of the study showed moderate to high correlation in components of The Northwick Park Neck Pain Questionnaire Gujarati version (ICC =0.882) ($P<0.05$) and internal consistency (Cronbach's alpha =0.88). **Conclusions:** The Gujarati version of The Northwick Park Neck Pain Questionnaire was cross-culturally adapted and validated for use among the Gujarati- speaking populations. The translated version has acceptable reliability and internal consistency.

KEYWORDS

Northwick Park Neck Pain questionnaire, Cervical, Interclass correlation.

INTRODUCTION

Neck pain is becoming increasingly common throughout the world. It has a considerable impact on individuals and their families, communities, health-care systems, and businesses. There is substantial heterogeneity between neck pain epidemiological studies, which makes it difficult to compare or pool data from different studies.[1] The estimated 1 year incidence of neck pain from available studies ranges between 10.4% and 21.3% with a higher incidence noted in office and computer workers. While some studies report that between 33% and 65% of people have recovered from an episode of neck pain at 1 year, most cases run an episodic course over a person's lifetime and, thus, relapses are common.[2]

The overall prevalence of neck pain in the general population ranges between 0.4% and 86.8% (mean: 23.1%); point prevalence ranges from 0.4% to 41.5% (mean: 14.4%); and 1 year prevalence ranges from 4.8% to 79.5% (mean: 25.8%). Prevalence is generally higher in women, higher in high-income countries compared with low- and middle-income countries and higher in urban areas compared with rural areas. Many environmental and personal factors influence the onset and course of neck pain. Most studies indicate a higher incidence of neck pain among women and an increased risk of developing neck pain until the 35–49 year age group, after which the risk begins to decline.[3]

Pain scales usually are used in the assessment of patients with neck pain. However, the presence and severity of pain represent only a small part of the health outcome. Rainville et al suggested that pain scales correlate poorly with measures of physical function.[4] There is increasing recognition that patient perspectives are essential both in making medical decisions and in judging treatment outcomes. Questionnaires designed for completion by the patient are used increasingly as a convenient and reproducible measuring tool for assessing patients with musculoskeletal problems, especially those with low back pain. Among various disability indexes for low back pain, the Oswestry Index probably is the best index covering several distinct activities of daily living. However, only a few methods exist to assess the disability of patients with neck pain. Vernon and Mior modified the Oswestry Low Back Pain Index and produced a 10-item scaled questionnaire, namely the Neck Disability Index (NDI).[4] Offered as a self-reporting instrument for assessing activities of daily living for patients with neck pain, it was validated and found reliable. However, the sample size in some of the analyses was small, with only 10 patients in the concurrent validity study. Most of the patients (70%) had experienced “whiplash” injury. Leak et al again modified the Oswestry questionnaire and developed the self-administered Northwick Park Neck Pain Questionnaire (NPQ).[5] These authors converted some of the questions (walking, standing, and sex life items in the Oswestry questionnaire to cover many activities (carrying, reading/television, and work) likely to be affected by neck pain. The NPQ consists of nine five- part questions that assess the patient's symptoms, from which a score is obtained. Patients need to answer all the questions except the ninth one, which is an option for patients who drive. Each question is scored from 0 to 4. The responses to the questions are summed and converted to a score percentage, which ranges from 0% to 100%, with 0% representing the least disabled and100% the most severely disabled. In addition to questions 1 through 9, all follow-up questionnaires contained a 10th question asking patients how their pain compared with that reported the last time. The questionnaire was found to be valid, easy for patients to complete, and simple to score. It provides a reliable outcome measure for patients with acute or chronic neck pain.[6]

The Northwick Park Neck Pain Questionnaire is one of the most common scale that has been used by the physiotherapist all over the world. Also, it is already translated in many other languages like Turkish, Korean, Spanish, Indonesian etc. We want to translate this scale in our mother language i.e. Gujarati, because it will be more beneficial for patients to understand the scale in Gujarati and it will be helpful to physiotherapists also who are from Gujarat.

METHODOLOGY

Ethical Approval: Ethical approval for the study was taken from the institutional ethical committee
Study Design : Reliability and validity study.
Study Setting: Various committee of Gandhinagar city
Sampling Technique: Purposive Sampling
Population: Native Gujarati Patients with neck pain in North Gujarat.
Duration Of Study: 1 Year
Study Size : . N=100

Inclusion Criteria

- AGE : More than 18 years of age
- Patient diagnosed with neck pain

- Subjects willing to participate.

Exclusion Criteria

- Patients having neurological disorders
- Patient not able to read and write Guajarati
- Uncooperative patients

The Northwick Park Neck Pain Questionnaire was cross-culturally adapted into a Gujarati version in the following steps:

First stage, the English version of The Northwick Park Neck Pain Questionnaire was translated into Gujarati version through standardized procedure recommended by Beaton et al. with some modification. We translated and culturally adapted The Northwick Park Neck Pain Questionnaire according to Indian living standards to adapt/fit and use in Indian Gujarati speaking neck pain population for the evaluation of self-rated neck functional status., stage I was done by the first author with the help of online translation portal.

We skipped stages II and III recommended by Beaton et al. In stage IV, 08 experts (02 orthopaedicians, 02 rheumatologists, 02 English professors, and 02 Gujarati professors) were volunteered for the review of questionnaire developed in stage I. Overall, Gujarati professors simplified the language, whereas medical experts helped with the medical terminology used in the questionnaire.

In stage V, questionnaire developed at the end of stage IV was administered to 20 Gujarati speaking neck pain patients. All patients understood the questions and responded correctly; hence there was no modification of questionnaire at this stage.

Validation study: Experts and translators obtained face validity and content validity.

I. Test-retest reliability: The recruited patients with neck pain were asked to complete the Gujarati version of The Northwick Park Neck Pain Questionnaire twice with a one-week gap in between. As a result, that person will not copy the same data and will not forget. The readings were recorded in order to determine test-retest reliability.
II. Internal consistency: Cronbach's alpha (α), a statistic calculated from pair wise correlations measured between paired readings of the Gujarati version of The Northwick Park Neck Pain Questionnaire, was used to assess internal consistency.

After checking reliability and validity of this questionnaire, we have taken 100 individuals with neck pain.

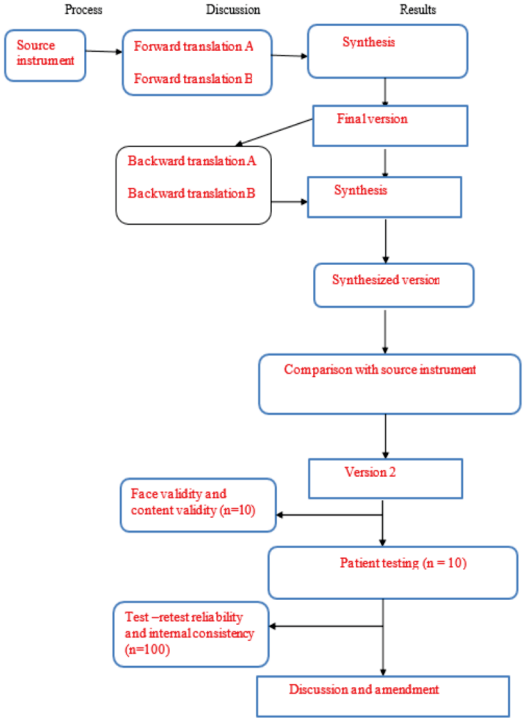


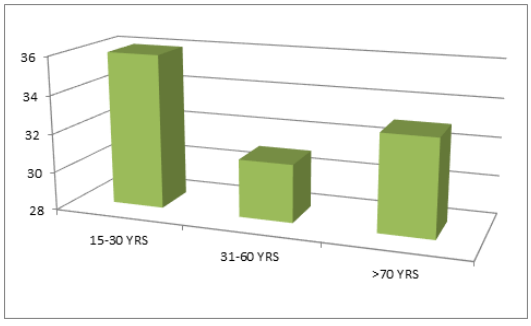
Chart:- Cross Cultural Adaption

RESULT

All statistical analysis was done using SPSS 25.0 software for windows. Descriptive analysis was used to obtain mean and standard deviations. Reliability testing was done using reliability analysis. Inter class correlation coefficient, ICC(2,1) and Cronbach's α were measured. Confidence interval were set at 95%, p = 0.05 for all the analysis.

1. Age Distribution

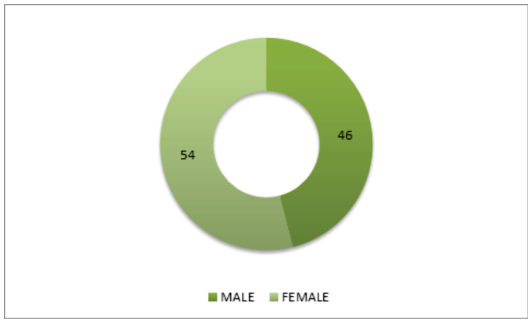
The research was performed on 100 patients with neck pain between the age of more then 18 years. There were 36 patients between the ages of 18 to 30, 31 patients between the age 31to 60, and 33 patients between the age of >70 years.



Graph : Age Distribution

2. Gender Distribution

The research was performed on 100 patient with neck pain . In which 54 are females and 46 are males.



Graph 7.2 : Gender Distribution

The content validity of Gujarati translated The Northwick Park Neck Pain Questionnaire by a 8 experts were found to be, I-CVI of individual items The Northwick Park Neck Pain Questionnaire of ≥ 0.93 and overall S-CVI for idiomatic equivalence, semantic equivalence and content relevance ≥ 0.90. For content validity equivalence all 6 experts answers were located between mostly agree and strongly agree of Gujarati version of The Northwick Park Neck Pain Questionnaire for idiomatic equivalence (average= 0.89) semantic equivalence(average = 0.91) and content relevance (average= 0.92). Test-retest reliability (n=100) was tested by using the interclass correlation coefficient, ICC (2,1) and Internal consistency (n=100) was reported in terms of Cronbach's α measured in two session after 1 week

Table 7.1:- Test- Retest Of Gujarati Version The Northwick Park Neck Pain Questionnaire

The Northwick Park Neck Pain Questionnaire	Week 1 (Mean)	Week 2 (Mean)	Cronbach's alpha	ICC	P- value
	17.5	18.73	0.88	0.882	0.01

DISCUSSION

Non-specific neck pain is very common in rheumatology patients. Of the working population, 30% aged 25-29 years and 50% over 45 years report one or more attacks of painful neck, which is the primary motive for patient presentations. In our study first report of the reliability and validity of Gujarati version of The Northwick Park Neck Pain Questionnaire for evaluating pain and function with neck pain patients.[7]

The restriction of activities of daily living caused by neck pain has an important place in the planning of treatment. Whatever the source of

the pain, the objective assessment is difficult and the evaluation should primarily be based on the patient's subjective experience of pain and disability. Instead of focusing on the examination findings for diagnostic purposes, it is more accurate for a multidisciplinary approach to evaluate the patient's performance in daily life. For this purpose, there are specific questionnaires developed for the evaluation of patients and the quantitative determination of treatment results.[8] Various features of the scale such as acceptability, ease of use, high reliability, validity and responsiveness to clinical changes can guide the evaluation and selection of an appropriate scale. Therefore, we attempted to adapt the NPQ into Gujarati. Tabachnick and Fidell reported that the sample size of 10 participants per item was sufficient for factor analysis . The present study included 100 patients with neck pain. Thus, the required sample size was sufficient.[9]

In this study 100 patients participated. Gujarati version of The Northwick Park Neck Pain Questionnaire was given twice with 1-week interval to measure the test- retest reliability and to validity. The results of the study showed good correlation neck pain scale (ICC= .815) ($P<0.01$) and internal consistency (Cronbach's alpha = . 989 and .978).

For content validity equivalence all 6 experts answer were located between mostly agree and strongly agree of Gujarati version of The Northwick Park Neck Pain Questionnaire (average=0.89) semantic equivalence (average = 0.90) and content relevance (average= 0.93). Thus, Gujarati version of The Northwick Park Neck Pain Questionnaire was content validated for idiomatic equivalence, semantic equivalence, content relevance.

Contrary to questionnaires evaluating general health, questionnaires related to regional pain and functions are considered to have higher validity because they are directed to a single body region. Therefore, the NDI was developed as the first questionnaire by Vernon et al in 1991 and then the NPQ was developed in 1994 and then the NPDS was developedin 1999. Vernon and Mior applied the NDI at a 1-week interval to patients who have had neck pain due to whiplash injury and without trauma and found the ICC score to be 0.89 . Leak et al found that ICC score was 0.84 for NPQ. They proposed that the NPQ is easy for patients to complete, simple to score and provides an objective measure for evaluating outcomes in patients with acute or chronic neck pain. Wheeler et al found that ICC score was 0.93 for NPDS. Other studies investigating the reliability of the neck questionnaires in the Turkish population, such as the Turkish version of the NPDS and the NDI, have similar ICC scores. Bicer et al conducted a study concerning chronic neck pain and reported that the value of the Cronbach's alpha coefficient for the reliability of the NPDS was 0.86. Aslanet al. conducted a study of patients with chronic neck pain who were administered with the NDI and NPDS. They found that ICC score was 0.979 at a 1-week interval for the NDI and the correlation between the NDI and the NPDS was 0.659 to 0.728.[10-11]

In previous studies, interrater reliability and interrater reliability of the Korean The Northwick Park Neck Pain Questionnaire were (ICC =(0.97) respectively. reliability and validity for level of pain and function had high sensitivity and specificity for the patient with Neck pain.

In Spanish version the concurrent validity had a high correlation (r = 0.74- 0.86) and inter and intra- rater reliability was between 0.4 to 0.6 and 0.6 to 0.8 The Northwick Park Neck Pain Questionnaire is valid and reliable for Spanish population.

It was found Gujarati version of The Northwick Park Neck Pain Questionnaire items equivalent to those in original version which is intended by translators involve in this study. The results showed that it was translate this scale into other languages without losing psychometric properties of the original English version.

CONCLUSION

The Gujarati version of The Northwick Park Neck Pain Questionnaire was cross- culturally adapted and validated for use among the Gujarati-speaking populations. The translated version has acceptable reliability and internal consistency.

ABBREVIATIONS

NPQ: Northwick Park Neck pain questionnaire
NDI: Neck Disability Index
ODI: Oswestry disability index
ICC: Interclass correlation

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ORIGINAL RESEARCH PAPER
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INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

CORRELATION BETWEEN CORE MUSCLE ENDURANCE AND FOOT POSTURE IN COLLEGE GOING STUDENTS: AN OBSERVATIONAL STUDY

Physiotherapy

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ABSTRACT

Background: Proper posture is considered to be a state of musculoskeletal balance that involves A minimal amount of Stress or strain to the body.it Compromises balance because of muscular Imbalance which can cause loss Of Proprioception sense in joint and decreased Balance, and trunk endurance is significantly Reduced in Reduced in forward head posture and may lead to poor muscular Control of the spine. **Aim:** To Determine the Correlation between core muscle endurance and foot posture in college Going Students. **Methodology:** An observational study Was conducted in 50 College Going Students of Ahmedabad and Convient Sampling was used. Age group 18-25 Year students Chek for Core Muscle Endurance Test and Foot Posture Analysis. The statistical evaluation become accomplished with SPSS version 29-2022, September. **Result:** Our Finding Suggest that from Descriptive analysis of data was expressed in mean and Standard Deviation for various parameters. Correlation were expressed in term of R value and P Value. P value less than 0.05 was considered to be Signifcant. **Conclusion:** Individuals with altered foot posture will have an effect on the Proximal segment through the Kinetic chain phenomenon of the body, Affecting the core endurance. Individuals with altered Foot posture have reduced core endurance.

KEYWORDS

Core Muscle,Foot Posture,College Students,Endurance

INTRODUCTION

Foot posture plays an important role in the quality of daily living.[1]The structure of the feet is such that it permits the functions of both the stability and the mobility depending on the tasks which are imposed on it.[1]

Kinetic Chain & Core

Core stability can be defined as the ability of the Lumbopelvic-Hip Complex to prevent buckling of the Vertebral Column and return it to equilibrium following perturbation by using Strength, Endurance and Motor Control in a functional manner through all the planes of motion and action despite changes in the center of gravity.[2]

Need Of Study:

1)The foot posture is important for provide stable base of support during walking, running and jumping.
2)Proximal stability is needed for distal mobility.
3)So the core provide proximal stability to perform proper distal component mobility. The affection in
4)proximal core muscle may be lead to distal component changes and visa versa.

Aims Of The Study:

To find out the Correlation between core muscle endurance and foot posture in college Going students.

OBJECTIVES:

1)To find out the Correlation between core muscle endurance and foot posture in college going students by using Flexor endurance test & FPI.
2)To find out the Correlation between core muscle endurance and foot posture in college going students by using Extensor endurance test & FPI.
3)To find out the Correlation between core muscle endurance and foot posture in college going students by using Rt. Side plank endurance test & FPI.
4)To find out the Correlation between core muscle endurance and foot posture in college going students by using Lt. Side plank endurance test & FPI.

Null hypothesis:

There is no significant Correlation between core muscle endurance and foot posture in college going students.

Alternate Hypothesis:

There is significant Correlation between core muscle endurance and foot posture in college going students. and foot posture in college going students.

MATERIAL

Pen, paper, pencil
Foot posture index questionnaire
Stop watch
Plinth or high level bed

METHODOLOGY

Sample Size: 50

Sampling Design : Convient sampling

Study Design: An observational study

Setting: Ahmedabad

Population: Age group between 18 to 25 years

Procedure

- Selection
- Fifty subjects with the age group between 18 to 25 years participate in this study.
- Core Endurance :
- 60 degree flexion endurance test,
- trunk extensor endurance test,
- Right side plank test
- left side plank test.
- Time noted in sec.
- Foot posture:
- Foot posture index.

Flexor Endurance Test Position

Extensor Endurance Test Position

Lt. & Rt. Side Plank Endurance Test Position

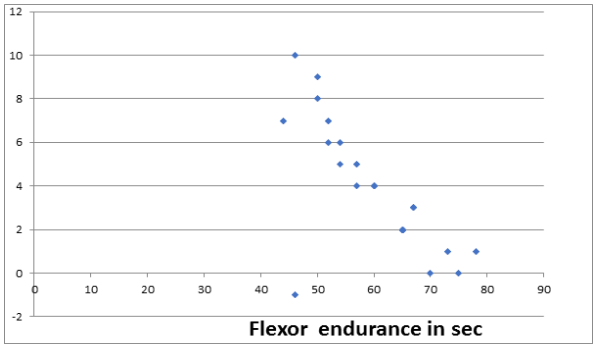
RESULTS

Descriptive analysis of data was expressed in mean and standard deviation for various parameters.Correlation were expressed in term of r value and P value.P value less than 0.05 was considered to be significant

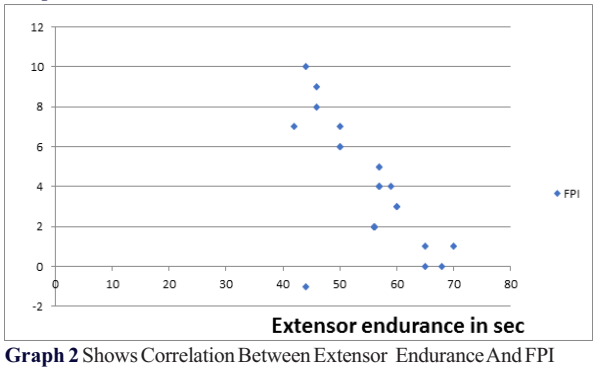
The graphical representation was done by scatter graph.

Table 1 : Descriptive Analysis

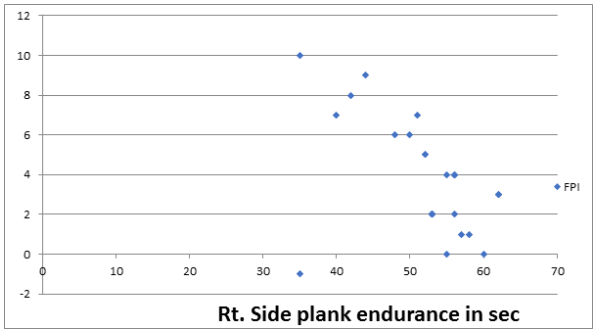
	MEAN	STANDARD DEVIATION
Age	22.34	1.7333
Flexor endurance test	60.1	9.2609
Extensor endurance test	55.34	7.3640
Rt. Side plank test	51.78	7.3326
Lt. side plank test	49.08	6.7698
Foot posture Index	3.78	2.8734



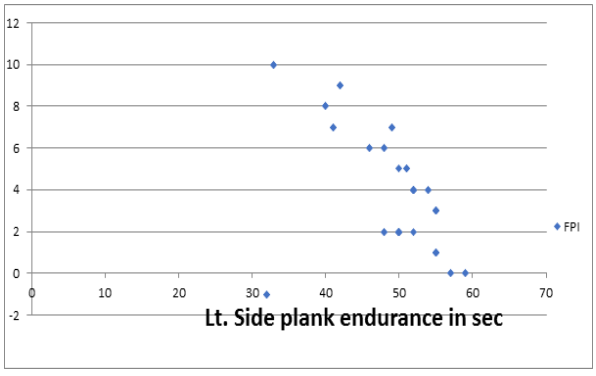
Graph 1 Shows Correlation Between Flexor Endurance And FPI



Graph 2 Shows Correlation Between Extensor Endurance And FPI



Graph 3 Shows Correlation Between Rt. Side Plank Endurance And FPI



Graph 4 Shows Correlation Between Lt. Side Plank Endurance And FPI

Table 2: Correlation Between Core Endurance & Foot Posture

Variables	r value	P value	
Flexor endurance test & FPI	-0.7231	0.04	significant
Extensor endurance test & FPI	-0.6734	0.03	significant
Rt. Side plank test & FPI	-0.5098	0.005	significant
Lt. side plank test & FPI	-0.5037	0.005	significant

RESULTS

Result shows there is a negative correlation between core endurance timing and foot posture index scoring.

DISCUSSION

The Purpose Of the Study find out correlation between core muscle endurance and foot posture in college going students. The Presents Study Suggest that changes in foot posture causes changes in the kinetic chain of the entire lower extremity upto the lumbar, pelvic and the hip region. Dr. Anvita Telang at el, Conducted study on Comparison of Core Stability in Individuals with Flexible Flat Foot and Normal Foot and conclude that Individuals with flexible flat foot have reduced core Stability.[3] Statistical significance was considered when p value was less than 0.05. The results from statistical analysis of the present study rejects the null hypothesis. There was an significant difference in Core muscle endurance in individuals with different foot posture in the age group of 18- 25 years. The reasons to the above findings are- changes in foot posture causes changes in the kinetic chain of the entire lower extremity upto the lumbar, pelvic and the hip region.

CONCLUSION

Individuals with altered foot posture will have an effect on the proximal segment through the kinetic chain phenomenon of the body, affecting the core endurance.

Individuals with altered foot posture have reduced core endurance.

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ORIGINAL RESEARCH PAPER

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INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

DAILY TRAVELLING AND LOW BACK PREVALANCE AMONG UNDERGRADUATE STUDENTS OF A SWARRNIM STARTUP AND INNOVATION UNIVERSITY GANDHINAGAR: A CROSS-SECTIONAL STUDY.

Physiotherapy

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ABSTRACT

Background: Low back pain (LBP) is considered the single leading cause of disability-related musculoskeletal conditions globally.Low Back Pain is a serious problem in all the develop countries and is one of the most displayed problem at health service. The prevalence of low back pain has been reported among many people especially when resulting from work related and occupational activities. 75-84% of the general population suffer from low back pain and among them, it is estimated that 5-10% of the people experience LBP resulting in severe morbidity, increased health care costs, sick leaves and individual suffering. **Result:** NPRS score >2 and ODI score >20 were considered positive for backpain patients and it has found that it is having prevalence of 59% in participants who travel frequently.Age group of 18-24 years having prevalence of 72% and age group 25-30 having 18%. **Methodology:** A sample of students will be taken in this survey from Swarrnim startup and innovation University Gandhinagar. All students who meet the inclusion criteria will be eligible to participate in the study. The data were recorded through the semi structured questionnaire. The questions include distance of travelling, posture during travelling, type of vehicle, duration of journey and intensity of pain were reported. An online, standardized, self-administrated questionnaire to be used for data collection. The questionnaire were in English language and had three sections. **Conclusions:** This study, conducted among young adult students of swarrnim start-up and Innovation University, Gandhinagar, revealed that youth those are travelling regularly more than 30 minutes a day are prone to developing LBP, which aligns with published Western literature. This study shows that there is 59 % of prevalence of low back pain in students who travels regularly.

KEYWORDS

Low back pain, Numerical pain rating scale, Oswetry disability scale

INTRODUCTION

Musculoskeletal conditions arise throughout an individual's life at various points of time. Out of the many problems suffered, low back pain is one of the most frequently reported conditions. Low back pain is defined as "pain and discomfort, localised below the costal margin and above the inferior gluteal folds, with or without leg pain" and can be categorized into 3 typesAcute, Sub-acute and Chronic. Acute low back pain is defined as an episode of pain persisting for less than 6 weeks; sub-acute as pain persisting between 6 and 12 weeks; chronic as pain persisting for 12 weeks or more.[1]

Low back pain (LBP) is considered the single leading cause of disability-related musculoskeletal conditions globally. [1]Low Back Pain is a serious problem in all the develop countries and is one of the most displayed problem at health service. Low Back Pain is not considered an illness but a syndrome. It is considered a syndrome because one of the factors causes Low Back Pain is lumbar overload (lumbar stress condition) [2]

What makes the complaint of low back pain so frustrating for physicians is that an estimated 85 percent of patients with isolated low back pain cannot be given a precise pathoanatomical diagnosis. What makes low back pain so frustrating for patients is that primary care and emergency physicians appear perplexed in the face of it. Discouraged patients seek guidance from surgeons and pain specialists or seek alternative treatments such as spinal manipulation and acupuncture when time is often all that is needed. Indeed, recovery is generally inevitable regardless of what is done. One study demonstrated that 90 percent of patients recover within two weeks of presentation. [3]

A broad differential should be maintained when seeing a patient with low back pain, and the physician should consider three distinct categories of pathology: mechanical, nonmechanical, and visceral disease. Mechanical causes of low back pain include lumbar strain or sprain (idiopathic), degenerative processes of discs and facets, herniated discs, spinal stenosis, osteoporotic compression fractures, traumatic fractures, and spondylolisthesis (defined as anterior displacement of a vertebra on the one beneath it).[4]

Nonmechanical causes include neoplastic diseases, Paget's disease of the bone, inflammatory arthritis (often associated with HLA-B27), and infections such as shingles, osteomyelitis, epidural abscess, and septic discitis. The visceral diseases presenting as low back pain include aortic aneurysm, pancreatitis, perforated ulcer, nephrolithiasis, pyelonephritis, perinephric abscess, retroperitoneal hematoma, and prostatitis.[5]

The prevalence of low back pain has been reported among many people especially when resulting from work related and occupational activities. [6-7]75-84% of the general population suffer from low back pain and among them, it is estimated that 5-10% of the people experience LBP resulting in severe morbidity, increased health care costs, sick leaves and individual suffering.[8-9] It is also one of the common reasons for a person to seek medical help.This pathology is manifested at patient with disability, unable patient to work and low quality of life.[10]

There is a link between LBP and some risk factors, including age, education, obesity, smoking, hereditary factors, prolonged standing, injury, stress, anxiety, depression, poor interpersonal relationships and lack of social support .[11] Men and women are equally reported to be affected by this condition. 50% of adults and 30% of adolescents are said to be affected at least once. [11] Of late, there has been rising incidence of LBP among many young adults and children, which is of concern. [12] Sports and physical activity is one of the main factors causing LBP. [13] It was also reported that children below 14 year of age who experienced LBP, got it in more severity before 25 years. [14] Other risk factors which contribute towards a LBP is obesity and a positive family history apart from depression, stress and anxiety.

It is more prevalent in female gender, daily smokers, heavy job holders and have direct impact on the quality of life .[15]The relationship of travelling, chair support during travelling, travelling posture and low back pain is present and need to be precisely identified.[15]

Treatment for nonspecific low back pain, Deyo and Weinstein recommend, is nonsteroidal anti-inflammatory drugs prescribed on a regular schedule rather than on an as-needed basis. For most patients, the best recommendation is a rapid return to normal activities without overdoing exercise or lifting. Bed rest does not increase the speed of recovery from acute low back pain and may inhibit healing, and should not be recommended. For patients with chronic low back pain, aerobic exercise with strengthening exercises of the back and legs appear to be beneficial.[16]

Considering that low back pain is an important factor in limiting physical and cognitive abilities, especially among college students, and that it is costly for the health services, a study of the prevalence, associated factors, and disability rate produced by low back pain among college going students is important, as this will produce health indicators for this population, enabling the prevention of related factors and reducing the impacts of low back pain.

METHODOLOGY

Study Design: A cross sectional study
Population: College going students of swarnim startup and inovation university.

Selection Criteria
Inclusion criteria:
- Age 16 to 30 years,
- Both female and male,
- Travel through any vehicle example: Bus, 2 wheelers and other vehiclek.

Exclusion criteria:
- Having recent injury to back,
- Patients with psychological problem,
- Not willing to participate.

Sampling Method: Convenient Sampling

Sample Size: 100

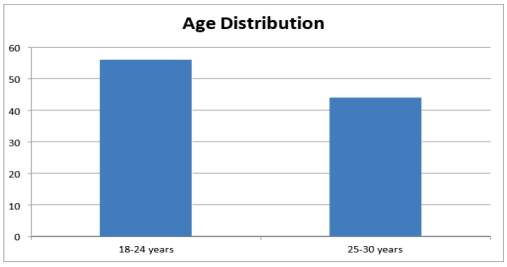
Outcome Measures :
1. NPRS (NUMERICAL PAIN RATING SCALE): This scale is for assessing the pain score of a patient.
2. ODI: Oswetery Disability Index : This scale is for assessing Functional ability
3. An online, standardized, self-administrated questionnaire
- A sample of students were taken in this survey from Swarrnim startup and innovation University Gandhinagar.
- All students who meet the inclusion criteria were eligible to participate in the study.
- The data were recorded through the semi structured questionnaire. The questions include distance of travelling, posture during travelling, type of vehicle, duration of journey and intensity of pain were reported.
- An online, standardized, self-administrated questionnaire to be used for data collection.
- The questionnaire were in English language and had three sections.
- Different sections of the questionnaire were adapted from the minimal dataset and the questionnaires that were validated and used in previous study.
- One to ten scoring to be used for questions reflecting the duration of current back pain, rating of pain intensity , number of episodes of LBP suffered during the past year, whether one feels tense or anxious, feeling depressed in the past year, perceptions of the likelihood that the current episode of LBP were become persistent and attitudinal questions such as 'physical activity worsens the pain', 'one should stop working if the pain increases in intensity', and 'one should not do work when currently suffering from pain'.

RESULTS
All statistical analysis was done using SPSS 25.0 software for windows. Descriptive analysis was used to obtain mean and standard deviations.

Demographic Data
AGE:
The research was performed on 100 participants between the age of 18-30. There were 56 patients between the ages of 18 to 24, 44 patients between the age 25 to 30.

Table1: Age Distribution

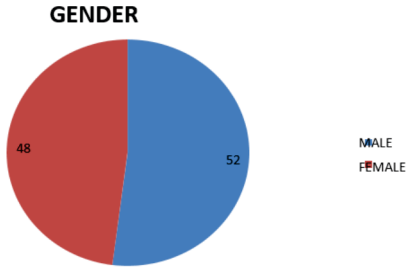
Age Distribution	
18-24 years	25-30 years
56	44



Graph 1: Age Distribution

Gender Distribution:
Table 2: Gender Distribution

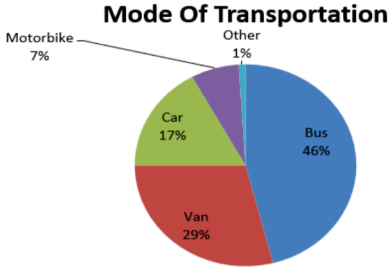
Gender Distribution	
Male	Female
52	48



Graph 2: Gender Distribution

Mode Of Transportation:
Table 3: Vehicle for travel.

Mode	Number	Percentage
Bus	46	46%
Van	29	29%
Car	17	17%
Motorbike	07	7%
Other	01	1%



Graph 3: Mode of transportation

Table 4: Distance for travel.

Distance	Number	Percentage
11-30 km	68	68%
31-50 km	25	25%
51-70 km	07	7%

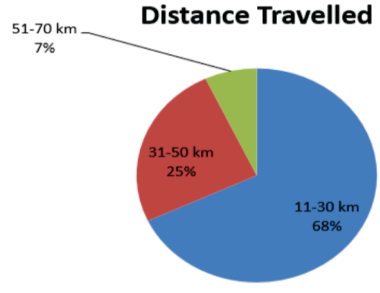


Chart: Distance Travelled

NPRS score >2 and ODI score > 20 were considered as a positive backpain patients from the given population and it has found that it is having prevalence of 59 % of back pain in participants who are traveling frequently.

Age group of 18-24 having prevalence of 72% and age group of 25-30 having prevalence of 18%.

Table 5: Mean value of NPRS and ODI

	Mean + SD
Age	23.25+4.46
NPRS	4.51+2.18
ODI	50.79 + 19.98

DISCUSSION

Various studies [1-3] reported that LBP is one of the most common causes of hospital visits and that it is the leading cause of activity limitations and work absences in many parts of the world. LBP poses a significant economic threat to the individual, family, workplace, and society. Initially considered to be a problem confined to developed countries, studies have now revealed an increasing prevalence in developing countries [15,16]. Although LBP can manifest at any age, LBP prevalence is the highest in the third decade of life [17]. LBP occurrence at an early age can cause disease progression, resulting in chronic LBP that has the potential to decrease an individual's quality of life [8]. Being a common health issue that affects all age groups, LBP and its risk factors have been evaluated by various authors internationally. However, data pertaining to the prevalence and risk factors for LBP in Indian subjects is scarce, particularly in young adults. This study, which included 1355 young adults, was unique as it not only examined LBP prevalence in young adults in swarnim startup and innovation university, Gandhinagar India,

According to Hestbaek et al. [18], the annual LBP prevalence in young adults is 32.4% compared with 59% annually, as observed in the current study. This study demonstrated that there is no sex predilection for LBP occurrence, which is consistent with several studies [19]. Furthermore, our results differ from those of Linton et al. [20] and Thomas et al. [21], which demonstrated a higher incidence in females and who also develop chronic backache compared with males. A meta-analysis by Hoy et al. [22] also showed an increased prevalence in females. Shiri et al.[23] conducted a meta-analysis and found that smokers have a higher prevalence and LBP incidence than non-smokers and that the pain is stronger in adolescents than in adults.

Static muscle load and flexion of the lumbar spine have been postulated as risk factors for LBP development; thus, prolonged sitting or sitting in an abnormal posture can aggravate LBP [25]. We found that posture while studying had no effect on LBP occurrence; however, the number of daily hours spent studying had a significant association with LBP.

With the increased sedentary life style, low back pain is getting common among adults as well as older people .it was observed in one study that the age of students did not mattered the younger students carried approximately the same as the oldeset one.studies on whole body vibration, as in travelling showed that unnatural posture or bad posture during travelling or work frequently adopted is the most of the people can be the source of low back pain.the truck drivers were observed in their sitting posture, frequency of such postures (bending,twisting,leaning).it was observed that such posture and other related activities were risk factors for developing of low back pain.

CONCLUSION

This study, conducted among young adult students of swarrnim start-up and Innovation University, Gandhinagar, revealed that youth those are travelling regularly more than 30 minutes a day are prone to developing LBP, which aligns with published Western literature. This study shows that there is 59 % of prevalence of low back pain in students who travels regularly.

Limitations

- Study was conducted in young adults.
- At the time of the study, these individuals often studied for long periods of time, which could be a major contributing factor to lbp occurrence. Thus, these subjects would have likely experienced high stress levels and monotony, which may have exacerbated lbp.
- Our study did not include sedentary lifestyle as a risk factor for lbp.
- this was a cross-sectional study, we could not assess LBP progression in these subjects

Future Recomendentions

Further studies are needed to evalute the possible risk factors for low back pain among students traveling from gandhinagar to swarnim university and other universities on regular basis, in order to implement forms of prevention and reduce the incidence, chronicity and impact on the individual's functionality.

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INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

"ASSOCIATION OF FORWARD HEAD POSTURE WITH PAIN AND CERVICAL RANGE OF MOTION IN DESK USERS"

Physiotherapy

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ABSTRACT

Background: Forward head posture afflicts a large percentage of population and can cause significant neck pain, the estimated 1-year incidence of neck pain ranges between 10.4 and 21.3%, and the overall prevalence of neck pain in general population can be as high as 86.8%. Strong evidence was found to relate neck pain with female gender, older age, being an ex-smoker, high job demands, and low social or work support. Regarding physical work factors, neck pain was significantly associated with holding the neck in a forward bent posture for a prolonged time and making repetitive movements. **Methodology:** Individuals selected according to inclusion/exclusion criteria and were explained regarding the study. Total 100 participants (Age 30 years and above) were included in the study. Subject were assessed for Forward Head Posture, Pain and Cervical ROM. **Result:** Association testing were done using pearsons Correlation method. Among a total of 100 office workers took part in the survey 73% were female. The mean age of participants was 39±8 years. Results shows Moderately positive Correlation of forward neck with reduction of ROM of Neck and moderately positive Correlation of Pain and forward head posture seen according to pearsons Correlation at the level of P<0.01. **Conclusion:** The present study demonstrated the Correlation of forward head posture with pain and cervical range of motion in desk users it shows moderately negative Correlation between pain and tragus to wall test and it shows positive Correlation between pain and cervical range of motion.

KEYWORDS

Forward Head Posture (FHP), Neck pain and disability scale (NPDS)

INTRODUCTION

Forward head posture (FHP) is the anterior positioning of the cervical spine, this posture is called as "text neck", "scholar's neck, "wearies neck", "reading neck". Forward head posture afflicts a large percentage of population and can cause significant neck pain, the estimated 1-year incidence of neck pain ranges between 10.4 and 21.3%, and the overall prevalence of neck pain in general population can be as high as 86.8%.[1]

Forward head posture (FHP) is the most common postural deformity seen in the sagittal plane. It can be defined as any alignment in which the external auditory meatus is positioned anterior to the plumb line through the shoulder joint. In FHP, head moves anteriorly and the peak of the increased cervical lordotic curve is a noticeable distance away from center of gravity.[2-3] FHP gradually leads to abnormal compression of zygapophyseal joint, posterior vertebral disks, narrowed intervertebral foramina and shortened posterior zygapophyseal joint capsule causing nerve root compression.[3]

The FHP could lead to muscle ischemia, muscle pain, fatigue, inflammation, reduced cervical range of motion and sometimes protrusion of nucleus pulpous, rotation of mandible which cause compression and irritation of retrodiscal pad. There are various methods to evaluate FHP but many studies have declared that Craniovertebral angle (CVA) is the best indicator to measure the FHP. CVA is measured by the angle between the imaginary line which passes through C7 and tragus and a horizontal line through C7.[4-5]

Neck pain is one of the very common musculoskeletal conditions in the general population. Neck pain can vary from a small discomfort to severe disabling pain making it one of the major health problems that carries important economic costs. Less severe neck pains occur due to poor posture, neck strains, occupational and sport injuries and mental state such as anxiety and depression, while mechanical and degenerative factors are more likely to develop chronic neck pain.[6]

Strong evidence was found to relate neck pain with female gender, older age, being an ex- smoker, high job demands, and low social or work support. Regarding physical work factors, neck pain was significantly associated with holding the neck in a forward bent posture for a prolonged time and making repetitive movements.[7] In addition, the increasing use of new information and communication technologies has led to an increase in time spent texting messages on mobile phones or using computers, which might have a long-term impact on neck pain, potentially due to prolonged periods of neck flexion.

The increasing use of new information and communication technologies has led to an increase in time spent texting messages on mobile phones or using computers, which might have a long-term impact on neck pain, potentially due to prolonged periods of neck flexion. Neck flexion may facilitate forward head posture (FHP), which refers to forward placement of the head in relation to the shoulder.[8] This is the most common cervical postural fault in the sagittal plane that is found with different severity levels in almost all populations. Greater FHP has been associated with greater deficits in cervical range of motion (ROM), particularly neck rotation and flexion.[9]

There exist several methods for the evaluation of the spinal posture i.e. radiography, 3D motion analysis via electromagnetic and optical tools, raster stereography, photographic postural analysis and in manual methods (Universal goniometer). Among which Universal goniometer has excellent reliability and is cost effective.

This change in posture can lead to a spatial change between the spine and the line of gravity, causing an overload on muscles and connective tissues[10]. Neck pain or neck dysfunction is a musculoskeletal disorder caused by improper posture with physical impairment or functional limitation. The FHP is known as an internal factor that causes dysfunction with shoulder and neck pain [11]. A FHP results in a posture in which the extended head and upper cervical, and the lower cervical vertebrae flex[12].

This increases the length of the external moment (the arm) by moving the gravitational center (the head) ahead of the load bearing axis [12]. The exposure to this constant load on the craniovertebral extension muscles and the noncontractile structures causes a change in the biomechanical movement, and this increased stress can cause musculoskeletal damage or pain [13]. In addition, FHP can also limit the functional movement in the head and neck area [14]. These limitations are caused by irregular rotation and gliding movement inside the articular capsule whilst moving the joint. Moreover, it was reported that extended periods of FHP can result in a decreased number of sarcomere, as well as shortening of the muscle fibers, which can affect muscular contraction.

With normal flexion of the cervical region, there is separation of the posterior structures with an increase of the intervertebral foramina [15] However, the altered mechanics associated with forward head posture may lead to excessive compression on the facet joints and posterior surfaces of the vertebral bodies[16]. in the forward head position, there is an overriding of the articular processes and narrowing of the

intervertebral space of the mid cervical region which approaches the relationship observed in cervical extension.

The use of computers has increased dramatically over the past decade in various offices so that staffs spend a lot of time sitting behind the computer. These rapid changes may be accompanied by increased prevalence of poor posture and resultant neck pain. FHP (forward head posture) and rounded shoulders are defined as protrusion of the head and shoulders in the sagittal plane.[17]

Early diagnosis of forward head posture will help to minimize the consequences. This study aims to investigate the incidence of forward head posture in desk users using Goniometer and its association with pain and range of motion of cervical spine.[18] The objective of this study is to find the percentage of forward head posture in desk users using Goniometer and to find the associated problems of forward head posture in desktop users on Neck Pain and Disability Scale and Cervical Range of Motion.

METHODOLOGY

Research Design: Observational Study

Study Population: 30 years and above.

Source of Data: Miscellaneous

Sample Size: 100 participants

Inclusion Criteria:
- Individuals who work for >3hrs/day on Desktop for 1 year.
- Both males and females age group 30 and above.

Exclusion Criteria:
- Cervical vertebrae fracture, Deformity of spine like scoliosis\kyphosis, Medical condition like vertigo, tumor in cervical region were excluded.

Materials:
- Consent form
- Goniometer
- Ruler scale
- Pen and pencil
- Mobile phone

Outcome Measures
- Neck Pain and Disability (NDI) Scale
- Cervical Range of Motion (ROM)
- TWT (Tragus to Wall Test)

Neck Pain and Disability Scale (NPDS):
- The NPDS is a 20-item measure that was specifically developed for patients with neck pain. It measures the intensity of pain; its interference with vocational, recreational, social, and functional aspects of living; and the extent of associated emotional factors. Patients responded to each item by marking along a 10-cm visual analogue scale. Item scores range from 0 to 5, and the total score is the sum of the item scores [possible range 0 (no pain)–100 (maximal pain)].
- High test - retest reliability is 0.93
- Time Required: 5 minutes

Cervical Range of Motion

Goniometers are the measuring tool to measure the range of motion in grades base on the landmarks. For example, goniometer are myrin goniometer, Spring-T goniometer and cervical range of motion instrument.

Procedure:

i) Cervical Flexion:
- Center fulcrum of the goniometer over the external auditory meatus.
- Align proximal arm so that it is either perpendicular or parallel to the ground.
- Align distal arm with the base of the nares.

ii) Cervical Extension:
- Center fulcrum of the goniometer over the external auditory meatus.
- Align proximal arm so that it is either perpendicular or parallel to the ground.
- Align distal arm with the base of the nares.

iii) Cervical Lateral Flexion:
- Center fulcrum of the goniometer over the spinous process of the C7 vertebra.
- Align proximal arm with the spinous processes of the thoracic vertebrae so that the arm is perpendicular to the ground.
- Align distal arm with the dorsal midline of the head, using the occipital protuberance for reference.

iv) Cervical Rotation:
- Center fulcrum of the goniometer over the center of the cranial aspect of the head.
- Align proximal arm parallel to an imaginary line between the left and right acromial processes.
- Align distal arm with the tip of the nose.

Tragus to Wall Test
- To objectively measure the cervical mobility of an individual.
- Shipe et al (2013) describe the measuring the tragus to wall distance (TWD) as: "the horizontal distance between the tragus, the auricular cartilaginous flap anterior to the external auditory meatus, and a wall
- The TWD can be measured as cued or relaxed, i.e the clinician prompts the individual to assume as close to an anatomical posture as possible e.g "Stand tall.", or the clinician measures the individual in their usual or presenting posture.
- The measurement can be done standing or sitting and it is worth documenting which position has been used.
- The TWD can be measured on both the individual's right and left, and then an average can be calculated.
- Reliability: In AS, test-retest correlations have been reported at between 0.93 and 0.95. Inter-tester reliability has also been reported as "excellent" in individuals with PD.
- Validity: In PD, the TWD has shown convergent validity with similar measures (occiput to wall status, C7 to wall distance, photographically derived trunk flexion angle, and inclinometric Thoracic Hyperkyphosis measure). It has also shown the ability to discriminate between groups (those who could touch occiput to wall when prompted to stand tall) and conditions (cued or relaxed).

Procedure Of The Study:

After getting approval from Institutional Ethical Committee (IEC)., individuals selected according to inclusion/exclusion criteria and were explained regarding the study. After explaining about the study, informed consent form were taken from the participants who were willing to participate in the study. Subject were assessed for Forward Head Posture, Pain and Cervical ROM.

RESULTS

All statistical analysis was done using SPSS 25.0 software for windows. Descriptive analysis was used to obtain mean and stanard deviations. Correlation testing were done using pearsons correlation method. Among a total of 100 office workers took part in the survey 73% were female. The mean age of participants was 39±8 years.

Descriptive Statistics:

Table 1: Mean Values and Standard Deviation

Variable	Mean	Standard Deviation	N
NPDS	22.4500	12.19155	100
TWD	9.4400	1.61633	100
FLEXION	70.9500	5.73026	100
EXTENSION	59.9700	6.40463	100
LSF	34.2400	7.22526	100
RSF	31.5000	7.51093	100
LR	68.1400	9.97676	100
RR	68.1800	10.68122	100

Table 2: Correlation of NPDS with TWD, Neck ROM parameters

NPDS	Correlation	TWD	Flexion	Extension	Side Flexion (Rt)	Side Flexion (Lt)	Rotation (Rt)	Rotation (Lt)
		-0.145	-0.009	0.190	0.004	-0.43	0.069	0.077
	Significance	0.149	-.926	0.058	0.967	0.670	0.498	0.444

Correlation between NPDS and TWD and Neck ROM parameters. The

correlations between NPDS and TWD were moderate negative significant correlation (r = -0.145, p = 0.149). The correlations between NPDS and NECK ROM is moderately positive correlation is seen. (Table 2).

Table 3: Correlation of TWD with NPDS, Neck ROM parameters

TWD	Correlation	NPDS	Flexion	Extension	Side Flexion (Rt)	Side Flexion (Lt)	Rotation (Rt)	Rotation (Lt)
		-0.145	- 0.013	0.145	-0.128	-0.084	0.016	0.017
	Significance	0.149	0.899	0.151	0.204	0.404	0.871	0.863

Correlation between TWD and NPDS and Neck ROM parameters. The correlations between NPDS and TWD were moderate negative significant correlation (r = -0.145, p = 0.149), The correlations between TWD and NECK ROM moderately positive correlation is seen. (Table 3)

Table 4: Correlation of Flexion ROM with NPDS & TWD

Flexion	Correlation	NPDS	TWD
		-.009	-.013
	Significance	.926	.899

Correlation of flexion ROM with NPDS & TWD. The moderately negative correlation between flexion ROM with NPDS and TWD were not significant. ®= -0.009, p= 0.926) (r= -0.013, p = 0.899) (Table 4)

Table 5: Correlation of Extension ROM with NPDS & TWD

Extension	Correlation	NPDS	TWD
		.190	.145
	Significance	.058	.151

Table 6: Correlation of Right-Side Flexion ROM with NPDS & TWD

Side Flexion (Rt)	Correlation	NPDS	TWD
		.004	-.128
	Significance	.967	.204

Table 7: Correlation of Left Side Flexion ROM with NPDS & TWD

Side Flexion (Lt)	Correlation	NPDS	TWD
		-.043	- .084
	Significance	.670	.404

Table 8: Correlation of Left Rotation with NPDS & TWD

Rotation (Lt)	Correlation	NPDS	TWD
		.077	.017
	Significance	.444	.863

Table 9: Correlation of Right Rotation with NPDS & TWD

Rotation (Rt)	Correlation	NPDS	TWD
		.069	.016
	Significance	.498	.871

Correlation between cervical Flexion TWD and NPDS and Neck ROM parameters. The correlations between NPDS and TWD with cervical ROM is moderate positive significant correlation The correlations between TWD and NECK ROM moderately positive correlation is seen. (Table 5 to 9).

Results shows Moderately positive correlation of forward neck with reduction of ROM of Neck and moderately positive correlation of Pain and forward head posture seen according to pearsons correlation at the level of P<0.01.

RESULTS DISCUSSION

The results of the present study show that among 100 office workers who was working with computers there is positive Correlation between NPDS, TWG and Neck ROM parameters. The correlations between NPDS and TWD were moderate negative significant correlation (r = -0.145, p = 0.149), The correlations between NPDS and Neck ROM is moderately positive correlation is seen.

There is also Correlation between cervical Flexion, TWD and NPDS and Neck ROM parameters The correlations between NPDS and TWD with cervical ROM is moderate positive significant correlation and the correlations between TWD and Neck ROM moderately positive correlation is seen. Results shows Moderately positive correlation of forward neck with reduction of ROM of Neck and moderately positive correlation of Pain and forward head posture seen according to pearsons correlation at the level of P<0.01.

One of study demonstrate that the prevalence of neck pain among Iranian office workers versus office workers in other countries almost is comparable so that it was reported 64% and 36.1% in sudan and sri lanka respectively [19]. Comparing comparison between the prevalence of shoulder pain among Iranian employees and employees of other countries shows that it is less common among Iranian office workers (9.3% versus 41 % and 34.3 % in Sudan and Sri Lanka respectively). In a survey on Chinese adolescents in 2008, the prevalence of forward head posture was reported as high as 25% [8]. In reviewing the literature, no data was found on the relationship between head and spinal posture during work and chronic neck pain. According to our study, office workers using computer had more forward head, kyphosis and rounded shoulder posture.[20]

The improper posture of head, cervical and thoracic spine was more common in the symptomatic group comparing the asymptomatic group during computer working that is equivalent to the results of mentioned cross-sectional studies that showed a significant relationship between individual's posture and neck pain.

Duration of computer use may have an impact on the incidence of neck pain. According to results of other cross-sectional studies, it was found that there is positive correlation between duration of sitting and neck pain prevalence. Another study showed that sitting behind desk for over 5 hours per day, is considered a risk factor for neck pain. Despite of these studies, in a systematic review, it was found that there is no significant correlation between duration of sitting and neck pain.

According to our study, there was no relationship between the duration of working with computer and neck pain (p = 0.322). In a prospective study with a 3-year follow-up by ariens et al on over 1,334 employees, it was observed that there is a strong relationship between duration of sitting in working hours and neck pain in such a way that if one is in sitting position for over 95% of his working hours, the probability of suffering from neck pain is increased (rr= 2.01%).

According to results of some studies, it was observed that FHP is more prevalent in women compared to men, while in present study it was seen that there is no difference in FHP prevalence in men and women. Another systematic review indicated that there is no correlation between participation in various sport and recreational exercises and neck pain. In a research by dimberg et al, it was found that taking part in rocket sport is a negative risk factor for neck pains . Of course, in our research on university office workers it was seen that they have no regular sport activity and a few of them may exercise a particular kind of sport at the weekends occasionally which was negligible and no positive or negative correlation was found in this regard. It needs further studies in the future. Another factor investigated in most previous studies is the relationship between driving and prevalence of neck and shoulder pain.

One of the study have revealed that office employees had a more improper posture while working with a computer versus sitting with forward looking (not a working) position, and that the defective posture in the working position was more severe in the symptomatic group. It may be due to poor ergonomics of chair, desk, computers position and also lack of attention paid to body position during work. Lack of awareness of posture while working among employees is important in causing improper posture of head and neck; so paying attention to head and neck posture during work might be a good way to decrease the poor posture. It can be introduced into the office environment by feedback methods, mirror or alarming instruments.

According to the results of Cagnie et al. study, it has been found that there is a positive correlation between duration of computer work and neck pain. Other studies that were published before 2000 showed that if duration of sitting at a desk is longer than 5 hours per day, it is considered as a risk factor for neck pain. In contrast to these findings, a systematic review of the 3 studies has found that there was no significant relationship between the duration of sitting and neck pain.[21,22]Based on our findings, there was no relationship between hours of work with a computer and neck pain (p = 0.322).

CONCLUSION

The present study demonstrated the Association of forward head posture with pain and cervical range of motion in desk users. It shows moderately negative correlation between pain and tragus to wall test and it shows positive correlation between pain and cervical range of motion.

Abbreviations

FHP: Forward Head Posture, NPRS: Numerical pain rating scale , VAS: Visual Analogue scale, CVA: Craniovertebral angle, NPDS: Neck pain and disability scale , ROM: Range of Motion, TWT: Tragus to wall test, TWD: Targus to wall distance

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"EVALUATION OF VALIDITY AND RELIABILITY OF THE GUJARATI VERSION OF KNEE INJURY AND OSTEOARTHRITIS OUTCOME SCORE (KOOS) IN KNEE PAIN PATIENTS"

Physiotherapy

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ABSTRACT

Background: The Knee injury and Osteoarthritis Outcome Score (KOOS) was originally developed in 1995 by Ewa M Roos and colleagues at the Departments of Orthopedics at Lund University in USA. Thus, the American-English and Swedish versions were developed simultaneously. Also, it has already been translated into many languages such as Hindi, Turkish, Indonesian, Spanish and Swedish. Translation of this scale into Gujarati can be more beneficial for Gujarati physiotherapist to find out better outcome. **Methodology:** The study was carried out on people aged 15 to 50 years in North Gujarat, India, those peoples who have knee pain.116 patients who fulfilled inclusion criteria were selected. Initially scale was translated to Gujarati by forward backward translation and patients were instructed to fill the scale at 1 week interval. Reliability and validity were found out. **Result:** The results of the study showed moderate to high correlation in components of The Knee Injury and Osteoarthritis Outcome Score (KOOS) Gujarati version (ICC= .851,0.835,0.814,0.891 and .977) (P<0.05) and internal consistency (cronbach's alpha = 0.868, 0.834, 0.814, 0.907 and 0.905). The Knee Injury and Osteoarthritis Outcome Score (KOOS) Gujarati version was content validated for idiomatic equivalence, semantic equivalence, content relevance. Face validity were established 100% as all participants answered the scale. For construct validity pearson correlation was done with lower extremity function scale and the pearson correlation value for all five component were -0.143 to 0.185. Correlation is significant at the 0.05 level. **Conclusion:** Gujarati version of the KOOS being a valid, reliable and responsive outcome measure in young patients having knee pain.

KEYWORDS

Knee Injuries and Osteoarthritis Outcome Score (KOOS), Reliability, Validity

INTRODUCTION

The knee is the largest joint in the body and it is a compound synovial joint. [1] The knee consists of two main joints: the femorotibial joint and the patellofemoral joint, which allow the knee to move in three different planes (sagittal, transverse, and frontal).

Patient-reported outcomes are an important element to evaluate the quality and the results of clinical practice as they directly and without any interpretation report a patient's health status.[2] Patients with ACL or meniscus injury have a higher than average risk of developing osteoarthritis, and about 50% have radiological signs of osteoarthritis 10-15 years after injury.

For the elderly population with knee osteoarthritis, well validated outcome measures exist-WOMAC-Western Ontario and McMaster Universities Arthritis Index. However, no outcome measure has been validated for use in younger or physically more active subjects with knee osteoarthritis. It may not be appropriate to use outcome measures assessing function as activities of daily living alone in younger and more active subjects with post traumatic osteoarthritis.

The Knee injury and Osteoarthritis Outcome Score (KOOS) was originally developed in 1995 by Ewa M Roos and colleagues at the Departments of Orthopedics at Lund University, Sweden and at the University of Vermont, USA.

Thus, the American-English and Swedish versions were developed simultaneously. It includes 42 items in 5 separately scored subscales; Pain, other Symptoms, Function in daily living (ADL), Function in Sport and Recreation (Sport/ Recreation), and knee-related Quality of Life (QOL).

The main reason for developing a single instrument with the purpose of covering several types of knee injury and including osteoarthritis (OA), was that traumatic knee injuries often causes concomitant damage to multiple structures (ligaments, menisci, cartilage, etc.) and frequently lead to the later development of OA.

The KOOS evaluates both short-term and long-term consequences of knee injury and include assessing pain; symptoms, such as swelling and restricted range of motion; activities of daily living; sport and recreation function; and knee-related quality of life in young and middle-aged subjects with ACL injury, meniscus injury, or posttraumatic osteoarthritis. The KOOS is self- administered and takes approximately 10 minutes to fill out as well as it is a feasible instrument.[3]

The Knee Injury and Osteoarthritis Outcome Score (KOOS) is one of the most commonly used scales that has been used by physical therapists worldwide. Also, it has already been translated into many languages such as Hindi, Turkish, Indonesian, Spanish and Swedish. Translation of this scale into Gujarati can be more beneficial for Gujarati physiotherapist to find out better outcome. So, there is a need to conduct this study.

METHODOLOGY

Study Design: A cross-sectional Study

Study Population: The study was carried out on people with knee pain in past 10 years from age group 15-50 Years in North Gujarat, India

Study Setting: Native Gujarati patients with knee pain in north Gujarat.

Sample size: 116

Sample Technique: Convenient sampling.

Inclusion criteria:

- Patients willing to participate.
- Both Male and Female
- Age: Between 15-50 years in north Gujarat
- Patient having knee pain with OA, RA and Meniscus injury and Ligament injury in past 10 years.
- Native Gujarati language and can able to read and write Gujarati.

Exclusion criteria:

- Patients having neurological disorders.
- Patient having musculoskeletal disorders other than OA, RA and Meniscus injury.
- Patients having visual problem that cannot be corrected by lenses.
- Non cooperative patients.

Figure 1: Flow Chart of the study Procedure

The Knee injury and osteoarthritis outcome score (KOOS) had been cross-culturally adapted into Gujarati version of Knee injury and osteoarthritis outcome score (KOOS) in following steps:

Step 1: Forward translation:
Two translators (one with the background of medical field and other with no background of medical field) who knew both English and Gujarati language were chosen to translate the questionnaire from English to Gujarati language.

Step 2: Synthesis:
Both the Gujarati versions were combined and two professionals who had knowledge of medical terminologies and were known to both the languages (English & Gujarati) developed a synthesized version.

Step 3: Back-translation:
The synthesized version of the questionnaire was back translated into English language by an independent translator, who knew both English and Gujarati language and had no information of the original questionnaire which was in English language.

Step 4: Expert panel:
A bilingual (in English and the Gujarati language) expert panel was convened which included the forward translator, health experts, as well as professionals with skill in questionnaire development and translation. The changes were done in the translated questionnaire based on the suggestions of the expert panel.

Step 5: Testing of the questionnaire:
A Pre Final Gujarati version of KOOS was given to participants who fulfilled the inclusion and exclusion criteria to find out the reliability and validity of the questionnaire.

Reliability Testing
Test-retest reliability:
The recruited patients with knee pain were asked to fill Gujarati version of Knee injury and osteoarthritis outcome score (KOOS) by themselves twice with minimum gap of one week duration. So that person may not copy the same data as well as he/she will not forgot. The readings were recorded to report test-retest reliability.

Internal consistency:
Internal consistency was measured with Cronbach's alpha (α), a statistic which was calculated from the pair wise correlations measured between paired readings of Gujarati version of Knee injury and osteoarthritis outcome score (KOOS).

Validity Testing
Construct Validity:
Convergent and divergent construct validity was determined by comparison of the administrations of the five subscales of the KOOS and the Lower extremity functional scale. It is expected the highest correlations when comparing the scales that are supposed to measure the same or similar constructs.

Content Validity:
Content equivalence was assessed under two headings: 1. Are the words in the translated Gujarati version of KOOS presented fluently and correctly as in the original version? 2. Do the words and phrase in the translated Gujarati version of KOOS have the same semantic meaning compared with the original version? For this answers from expert panel member's fall between "mostly agree" to "strong agree". This was assessed by an expert panel and they assessed the KOOS-G for content equivalence and content relevance on 5 point likert scale. Content relevance was evaluated by expert judges or panels: How the Gujarati version of KOOS statement is relevant to assess function in knee pain subjects? For this answers from expert panel members' fall between "mostly agree" to "strong agree".

Face Validity:
Face Validity was assessed by asking one question to each of the, 'Do you think this scale is relevant to your condition.' The answer was noted as 'yes' or 'no'. Face validity of the KOOS was established when all the patients questioned about the relevance of the scale to their condition.

RESULTS

All statistical analysis was done using SPSS 25.0 software for windows. Descriptive analysis was used to obtain mean and standard deviations. Reliability testing was done using **reliability analysis**. Inter class correlation coefficient, ICC (2,1) and cronbach's α were measured. Validity testing was done using **Pearson's correlation.** Confidence interval were set at 95%, p = 0.05 for all the analysis.

Age distribution:
The research was performed on 116 patients with knee pain between the age of 15-50. There were 46 patients between the ages of 15 to 30 and 70 patients between the age 31 to 50.

Gender distribution:
The research was performed on 116 patients with Knee pain. In which 55 are Females and 61 are Males.

Test-Retest Reliability:
Test-retest reliability (n=116) was tested by using the interclass correlation coefficient, ICC(2,1) and Internal consistency (n=116) was reported in terms of cronbach's α measured in two session after 1 week is reported.

Table 1: Test- Retest Reliability of Gujarati Version Knee Injury and Osteoarthritis Outcome Score (KOOS)

Knee injury and osteoarthritis outcome score (KOOS)	Session 1 (Mean)	session 2 (Mean)	Cronbach's alpha	ICC	P-value
Pain	19.34	17.22	.868	.851	0.01
Symptoms	14.67	14.29	.834	.835	0.01
Activities of daily living	34.88	36.47	.814	.814	0.04
Sport and recreation function	10.74	11.92	.907	.891	0.01
Knee-related quality of life	9.17	9.91	.905	.897	0.04

Face Validity:
Face validity of the KOOS G was established when all the 116 patients questioned about the relevance of the scale answered YES. i.e. 100%

Construct Validity:
Table 2: Correlation of Koos- G Pain and Lower Extremity Function Scale

PAINKOOS -G		LEFS
	PEARSON CORRELATION	0.023
	SIGNIFICANCE (2 Tailed)	0.804
	N	116

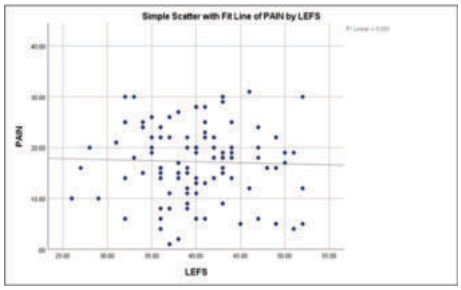

Figure 2: Correlation of KOOS- G Pain and Lower Extremity Function Scale

Table 3: Correlation of KOOS- G Symptoms and Lower Extremity Function Scale

SYMPTOMS KOOS -G		LEFS
	PEARSON CORRELATION	0.065
	SIGNIFICANCE (2 Tailed)	0.491
	N	116

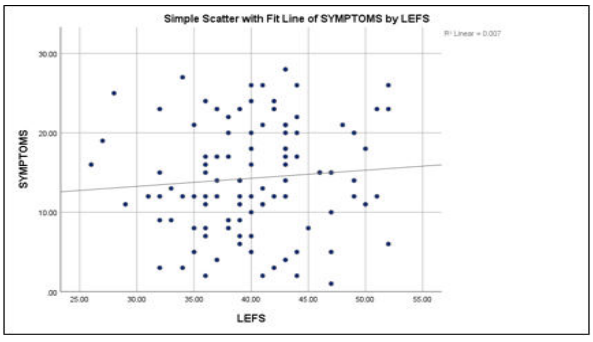

Figure 3: Correlation of KOOS- G Symptoms and Lower Extremity Function Scale

In convergent validity there was a positive correlation of ADL and sports with LEFS. There was a positive correlation between LEFS and PAIN (r=0.023) and between LEFS and SYMPTOMS (r=0.065). (Table 2 and 3)

Table 4: Correlation of Koos- G ADL and Lower Extremity Function Scale

ADL KOOS -G		LEFS
	PEARSON CORRELATION	-0.143
	SIGNIFICANCE (2 Tailed)	0.125
	N	116

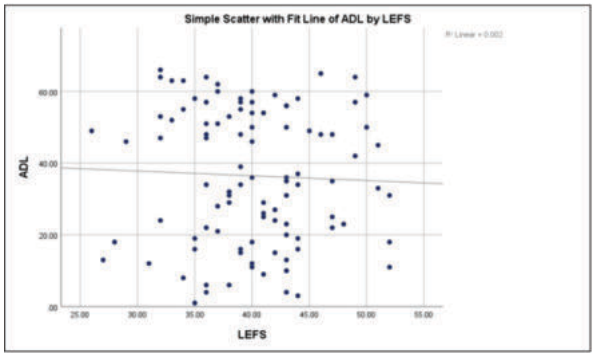

Figure 4: Correlation of Koos- G ADL and Lower Extremity Function Scale

Table 5: Correlation of Koos- G Sports and Lower Extremity Function Scale

SPORTS KOOS -G		LEFS
	PEARSON CORRELATION	-0.033
	SIGNIFICANCE (2 Tailed)	0.728
	N	116

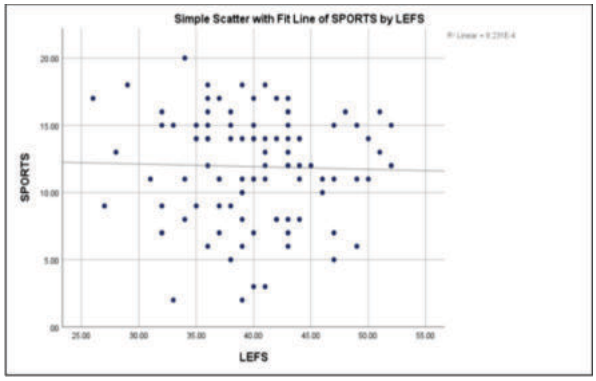

Figure 5: Correlation of Koos- G Sports and Lower Extremity Function Scale

In convergent validity there was a negative correlation of ADL and sports with LEFS. There was a positive correlation between LEFS and ADL (r= -0.143) and between LEFS and sports (r= -0.033). (Table 4 and 5)

Table 6: Correlation of Koos- G QOL and Lower Extremity Function Scale

QOL KOOS -G		LEFS
	PEARSON CORRELATION	0.185
	SIGNIFICANCE (2 Tailed)	0.046
	N	116

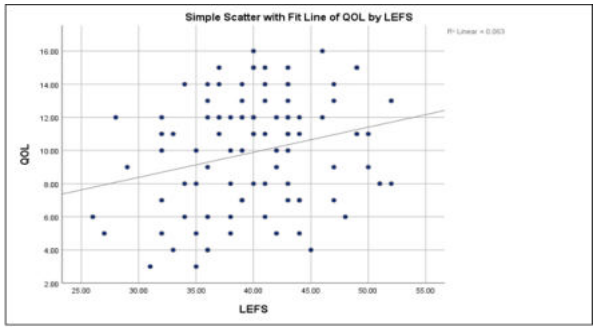

Figure 6: Correlation Of KOOS- G QOL and Lower Extremity Function Scale

In convergent validity there was a positive correlation of QOL with LEFS. There was a positive correlation between LEFS and ADL (r=0.185).

Content Validity:

The content validity of Gujarati translated knee injury and osteoarthritis outcome score (KOOS) by a 6 experts were found to be, I-CVI of individual items knee injury and osteoarthritis outcome score (KOOS) of ≥ 0.89 and overall S-CVI for idiomatic equivalence, semantic equivalence and content relevance ≥ 0.90. For content validity equivalence all 6 experts answers were located between mostly agree and strongly agree of Gujarati version of knee injury and osteoarthritis outcome score (KOOS).

Table 7: Content Validity of Gujarati Version Knee Injury and Osteoarthritis Outcome Score (KOOS)

Scale Component	I-CVI	S-CVI
Pain	0.89	0.918
Symptoms	0.94	
ADL	0.92	
Sports	0.92	
QOL	0.90	

DISCUSSION

This is a cross-sectional study of translation and measurement of psychometric properties of Gujarati version of Knee Injury and Osteoarthritis Outcome Score (KOOS) on patient with Knee pain.

In this study 116 patients participated. Gujarati version of The Knee Injury and Osteoarthritis Outcome Score (KOOS) was given twice with 1- week interval to measure the test- retest reliability and to validity. The results of the study showed moderate to high correlation in components of The Knee Injury and Osteoarthritis Outcome Score (KOOS) Gujarati version (ICC= .851,0.835,0.814,0.891 and .977) (P<0.05) and internal consistency (cronbach's alpha = 0.868, 0.834, 0.814, 0.907 and 0.905).

Both the internal consistency and the test-retest reliability results confirmed the reliability of the Gujarati version of the KOOS. We found that all the KOOS subscales on the Gujarati version have adequate internal consistency, with all Cronbach α values >0.70 (range, 0.86-0.90). These values are comparable to those for the Finnish version (Cronbach α range, 0.79-0.96) and the Malaysian version (Cronbach α range, 0.78-0.95). Our test-retest reliability analysis showed that the Gujarati version of the KOOS has excellent reliability, with all ICC values >0.90 (range, 0.91-0.99). Our results are similar to those for the Italian version (ICC range 0.85-0.95)

For content validity equivalence all 6 experts answer were located

between mostly agree and strongly agree of The Knee Injury and Osteoarthritis Outcome Score (KOOS) Gujarati version for idiomatic equivalence (average=0.89) semantic equivalence (average = 0.92) and content relevance (average= 0.93). Thus, The Knee Injury and Osteoarthritis Outcome Score (KOOS) Gujarati version was content validated for idiomatic equivalence, semantic equivalence, content relevance. Face validity were established 100% as all participants answered the scale.

For construct validity pearson correlation was done with lower extremity function scale and the pearson correlation value for all five component were -0.143 to 0.185. Correlation is significant at the 0.05 level.

In previous studies, interrater reliability and intrarater reliability of the The Knee Injury and Osteoarthritis Outcome Score (KOOS) of Turkish version were (ICC & cronbach's alpha = (0.839 and 0.904) respectively.[4]

In Indonesian version for the construct validity, moderate Pearson correlation coefficients were found between the KOOS subscales and the SF36. Cronbach α was 0.84 to 0.97 for all subscales, indicating adequate internal consistency. The test-retest reliability was excellent, with intraclass correlation coefficients ranging from 0.91 to 0.99 for all subscales.[5]

Swedish version of the scale was applied on the participants at 2 week intervals. Test-retest reliability. For the five subscales of the KOOS, the random effects intra class correlation coefficients (ICC) were: Pain 0.86, Symptoms 0.84, Activities of Daily Living (ADL) 0.91, Sport and Recreation Function 0.78, and for Knee-related Quality of Life (QOL) 0.83. Internal consistency, as measured by Cronbach's alpha, was for the subscale Pain 0.84, Symptoms 0.74, ADL 0.95, Sport/Rec 0.85, and for QOL 0.71 [6]

It was found The Knee Injury and Osteoarthritis Outcome Score (KOOS) Gujarati version items equivalent to those in original version which is intended by translators involve in this study. The results showed that it was translated this scale into other languages without losing psychometric properties of the original English version.

CONCLUSION

The present study demonstrated the Gujarati version of the KOOS being a valid, reliable and responsive outcome measure in patients having knee pain. The Gujarati KOOS can be applied as a patient-reported and disease specific instrument in future studies including Knee pain subjects in Gujarat.

Abbreviations

KOOS: Knee injury and Osteoarthritis Outcome Score, OA: Osteoarthritis, ICC: Inter class correlation, RA: Rheumatoid Arthritis, LEFS: Lower Extremity Function Scale, QOL: Quality of Life, S-CVI: Scale Level Content Validity Index, I-CVI: Item Level Content Validity Index

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INCIDENCE OF FLAT FOOT IN PLANTER FASCITIS AMONG GUJARAT STATE: AN OBSERVATIONAL STUDY

Physiotherapy

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ABSTRACT

Background: Flexible flatfoot is defined as the postural appearance of the foot, with depressed medial longitudinal arch and pronated subtalar joint and the calcaneus assuming a valgus position under weight bearing conditions. About 10% to 25% population exhibits a flatfoot to varying degrees. In clinical practice, some subjects become symptomatic with foot pain or lower extremity soreness and limitation in their functional activities such as limitation of long distance walking or running and high-impact sports. **Methodology:** Total 100 Subjects will be assessed on basis of following 2 tests and analysis will be done accordingly. First patients will diagnosed for plantar fasciitis with the help of windlass test and then they will be assessed for the flat foot with the help of Navicular drop test. **Result:** Out of 100 participants 68 participants showed increase in pronation of foot according to navicular drop test mean distance were 12.3mm distance more then 9mm can be considered as reduction in arch so the prevalence of flat foot is 68%. **Conclusions:** There is 68% of prevalence of flat foot in patient with plantar fasciitis.

KEYWORDS

Flat foot, Navicular drop test, Plantar fascitis

INTRODUCTION

Flexible flatfoot is defined as the postural appearance of the foot, with depressed medial longitudinal arch and pronated subtalar joint and the calcaneus assuming a valgus position under weight bearing conditions.[1] About 10% to 25% population exhibits a flatfoot to varying degrees.[2]In clinical practice, some subjects become symptomatic with foot pain or lower extremity soreness and limitation in their functional activities such as limitation of long distance walking or running and high-impact sports.

This is a foot with less developed longitudinal arches. Relevant anatomy: A normal foot has longitudinal and transverse arches. The longitudinal arch consists of medial and lateral components resting on a common pillar posteriorly - the tuberosity of the calcaneum. The talus is the keystone of the arches. It receives the body weight and transmits it to the arches below. Through the arches, the weight is transmitted to the ground via the tuberosity of the calcaneum and the heads of first and fifth metatarsals.[3] The integrity of the arches is maintained by the plantar ligaments, the plantar aponeurosis, the extrinsic and intrinsic muscles and the structure of the bones of the foot[4]

Anatomically, the major medial longitudinal arch is formed by the calcaneus, talus, and navicular; the medial, middle, and lateral cuneiforms in addition to the 1st, 2nd, 3rd metatarsals. In dynamic structures, the plantar fascia is essential to the maintenance of the medial longitudinal arch.[5] Kitaoka and associates demonstrated that the posterior tibial tendon owns significant influence as an arch stabilizer during in vitro studies.[5,6] The intrinsic musculature of the foot was also proven to have a significant role in dynamic arch maintenance.

In adult population,pesplanus foot type exist about 10–25% and has been related to musculoskeletal symptoms like back and knee jointpain.[7] Presence of an averted rear foot, lowered medial longitudinal arch (MLA),abducted and dorsi flexed mid foot are the characteristic feature of the flat foot.[8] The cause of pes planus depends on the direct effect between external and internal forces at the articular surfaces, supporting ligaments, joint capsules, extrinsic and intrinsic muscles .Fatigue, paralysis of the intrinsic muscles of the foot due to anaesthesia can also results in reduced height of the MLA[9].

There are few reports which indicate that, plantar fascia contributes in supporting the MLA along with flexor digitorum brevis and abductor hallucis muscles(ABH)[10,11]. There are reports that the paralysis of ABH lowers medial arch height because it is the active elevator of the MLA[12] . About 80% of the resistance for lowering of MLA is furnished by tension in the plantar fascia in the final stage of the swing [13] .Persons with pesplanus tend to develop plantar fasciitis and plantar fascia becomes thicker and rigid due to excessive load .In pesplanus, the altered nature of the plantar fascia is not well understood in the mid and forefoot area where it divides into digital slips, however there reports suggesting studies at its calcaneal attachment[14,15,16] . In the foot,after skeletal maturity if the medial longitudinal arch undergoes a complete or partial collapse then it is referred as flat foot according to foot and ankle specialists[17] .The prevalence of flat feet is not well established. Most of the studies on prevalence of flat foot were done on children below 10 year age.

Plantar fasciitis is the most common cause of the inferior heel pain and may affect up to 10% of running athletes It is associated with biomechanical factors such as pes cavus, foot pronation, heel valgus, sudden gain in body weight or obesity, increased running distance or intensity, shoes with poor cushioning, change in the walking or running surface, and tightness of the Achilles tendon.[18]

In one study, 83% of patients seen with plantar fasciitis were active, working adults ranging from twenty-five to sixty-four years of age^ Often referred to as painful heel syndrome or chronic plantar heel pain, this disorder is diagnosed on the basis of a history of pain on taking the first few steps in the morning,[19] worsening pain with weight-bearing, and pain and tenderness to palpation over the medial calcaneal tubercle'"\ Two large national datasets of ambulatory care data (excluding visits to podiatrists or federal, military, or Veterans Administration facilities) from the National Center for Health Statistics at the U.S. Centers for Disease Control and Prevention found that plantar fasciitis accounts for an average of one million patient visits per year to medical doctors'. Sixty-two percent of these visits were made to general medicine clinics, while 31% of patients were evaluated by orthopaedic or general surgeons.[20]

Study Design And Setting

Study Design: CROSS SECTIONAL STUDY
Population: Patients with plantar fasciitis
Sample Size: 100

Selection Criteria

Inclusion criteria:

- Age group between 20 to 40 years.
- Both genders– male and female.
- Subject willing to participate in study.
- Vendors with 6 to 8 hours of duty.

Exclusion criteria:

- Subject with any systemic illness and other musculoskeletal disorders specifically in lower limb like foot injuries, degenerative changes of hip and knee.

- Subject with any recent surgeries of lower limb.

MATERIALS REQUIRED

- Paper, Pen and Pencil
- Inch Tape
- Marker
- Step Stool

METHEDOLOGY

Subjects will be assessed on basis of following 2 tests and analysis will be done accordingly. First patients will diagnosed for plantar fasciitis with the help of windlass test and then they will be assessed for the flat foot with the help of Navicular drop test.

Windlass Test:

Maintaining the sitting position and then coming in standing position. In high sitting position, the ankle will be stabilized and the great toe will dorsi-flexed (no-weight bearing). In standing position, the subject will be asked to stand on toes of both the foot (weight bearing). In both the positions the subject will be asked if there is any unpleasant pain in the sole or heel of the foot. Both the plantar fascia passive stretching test and the windlass test (in non- weight bearing position) were supposed to be performed on the both the limbs (foot) simultaneously. If the subject will complain for any pain then the respective test will be marked positively and there will be no pain then the respective test will be marked negative.

Navicular drop test.

Purpose: To assess the height of navicular bone.
Test position: Standing
First mark the navicular tuberosity next measure the height of the navicular bone with the subtalar joint in neutral and the patient bearing most of the weight on the contralateral limb. Finally have the patient assume equal weight on both feet and re-measure the first and second measurement is the navicular drop. A difference of > 10mm is considered significant excessive foot pronation.

RESULTS

All statistical analysis was done using SPSS 25.0 software for windows. Descriptive analysis was used to obtain mean and standard deviations.

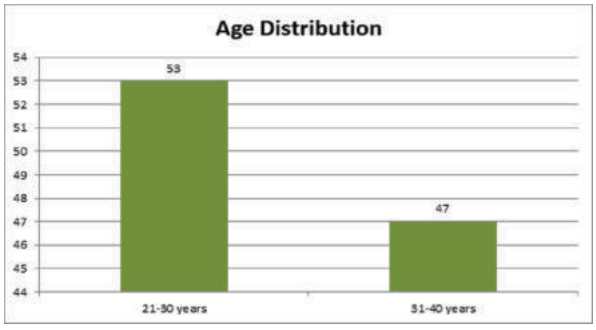
Demographic Data

AGE:

The research was performed on 100 participants between the age of 20-40. There were 53 patients between the ages of 20 to 30, 47 patients between the age 31to 40.

Table 1: Age Distribution

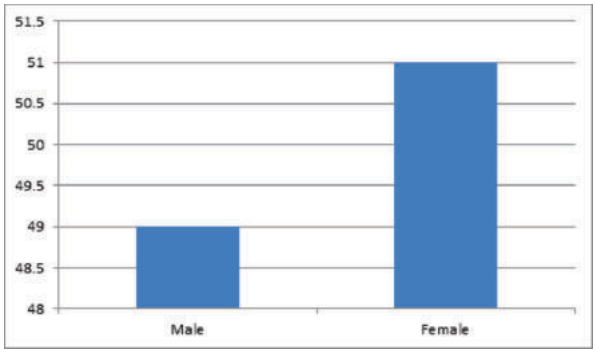
Age Distribution	
21-30 years	31-40 years
53	47



Graph 1: Age Distribution

Gender Distribution:

The research was performed on 100 participants between the age of 20-40. There were 49 Male participants and 51 female participants.



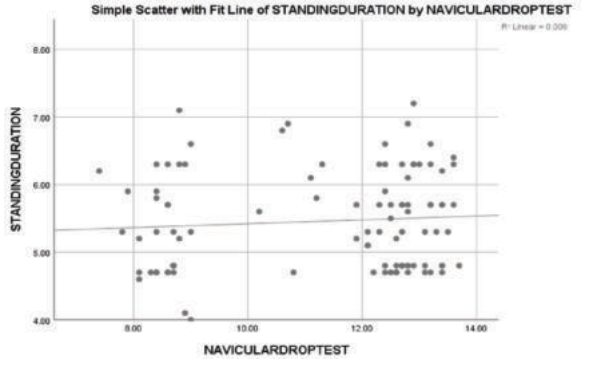
Graph 2: Gender Distribution

Table 2: Mean Value Of Fpi & Standing Duration

	Mean + SD
Age	27.8+4.6
Navicular drop test	12.3+5.2 mm
Standing Duration	5.8+ 0.8 hours

Table 3: Incidence Of Flatfoot Using Navicular Drop Test

Test Name	Positive	Negative
Windlass test	100	0
Navicular drop test	68	32



Graph 3 : Corelation Between Standing Duration And Flat Foot

Out of 100 participants 68 participants showed increase in pronation of foot according to navicular drop test mean distance were 12.3mm distance more then 9mm can be considered as reduction in arch so the prevalence of flat foot is 68% it also shows positive correlation between standing duration and flat foot.

DISCUSSION

Flatfoot is a biomechanical disorder frequently seen in clinical practice. one study reveals that the prevalence of flat foot was 26.62%.

Described finding is practically identical to a study conducted in Japan on a sample of 242 women and 98 men, in which a prevalence of 26.5% was observed, along with how said finding is related with obesity and the effects of pain and functionality . Similar findings regarding the prevalence of flat foot can be found in other publications. In other population studies (Springfield, Massachusetts) the prevalence of flat foot was 19.0% (20.1% in females and 17.2% in males) . Another study conducted in the Boston area found a prevalence of 20% in women 17% in men. There are even studies, conducted in a diabetic population on a sample of 230 patients, which refer to a prevalence as high as 37%

The present study was performed on 100 participants between the age of 20-40. There were 53 patients between the ages of 20 to 30, 47 patients between the age 31to 40. It was having mean Navicular drop test score of 12.3±5.2 mm and mean standing hours were 5.8±0.8 hours and they show positive correlation of standing hours with flat foot. Prevalence of flat foot among plantar fasciitis is 68%.

Previous studies of plantar fasciitis have found that up to 10% of the population is affected during their lifetime^ and over one million Americans per year' have this condition. The incidence rate of plantar fasciitis in our population was 10.5 per 1000 person-years, with a rate of 9.2 for men and 18.0 for women per 1000 person-years. Although we are aware of no known studies in the literature with incidence rates, prevalence rates of plantar fasciitis ranging between 4% and 22% have been reported among a population of runners.

Another study conducted in India reveals how the use of footwear at early ages, along with obesity and ligamentous laxity, increases the prevalence of flat foot

Another study conducted in Nigeria on 560 children aged between six and 12 years shows that although in the univariate analysis an association was found with type of footwear and age, after taking both into consideration, only age remained as a variable associated the presence of flat foot . Urban residence as a risk factor for the prevalence of flat foot has also been described in a study conducted on children in the Congo, where, after studying 1,851 footprints from 906 girls and 945 boys aged between three and 12 years, it was observed that prevalence diminishes with age, is higher in urban areas and in the masculine sex, and that the use of footwear has little influence on said prevalence . This study shows how the BMI, comorbidity and foot size are associated with the prevalence of flat foot. There are variability in the literature review. A number of studies describe how this foot disorder increases with age , other studies describe how flat foot diminishes with age, after adjusting for other covariates , and others indicate that neither age, gender nor BMI are related with flat foot.

Also in another study, the prevalence of flat foot was assessed where in it was found that real prevalence of symptomatic flatfoot is not very high in adolescents due to its nature of spontaneous correction as age increasesAlso in another study, the prevalence of flat foot was assessed where in it was found that real prevalence of symptomatic flatfoot is not very high in adolescents due to its nature of spontaneous correction as age increases [18,19]. According to age, the subjects between age 20-29 years were suffering 31.8% of flat foot, 30-39 years were having 42% flat foot, 40-49 years were having 16.7% flat foot, above 50 years were having 37.5% flat foot. similarly subjects between age 20-29 years were suffering 47.7% of high arched foot, 30-39 years were having 50% high arched foot, 40-49 years were having 61.1% high arched foot, above 50 years were having 50 % high arched foot.

According to gender it was found that high arched foot had higher incidences in males (55.2%) whereas flat feet were found to have higher incidences in females (38.7%).

A number of studies also describe different radiological findings in the morphology of the foot according to different ethnic groups. Others indicate how the different radiological morphology (angle of the talus with the first metatarsal) is related with the symptomatic presence or absence of flat foot. Even though obesity has repeatedly been associated with the presence of flat foot , not all studies point towards this association . In some articles, not only is the association of flat foot with characteristics (e.g., age, sex, BMI and concomitant illness) indicated, but also as a modifier of health . Thus, there are studies of 97,279 military recruits which associate flat foot with localised knee pain . As we have previously mentioned, in the article which finds a prevalence of flat foot identical that in our study it can also be seen how said alteration is also associated with the presence of pain and fatigue in women.

CONCLUSION

This study, conducted among adults of Gujarat state, revealed that youth those are having plantar fasciitis prone to developing flat foot, which aligns with published Western literature. This study shows that there is 68 % of prevalence of flat foot in adults who had plantar fasciitis. this study also suggest standing duration was positively correlated with pronation of foot in persons with plantar fasciitis.

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EFFICACY OF HIGH INTENSITY LASER THERAPY IN BACK PAIN: AN EVIDENCE BASED STUDY

Physiotherapy

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ABSTRACT

Background: Back pain is the leading cause of activity limitation and work absence throughout much of the world, and it causes an enormous economic burden on individuals, families, communities, industry and governments. High Intensity Laser Therapy (HILT) has photochemistry effects that stimulate oxidation of mitochondria and ATP creation by delivering high energy output inside tissues. HILT can cause quick absorption of edema and removal of exudates through increased metabolism and blood circulation. Although many nonsurgical treatments for chronic back pain have been introduced so far, there is a paucity of research on HILT. **Methodology:** This Evidence based study was conducted from 2011 to 2023. Search engines used to find appropriate articles were: PubMed, Google Scholar, PEDro, ResearchGate, ScienceDirect. Key words used were: Back pain, HILT, High Intensity Laser Therapy, Laser Therapy. Articles were assessed via 2 scales: Centre for Evidence-Based Medicine's (CEBM's) Levels of Evidence and PEDro scale. **Result:** Total 136 articles were found, out of which 15 articles were relevant and from those 9 articles were included in this evidence-based study. From total 9 studies, there is 2 Systematic review and meta-analysis, 1 Systematic review, 3 Randomized controlled trials and 2 Comparative studies. Their Level of evidence was 1a, 1b and 2a. **Conclusions:** High intensity laser therapy can be considered a complimentary modality for effective management of low back pain to improve pain and function. When compared or combined with other modalities such as ultrasound and tens it improves pain and function more efficiently.

KEYWORDS

Back Pain, HILT, High Intensity Laser Therapy , Laser Therapy

INTRODUCTION

Low back pain is the leading cause of activity limitation and work absence throughout much of the world, and it causes an enormous economic burden on individuals, families, communities, industry and governments. Until 10 years ago, it was largely thought of as a problem confined to Western countries; however, since that time an increasing amount of research has demonstrated that low back pain is also a major problem in low and middle income countries.

Studies suggest that low back pain may arise from any one of a number of anatomical structures, including bones, intervertebral discs, joints, ligaments, muscles, neural structures and blood vessels. In a minority of instances, approximately 5–15%, low back pain can be attributed to a specific cause such as an osteoporotic fracture, neoplasm or infection .[1] For the remaining 85–95% of cases, the specific cause of low back pain is unclear.

The search for causes of low back pain continues through causal inference, which is a process whereby several criteria are examined to assess causation. These include assessment of bias and confounding; demonstrating a temporal relationship (i.e., the cause must precede the effect); plausibility; consistency with other studies; the strength of the association (i.e., the relative risk); the dose– response relationship (i.e., does increased exposure lead to increased effect); and reversibility (i.e., does removal of the exposure reduce the disease risk)[2]. Due to methodological heterogeneity in studies that have investigated causation of low back pain, it is difficult to draw any conclusions about causality.

Many studies have significant bias and confounding and relatively few cohort studies have been conducted. It has also been difficult to determine a temporal relationship between risk factors and low back pain (e.g., depression and low back pain), and it has been difficult to quantify exposure variables (e.g., in the occupational setting: the frequency/amount of lifting).[3]

There are a number of psychosocial factors associated with low back pain, including stress, anxiety, depression and certain types of pain behaviour; however, the direction for these relationships is often unclear. Evidence shows that psychosocial factors are also significantly associated with the transition from acute to chronic low back pain. Psychosocial workplace factors have also been shown to be important risk factors for low back pain. In two systematic reviews, it was found that job dissatisfaction, monotonous tasks, poor work relations, lack of social support in the workplace, demands, stress and perceived ability were associated with an increased occurrence of low back pain. Job dissatisfaction has also been shown to be associated with transition from acute to chronic low back pain.[4]

Other occupational factors have been shown to be associated with low back pain. One study demonstrated a clear correlation between physical demands of work and the prevalence of low back pain (with the exception of lifetime prevalence in female workers). They found the point prevalence of low back pain was 39% in manual workers, but only 18.3% in male sedentary workers. More recently, a systematic review found that manual handling, bending, twisting and whole-body vibration are risk factors for low back pain. Although the data on occupational risk in low-income countries are relatively limited, it has been estimated that 80–90% of the population in these areas are involved in 'heavy work', which suggests this may have a significant impact on the occurrence of low back pain.[5]

More recently, the pulsed neodymium-doped yttrium aluminium garnet (Nd:YAG) laser, a form of high-intensity laser therapy (HILT), was introduced to the field of physical therapy. This laser works with high peak power (3 kW), and a wavelength of 1,064 nm, and is considered to be a nonpainful and noninvasive therapeutic modality. It is able to stimulate areas that are difficult to reach with the low-power laser, such as the large and/or deep joints . The use of the pulsed Nd:YAG laser has been increasing, with patients reporting significant pain reduction. Studies have documented the anti-inflammatory, anti-oedematous, and analgesic effects of the Nd:YAG laser, justifying its use in patients with pain issues.

High Intensity Laser Therapy (HILT) has photochemistry effects that stimulate oxidation of mitochondria and ATP creation by delivering high energy output inside tissues. HILT can cause quick absorption of edema and removal of exudates through increased metabolism and blood circulation. Although many nonsurgical treatments for chronic back pain have been introduced so far, there is a paucity of research on HILT.[6]

METHODOLOGY

Study Design:

An Evidence Based Study. This was conducted according to PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-analysis) guidelines. (Figure 1).

Literature Search:

A specified literature search was performed from 2011 to 2023 (12 years). Literature was searched using following search engines: Google Scholar, PEDro, PubMed, ResearchGate, ScienceDirect

KEY WORDS USED FOR THE SEARCH WERE:
Back Pain, HILT, High Intensity Laser Therapy, Laser Therapy

ASSESSMENT OF METHODOLOGICAL QUALITY:
Data was assessed using 2 parameters: (1) Centre for Evidence-Based Medicine's (CEBM's) Levels of Evidence and (2) PEDro scale

1. The CEBM Levels of Evidence scale: It assesses quality based on study design, which categorize the studies in a scale ranging from 1 to 5 with further subdivision for each

2. The PEDro scale: It assesses methodological quality and consists of a checklist of 11criteria, 10 of which are scored. For each criterion the study met, 1 point was awarded. The points were presented as a score out of 10. For this review, investigations with PEDro scores of 6 to 10 were considered high quality, of 4 to 5 were considered moderate quality, and of 0 to 3 were considered low quality.

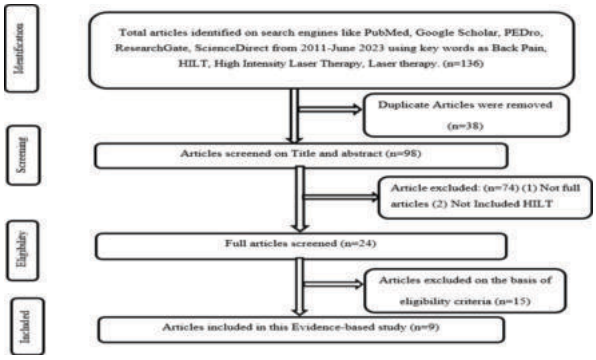

Figure 1: Preferred Reporting Items For Systematic Reviews And Meta-analysis (PRISMA)

Table 1: Characteristics Of Included Studies

Sr No.	TITLE	Study design & Duration	Articles Or Sample Size	Pedro And Level Of Evidence
1	The effectiveness of high intensity laser therapy in management of spinal disorders	Systemic review and meta-analysis	6	1a
2	The effectiveness of laser therapy on the management of chronic low back pain	Systemic review	397	1a
3	Effectiveness of high intensity laser therapy in the treatment of musculoskeletal disorders	Systemic review meta-analysis of randomized controlled trial	12 studies selected including 736 participants	1a
4	Short-term effect of high intensity laser therapy versus ultrasound therapy in treatment of low back pain	A randomized controlled trial	30	8/10 1b
5	Comparison of two different electrotherapy methods in low back pain treatment	Comparative study	40	5/10 2a
6	Long-term effect of high –intensity laser therapy in the treatment of patients with chronic low back pain	A randomized blinded placebo-controlled trial	72	5/10 2a
7	Effect of high intensity laser therapy on pain and function of patients with chronic back pain	Comparative study	20	3/10 2b
8	Comparison of high intensity laser therapy and combination of transcutaneous nerve stimulation and ultrasound treatment in patients with chronic lumbar radiculopathy	A randomized single-blinded study	54	5/10 2a
9	Laser photo biomodulation is more effective than ultrasound therapy in patients with chronic non-specific low back pain	Comparative study	45	4/10 2a

RESULTS
Evidences were reviewed and analysis was done on the basis of PEDro score and CEBM's Level of Evidence Scale. Risk of bias is also assessed.

Total 136 articles were found, out of which 15 articles were relevant and from those 9 articles were included in this evidence-based study and other articles were excluded.

From total 9 studies, there is 3 meta-analysis and systematic reviews, 3 comparative study, 3 Randomized controlled trial. All studies shown that High Intensity Laser Therapy is effective in management of Low back pain.

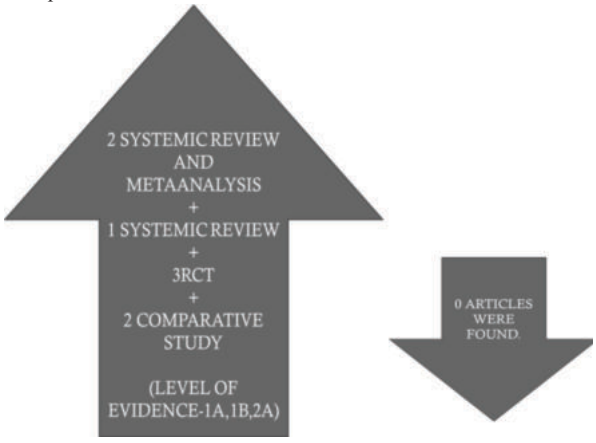

Figure 2: Result of Evidence Based Study

DISCUSSION
This evidence-based study included total 9 studies, there is 2 Systematic review and meta-analysis, 1 Systematic review, 3 Randomized controlled trials and 2 Comparative studies.

Laser treatment is noninvasive, painless, and can be easily administered in primary care settings for a wide range of conditions [7]. It has been reported that the use of laser therapy significantly reduces pain levels in both acute and chronic conditions such as rheumatoid arthritis, chronic osteoarthritis, carpal tunnel syndrome, fibromyalgia, knee injury, shoulder pain, and postoperative pain [8]. Although low level laser therapy does not elevate tissue temperatures more than a few degrees [9], studies have found that the treatment has the potential to reduce inflammation, pain and improve function [10]. Low level laser therapy significantly increases microcirculation, activates angiogenesis, and stimulates immunological processes and nerve regeneration. Moreover, it has an analgesic effect through stimulating an increased production of endorphins. More recently, the pulsed neodymium-doped yttrium aluminum garnet (Nd:YAG) laser, a form of high-intensity laser therapy (HILT), was introduced to the field of physical therapy. This laser works with high peak power (3 kW), and a wavelength of 1,064 nm, and is considered to be a nonpainful and noninvasive therapeutic modality. It is able to stimulate areas that are difficult to reach with the low-power laser, such as the large and/or deep joints. The use of the pulsed Nd:YAG laser has been increasing, with patients reporting significant pain reduction [37]. Studies have documented the anti-inflammatory, anti-oedematous, and analgesic effects of the Nd:YAG laser, justifying its use in patients with pain issues [11].

HILT has been known to reduce heat accumulation in tissues and to have photothermal and photochemical effects in deep tissues for limited periods.[12] These properties favor treatment of deep tissues and structures by increasing cell metabolism, vascular permeability, and blood flow.[13] The pain control effect achieved by HILT might be attributed to multiple mechanisms. In the central nervous system, the secretion of endogenous opioids such as b-endorphins is increased by

laser therapy and these could centrally inhibit pain sensations.[14] In the peripheral nervous system, substance P sensitizes pain transmitting neurons and leads to hyperalgesia; however, laser therapy has been reported to decrease the secretion of substance P by peripheral receptors.[15] Laser therapy might increase the latency and decrease the conduction velocity of sensory nerves by inhibiting Ae- and C-fiber transmission; these in turn may decrease the transmission of pain signals.[16] In tissues, laser therapy may also reduce the release of histamine and bradykinin in injured tissues and increase the pain threshold.[17] These multiple actions of laser therapy may represent the underlying mechanisms involved in the control the pain in MSD. In addition, a decrease in pain sensation has a significant effect on the increase of range of motion and the quality of life of the patient.[18] Thus, functional ability in patients with MSD could also be also improved.

According to the Arndt-Schulz principle, excessive energy delivered to tissues may produce adverse effects to the human body [19]. There was no definite HILT protocol existing for the treatment of spinal disorders, with the frequency of sessions as well as the duration of study varying between studies; one session daily was given for patients for one week [20], for two weeks, three weeks or two sessions/week for 4–6 weeks [21]. The current systematic review showed variation in laser source, wavelength, power, fluency, radiant exposure, application area, energy and time delivered to patients. Furthermore, there were variations in terms of treatment protocol, frequency and duration. All these variations may explain the heterogeneity in the meta-analysis. Some studies used the term intensity or the power density, that is the power per unit area, which may considered as incorrect terminology used to describe the laser type [22]. There is no definite limit to differentiate between LLLT and HILT. In addition, the term intensity does not distinguish between the radiant exitance (emitted light) from the energy density of irradiance, which is the irradiated light arriving that depends on the beam area (light exit) [23]. Such a term may lead to confusion and may be an improper laser description or title. Therefore, future studies should use such terms with caution.

CONCLUSION

High intensity laser therapy can be considered a complimentary modality for effective management of low back pain to improve pain and function. When compared or combined with other modalities such as ultrasound and tens it improves pain and function more efficiently.

Conflict Of Interest:
There Is No Conflict Of Interest.

Abbreviations

LBP: Low back pain, CNSLBP: Chronic Non-specific Low back pain, PEDro: Physiotherapy Evidence Database, CINAHL: Cumulative Index Of Nursing And Allied Health Literature, CEBM: Center Of Evidence Based Medicine, TENS: Transcutaneous Electrical Nerve Stimulation, US: Ultrasound, IFT: Interferential Therapy, HMP: Hot Moist Pack, VAS: Visual Analogue Scale, NPRS: Numeric Pain Rating Scale, ODI: Oswestry Disability Index, MODI: Modified Oswestry Disability Index, PPA: Pain Pressure Algometer, BDI: Back Depression Inventory, RMQ: Ronald Morris Questionnaire, MPQ: Mcgill Pain Questionnaire, RCT: Randomized Controlled Trial, SWD: Short Wave Diathermy, ROM: Range of Motion

Ethical Approval

Ethical approval was not required.

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CORRELATION BETWEEN CORE MUSCLE ENDURANCE AND FOOT POSTURE IN COLLEGE GOING STUDENTS: AN OBSERVATIONAL STUDY

Physiotherapy

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ABSTRACT

Background: Proper posture is considered to be a state of musculoskeletal balance that involves A minimal amount of Stress or strain to the body.it Compromises balance because of muscular Imbalance which can cause loss Of Proprioception sense in joint and decreased Balance, and trunk endurance is significantly Reduced in Reduced in forward head posture and may lead to poor muscular Control of the spine. **Aim:** To Determine the Correlation between core muscle endurance and foot posture in college Going Students. **Methodology:** An observational study Was conducted in 50 College Going Students of Ahmedabad and Convient Sampling was used. Age group 18-25 Year students Chek for Core Muscle Endurance Test and Foot Posture Analysis. The statistical evaluation become accomplished with SPSS version 29-2022, September. **Result:** Our Finding Suggest that from Descriptive analysis of data was expressed in mean and Standard Deviation for various parameters. Correlation were expressed in term of R value and P Value. P value less than 0.05 was considered to be Signifcant. **Conclusion:** Individuals with altered foot posture will have an effect on the Proximal segment through the Kinetic chain phenomenon of the body, Affecting the core endurance. Individuals with altered Foot posture have reduced core endurance.

KEYWORDS

Core Muscle,Foot Posture,College Students,Endurance

INTRODUCTION

Foot posture plays an important role in the quality of daily living.[1]The structure of the feet is such that it permits the functions of both the stability and the mobility depending on the tasks which are imposed on it.[1]

Kinetic Chain & Core

Core stability can be defined as the ability of the Lumbopelvic-Hip Complex to prevent buckling of the Vertebral Column and return it to equilibrium following perturbation by using Strength, Endurance and Motor Control in a functional manner through all the planes of motion and action despite changes in the center of gravity.[2]

Need Of Study:

1)The foot posture is important for provide stable base of support during walking, running and jumping.
2)Proximal stability is needed for distal mobility.
3)So the core provide proximal stability to perform proper distal component mobility. The affection in
4)proximal core muscle may be lead to distal component changes and visa versa.

Aims Of The Study:

To find out the Correlation between core muscle endurance and foot posture in college Going students.

OBJECTIVES:

1)To find out the Correlation between core muscle endurance and foot posture in college going students by using Flexor endurance test & FPI.
2)To find out the Correlation between core muscle endurance and foot posture in college going students by using Extensor endurance test & FPI.
3)To find out the Correlation between core muscle endurance and foot posture in college going students by using Rt. Side plank endurance test & FPI.
4)To find out the Correlation between core muscle endurance and foot posture in college going students by using Lt. Side plank endurance test & FPI.

Null hypothesis:

There is no significant Correlation between core muscle endurance and foot posture in college going students.

Alternate Hypothesis:

There is significant Correlation between core muscle endurance and foot posture in college going students. and foot posture in college going students.

MATERIAL

Pen, paper, pencil
Foot posture index questionnaire
Stop watch
Plinth or high level bed

METHODOLOGY

Sample Size: 50

Sampling Design : Convient sampling

Study Design: An observational study

Setting: Ahmedabad

Population: Age group between 18 to 25 years

Procedure

- Selection
- Fifty subjects with the age group between 18 to 25 years participate in this study.
- Core Endurance :
- 60 degree flexion endurance test,
- trunk extensor endurance test,
- Right side plank test
- left side plank test.
- Time noted in sec.
- Foot posture:
- Foot posture index.

Flexor Endurance Test Position

Extensor Endurance Test Position

Lt. & Rt. Side Plank Endurance Test Position

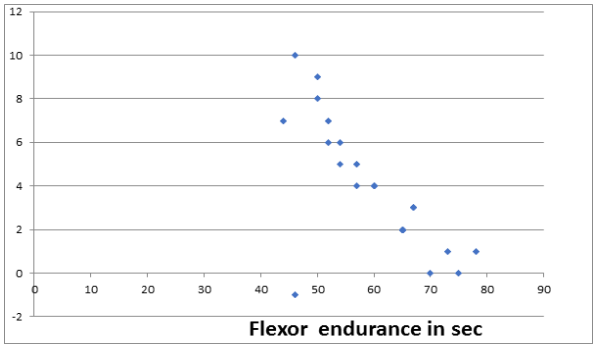
RESULTS

Descriptive analysis of data was expressed in mean and standard deviation for various parameters.Correlation were expressed in term of r value and P value.P value less than 0.05 was considered to be significant

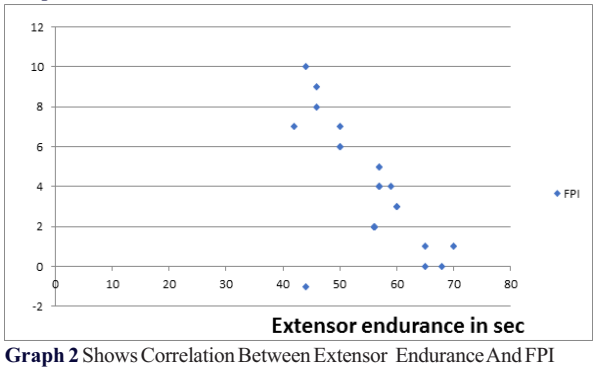
The graphical representation was done by scatter graph.

Table 1 : Descriptive Analysis

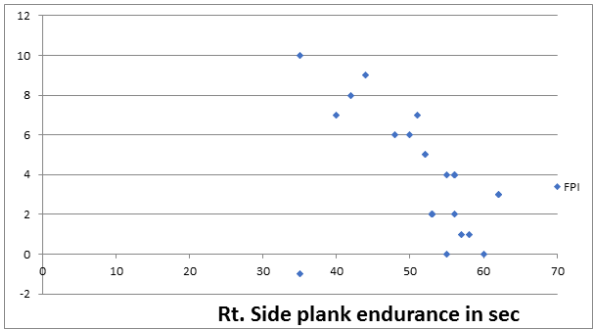
	MEAN	STANDARD DEVIATION
Age	22.34	1.7333
Flexor endurance test	60.1	9.2609
Extensor endurance test	55.34	7.3640
Rt. Side plank test	51.78	7.3326
Lt. side plank test	49.08	6.7698
Foot posture Index	3.78	2.8734



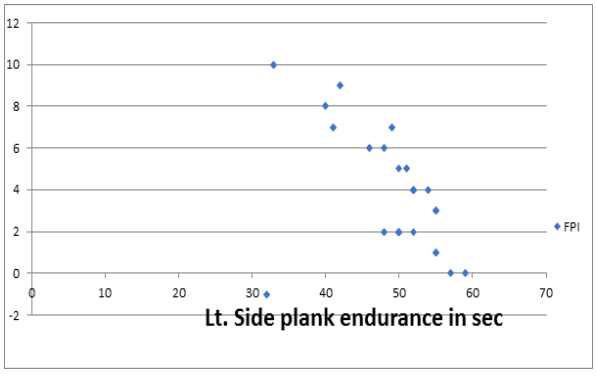
Graph 1 Shows Correlation Between Flexor Endurance And FPI



Graph 2 Shows Correlation Between Extensor Endurance And FPI



Graph 3 Shows Correlation Between Rt. Side Plank Endurance And FPI



Graph 4 Shows Correlation Between Lt. Side Plank Endurance And FPI

Table 2: Correlation Between Core Endurance & Foot Posture

Variables	r value	P value	
Flexor endurance test & FPI	-0.7231	0.04	significant
Extensor endurance test & FPI	-0.6734	0.03	significant
Rt. Side plank test & FPI	-0.5098	0.005	significant
Lt. side plank test & FPI	-0.5037	0.005	significant

RESULTS

Result shows there is a negative correlation between core endurance timing and foot posture index scoring.

DISCUSSION

The Purpose Of the Study find out correlation between core muscle endurance and foot posture in college going students. The Presents Study Suggest that changes in foot posture causes changes in the kinetic chain of the entire lower extremity upto the lumbar, pelvic and the hip region. Dr. Anvita Telang at el, Conducted study on Comparison of Core Stability in Individuals with Flexible Flat Foot and Normal Foot and conclude that Individuals with flexible flat foot have reduced core Stability.[3] Statistical significance was considered when p value was less than 0.05. The results from statistical analysis of the present study rejects the null hypothesis. There was an significant difference in Core muscle endurance in individuals with different foot posture in the age group of 18- 25 years. The reasons to the above findings are- changes in foot posture causes changes in the kinetic chain of the entire lower extremity upto the lumbar, pelvic and the hip region.

CONCLUSION

Individuals with altered foot posture will have an effect on the proximal segment through the kinetic chain phenomenon of the body, affecting the core endurance.

Individuals with altered foot posture have reduced core endurance.

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ORIGINAL RESEARCH PAPER
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COMPARISON BETWEEN AEROBIC EXERCISE AND DEEP BREATHING EXERCISE WITH POSITIVE EXPIRATORY PRESSURE BREATHING EXERCISE IN POST CABG PATIENT IN RECOVERY PHASE.

Cardiology

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ABSTRACT

Background: Coronary artery bypass graft (CABG) Surgery is Known to induce significant muscle wasting. Thus, vast no of patients is facing reduces endurance after surgery with the help of this study. The resultant significant treatment can be beneficial to help vast no of patients with endurance problems. **Methodology:** Participants' subjects meeting inclusion criteria will be included in the study. The sample will be initially selected then randomly divided into 2 groups, group A and group B Treatment with aerobic exercise group A n=30 patients. Treatment with deep breathing exercise with positive expiratory pressure breathing exercise group B n=30 patients. consent form will be signed by both groups. **Result:** The research was performed on 60 participants between the age of 35-65 years. There were group(A) 30 patients between age 35-55, group(B) 30 patients between age 35-60. The statistical software SPSS 25.0 version was used to analyze the data. Before taking statistical data, outcome measure by the six-minute walk test. All outcome measures were analyzed using suitable statistical analysis at baseline and after (4to8) weeks of intervention level ofsignificance was kept at 95% changes in the outcome measures were analyzed within group as well as between. **Conclusions:** Aerobic exercise is better than deep breathing exercise with positive expiratory pressure breathing exercise in post CABG patients in recovery phase.

KEYWORDS

Aerobic exercise, CABG, Deep breathing exercise, spirometry, positive expiratory pressure breathing (PEEP)

INTRODUCTION-

It is a surgical procedure in which the chest is opened, and surgery is performed on the heart. The term "open" refers to the chest, not to the heart itself. Two types of cardiac surgery are closed and open-heart surgery. (1) (2) The heart is a muscular organ that pumps blood throughout the circulatory system. It is situated between two lungs in the mediastinum. It is made up of four chambers, right atrium, right ventricle, left atrium, left ventricle. Heart beats 72/min. CABG (coronary artery bypass grafting) is done when there is multiple severe coronary stenosis associated with unstable or uncontrolled angina. CABG is a surgical procedure used to treat coronary artery disease. The blocked or narrowed coronary arteries are simply bypassed, replacing the blocked portion of the coronary artery with a piece of patent blood vessels taken from any other less sensitive area of the body. Such vascular grafts may be pieces of a vein taken from the legs or mammary artery in the chest. One end of the graft is attached above the blockage and the other end is attached below the blockage through the new graft to reach the heart muscle. CABG can also be performed off pump and on pump. (3)(4)(5) Aerobic exercise is submaximal, rhythmic, repetitive exercise of large muscle groups, during which the needed energy is supplied by inspired oxygen. Aerobic exercise training is augmentation of the energy utilization of the muscles by means of an exercise program. The improvement of the muscles ability to use energy is a direct result of increased levels of oxidative enzymes in the muscles, increased mitochondrial density and size and an increased muscle fiber capillary supply. Training is dependent on exercise of sufficient intensity, duration, and frequency. Training produced cardiovascular and /or muscular adaptation and is reflected in an individual's endurance. Aerobic exercise is any type of cardiac conditioning. It can include activities like brisk walking, swimming, running, or cycling. Aerobic exercise can be effective in increasing endurance of cardio-respiratory system by improving stroke volume at rest, lowering resting heart rate, lowering blood pressure, aerobic exercise is critical component of cardiac rehabilitation following cardiac rehabilitation.

Aerobic exercise traditionally commenced two to six weeks following hospital discharge and most commonly includes stationary cycling or treadmill walking. (6)(7)(8) INTRODUCTION 4 Deep breathing exercise is a fundamental intervention for the prevention or comprehensive management of impairments related to acute or chronic pulmonary disorders and Post Surgical patients. Deep breathing exercises come in many forms including diaphragmatic, breathing, segmental breathing, inspiratory resistance training incentive spirometry, pursed-lip breathing. (9) When the diaphragm is functioning effectively in its role as the primary muscles of inspiration, ventilation is efficient and the oxygen consumption of the muscle of ventilation is low during relaxed (tidal) breathing. When a patient relies substantially on the accessory muscles of inspiration the mechanical work of breathing (oxygen consumption) increases and the efficiency of ventilation decreases. Although at an involuntary level, a patient with primary or secondary pulmonary dysfunction can be taught how to control breathing by optimal use of the diaphragm and decreased use of accessory muscles. Diaphragmatic breathing is designed to improve the efficiency of ventilation, decrease the work of breathing, increase the excursion (descent or ascent) of the diaphragm, and improve gas exchange and oxygenation. (10) (11). Pursed-lip breathing is a strategy that involves lightly pursing the lips together during controlled exhalation. Many therapists breathing and controlled expiration is a useful procedure, particularly to relieve dyspnea if it is performed appropriately. Pursed-lip breathing decreases the respiratory rate and the work of breathing (oxygen consumption), increases the tidal volume, and improves exercise tolerance. (12)

Positive expiratory pressures breathing is a technique in which resistance to airflow is applied during exhalation, similar to what occurs during pursed-lip breathing, except that the patient breathes through a specially designed mouthpiece or mask that controls resistance to airflow. This breathing technique is used to hold airways open during exhalation to mobilize accumulated secretions and improve their clearance. Positive expiratory pressure breathing provides an alternative or adjunct to postural drainage which a patient can perform independently. (13) Following coronary artery bypass graft (CABG), the main cause of postoperative morbidity and mortality are postoperative pulmonary complications, respiratory dysfunction, and arterial hypoxemia. Incentive spirometry is a treatment technique that uses a mechanical device (an incentive spirometry) to reduce such pulmonary INTRODUCTION 5 complications during postoperative care. An incentive spirometry is a device that measures the volume of the air inhales into the lungs during inspiration when breathing in through an incentive spirometry, a piston rises inside the device and measures the volume of the inspired air. Here we used flow-oriented incentive spirometry (Tri-flow device) has three chambers with one ball in each chamber capacity up to 1200ml. (14) (15) (16) The 6-minute walk test (6-MWT) is an assessment that a

doctor may use to determine a person's exercise tolerance. It may be useful for measuring the functional ability and fitness of people with certain health conditions. (17) The Borg rating of perceived exertion (RPE) scale is an objective reassure of fatigue. This scale can also be used to monitor exercise intensity. (18)

METHODOLOGY

Study Design And Setting

Study Design: Comparative Study

Source Of Data: Zydus Hospital, and Trisha Heart Care and Physiotherapy center.

Population: Post CABG Patients in Recovery Phase.

Sampling Method: Random Sampling (fish bowel method)

Sample Size: 60 Patients (Treatment with Aerobic Exercise n=30 Patients, Treatment with Deep Breathing exercise With Positive expiratory pressure breathing exercise n=30 Patients)

Duration Of the Study: One Year.

MATERIAL & TOOLS USED:

Paper Pen
Assessment sheet Consent Form Incentive spirometry
Positive expiratory pressure breathing device. Cycle ergometer
Stopwatch Pulse oximeter
Blood pressure instrument

DATA COLLECTION PROCEDURE:

Participants who were meeting the inclusion and exclusion criteria have been selected for the study followed by the signature of participants on their consent form. The sampling was done randomly followed by convenient allocation within 2 groups: group A and group B. Treatment of aerobic exercise was given to the participants of group A (n=30 patients). Treatment of deep breathing exercise with positive expiratory pressure breathing exercise was given to the subjects of group B (n=30 patients).

GROUP-A

Treatment with aerobic exercise:

Figure-3 Cycle Ergometer

Group- B

Treatment with diaphragmatic breathing procedure:

Figure-4 Treatment with diaphragmatic breathing procedure

Pursed lip breathing procedure:

Figure-5 Pursed lip breathing procedure

Incentive Spirometry Procedure

Figure-6 Incentive spirometry procedure

Positive Expiratory Pressure Breathing Procedure:

Figure-7 Positive Expiratory Pressure Breathing Procedure

Outcome Measures

6-minute Walk Test:

Figure-8 *6-minute Walk Test*

RESULT

Table -1 Age Distribution

Demographic Details	Group- A	Group - B
AGE	35-55	35-60
NUMBERS	30	30

Table-2 Gender Distribution

GENDER	GROUP-A	GROUP-B	TOTAL
MALE	15	15	30
FEMALE	15	15	30
TOTAL	30	30	60

Table-3 Pre-treatment

	Group-A		Group-B		P-value
6MWD	MEAN	SD	MEAN	SD	
	367	43.5	322	49.2	>0.05

Table-4 MWD (Six Minute Walk Distance) Pre And Post

Group	PRE		POST		P - Value
	MEAN	SD	MEAN	SD	
GROUP - A	367	43	383	37.7	< 0.05
GROUP - B	322	50	332	47.3	> 0.05

Table-5 Comparison Between Group A- B

GROUP	MEAN	SD	P- Value
GROUP - A	367	43.13	
GROUP - B	322	49.2	<0.05

CASE STUDY

Worldwide approximately 400,000 people have undergone CABG in 2021-2022. Thus, vast numbers of patients are facing reduced endurance after surgery. With the help of this study, the resultant significant treatment can be beneficial to help vast number of patients with endurance problem. (4)(5)(6)

CONCLUSIONS

According to this study, Aerobic exercise is better than deep breathing exercise with positive expiratory pressure breathing exercise in post CABG patients in recovery phase. SUMMARY This study compared aerobic exercise and deep breathing exercise with positive expiratory pressure breathing exercise in post CABG patients in recovery phase. They were randomly allocated into groups or outcome was measured pre and post after 4 to 8 weeks of intervention. Both treatments were significantly effective in post CABG patients in the recovery phase but, more effective was in group A.

Limitations Limited age group may be applicable to larger age group. Limited sample size. Before recovery phase further study done with different age group geriatric group population. Future recommendation Further study can be done with large sample size. Study can be done with long term follow up.

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INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

INCIDENCE OF FLAT FOOT IN PLANTER FASCITIS AMONG GUJARAT STATE: AN OBSERVATIONAL STUDY

Physiotherapy

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ABSTRACT

Background: Flexible flatfoot is defined as the postural appearance of the foot, with depressed medial longitudinal arch and pronated subtalar joint and the calcaneus assuming a valgus position under weight bearing conditions. About 10% to 25% population exhibits a flatfoot to varying degrees. In clinical practice, some subjects become symptomatic with foot pain or lower extremity soreness and limitation in their functional activities such as limitation of long distance walking or running and high-impact sports. **Methodology:** Total 100 Subjects will be assessed on basis of following 2 tests and analysis will be done accordingly. First patients will diagnosed for plantar fasciitis with the help of windlass test and then they will be assessed for the flat foot with the help of Navicular drop test. **Result:** Out of 100 participants 68 participants showed increase in pronation of foot according to navicular drop test mean distance were 12.3mm distance more then 9mm can be considered as reduction in arch so the prevalence of flat foot is 68%. **Conclusions:** There is 68% of prevalence of flat foot in patient with plantar fasciitis.

KEYWORDS

Flat foot, Navicular drop test, Plantar fascitis

INTRODUCTION

Flexible flatfoot is defined as the postural appearance of the foot, with depressed medial longitudinal arch and pronated subtalar joint and the calcaneus assuming a valgus position under weight bearing conditions.[1] About 10% to 25% population exhibits a flatfoot to varying degrees.[2]In clinical practice, some subjects become symptomatic with foot pain or lower extremity soreness and limitation in their functional activities such as limitation of long distance walking or running and high-impact sports.

This is a foot with less developed longitudinal arches. Relevant anatomy: A normal foot has longitudinal and transverse arches. The longitudinal arch consists of medial and lateral components resting on a common pillar posteriorly - the tuberosity of the calcaneum. The talus is the keystone of the arches. It receives the body weight and transmits it to the arches below. Through the arches, the weight is transmitted to the ground via the tuberosity of the calcaneum and the heads of first and fifth metatarsals.[3] The integrity of the arches is maintained by the plantar ligaments, the plantar aponeurosis, the extrinsic and intrinsic muscles and the structure of the bones of the foot[4]

Anatomically, the major medial longitudinal arch is formed by the calcaneus, talus, and navicular; the medial, middle, and lateral cuneiforms in addition to the 1st, 2nd, 3rd metatarsals. In dynamic structures, the plantar fascia is essential to the maintenance of the medial longitudinal arch.[5] Kitaoka and associates demonstrated that the posterior tibial tendon owns significant influence as an arch stabilizer during in vitro studies.[5,6] The intrinsic musculature of the foot was also proven to have a significant role in dynamic arch maintenance.

In adult population,pesplanus foot type exist about 10–25% and has been related to musculoskeletal symptoms like back and knee jointpain.[7] Presence of an averted rear foot, lowered medial longitudinal arch (MLA),abducted and dorsi flexed mid foot are the characteristic feature of the flat foot.[8] The cause of pes planus depends on the direct effect between external and internal forces at the articular surfaces, supporting ligaments, joint capsules, extrinsic and intrinsic muscles .Fatigue, paralysis of the intrinsic muscles of the foot due to anaesthesia can also results in reduced height of the MLA[9].

There are few reports which indicate that, plantar fascia contributes in supporting the MLA along with flexor digitorum brevis and abductor hallucis muscles(ABH)[10,11]. There are reports that the paralysis of ABH lowers medial arch height because it is the active elevator of the MLA[12] . About 80% of the resistance for lowering of MLA is furnished by tension in the plantar fascia in the final stage of the swing [13] .Persons with pesplanus tend to develop plantar fasciitis and plantar fascia becomes thicker and rigid due to excessive load .In pesplanus, the altered nature of the plantar fascia is not well understood in the mid and forefoot area where it divides into digital slips, however there reports suggesting studies at its calcaneal attachment[14,15,16] . In the foot,after skeletal maturity if the medial longitudinal arch undergoes a complete or partial collapse then it is referred as flat foot according to foot and ankle specialists[17] .The prevalence of flat feet is not well established. Most of the studies on prevalence of flat foot were done on children below 10 year age.

Plantar fasciitis is the most common cause of the inferior heel pain and may affect up to 10% of running athletes It is associated with biomechanical factors such as pes cavus, foot pronation, heel valgus, sudden gain in body weight or obesity, increased running distance or intensity, shoes with poor cushioning, change in the walking or running surface, and tightness of the Achilles tendon.[18]

In one study, 83% of patients seen with plantar fasciitis were active, working adults ranging from twenty-five to sixty-four years of age^ Often referred to as painful heel syndrome or chronic plantar heel pain, this disorder is diagnosed on the basis of a history of pain on taking the first few steps in the morning,[19] worsening pain with weight-bearing, and pain and tenderness to palpation over the medial calcaneal tubercle'"\ Two large national datasets of ambulatory care data (excluding visits to podiatrists or federal, military, or Veterans Administration facilities) from the National Center for Health Statistics at the U.S. Centers for Disease Control and Prevention found that plantar fasciitis accounts for an average of one million patient visits per year to medical doctors'. Sixty-two percent of these visits were made to general medicine clinics, while 31% of patients were evaluated by orthopaedic or general surgeons.[20]

Study Design And Setting

Study Design: CROSS SECTIONAL STUDY
Population: Patients with plantar fasciitis
Sample Size: 100

Selection Criteria

Inclusion criteria:

- Age group between 20 to 40 years.
- Both genders– male and female.
- Subject willing to participate in study.
- Vendors with 6 to 8 hours of duty.

Exclusion criteria:

- Subject with any systemic illness and other musculoskeletal disorders specifically in lower limb like foot injuries, degenerative changes of hip and knee.

- Subject with any recent surgeries of lower limb.

MATERIALS REQUIRED

- Paper, Pen and Pencil
- Inch Tape
- Marker
- Step Stool

METHEDOLOGY

Subjects will be assessed on basis of following 2 tests and analysis will be done accordingly. First patients will diagnosed for plantar fasciitis with the help of windlass test and then they will be assessed for the flat foot with the help of Navicular drop test.

Windlass Test:

Maintaining the sitting position and then coming in standing position. In high sitting position, the ankle will be stabilized and the great toe will dorsi-flexed (no-weight bearing). In standing position, the subject will be asked to stand on toes of both the foot (weight bearing). In both the positions the subject will be asked if there is any unpleasant pain in the sole or heel of the foot. Both the plantar fascia passive stretching test and the windlass test (in non- weight bearing position) were supposed to be performed on the both the limbs (foot) simultaneously. If the subject will complain for any pain then the respective test will be marked positively and there will be no pain then the respective test will be marked negative.

Navicular drop test.

Purpose: To assess the height of navicular bone.
Test position: Standing
First mark the navicular tuberosity next measure the height of the navicular bone with the subtalar joint in neutral and the patient bearing most of the weight on the contralateral limb. Finally have the patient assume equal weight on both feet and re-measure the first and second measurement is the navicular drop. A difference of > 10mm is considered significant excessive foot pronation.

RESULTS

All statistical analysis was done using SPSS 25.0 software for windows. Descriptive analysis was used to obtain mean and standard deviations.

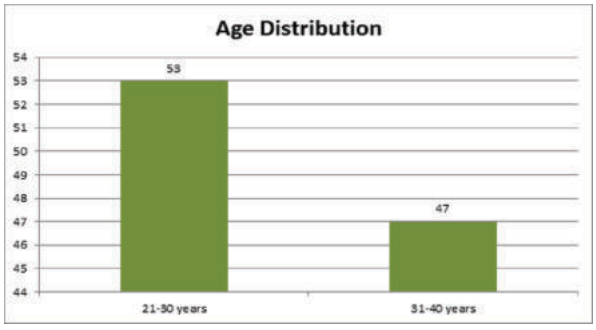
Demographic Data

AGE:

The research was performed on 100 participants between the age of 20-40. There were 53 patients between the ages of 20 to 30, 47 patients between the age 31to 40.

Table 1: Age Distribution

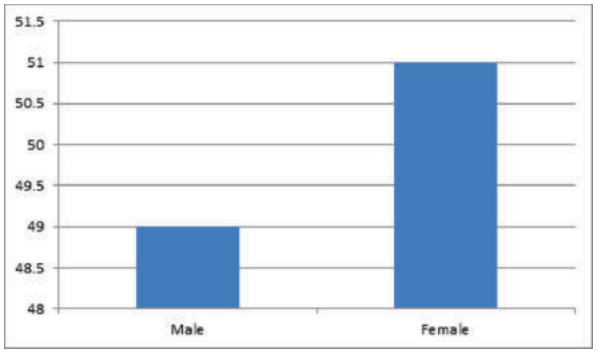
Age Distribution	
21-30 years	31-40 years
53	47



Graph 1: Age Distribution

Gender Distribution:

The research was performed on 100 participants between the age of 20-40. There were 49 Male participants and 51 female participants.



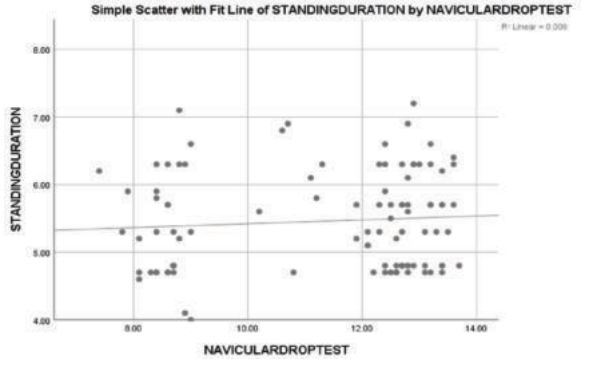
Graph 2: Gender Distribution

Table 2: Mean Value Of Fpi & Standing Duration

	Mean + SD
Age	27.8+4.6
Navicular drop test	12.3+5.2 mm
Standing Duration	5.8+ 0.8 hours

Table 3: Incidence Of Flatfoot Using Navicular Drop Test

Test Name	Positive	Negative
Windlass test	100	0
Navicular drop test	68	32



Graph 3 : Corelation Between Standing Duration And Flat Foot

Out of 100 participants 68 participants showed increase in pronation of foot according to navicular drop test mean distance were 12.3mm distance more then 9mm can be considered as reduction in arch so the prevalence of flat foot is 68% it also shows positive correlation between standing duration and flat foot.

DISCUSSION

Flatfoot is a biomechanical disorder frequently seen in clinical practice. one study reveals that the prevalence of flat foot was 26.62%.

Described finding is practically identical to a study conducted in Japan on a sample of 242 women and 98 men, in which a prevalence of 26.5% was observed, along with how said finding is related with obesity and the effects of pain and functionality . Similar findings regarding the prevalence of flat foot can be found in other publications. In other population studies (Springfield, Massachusetts) the prevalence of flat foot was 19.0% (20.1% in females and 17.2% in males) . Another study conducted in the Boston area found a prevalence of 20% in women 17% in men. There are even studies, conducted in a diabetic population on a sample of 230 patients, which refer to a prevalence as high as 37%

The present study was performed on 100 participants between the age of 20-40. There were 53 patients between the ages of 20 to 30, 47 patients between the age 31to 40. It was having mean Navicular drop test score of 12.3±5.2 mm and mean standing hours were 5.8±0.8 hours and they show positive correlation of standing hours with flat foot. Prevalence of flat foot among plantar fasciitis is 68%.

Previous studies of plantar fasciitis have found that up to 10% of the population is affected during their lifetime^ and over one million Americans per year' have this condition. The incidence rate of plantar fasciitis in our population was 10.5 per 1000 person-years, with a rate of 9.2 for men and 18.0 for women per 1000 person-years. Although we are aware of no known studies in the literature with incidence rates, prevalence rates of plantar fasciitis ranging between 4% and 22% have been reported among a population of runners.

Another study conducted in India reveals how the use of footwear at early ages, along with obesity and ligamentous laxity, increases the prevalence of flat foot

Another study conducted in Nigeria on 560 children aged between six and 12 years shows that although in the univariate analysis an association was found with type of footwear and age, after taking both into consideration, only age remained as a variable associated the presence of flat foot . Urban residence as a risk factor for the prevalence of flat foot has also been described in a study conducted on children in the Congo, where, after studying 1,851 footprints from 906 girls and 945 boys aged between three and 12 years, it was observed that prevalence diminishes with age, is higher in urban areas and in the masculine sex, and that the use of footwear has little influence on said prevalence . This study shows how the BMI, comorbidity and foot size are associated with the prevalence of flat foot. There are variability in the literature review. A number of studies describe how this foot disorder increases with age , other studies describe how flat foot diminishes with age, after adjusting for other covariates , and others indicate that neither age, gender nor BMI are related with flat foot.

Also in another study, the prevalence of flat foot was assessed where in it was found that real prevalence of symptomatic flatfoot is not very high in adolescents due to its nature of spontaneous correction as age increasesAlso in another study, the prevalence of flat foot was assessed where in it was found that real prevalence of symptomatic flatfoot is not very high in adolescents due to its nature of spontaneous correction as age increases [18,19]. According to age, the subjects between age 20-29 years were suffering 31.8% of flat foot, 30-39 years were having 42% flat foot, 40-49 years were having 16.7% flat foot, above 50 years were having 37.5% flat foot. similarly subjects between age 20-29 years were suffering 47.7% of high arched foot, 30-39 years were having 50% high arched foot, 40-49 years were having 61.1% high arched foot, above 50 years were having 50 % high arched foot.

According to gender it was found that high arched foot had higher incidences in males (55.2%) whereas flat feet were found to have higher incidences in females (38.7%).

A number of studies also describe different radiological findings in the morphology of the foot according to different ethnic groups. Others indicate how the different radiological morphology (angle of the talus with the first metatarsal) is related with the symptomatic presence or absence of flat foot. Even though obesity has repeatedly been associated with the presence of flat foot , not all studies point towards this association . In some articles, not only is the association of flat foot with characteristics (e.g., age, sex, BMI and concomitant illness) indicated, but also as a modifier of health . Thus, there are studies of 97,279 military recruits which associate flat foot with localised knee pain . As we have previously mentioned, in the article which finds a prevalence of flat foot identical that in our study it can also be seen how said alteration is also associated with the presence of pain and fatigue in women.

CONCLUSION

This study, conducted among adults of Gujarat state, revealed that youth those are having plantar fasciitis prone to developing flat foot, which aligns with published Western literature. This study shows that there is 68 % of prevalence of flat foot in adults who had plantar fasciitis. this study also suggest standing duration was positively correlated with pronation of foot in persons with plantar fasciitis.

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INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

"COMPARISON OF ULTRASOUND AND SHOCKWAVE THERAPY IN TENDINOPATHY- AN EVIDENCE BASED STUDY"

Physiotherapy

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ABSTRACT

Background: Tendinopathy is a failed healing response of the tendon, with haphazard proliferation of tenocytes, intracellular abnormalities in tenocytes, disruption of collagen fibres, and a subsequent increase in non-collagenous matrix. There is always remains controversy regarding effectiveness of different treatment techniques for tendinopathy and aim of present study is to find and justify better treatment modality for management of tendinopathy. **Purpose:** To study the evidences regarding effect of Shock wave therapy versus Ultrasound therapy in tendinopathies. **Methodology:** This Evidence based study was conducted from June 2017 to June 2022. Search engines used to find appropriate articles were: PubMed, Google Scholar, PEDro, ResearchGate, ScienceDirect and Embase. Key words used were: Ultrasound, Shock wave Therapy and Tendinopathy. Articles were assessed via 2 scales: Centre for Evidence-Based Medicine's (CEBM's) Levels of Evidence and PEDro scale. **Results:** Total 156 articles were found, out of which 12 articles were relevant and from those 6 articles were included in this evidence-based study. From 6 studies, 1 Meta-analysis (Level of evidence 1a), 2 Randomized controlled trails (Level of evidence 1b) and 3 Comparative studies (Level of evidence 2b). **Conclusion:** There are moderate to strong evidences suggests the Shock wave therapy has more effect on Achilles, Gluteal, Rotator cuff and Lateral Elbow tendinopathies when compared to ultrasound.

KEYWORDS

Ultrasound, Shock wave Therapy and Tendinopathy

INTRODUCTION

Tendinopathy is a degenerative tendon disorder associated with chronic pain, swelling, and impaired physical function. Tendons are susceptible to injury as they undergo high forces during loading activities, receive little vascular blood supply, have low elasticity and decreased metabolism. Tendinopathy is thought to be caused by repetitive tendon microtrauma and subsequent failed healing responses, characterized by neovascularization, incidence of calcium deposits or calcification and increased tendon thickness or swelling.[1]

Histologically, tendinopathy is characterized by the absence of inflammatory cells, poor healing, non-inflammatory intratendinous collagen degeneration, collagen fiber disorientation and thinning, hypercellularity with high concentrations of glycosaminoglycans and proteoglycans, and neovascularization. [2][3]Although inflammatory cells are typically present in tendinopathy, tendon cell degeneration rather than inflammation is considered the pathological hallmark of the disorder, leading to the adoption of the term tendinopathy rather than the previously used diagnosis of tendinitis.

A variety of therapeutic techniques have been proposed for the appropriate management of patients with tendinopathy including exercise, orthotics, manual therapy, passive modalities, acupuncture or a combination of them. However, the effectiveness of each treatment option remains debatable.

Extracorporeal shockwave therapy is a popular method in the management of common tendinopathies and has been proposed as an effective supplement to other noninvasive therapies. The ultrasound is a commonly used modality for tendinosis. It Improves microcirculation, migration and synthesis of collagen fibers to the tendon [4]. There is growing evidence from in vitro and animal-based models that low intensity pulsed ultrasound (LIPUS) may also have beneficial effects on non-mineralized tissues, such as ligaments and tendons. For instance, using these models low intensity pulsed ultrasound (LIPUS) has been found to accelerate knee medial collateral ligament healing [5][6][7], augment tendon repair [8] and modulate tendon cell activity. Alexander et al showed that higher doses of ultrasound energy improved pain in individuals with shoulder calcific tendinitis. In contrast, Warden et al. found that lower doses of ultrasound was no better than placebo for the treatment of individuals with patellar tendinopathy.

So, there is always remains controversy regarding effectiveness of different treatment techniques for tendinopathy and aim of present study is to find and justify better treatment modality for management of tendinopathy.

METHODOLOGY

Study Design: This is an Evidence Based Study, which was conducted according to PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-analysis) guidelines. (Figure 1).

Literature Search:

A specified literature search was performed from June 2017 to June 2022 (Last 5 years). Literature was searched using following search engines: Google Scholar, PEDro, PubMed, ResearchGate, ScienceDirect, Embase

Key Words Used For The Search Were:

Ultrasound, Shock wave Therapy and Tendinopathy

METHOD OF SELECTION OF ARTICLES:

Inclusion Criteria:

(1) Studies involving any type of Tendinopathy from June 2017 to June 2022 (Last 5 years), (2) Studies which compared Ultrasound or Shockwave Therapy in any type of Tendinopathy, (3) Articles on tendinopathy having study design of Systematic reviews, Meta-analysis and RCTs, (4) Articles published in English, (5) Studies done on Human participants.

Exclusion Criteria:

(1) Articles on tendinopathy having study design of Case Control and Cohort (2) Studies done on animals.

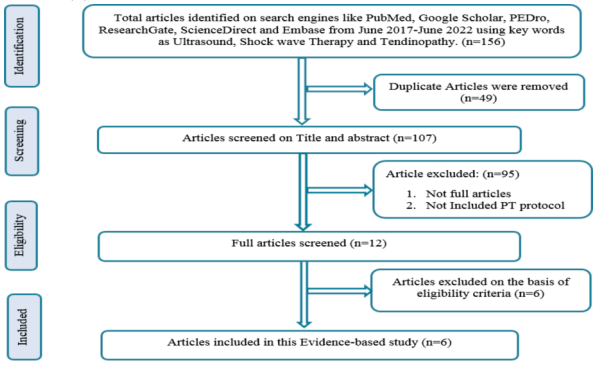

Figure 1: Preferred Reporting Items for systematic reviews and Meta-analysis (PRISMA)

Table 1: Characteristics of Included Studies

SR NO.	TITLE	Study design & Duration	Articles Or Sample Size	Outcome Measures	Pedro And Level Of Evidence
1	Analgesic Effect of Extracorporeal Shock-Wave Therapy in Individuals with Lateral Epicondylitis: A Randomized Controlled Trial [9]	A Randomized Controlled Trial (5 sessions)	40	VAS, Taiwan Version of DASH and Dynamometer	8/10 1b
2	Achilles tendinopathy: Comparison between shockwave and ultrasound therapy [10]	A comparative study (4 weeks)	130	The University of Peloponnese Pain, Functionality and Quality of life Questionnaire - the UoP-PFQ'	4/10 2b
3	Comparison of Radial Extracorporeal Shock Wave Therapy and Traditional Physiotherapy in Rotator Cuff Calcific Tendinitis Treatment [11]	A comparative study (4 weeks)	80	Age, height, Weight, BMI, VAS, Goniometer (Internal and external rotation ROM) and QuickDASH	4/10 2b
4	Comparison of Radial Extracorporeal Shockwave Therapy versus Ultrasound Therapy in the Treatment of Rotator Cuff Tendinopathy [12]	A comparative study (4 weeks)	115	The University of Peloponnese Pain, Functionality and Quality of life Questionnaire - the UoP-PFQ'	4/10 2b
5	Focused extracorporeal shock wave therapy for greater trochanteric pain syndrome with gluteal tendinopathy: a randomized controlled trial [13]	A randomized controlled trial (3 weeks)	50	NPRS, LEFS	7/10 1b
6	A comparative study of the efficacy of ultrasonics and extracorporeal shock wave in the treatment of tennis elbow: a meta-analysis of randomized controlled trials [14]	A meta-analysis	5 articles involving 117 participants	-	- 1a

Assessment of Methodological Quality:
Data was assessed using 2 parameters: (1) Centre for Evidence-Based Medicine's (CEBM's) Levels of Evidence and (2) PEDro scale (Appendix 1 & 2)

RESULTS

Evidences were reviewed and analysis was done on the basis of PEDro score and CEBM's Level of Evidence Scale. Risk of bias is also assessed.

Total 156 articles were found, out of which 12 articles were relevant and from those 6 articles were included in this evidence-based study and other articles were excluded as per Inclusion and Exclusion criteria.

From total 6 studies, there is 1 meta-analysis on efficacy of ultrasonics and extracorporeal shock wave in the treatment of tennis elbow and their result shown that Extracorporeal shock wave Therapy is a superior adjuvant therapy for tennis elbow compared to Ultrasound. Its level of evidence was 1a. 5 out of 6 studies (2 Randomized controlled trials and 3 Comparative studies) were shown that Shock wave (Either Extracorporeal or Radial) was effective treatment for reducing pain and improving disability in subjects with Achilles, Lateral elbow, Gluteal, Rotator cuff tendinopathies when compared to Ultrasound. Their Level of evidence was 1b and 2b.

DISCUSSION

Total 6 studies (1 Meta-analysis, 2 Randomized controlled trials and 3 comparative study) were included in this evidence-based study. The methodological qualities of included studies were moderate to high. The sample size varied from 40-117 subjects.

There are 1 strong evidence (Meta-analysis) which suggest that shock wave therapy is an effective treatment for reducing pain and disability in patients with Lateral elbow tendinopathy when compared to Ultrasound.

There are 2 moderates to high quality of evidences (2 Randomized Controlled Trials) which suggest that shock wave therapy alone or can be adjunct to other conventional treatment provide significant benefits in reducing pain and dysfunctions in patients with Lateral elbow and Gluteal tendinopathies. Total study duration varied from 3 to 5 weeks.

Furthermore, there are 3 low to moderate quality of evidences (3 Comparative Studies) having small to large sample size which compares Ultrasound with Shockwave therapy and their results confirms that Shock wave therapy effectively reduces pain and promotes healing in Rotator cuff and Achillies Tendinopathy. Total Study duration was 4 weeks.

Haupt proposed four possible phase mechanisms of ESWT effects on tissue: physical, physicochemical, chemical and biological. In the physical phase, shockwave pressures cause absorption, refection, refraction and transmission of energy into cells. These tensile forces induce cavitation, increasing cell membrane permeability and activating cell signaling pathways. These include mechano-transduction pathways and those that regulate a variety of gene expressions. In the physicochemical phase, cells release molecules such as adenosine triphosphate (ATP), activating cell signaling pathways. In the chemical phase, ion channels in cell membranes are altered allowing cell calcium mobilization. The biological phase plays host to a plethora of identified biological responses due to tissue and cell stimulation.

Tissue-healing responses are mediated by release of vascular endothelial growth factor (VEGF), endothelial progenitor cells, endothelial nitric oxide synthase (eNOS), insulin-like growth factor (IGF1) proliferating cell nuclear antigen (PCNA) and various other functional proteins.

Cellular modulation is activated by upregulation and downregulation of proteins which promotes processes such as neovascularization, anti-inflammation, anti-apoptosis, chondroprotective effects angiogenesis and regeneration of bone and tendon tissue. [15]

It should be noted that there were no any adverse effects reported from Shockwave Therapy from included articles.

CONCLUSION

From this Evidence based study, it can be concluded that there are moderate to strong evidences suggests the Shock wave therapy has more effect on Achilles, Gluteal, Rotator cuff and Lateral Elbow tendinopathies when compared to ultrasound.

Conflict Of Interest : There is no conflict of interest.

Abbreviations
RCTs: Randomized controlled Trials, VAS: Visual Analogue Scale, VAS-FA: VAS foot and ankle, eNOS: Endothelial Nitric Oxide Synthase, VEGF: Vascular Endothelial Growth Fact, PCNA: Proliferating Cell Antinuclear Antigen, ESWT: Extracorporeal Shockwave Therapy, F-SWT: Focused Shockwave Therapy, R-SWT: Radial Shockwave Therapy, LIPUS: Low Intensity Pulsed Ultrasound, TUS: Therapeutic Ultrasound. PEDro: Physiotherapy Evidence Database, CINAHL: Cumulative Index of Nursing and Allied Health Literature, CEBM: Center of Evidence Based Medicine, PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-analysis, DASH: Disability of Arm, Shoulder and Hand, ROM: Range of Motion, BMI: Body Mass Index, NPRS: Numerical Pain Rating Scale, LEFS: Lower Extremity Functional Scale, GTPS: Greater Trochanteric Pain Syndrome, ATP: Adenosine Triphosphate, OVID: Offshore Vessel Inspection Database, EMBASE: Excerpta Medica Database, IGF1: Insulin-Like Growth Factor1

Ethical Approval
Ethical approval was not required.

Appendix 1- CEBM's Level of Evidence
It assesses quality based on study design, which categorize the studies

in a scale ranging from 1 to 5 with further subdivision for 5each.

Level	Definition
1a	Systematic reviews of randomized controlled trials
1b	Individual randomized controlled trials
1c	All-or-none studies
2b	Systematic reviews of cohort studies
2b	Individual cohort studies or low-quality randomized controlled trials
2c	Outcome research
3a	Systematic reviews of case-control studies
3b	Individual case-control studies
4	Case series, poorly designed cohort or case-control studies
5	Animal and bench research, expert opinion

Appendix 2-PEDro Scale

It assesses methodological quality and consists of a checklist of 11 criteria, 10 of which are scored. For each criterion the study met, 1 point was awarded. The points were tallied and presented as a score out of 10. The scale applies only to experimental studies. For this review, investigations with PEDro scores of 6 to 10 were considered high quality, of 4 to 5 were considered moderate quality, and of 0 to 3 were considered low quality.

No.	Description	Yes/No
1	Eligibility criteria were specified (No points awarded)	
2	Subjects were randomly allocated to groups	
3	Allocation was concealed	
4	The groups were similar at baseline regarding the most important prognostic indicators	
5	There was blinding of all subjects	
6	There was blinding of all therapists who administered the therapy	
7	There was blinding of all assessors who measured at least one key outcome	
8	Measure of at least one key outcome were obtained from more than 85% of the subjects initially allocated to groups	
9	All subjects for whom outcome measures were available received the treatment or control condition as allocated	
10	The result of between group comparisons are reported for at least one key outcome	
11	The study provides both point measures and measures of variability for at least one key outcome	

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"EVALUATION OF VALIDITY AND RELIABILITY OF THE GUJARATI VERSION OF KNEE INJURY AND OSTEOARTHRITIS OUTCOME SCORE (KOOS) IN KNEE PAIN PATIENTS"

Physiotherapy

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ABSTRACT

Background: The Knee injury and Osteoarthritis Outcome Score (KOOS) was originally developed in 1995 by Ewa M Roos and colleagues at the Departments of Orthopedics at Lund University in USA. Thus, the American-English and Swedish versions were developed simultaneously. Also, it has already been translated into many languages such as Hindi, Turkish, Indonesian, Spanish and Swedish. Translation of this scale into Gujarati can be more beneficial for Gujarati physiotherapist to find out better outcome. **Methodology:** The study was carried out on people aged 15 to 50 years in North Gujarat, India, those peoples who have knee pain.116 patients who fulfilled inclusion criteria were selected. Initially scale was translated to Gujarati by forward backward translation and patients were instructed to fill the scale at 1 week interval. Reliability and validity were found out. **Result:** The results of the study showed moderate to high correlation in components of The Knee Injury and Osteoarthritis Outcome Score (KOOS) Gujarati version (ICC= .851,0.835,0.814,0.891 and .977) (P<0.05) and internal consistency (cronbach's alpha = 0.868, 0.834, 0.814, 0.907 and 0.905). The Knee Injury and Osteoarthritis Outcome Score (KOOS) Gujarati version was content validated for idiomatic equivalence, semantic equivalence, content relevance. Face validity were established 100% as all participants answered the scale. For construct validity pearson correlation was done with lower extremity function scale and the pearson correlation value for all five component were -0.143 to 0.185. Correlation is significant at the 0.05 level. **Conclusion:** Gujarati version of the KOOS being a valid, reliable and responsive outcome measure in young patients having knee pain.

KEYWORDS

Knee Injuries and Osteoarthritis Outcome Score (KOOS), Reliability, Validity

INTRODUCTION

The knee is the largest joint in the body and it is a compound synovial joint. [1] The knee consists of two main joints: the femorotibial joint and the patellofemoral joint, which allow the knee to move in three different planes (sagittal, transverse, and frontal).

Patient-reported outcomes are an important element to evaluate the quality and the results of clinical practice as they directly and without any interpretation report a patient's health status.[2] Patients with ACL or meniscus injury have a higher than average risk of developing osteoarthritis, and about 50% have radiological signs of osteoarthritis 10-15 years after injury.

For the elderly population with knee osteoarthritis, well validated outcome measures exist-WOMAC-Western Ontario and McMaster Universities Arthritis Index. However, no outcome measure has been validated for use in younger or physically more active subjects with knee osteoarthritis. It may not be appropriate to use outcome measures assessing function as activities of daily living alone in younger and more active subjects with post traumatic osteoarthritis.

The Knee injury and Osteoarthritis Outcome Score (KOOS) was originally developed in 1995 by Ewa M Roos and colleagues at the Departments of Orthopedics at Lund University, Sweden and at the University of Vermont, USA.

Thus, the American-English and Swedish versions were developed simultaneously. It includes 42 items in 5 separately scored subscales; Pain, other Symptoms, Function in daily living (ADL), Function in Sport and Recreation (Sport/ Recreation), and knee-related Quality of Life (QOL).

The main reason for developing a single instrument with the purpose of covering several types of knee injury and including osteoarthritis (OA), was that traumatic knee injuries often causes concomitant damage to multiple structures (ligaments, menisci, cartilage, etc.) and frequently lead to the later development of OA.

The KOOS evaluates both short-term and long-term consequences of knee injury and include assessing pain; symptoms, such as swelling and restricted range of motion; activities of daily living; sport and recreation function; and knee-related quality of life in young and middle-aged subjects with ACL injury, meniscus injury, or posttraumatic osteoarthritis. The KOOS is self- administered and takes approximately 10 minutes to fill out as well as it is a feasible instrument.[3]

The Knee Injury and Osteoarthritis Outcome Score (KOOS) is one of the most commonly used scales that has been used by physical therapists worldwide. Also, it has already been translated into many languages such as Hindi, Turkish, Indonesian, Spanish and Swedish. Translation of this scale into Gujarati can be more beneficial for Gujarati physiotherapist to find out better outcome. So, there is a need to conduct this study.

METHODOLOGY

Study Design: A cross-sectional Study

Study Population: The study was carried out on people with knee pain in past 10 years from age group 15-50 Years in North Gujarat, India

Study Setting: Native Gujarati patients with knee pain in north Gujarat.

Sample size: 116

Sample Technique: Convenient sampling.

Inclusion criteria:

- Patients willing to participate.
- Both Male and Female
- Age: Between 15-50 years in north Gujarat
- Patient having knee pain with OA, RA and Meniscus injury and Ligament injury in past 10 years.
- Native Gujarati language and can able to read and write Gujarati.

Exclusion criteria:

- Patients having neurological disorders.
- Patient having musculoskeletal disorders other than OA, RA and Meniscus injury.
- Patients having visual problem that cannot be corrected by lenses.
- Non cooperative patients.

Figure 1: Flow Chart of the study Procedure

The Knee injury and osteoarthritis outcome score (KOOS) had been cross-culturally adapted into Gujarati version of Knee injury and osteoarthritis outcome score (KOOS) in following steps:

Step 1: Forward translation:
Two translators (one with the background of medical field and other with no background of medical field) who knew both English and Gujarati language were chosen to translate the questionnaire from English to Gujarati language.

Step 2: Synthesis:
Both the Gujarati versions were combined and two professionals who had knowledge of medical terminologies and were known to both the languages (English & Gujarati) developed a synthesized version.

Step 3: Back-translation:
The synthesized version of the questionnaire was back translated into English language by an independent translator, who knew both English and Gujarati language and had no information of the original questionnaire which was in English language.

Step 4: Expert panel:
A bilingual (in English and the Gujarati language) expert panel was convened which included the forward translator, health experts, as well as professionals with skill in questionnaire development and translation. The changes were done in the translated questionnaire based on the suggestions of the expert panel.

Step 5: Testing of the questionnaire:
A Pre Final Gujarati version of KOOS was given to participants who fulfilled the inclusion and exclusion criteria to find out the reliability and validity of the questionnaire.

Reliability Testing
Test-retest reliability:
The recruited patients with knee pain were asked to fill Gujarati version of Knee injury and osteoarthritis outcome score (KOOS) by themselves twice with minimum gap of one week duration. So that person may not copy the same data as well as he/she will not forgot. The readings were recorded to report test-retest reliability.

Internal consistency:
Internal consistency was measured with Cronbach's alpha (α), a statistic which was calculated from the pair wise correlations measured between paired readings of Gujarati version of Knee injury and osteoarthritis outcome score (KOOS).

Validity Testing
Construct Validity:
Convergent and divergent construct validity was determined by comparison of the administrations of the five subscales of the KOOS and the Lower extremity functional scale. It is expected the highest correlations when comparing the scales that are supposed to measure the same or similar constructs.

Content Validity:
Content equivalence was assessed under two headings: 1. Are the words in the translated Gujarati version of KOOS presented fluently and correctly as in the original version? 2. Do the words and phrase in the translated Gujarati version of KOOS have the same semantic meaning compared with the original version? For this answers from expert panel member's fall between "mostly agree" to "strong agree". This was assessed by an expert panel and they assessed the KOOS-G for content equivalence and content relevance on 5 point likert scale. Content relevance was evaluated by expert judges or panels: How the Gujarati version of KOOS statement is relevant to assess function in knee pain subjects? For this answers from expert panel members' fall between "mostly agree" to "strong agree".

Face Validity:
Face Validity was assessed by asking one question to each of the, 'Do you think this scale is relevant to your condition.' The answer was noted as 'yes' or 'no'. Face validity of the KOOS was established when all the patients questioned about the relevance of the scale to their condition.

RESULTS

All statistical analysis was done using SPSS 25.0 software for windows. Descriptive analysis was used to obtain mean and standard deviations. Reliability testing was done using **reliability analysis**. Inter class correlation coefficient, ICC (2,1) and cronbach's α were measured. Validity testing was done using **Pearson's correlation.** Confidence interval were set at 95%, p = 0.05 for all the analysis.

Age distribution:
The research was performed on 116 patients with knee pain between the age of 15-50. There were 46 patients between the ages of 15 to 30 and 70 patients between the age 31 to 50.

Gender distribution:
The research was performed on 116 patients with Knee pain. In which 55 are Females and 61 are Males.

Test-Retest Reliability:
Test-retest reliability (n=116) was tested by using the interclass correlation coefficient, ICC(2,1) and Internal consistency (n=116) was reported in terms of cronbach's α measured in two session after 1 week is reported.

Table 1: Test- Retest Reliability of Gujarati Version Knee Injury and Osteoarthritis Outcome Score (KOOS)

Knee injury and osteoarthritis outcome score (KOOS)	Session 1 (Mean)	session 2 (Mean)	Cronbach's alpha	ICC	P-value
Pain	19.34	17.22	.868	.851	0.01
Symptoms	14.67	14.29	.834	.835	0.01
Activities of daily living	34.88	36.47	.814	.814	0.04
Sport and recreation function	10.74	11.92	.907	.891	0.01
Knee-related quality of life	9.17	9.91	.905	.897	0.04

Face Validity:
Face validity of the KOOS G was established when all the 116 patients questioned about the relevance of the scale answered YES. i.e. 100%

Construct Validity:
Table 2: Correlation of Koos- G Pain and Lower Extremity Function Scale

PAINKOOS -G		LEFS
	PEARSON CORRELATION	0.023
	SIGNIFICANCE (2 Tailed)	0.804
	N	116

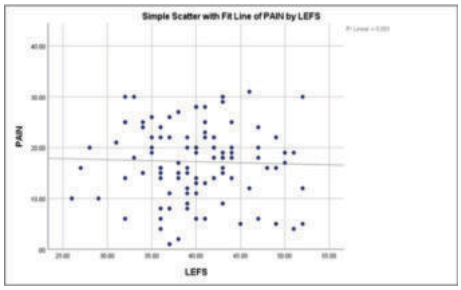

Figure 2: Correlation of KOOS- G Pain and Lower Extremity Function Scale

Table 3: Correlation of KOOS- G Symptoms and Lower Extremity Function Scale

SYMPTOMS KOOS -G		LEFS
	PEARSON CORRELATION	0.065
	SIGNIFICANCE (2 Tailed)	0.491
	N	116

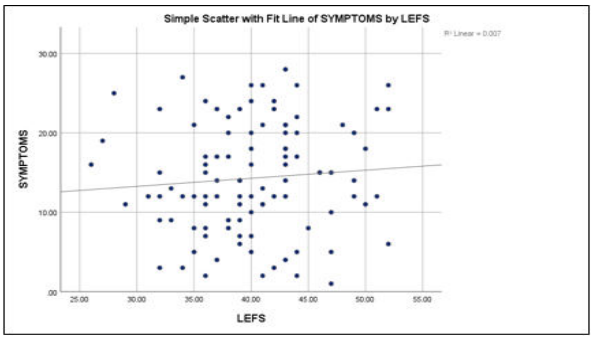

Figure 3: Correlation of KOOS- G Symptoms and Lower Extremity Function Scale

In convergent validity there was a positive correlation of ADL and sports with LEFS. There was a positive correlation between LEFS and PAIN (r=0.023) and between LEFS and SYMPTOMS (r=0.065). (Table 2 and 3)

Table 4: Correlation of Koos- G ADL and Lower Extremity Function Scale

ADL KOOS -G		LEFS
	PEARSON CORRELATION	-0.143
	SIGNIFICANCE (2 Tailed)	0.125
	N	116

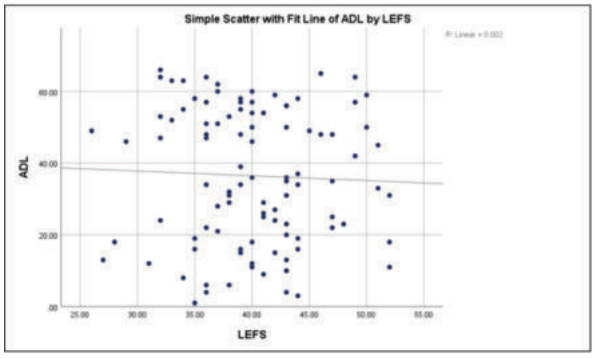

Figure 4: Correlation of Koos- G ADL and Lower Extremity Function Scale

Table 5: Correlation of Koos- G Sports and Lower Extremity Function Scale

SPORTS KOOS -G		LEFS
	PEARSON CORRELATION	-0.033
	SIGNIFICANCE (2 Tailed)	0.728
	N	116

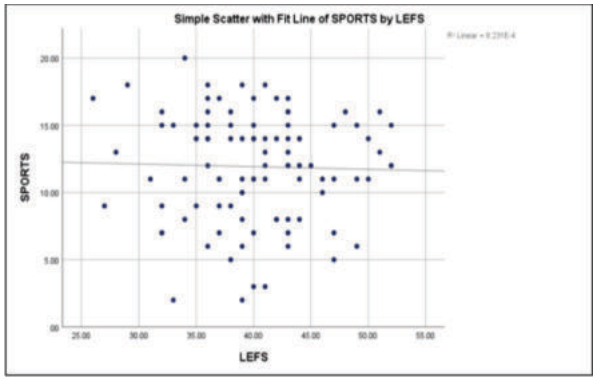

Figure 5: Correlation of Koos- G Sports and Lower Extremity Function Scale

In convergent validity there was a negative correlation of ADL and sports with LEFS. There was a positive correlation between LEFS and ADL (r= -0.143) and between LEFS and sports (r= -0.033). (Table 4 and 5)

Table 6: Correlation of Koos- G QOL and Lower Extremity Function Scale

QOL KOOS -G		LEFS
	PEARSON CORRELATION	0.185
	SIGNIFICANCE (2 Tailed)	0.046
	N	116

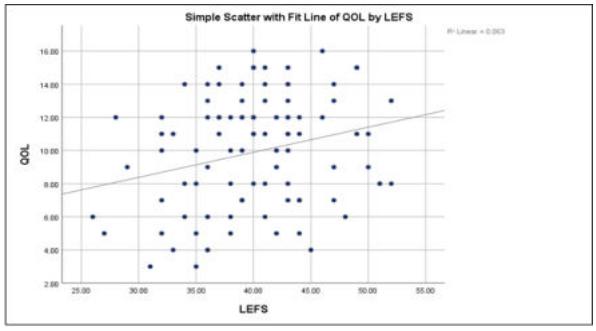

Figure 6: Correlation Of KOOS- G QOL and Lower Extremity Function Scale

In convergent validity there was a positive correlation of QOL with LEFS. There was a positive correlation between LEFS and ADL (r=0.185).

Content Validity:

The content validity of Gujarati translated knee injury and osteoarthritis outcome score (KOOS) by a 6 experts were found to be, I-CVI of individual items knee injury and osteoarthritis outcome score (KOOS) of ≥ 0.89 and overall S-CVI for idiomatic equivalence, semantic equivalence and content relevance ≥ 0.90. For content validity equivalence all 6 experts answers were located between mostly agree and strongly agree of Gujarati version of knee injury and osteoarthritis outcome score (KOOS).

Table 7: Content Validity of Gujarati Version Knee Injury and Osteoarthritis Outcome Score (KOOS)

Scale Component	I-CVI	S-CVI
Pain	0.89	0.918
Symptoms	0.94	
ADL	0.92	
Sports	0.92	
QOL	0.90	

DISCUSSION

This is a cross-sectional study of translation and measurement of psychometric properties of Gujarati version of Knee Injury and Osteoarthritis Outcome Score (KOOS) on patient with Knee pain.

In this study 116 patients participated. Gujarati version of The Knee Injury and Osteoarthritis Outcome Score (KOOS) was given twice with 1- week interval to measure the test- retest reliability and to validity. The results of the study showed moderate to high correlation in components of The Knee Injury and Osteoarthritis Outcome Score (KOOS) Gujarati version (ICC= .851,0.835,0.814,0.891 and .977) (P<0.05) and internal consistency (cronbach's alpha = 0.868, 0.834, 0.814, 0.907 and 0.905).

Both the internal consistency and the test-retest reliability results confirmed the reliability of the Gujarati version of the KOOS. We found that all the KOOS subscales on the Gujarati version have adequate internal consistency, with all Cronbach α values >0.70 (range, 0.86-0.90). These values are comparable to those for the Finnish version (Cronbach α range, 0.79-0.96) and the Malaysian version (Cronbach α range, 0.78-0.95). Our test-retest reliability analysis showed that the Gujarati version of the KOOS has excellent reliability, with all ICC values >0.90 (range, 0.91-0.99). Our results are similar to those for the Italian version (ICC range 0.85-0.95)

For content validity equivalence all 6 experts answer were located

between mostly agree and strongly agree of The Knee Injury and Osteoarthritis Outcome Score (KOOS) Gujarati version for idiomatic equivalence (average=0.89) semantic equivalence (average = 0.92) and content relevance (average= 0.93). Thus, The Knee Injury and Osteoarthritis Outcome Score (KOOS) Gujarati version was content validated for idiomatic equivalence, semantic equivalence, content relevance. Face validity were established 100% as all participants answered the scale.

For construct validity pearson correlation was done with lower extremity function scale and the pearson correlation value for all five component were -0.143 to 0.185. Correlation is significant at the 0.05 level.

In previous studies, interrater reliability and intrarater reliability of the The Knee Injury and Osteoarthritis Outcome Score (KOOS) of Turkish version were (ICC & cronbach's alpha = (0.839 and 0.904) respectively.[4]

In Indonesian version for the construct validity, moderate Pearson correlation coefficients were found between the KOOS subscales and the SF36. Cronbach α was 0.84 to 0.97 for all subscales, indicating adequate internal consistency. The test-retest reliability was excellent, with intraclass correlation coefficients ranging from 0.91 to 0.99 for all subscales.[5]

Swedish version of the scale was applied on the participants at 2 week intervals. Test-retest reliability. For the five subscales of the KOOS, the random effects intra class correlation coefficients (ICC) were: Pain 0.86, Symptoms 0.84, Activities of Daily Living (ADL) 0.91, Sport and Recreation Function 0.78, and for Knee-related Quality of Life (QOL) 0.83. Internal consistency, as measured by Cronbach's alpha, was for the subscale Pain 0.84, Symptoms 0.74, ADL 0.95, Sport/Rec 0.85, and for QOL 0.71 [6]

It was found The Knee Injury and Osteoarthritis Outcome Score (KOOS) Gujarati version items equivalent to those in original version which is intended by translators involve in this study. The results showed that it was translated this scale into other languages without losing psychometric properties of the original English version.

CONCLUSION

The present study demonstrated the Gujarati version of the KOOS being a valid, reliable and responsive outcome measure in patients having knee pain. The Gujarati KOOS can be applied as a patient-reported and disease specific instrument in future studies including Knee pain subjects in Gujarat.

Abbreviations

KOOS: Knee injury and Osteoarthritis Outcome Score, OA: Osteoarthritis, ICC: Inter class correlation, RA: Rheumatoid Arthritis, LEFS: Lower Extremity Function Scale, QOL: Quality of Life, S-CVI: Scale Level Content Validity Index, I-CVI: Item Level Content Validity Index

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VALIDATION OF THE GUJARATI VERSION OF THE NORTHWICK PARK NECK PAIN QUESTIONNAIRE.

Physiotherapy

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ABSTRACT

Background: Neck pain is becoming increasingly common throughout the world. It has a considerable impact on individuals and their families, communities, health-care systems, and businesses. There is substantial heterogeneity between neck pain epidemiological studies, which makes it difficult to compare from different studies. The prevalence of neck pain in the general population ranges between 0.4% and 86.8% (mean: 23.1%); point prevalence ranges from 0.4% to 41.5% (mean: 14.4%); and 1 year prevalence ranges from 4.8% to 79.5% (mean: 25.8%). Northwick Park Neck Pain Questionnaire is one of the most commonly used scales that has been used by physical therapists worldwide. Also, it has already been translated into many languages such as Turkish, Indonesian, Spanish and Swedish. We would like to translate this scale into Gujarati language. Because it is more beneficial for the patient to understand the Gujarati scale and it is also helpful for the Gujarati physiotherapist. **Methodology:** The study was carried out on people aged more then 18 years in Gujarat, India. Those peoples who have knee injury.100 patients who fulfilled inclusion criteria were selected. Initially scale was translated to Gujarati by forward backward translation and patients were instructed to fill the scale at 1 week interval. **Result:** 100 patients participated. Gujarati version of The Northwick Park Neck Pain Questionnaire was given twice with 1- week interval to measure the test- retest reliability and validity. The results of the study showed moderate to high correlation in components of The Northwick Park Neck Pain Questionnaire Gujarati version (ICC =0.882) ($P<0.05$) and internal consistency (Cronbach's alpha =0.88). **Conclusions:** The Gujarati version of The Northwick Park Neck Pain Questionnaire was cross-culturally adapted and validated for use among the Gujarati- speaking populations. The translated version has acceptable reliability and internal consistency.

KEYWORDS

Northwick Park Neck Pain questionnaire, Cervical, Interclass correlation.

INTRODUCTION

Neck pain is becoming increasingly common throughout the world. It has a considerable impact on individuals and their families, communities, health-care systems, and businesses. There is substantial heterogeneity between neck pain epidemiological studies, which makes it difficult to compare or pool data from different studies.[1] The estimated 1 year incidence of neck pain from available studies ranges between 10.4% and 21.3% with a higher incidence noted in office and computer workers. While some studies report that between 33% and 65% of people have recovered from an episode of neck pain at 1 year, most cases run an episodic course over a person's lifetime and, thus, relapses are common.[2]

The overall prevalence of neck pain in the general population ranges between 0.4% and 86.8% (mean: 23.1%); point prevalence ranges from 0.4% to 41.5% (mean: 14.4%); and 1 year prevalence ranges from 4.8% to 79.5% (mean: 25.8%). Prevalence is generally higher in women, higher in high-income countries compared with low- and middle-income countries and higher in urban areas compared with rural areas. Many environmental and personal factors influence the onset and course of neck pain. Most studies indicate a higher incidence of neck pain among women and an increased risk of developing neck pain until the 35–49 year age group, after which the risk begins to decline.[3]

Pain scales usually are used in the assessment of patients with neck pain. However, the presence and severity of pain represent only a small part of the health outcome. Rainville et al suggested that pain scales correlate poorly with measures of physical function.[4] There is increasing recognition that patient perspectives are essential both in making medical decisions and in judging treatment outcomes. Questionnaires designed for completion by the patient are used increasingly as a convenient and reproducible measuring tool for assessing patients with musculoskeletal problems, especially those with low back pain. Among various disability indexes for low back pain, the Oswestry Index probably is the best index covering several distinct activities of daily living. However, only a few methods exist to assess the disability of patients with neck pain. Vernon and Mior modified the Oswestry Low Back Pain Index and produced a 10-item scaled questionnaire, namely the Neck Disability Index (NDI).[4] Offered as a self-reporting instrument for assessing activities of daily living for patients with neck pain, it was validated and found reliable. However, the sample size in some of the analyses was small, with only 10 patients in the concurrent validity study. Most of the patients (70%) had experienced “whiplash” injury. Leak et al again modified the Oswestry questionnaire and developed the self-administered Northwick Park Neck Pain Questionnaire (NPQ).[5] These authors converted some of the questions (walking, standing, and sex life items in the Oswestry questionnaire to cover many activities (carrying, reading/television, and work) likely to be affected by neck pain. The NPQ consists of nine five- part questions that assess the patient's symptoms, from which a score is obtained. Patients need to answer all the questions except the ninth one, which is an option for patients who drive. Each question is scored from 0 to 4. The responses to the questions are summed and converted to a score percentage, which ranges from 0% to 100%, with 0% representing the least disabled and100% the most severely disabled. In addition to questions 1 through 9, all follow-up questionnaires contained a 10th question asking patients how their pain compared with that reported the last time. The questionnaire was found to be valid, easy for patients to complete, and simple to score. It provides a reliable outcome measure for patients with acute or chronic neck pain.[6]

The Northwick Park Neck Pain Questionnaire is one of the most common scale that has been used by the physiotherapist all over the world. Also, it is already translated in many other languages like Turkish, Korean, Spanish, Indonesian etc. We want to translate this scale in our mother language i.e. Gujarati, because it will be more beneficial for patients to understand the scale in Gujarati and it will be helpful to physiotherapists also who are from Gujarat.

METHODOLOGY

Ethical Approval: Ethical approval for the study was taken from the institutional ethical committee
Study Design : Reliability and validity study.
Study Setting: Various committee of Gandhinagar city
Sampling Technique: Purposive Sampling
Population: Native Gujarati Patients with neck pain in North Gujarat.
Duration Of Study: 1 Year
Study Size : . N=100

Inclusion Criteria

- AGE : More than 18 years of age
- Patient diagnosed with neck pain

- Subjects willing to participate.

Exclusion Criteria

- Patients having neurological disorders
- Patient not able to read and write Guajarati
- Uncooperative patients

The Northwick Park Neck Pain Questionnaire was cross-culturally adapted into a Gujarati version in the following steps:

First stage, the English version of The Northwick Park Neck Pain Questionnaire was translated into Gujarati version through standardized procedure recommended by Beaton et al. with some modification. We translated and culturally adapted The Northwick Park Neck Pain Questionnaire according to Indian living standards to adapt/fit and use in Indian Gujarati speaking neck pain population for the evaluation of self-rated neck functional status., stage I was done by the first author with the help of online translation portal.

We skipped stages II and III recommended by Beaton et al. In stage IV, 08 experts (02 orthopaedicians, 02 rheumatologists, 02 English professors, and 02 Gujarati professors) were volunteered for the review of questionnaire developed in stage I. Overall, Gujarati professors simplified the language, whereas medical experts helped with the medical terminology used in the questionnaire.

In stage V, questionnaire developed at the end of stage IV was administered to 20 Gujarati speaking neck pain patients. All patients understood the questions and responded correctly; hence there was no modification of questionnaire at this stage.

Validation study: Experts and translators obtained face validity and content validity.

I. Test-retest reliability: The recruited patients with neck pain were asked to complete the Gujarati version of The Northwick Park Neck Pain Questionnaire twice with a one-week gap in between. As a result, that person will not copy the same data and will not forget. The readings were recorded in order to determine test-retest reliability.
II. Internal consistency: Cronbach's alpha (α), a statistic calculated from pair wise correlations measured between paired readings of the Gujarati version of The Northwick Park Neck Pain Questionnaire, was used to assess internal consistency.

After checking reliability and validity of this questionnaire, we have taken 100 individuals with neck pain.

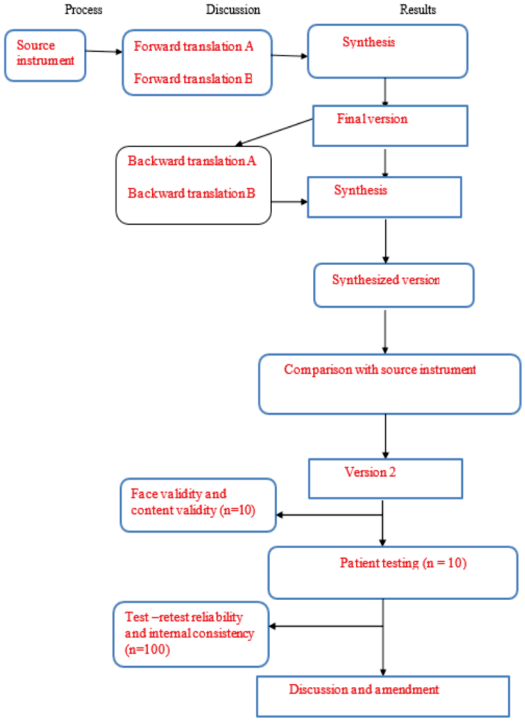


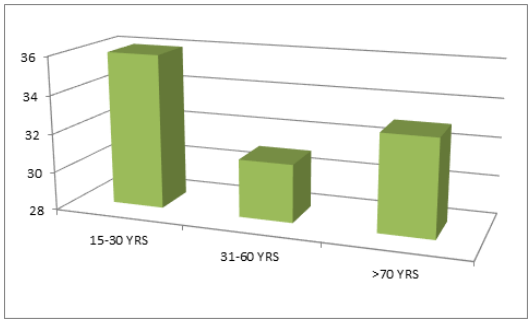
Chart:- Cross Cultural Adaption

RESULT

All statistical analysis was done using SPSS 25.0 software for windows. Descriptive analysis was used to obtain mean and standard deviations. Reliability testing was done using reliability analysis. Inter class correlation coefficient, ICC(2,1) and Cronbach's α were measured. Confidence interval were set at 95%, p = 0.05 for all the analysis.

1. Age Distribution

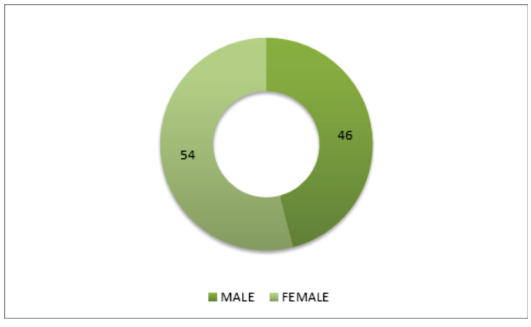
The research was performed on 100 patients with neck pain between the age of more then 18 years. There were 36 patients between the ages of 18 to 30, 31 patients between the age 31to 60, and 33 patients between the age of >70 years.



Graph : Age Distribution

2. Gender Distribution

The research was performed on 100 patient with neck pain . In which 54 are females and 46 are males.



Graph 7.2 : Gender Distribution

The content validity of Gujarati translated The Northwick Park Neck Pain Questionnaire by a 8 experts were found to be, I-CVI of individual items The Northwick Park Neck Pain Questionnaire of ≥ 0.93 and overall S-CVI for idiomatic equivalence, semantic equivalence and content relevance ≥ 0.90. For content validity equivalence all 6 experts answers were located between mostly agree and strongly agree of Gujarati version of The Northwick Park Neck Pain Questionnaire for idiomatic equivalence (average= 0.89) semantic equivalence(average = 0.91) and content relevance (average= 0.92). Test-retest reliability (n=100) was tested by using the interclass correlation coefficient, ICC (2,1) and Internal consistency (n=100) was reported in terms of Cronbach's α measured in two session after 1 week

Table 7.1:- Test- Retest Of Gujarati Version The Northwick Park Neck Pain Questionnaire

The Northwick Park Neck Pain Questionnaire	Week 1 (Mean)	Week 2 (Mean)	Cronbach's alpha	ICC	P- value
	17.5	18.73	0.88	0.882	0.01

DISCUSSION

Non-specific neck pain is very common in rheumatology patients. Of the working population, 30% aged 25-29 years and 50% over 45 years report one or more attacks of painful neck, which is the primary motive for patient presentations. In our study first report of the reliability and validity of Gujarati version of The Northwick Park Neck Pain Questionnaire for evaluating pain and function with neck pain patients.[7]

The restriction of activities of daily living caused by neck pain has an important place in the planning of treatment. Whatever the source of

the pain, the objective assessment is difficult and the evaluation should primarily be based on the patient's subjective experience of pain and disability. Instead of focusing on the examination findings for diagnostic purposes, it is more accurate for a multidisciplinary approach to evaluate the patient's performance in daily life. For this purpose, there are specific questionnaires developed for the evaluation of patients and the quantitative determination of treatment results.[8] Various features of the scale such as acceptability, ease of use, high reliability, validity and responsiveness to clinical changes can guide the evaluation and selection of an appropriate scale. Therefore, we attempted to adapt the NPQ into Gujarati. Tabachnick and Fidell reported that the sample size of 10 participants per item was sufficient for factor analysis . The present study included 100 patients with neck pain. Thus, the required sample size was sufficient.[9]

In this study 100 patients participated. Gujarati version of The Northwick Park Neck Pain Questionnaire was given twice with 1-week interval to measure the test- retest reliability and to validity. The results of the study showed good correlation neck pain scale (ICC= .815) ($P<0.01$) and internal consistency (Cronbach's alpha = . 989 and .978).

For content validity equivalence all 6 experts answer were located between mostly agree and strongly agree of Gujarati version of The Northwick Park Neck Pain Questionnaire (average=0.89) semantic equivalence (average = 0.90) and content relevance (average= 0.93). Thus, Gujarati version of The Northwick Park Neck Pain Questionnaire was content validated for idiomatic equivalence, semantic equivalence, content relevance.

Contrary to questionnaires evaluating general health, questionnaires related to regional pain and functions are considered to have higher validity because they are directed to a single body region. Therefore, the NDI was developed as the first questionnaire by Vernon et al in 1991 and then the NPQ was developed in 1994 and then the NPDS was developedin 1999. Vernon and Mior applied the NDI at a 1-week interval to patients who have had neck pain due to whiplash injury and without trauma and found the ICC score to be 0.89 . Leak et al found that ICC score was 0.84 for NPQ. They proposed that the NPQ is easy for patients to complete, simple to score and provides an objective measure for evaluating outcomes in patients with acute or chronic neck pain. Wheeler et al found that ICC score was 0.93 for NPDS. Other studies investigating the reliability of the neck questionnaires in the Turkish population, such as the Turkish version of the NPDS and the NDI, have similar ICC scores. Bicer et al conducted a study concerning chronic neck pain and reported that the value of the Cronbach's alpha coefficient for the reliability of the NPDS was 0.86. Aslanet al. conducted a study of patients with chronic neck pain who were administered with the NDI and NPDS. They found that ICC score was 0.979 at a 1-week interval for the NDI and the correlation between the NDI and the NPDS was 0.659 to 0.728.[10-11]

In previous studies, interrater reliability and interrater reliability of the Korean The Northwick Park Neck Pain Questionnaire were (ICC =(0.97) respectively. reliability and validity for level of pain and function had high sensitivity and specificity for the patient with Neck pain.

In Spanish version the concurrent validity had a high correlation (r = 0.74- 0.86) and inter and intra- rater reliability was between 0.4 to 0.6 and 0.6 to 0.8 The Northwick Park Neck Pain Questionnaire is valid and reliable for Spanish population.

It was found Gujarati version of The Northwick Park Neck Pain Questionnaire items equivalent to those in original version which is intended by translators involve in this study. The results showed that it was translate this scale into other languages without losing psychometric properties of the original English version.

CONCLUSION

The Gujarati version of The Northwick Park Neck Pain Questionnaire was cross- culturally adapted and validated for use among the Gujarati-speaking populations. The translated version has acceptable reliability and internal consistency.

ABBREVIATIONS

NPQ: Northwick Park Neck pain questionnaire
NDI: Neck Disability Index
ODI: Oswestry disability index
ICC: Interclass correlation

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INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

CORRELATION BETWEEN CORE MUSCLE ENDURANCE AND FOOT POSTURE IN COLLEGE GOING STUDENTS: AN OBSERVATIONAL STUDY

Physiotherapy

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ABSTRACT

Background: Proper posture is considered to be a state of musculoskeletal balance that involves A minimal amount of Stress or strain to the body.it Compromises balance because of muscular Imbalance which can cause loss Of Proprioception sense in joint and decreased Balance, and trunk endurance is significantly Reduced in Reduced in forward head posture and may lead to poor muscular Control of the spine. **Aim:** To Determine the Correlation between core muscle endurance and foot posture in college Going Students. **Methodology:** An observational study Was conducted in 50 College Going Students of Ahmedabad and Convient Sampling was used. Age group 18-25 Year students Chek for Core Muscle Endurance Test and Foot Posture Analysis. The statistical evaluation become accomplished with SPSS version 29-2022, September. **Result:** Our Finding Suggest that from Descriptive analysis of data was expressed in mean and Standard Deviation for various parameters. Correlation were expressed in term of R value and P Value. P value less than 0.05 was considered to be Signifcant. **Conclusion:** Individuals with altered foot posture will have an effect on the Proximal segment through the Kinetic chain phenomenon of the body, Affecting the core endurance. Individuals with altered Foot posture have reduced core endurance.

KEYWORDS

Core Muscle,Foot Posture,College Students,Endurance

INTRODUCTION

Foot posture plays an important role in the quality of daily living.[1]The structure of the feet is such that it permits the functions of both the stability and the mobility depending on the tasks which are imposed on it.[1]

Kinetic Chain & Core

Core stability can be defined as the ability of the Lumbopelvic-Hip Complex to prevent buckling of the Vertebral Column and return it to equilibrium following perturbation by using Strength, Endurance and Motor Control in a functional manner through all the planes of motion and action despite changes in the center of gravity.[2]

Need Of Study:

1)The foot posture is important for provide stable base of support during walking, running and jumping.
2)Proximal stability is needed for distal mobility.
3)So the core provide proximal stability to perform proper distal component mobility. The affection in
4)proximal core muscle may be lead to distal component changes and visa versa.

Aims Of The Study:

To find out the Correlation between core muscle endurance and foot posture in college Going students.

OBJECTIVES:

1)To find out the Correlation between core muscle endurance and foot posture in college going students by using Flexor endurance test & FPI.
2)To find out the Correlation between core muscle endurance and foot posture in college going students by using Extensor endurance test & FPI.
3)To find out the Correlation between core muscle endurance and foot posture in college going students by using Rt. Side plank endurance test & FPI.
4)To find out the Correlation between core muscle endurance and foot posture in college going students by using Lt. Side plank endurance test & FPI.

Null hypothesis:

There is no significant Correlation between core muscle endurance and foot posture in college going students.

Alternate Hypothesis:

There is significant Correlation between core muscle endurance and foot posture in college going students. and foot posture in college going students.

MATERIAL

Pen, paper, pencil
Foot posture index questionnaire
Stop watch
Plinth or high level bed

METHODOLOGY

Sample Size: 50

Sampling Design : Convient sampling

Study Design: An observational study

Setting: Ahmedabad

Population: Age group between 18 to 25 years

Procedure

- Selection
- Fifty subjects with the age group between 18 to 25 years participate in this study.
- Core Endurance :
- 60 degree flexion endurance test,
- trunk extensor endurance test,
- Right side plank test
- left side plank test.
- Time noted in sec.
- Foot posture:
- Foot posture index.

Flexor Endurance Test Position

Extensor Endurance Test Position

Lt. & Rt. Side Plank Endurance Test Position

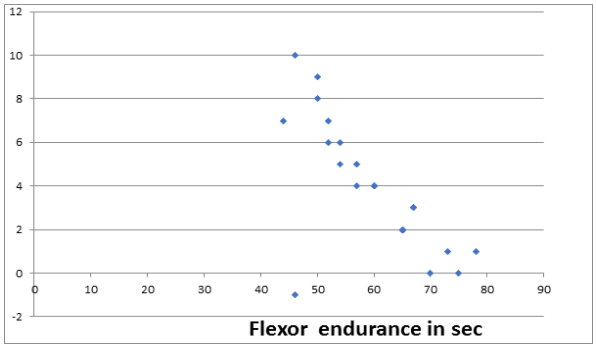
RESULTS

Descriptive analysis of data was expressed in mean and standard deviation for various parameters.Correlation were expressed in term of r value and P value.P value less than 0.05 was considered to be significant

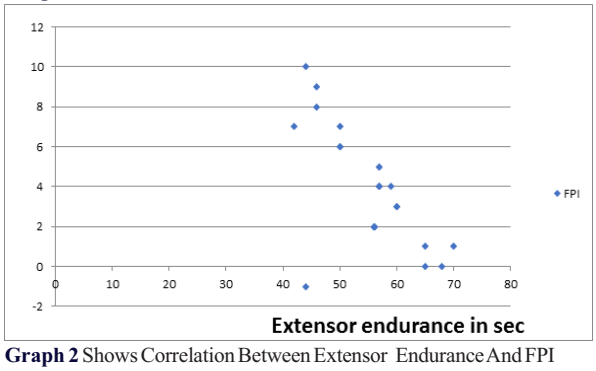
The graphical representation was done by scatter graph.

Table 1 : Descriptive Analysis

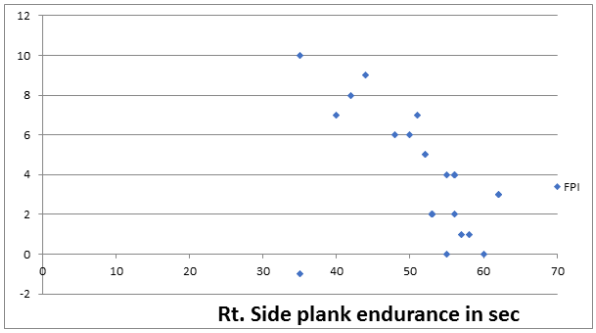
	MEAN	STANDARD DEVIATION
Age	22.34	1.7333
Flexor endurance test	60.1	9.2609
Extensor endurance test	55.34	7.3640
Rt. Side plank test	51.78	7.3326
Lt. side plank test	49.08	6.7698
Foot posture Index	3.78	2.8734



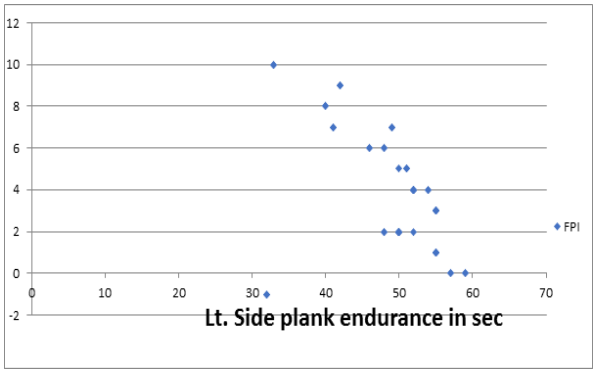
Graph 1 Shows Correlation Between Flexor Endurance And FPI



Graph 2 Shows Correlation Between Extensor Endurance And FPI



Graph 3 Shows Correlation Between Rt. Side Plank Endurance And FPI



Graph 4 Shows Correlation Between Lt. Side Plank Endurance And FPI

Table 2: Correlation Between Core Endurance & Foot Posture

Variables	r value	P value	
Flexor endurance test & FPI	-0.7231	0.04	significant
Extensor endurance test & FPI	-0.6734	0.03	significant
Rt. Side plank test & FPI	-0.5098	0.005	significant
Lt. side plank test & FPI	-0.5037	0.005	significant

RESULTS

Result shows there is a negative correlation between core endurance timing and foot posture index scoring.

DISCUSSION

The Purpose Of the Study find out correlation between core muscle endurance and foot posture in college going students. The Presents Study Suggest that changes in foot posture causes changes in the kinetic chain of the entire lower extremity upto the lumbar, pelvic and the hip region. Dr. Anvita Telang at el, Conducted study on Comparison of Core Stability in Individuals with Flexible Flat Foot and Normal Foot and conclude that Individuals with flexible flat foot have reduced core Stability.[3] Statistical significance was considered when p value was less than 0.05. The results from statistical analysis of the present study rejects the null hypothesis. There was an significant difference in Core muscle endurance in individuals with different foot posture in the age group of 18- 25 years. The reasons to the above findings are- changes in foot posture causes changes in the kinetic chain of the entire lower extremity upto the lumbar, pelvic and the hip region.

CONCLUSION

Individuals with altered foot posture will have an effect on the proximal segment through the kinetic chain phenomenon of the body, affecting the core endurance.

Individuals with altered foot posture have reduced core endurance.

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"A CORRELATION OF FLAT FOOT AND PROLONGED STANDING AMONG STREET VENDORS IN AHEMDABAD."

Physiotherapy

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ABSTRACT

Background: Flat foot can lead to many unpleasant problems including heel pain, bunions, hammertoes, shin splints and even knee, hip or back pain [9]. Most cases of flat foot are caused by loose joint connections. This develops with repetitive stress on the main supporting tendon of the arch over a long period of time [3]. It is believed that Asians have less ligament laxity and accordingly lower prevalence of flat foot than Europeans and Americans [10]. The prevalence of flat feet has been investigated by many researchers in different parts of the world. Higher prevalence (21 to 57%) is reported among children of two to six years which declines (13.4% to 27.6%) in primary school children [14]. In adult population, it is reported to be approximately 5 to 14% by different researchers. The true prevalence of flat foot is uncertain due to lack of exact clinical or radiographic criteria for defining flat foot **Methodology:** Street vendors of Ahmedabad were selected for the study and asked for total standing hours in their day and flat feet were assessed by the FPI-6 score. FPI-6 is a clinical tool that classifies foot posture according to six items (Redmond, 2005): (i) palpation of the head of the talus; (ii) curvatures above and below the lateral malleolus; (iii) position of the calcaneus in the frontal plane; (iv) prominence in the talo-navicular joint; (v) the medial longitudinal arch's congruence; and (vi) abduction/adduction of the forefoot on the rear-foot. Each item is scored from −2 to 2, resulting in a total score of −12 to 12. Negative values indicate supinated foot posture and positive values indicate pronated foot posture. **Result:** The research was performed on 100 participants between the age of 20-40. There were 56 patients between the ages of 20 to 30, 44 patients between the age 31to 40. Moderately negative correlation seen in standing duration and pronation of foot. **Conclusions:** There is no correlation between standing time and flat foot in street vendors of Ahmedabad.

KEYWORDS

Foot posture index, Medial Longitudinal Ach, Flat foot, Pes Plano-Valgus, Adult Flatfoot.

INTRODUCTION

The structure and dynamicity of foot arches are essential for functions of foot like shock absorption, body weight transmission and to act as a lever for propelling the body forward during locomotion. Medial Longitudinal Arch (MLA) of foot is higher than the Lateral longitudinal arch and its curvature flattens to variable degree during weight bearing[1]. Pes planus is a medical condition where the curvature of MLA is more flat than normal and entire sole of the foot comes into near complete or complete contact with the ground [2]. The height of MLA is most important measurement in determining the degree of pes planus. The feet appear to be flat in infants due to presence of fat. The arches become prominent when the child starts walking and the foot starts bearing the weight. The arches of foot rapidly develop between two to six years and become structurally mature around 12-13 years. [3]

Prevalence of flat feet is higher in children due to ligament laxity and declines with age. Early shoe wearing in children impairs the development of longitudinal arches[4]. The true prevalence of flat foot is uncertain due to lack of exact clinical or radiographic criteria for defining flat foot.

Flatfoot can also be acquired in adulthood. In the adult-acquired condition, patients typically present with an insidious onset of vague pain in the medial foot and behind the medial malleolus along the course of the tibialis posterior tendon [4]. As the condition progresses, these patients have more complaints related to loss of function and changes in the shape of the foot. In the late stages, rigidity, arthritic changes, and ankle valgus may also be observed. In adulthood, the tibialis posterior tendon should maintain its integrity between the medial malleolus and navicular tuberosity When the tendon is elongated, the plantar structures such as the spring ligament stretch excessively, leading to joint subluxation.

A cross-sectional study in 24 subjects with tibialis posterior tendon abnormality and 48 sex- and age-matched controls showed that advanced tibialis posterior tendon pathology was statistically significantly associated with adult-acquired flatfoot deformity and spring ligament pathology[5]. As the pathology progresses, the medial arch collapses. This leads to compensation of the foot by forefoot supinatus and calcaneal valgus, resulting in the deformity of pes planovalgus[6]. An ankle equinus may also present as either a primary deforming force or a secondary adaptation in such patients.

Adult flatfoot is defined as a foot condition that persists or develops after skeletal maturity and is characterized by partial or complete loss or collapse of medial longitudinal arch. Adult flatfoot may present as an incidental finding or as a symptomatic condition with clinical consequences ranging from mild limitations to severe disability and pain causing major impediments. It is often a complex disorder with variety of symptoms and various degrees of deformity[7].

The human foot is designed in the form of elastic arches or springs. These arches are segmented, so that they can best sustain the stresses of weight and of thrusts. An arched foot is a distinctive feature of man[8]. Absence or collapse of the arches leads to flatfoot (pes planus), which may be congenital or acquired. The effects of a flat foot are as follows Loss of spring in the foot leads to a clumsy, shuffling gait, b) Loss of the shock absorbing function makes the foot more liable to trauma and osteoarthritis, c) Loss of the concavity of the sole leads to compression of the nerves and vessels of the sole[9].

Flat foot deformity was classified into three subtypes, rigid flat foot, Flexible Flat Foot (FFF) and Flexible Flat Foot with Short Tendo-Achilles (FFF-STA)[10]. FFF is generally asymptomatic while FFF-STA gives rise to pain and functional disability. Rigid flat foot is often symptomatic and associated with tarsal coalitions and reduced range of motion at subtalar joint.

There are many different causes of flat foot, which can be separated into 2 main categories. The first category, congenital flat foot, includes the completely asymptomatic, pediatric flexible flat foot, by far the most common form of congenital flat foot. Flexible means that an arch is present until weight is put on the foot, at which time the arch disappears. The second category, acquired flat foot, develops over time, rather than at birth, and many different factors contribute to its development. These include the type of shoes a child wears[11], rheumatic arthritis, compensation for other abnormalities further up the leg, or more severe factors such as rupture of the ligaments or tendons in the foot. The most common acquired flat foot in adults is due to posterior tibial tendon dysfunction.[12]

Flat foot can lead to many unpleasant problems including heel pain, bunions, hammertoes, shin splints and even knee, hip or back pain. Most cases of flat foot are caused by loose joint connections. This develops with repetitive stress on the main supporting tendon of the arch over a long period of time. It is believed that Asians have less

ligament laxity and accordingly lower prevalence of flat foot than Europeans and Americans.[13]

The prevalence of flat feet has been investigated by many researchers in different parts of the world. Higher prevalence (21 to 57%) is reported among children of two to six years which declines (13.4% to 27.6%) in primary school children. In adult population, it is reported to be approximately 5 to 14% by different researchers. The true prevalence of flat foot is uncertain due to lack of exact clinical or radiographic criteria for defining flat foot.[14]

Studies have found relation between these indices and their validity has been determined using diagnosis carried out with a pod scope on children as a reference group. Prevalence changes with age, the type of population studied and the presence of other pathologies. Some studies show prevalence between 26.5% and 19.0% and other studies on patients with associated comorbidity report a prevalence of 37%. Flat foot has been associated to family history, the use of footwear in infancy, obesity and urban residence, and it has also been associated with age, gender and foot length. The presence of flat foot has also been associated with the presence of different states of health, the presence of pain, and the fatigue in women. Other studies, however, find no relationship of pain or functionality with the changes in the foot. [15]

Flat foot can lead to many unpleasant problems including heel pain, bunions, hammertoes, shin splints and even knee, hip or back pain. Most cases of flat foot are caused by loose joint connections. This develops with repetitive stress on the main supporting tendon of the arch over a long period of time. It is believed that Asians (including Arabs) have less ligament laxity and accordingly lower prevalence of flat foot than Europeans and Americans.[16]

METHODOLOGY

Study Design And Setting

Study Design: CORRELATION STUDY

Population: STREET VENDORS IN AHEMDABAD

Sampling Method: CONVENIENT SAMPLING

Sample Size: 100

Selection Criteria

Inclusion criteria:

- Age group between 22 to 40 years.
- Both genders– male and female.
- Subject willing to participate in study.
- Vendors with 6 to 8 hours of duty.

Exclusion criteria:

- Subject with any systemic illness and other musculoskeletal disorders specifically in lower limb like foot injuries, degenerative changes of hip and knee.
- Subject with any recent surgeries of lower limb.

Outcome Measures:

Foot Pressure Index

THE FOOT POSTURE INDEX (FPI) is a novel, foot-specific outcome measure that was developed in order to quantify variation in the position of the foot easily and quickly in a clinical setting. It is particularly intended for large sample studies where complex instrumented assessment (e.g., gait laboratory assessment) is impractical or unnecessary. It has already been used in studies of risk factors for injury in athletes and naval recruits, treatment of plantar heel pain, and response to orthotic therapy in different foot types. The FPI consists of a series of criterion-based observations that combine to provide a quantification of postural variation in 3 major regions of the foot (rear-foot, mid-foot, forefoot) in the 3 cardinal body planes. FPI-6 is a clinical tool that classifies foot posture according to six items (Redmond, 2005): (i) palpation of the head of the talus; (ii) curvatures above and below the lateral malleolus; (iii) position of the calcaneus in the frontal plane; (iv) prominence in the talo-navicular joint; (v) the medial longitudinal arch's congruence; and (vi) abduction/adduction of the forefoot on the rear-foot. Each item is scored from −2 to 2, resulting in a total score of −12 to 12. Negative values indicate supinated foot posture and positive values indicate pronated foot posture.

Reliability And Validity Of Foot Posture Index:

Mariana R.C. Aquino et al in their study of Reliability of Foot Posture Index individual and total scores for adults and older adults concluded that The relatively low reliability in light of this high level of agreement suggest that the current version of FPI-6 can be a useful tool to assess foot posture for adults and should be further examined. On the other hand, FPI- 6 should be cautiously used for older adults.

Data Collection Procedure:

After receiving the ethical committee clearance to study research from institute, participants who fulfill the selection criteria were evaluated clinically through assessment and the purpose and procedure of the study was explained to the subjects and requested to sign the consent form. Prior to study the entire subject's demographic data including age, sex, height, weight, Body Mass Index, occupation, address, etc., will be noted.Outcome measures were taken. Result was analyzed statistically using SPSS 25.0 software.

Procedure:

The participant stood on a step, with the arms by the side and looking straight ahead the examiners were not allowed to see the participant's contralateral foot during the evaluation of foot posture (Fig.2). The entire procedure was performed at a clinic. Each FPI-6 item was independently evaluated and scored by each examiner in separate sheets. First, the examiners evaluated the left foot, and then, the right foot.

RESULTS

All statistical analysis was done using SPSS 25.0 software for windows. Descriptive analysis was used to obtain mean and standard deviations.

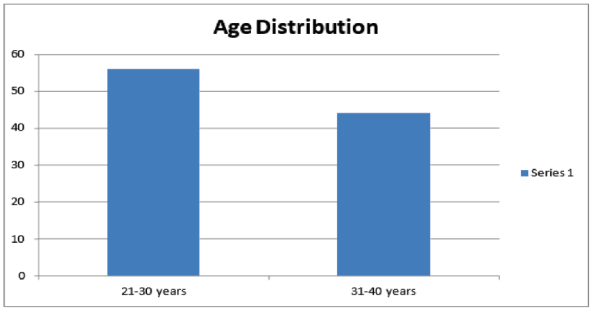
Demographic Data

Age:

The research was performed on 100 participants between the age of 20-40. There were 56 patients between the ages of 20 to 30, 44 patients between the age 31to 40.

Table 1: Age Distribution

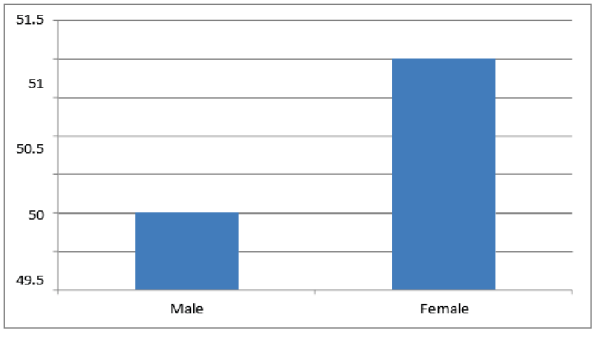
Age Distribution	
21-30 years	31-40 years
56	44



Graph 1: Age Distribution

Gender Distribution:

The research was performed on 100 participants between the age of 20-40. There were 49 Male participants and 51 female participants.



Graph 2: Gender Distribution

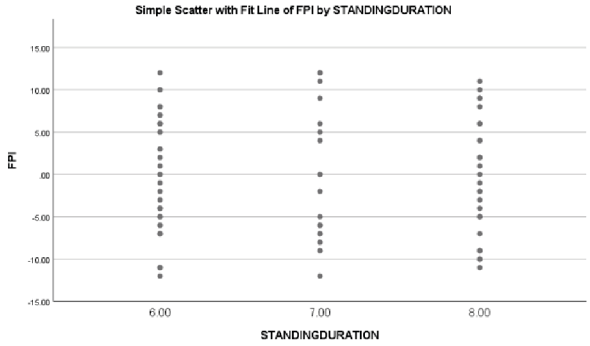
Table 2: Mean Value Of Fpi & Standing Duration

	Mean + SD
Age	27.6+4.3
FPI-6	12.5+5.2
Standing Duration	6.3+ 0.8 hours

Correlations

Table 3: Correlations Of Fpi And Standing Duration

duration			FPI6
Duration	Pearson Correlation	1	-.013
	Sig. (2-tailed)		.897
	N	100	95
FPI6	Pearson Correlation	-.013	1
	Sig. (2-tailed)	.897	
	N	95	95



Graph 3: Correlation of FPI &standing duration

- As results are showing the person's correlation between standing hours and FPI was -0.013 that shows the moderately negative correlation seen in standing duration and pronation of foot.

DISCUSSION

Flatfoot is a biomechanical disorder frequently seen in clinical practice. This study reveals that the prevalence of flat foot was 26.62%. Described finding is practically identical to a study conducted in Japan on a sample of 242 women and 98 men, in which a prevalence of 26.5% was observed, along with how said finding is related with obesity and the effects of pain and functionality. Similar findings regarding the prevalence of flat foot can be found in other publications. In other population studies (Springfield, Massachusetts) the prevalence of flat foot was 19.0% (20.1% in females and 17.2% in males). Another study conducted in the Boston area found a prevalence of 20% in women 17% in men. There are even studies, conducted in a diabetic population on a sample of 230 patients, which refer to a prevalence as high as 37% The present study was performed on 100 participants between the age of 20-40. There were 56 patients between the ages of 20 to 30, 44 patients between the age 31to 40. It was having mean FPI of 12.5±2.5 and mean standing hours were 6.3±0.8 hours and they show moderately positive correlation of standing hours with flat foot.

Another study conducted in India reveals how the use of footwear at early ages, along with obesity and ligamentous laxity, increases the prevalence of flat foot Another study conducted in Nigeria on 560 children aged between six and 12 years shows that although in the univariate analysis an association was found with type of footwear and age, after taking both into consideration, only age remained as a variable associated the presence of flat foot. Urban residence as a risk factor for the prevalence of flat foot has also been described in a study conducted on children in the Congo, where, after studying 1,851 footprints from 906 girls and 945 boys aged between three and 12 years, it was observed that prevalence diminishes with age, is higher in urban areas and in the masculine sex, and that the use of footwear has little influence on said prevalence. This study shows how the BMI, comorbidity and foot size are associated with the prevalence of flat foot. There is variability in the literature review. A number of studies describe how this foot disorder increases with age, other studies describe how flat foot diminishes with age, after adjusting for other covariates, and others indicate that neither age, gender nor BMI are related with flat foot. Also in another study, the prevalence of flat foot was assessed where in it was found that real prevalence of symptomatic flatfoot is not very high in adolescents due to its nature of spontaneous correction as age increases also in another study, the prevalence of flat foot was assessed where in it was found that real prevalence of symptomatic flatfoot is not very high in adolescents due to its nature of spontaneous correction as age increases [18, 19]. According to age, the subjects between age 20-29 years were suffering 31.8% of flat foot, 30-39 years were having 42% flat foot, 40-49 years were having 16.7% flat foot, above 50 years were having 37.5% flat foot. similarly subjects between age 20-29 years were suffering 47.7% of high arched foot, 30-39 years were having 50% high arched foot, 40-49 years were having 61.1% high arched foot, above 50 years were having 50 % high arched foot.

According to gender it was found that high arched foot had higher incidences in males (55.2%) whereas flat feet were found to have higher incidences in females (38.7%).

A number of studies also describe different radiological findings in the morphology of the foot according to different ethnic groups. Others indicate how the different radiological morphology (angle of the talus with the first metatarsal) is related with the symptomatic presence or absence of flat foot. Even though obesity has repeatedly been associated with the presence of flat foot, not all studies point towards this association. In some articles, not only is the association of flat foot with characteristics (e.g., age, sex, BMI and concomitant illness) indicated, but also as a modifier of health. Thus, there are studies of 97,279 military recruits which associate flat foot with localized knee pain. As we have previously mentioned, in the article which finds a prevalence of flat foot identical that in our study it can also be seen how said alteration is also associated with the presence of pain and fatigue in women.

CONCLUSION

According this study, standing duration was negatively correlated with pronation of foot in vendors of Ahmedabad city. Its suggest that flat foot is not correlated with long standing duration in vendors.

Abbreviations

FPI: Foot Pressure Index, NPRS: Numerical Pain Rating Scale, VAS: Visual Analogue Scale, ROM: Range of Motion.

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COMPARISON BETWEEN AEROBIC EXERCISE AND DEEP BREATHING EXERCISE WITH POSITIVE EXPIRATORY PRESSURE BREATHING EXERCISE IN POST CABG PATIENT IN RECOVERY PHASE.

Cardiology

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ABSTRACT

Background: Coronary artery bypass graft (CABG) Surgery is Known to induce significant muscle wasting. Thus, vast no of patients is facing reduces endurance after surgery with the help of this study. The resultant significant treatment can be beneficial to help vast no of patients with endurance problems. **Methodology:** Participants' subjects meeting inclusion criteria will be included in the study. The sample will be initially selected then randomly divided into 2 groups, group A and group B Treatment with aerobic exercise group A n=30 patients. Treatment with deep breathing exercise with positive expiratory pressure breathing exercise group B n=30 patients. consent form will be signed by both groups. **Result:** The research was performed on 60 participants between the age of 35-65 years. There were group(A) 30 patients between age 35-55, group(B) 30 patients between age 35-60. The statistical software SPSS 25.0 version was used to analyze the data. Before taking statistical data, outcome measure by the six-minute walk test. All outcome measures were analyzed using suitable statistical analysis at baseline and after (4to8) weeks of intervention level ofsignificance was kept at 95% changes in the outcome measures were analyzed within group as well as between. **Conclusions:** Aerobic exercise is better than deep breathing exercise with positive expiratory pressure breathing exercise in post CABG patients in recovery phase.

KEYWORDS

Aerobic exercise, CABG, Deep breathing exercise, spirometry, positive expiratory pressure breathing (PEEP)

INTRODUCTION-

It is a surgical procedure in which the chest is opened, and surgery is performed on the heart. The term "open" refers to the chest, not to the heart itself. Two types of cardiac surgery are closed and open-heart surgery. (1) (2) The heart is a muscular organ that pumps blood throughout the circulatory system. It is situated between two lungs in the mediastinum. It is made up of four chambers, right atrium, right ventricle, left atrium, left ventricle. Heart beats 72/min. CABG (coronary artery bypass grafting) is done when there is multiple severe coronary stenosis associated with unstable or uncontrolled angina. CABG is a surgical procedure used to treat coronary artery disease. The blocked or narrowed coronary arteries are simply bypassed, replacing the blocked portion of the coronary artery with a piece of patent blood vessels taken from any other less sensitive area of the body. Such vascular grafts may be pieces of a vein taken from the legs or mammary artery in the chest. One end of the graft is attached above the blockage and the other end is attached below the blockage through the new graft to reach the heart muscle. CABG can also be performed off pump and on pump. (3)(4)(5) Aerobic exercise is submaximal, rhythmic, repetitive exercise of large muscle groups, during which the needed energy is supplied by inspired oxygen. Aerobic exercise training is augmentation of the energy utilization of the muscles by means of an exercise program. The improvement of the muscles ability to use energy is a direct result of increased levels of oxidative enzymes in the muscles, increased mitochondrial density and size and an increased muscle fiber capillary supply. Training is dependent on exercise of sufficient intensity, duration, and frequency. Training produced cardiovascular and /or muscular adaptation and is reflected in an individual's endurance. Aerobic exercise is any type of cardiac conditioning. It can include activities like brisk walking, swimming, running, or cycling. Aerobic exercise can be effective in increasing endurance of cardio-respiratory system by improving stroke volume at rest, lowering resting heart rate, lowering blood pressure, aerobic exercise is critical component of cardiac rehabilitation following cardiac rehabilitation.

Aerobic exercise traditionally commenced two to six weeks following hospital discharge and most commonly includes stationary cycling or treadmill walking. (6)(7)(8) INTRODUCTION 4 Deep breathing exercise is a fundamental intervention for the prevention or comprehensive management of impairments related to acute or chronic pulmonary disorders and Post Surgical patients. Deep breathing exercises come in many forms including diaphragmatic, breathing, segmental breathing, inspiratory resistance training incentive spirometry, pursed-lip breathing. (9) When the diaphragm is functioning effectively in its role as the primary muscles of inspiration, ventilation is efficient and the oxygen consumption of the muscle of ventilation is low during relaxed (tidal) breathing. When a patient relies substantially on the accessory muscles of inspiration the mechanical work of breathing (oxygen consumption) increases and the efficiency of ventilation decreases. Although at an involuntary level, a patient with primary or secondary pulmonary dysfunction can be taught how to control breathing by optimal use of the diaphragm and decreased use of accessory muscles. Diaphragmatic breathing is designed to improve the efficiency of ventilation, decrease the work of breathing, increase the excursion (descent or ascent) of the diaphragm, and improve gas exchange and oxygenation. (10) (11). Pursed-lip breathing is a strategy that involves lightly pursing the lips together during controlled exhalation. Many therapists breathing and controlled expiration is a useful procedure, particularly to relieve dyspnea if it is performed appropriately. Pursed-lip breathing decreases the respiratory rate and the work of breathing (oxygen consumption), increases the tidal volume, and improves exercise tolerance. (12)

Positive expiratory pressures breathing is a technique in which resistance to airflow is applied during exhalation, similar to what occurs during pursed-lip breathing, except that the patient breathes through a specially designed mouthpiece or mask that controls resistance to airflow. This breathing technique is used to hold airways open during exhalation to mobilize accumulated secretions and improve their clearance. Positive expiratory pressure breathing provides an alternative or adjunct to postural drainage which a patient can perform independently. (13) Following coronary artery bypass graft (CABG), the main cause of postoperative morbidity and mortality are postoperative pulmonary complications, respiratory dysfunction, and arterial hypoxemia. Incentive spirometry is a treatment technique that uses a mechanical device (an incentive spirometry) to reduce such pulmonary INTRODUCTION 5 complications during postoperative care. An incentive spirometry is a device that measures the volume of the air inhales into the lungs during inspiration when breathing in through an incentive spirometry, a piston rises inside the device and measures the volume of the inspired air. Here we used flow-oriented incentive spirometry (Tri-flow device) has three chambers with one ball in each chamber capacity up to 1200ml. (14) (15) (16) The 6-minute walk test (6-MWT) is an assessment that a

doctor may use to determine a person's exercise tolerance. It may be useful for measuring the functional ability and fitness of people with certain health conditions. (17) The Borg rating of perceived exertion (RPE) scale is an objective reassure of fatigue. This scale can also be used to monitor exercise intensity. (18)

METHODOLOGY

Study Design And Setting

Study Design: Comparative Study

Source Of Data: Zydus Hospital, and Trisha Heart Care and Physiotherapy center.

Population: Post CABG Patients in Recovery Phase.

Sampling Method: Random Sampling (fish bowel method)

Sample Size: 60 Patients (Treatment with Aerobic Exercise n=30 Patients, Treatment with Deep Breathing exercise With Positive expiratory pressure breathing exercise n=30 Patients)

Duration Of the Study: One Year.

MATERIAL & TOOLS USED:

Paper Pen
Assessment sheet Consent Form Incentive spirometry
Positive expiratory pressure breathing device. Cycle ergometer
Stopwatch Pulse oximeter
Blood pressure instrument

DATA COLLECTION PROCEDURE:

Participants who were meeting the inclusion and exclusion criteria have been selected for the study followed by the signature of participants on their consent form. The sampling was done randomly followed by convenient allocation within 2 groups: group A and group B. Treatment of aerobic exercise was given to the participants of group A (n=30 patients). Treatment of deep breathing exercise with positive expiratory pressure breathing exercise was given to the subjects of group B (n=30 patients).

GROUP-A

Treatment with aerobic exercise:

Figure-3 Cycle Ergometer

Group- B

Treatment with diaphragmatic breathing procedure:

Figure-4 Treatment with diaphragmatic breathing procedure

Pursed lip breathing procedure:

Figure-5 Pursed lip breathing procedure

Incentive Spirometry Procedure

Figure-6 Incentive spirometry procedure

Positive Expiratory Pressure Breathing Procedure:

Figure-7 Positive Expiratory Pressure Breathing Procedure

Outcome Measures

6-minute Walk Test:

Figure-8 *6-minute Walk Test*

RESULT

Table -1 Age Distribution

Demographic Details	Group- A	Group - B
AGE	35-55	35-60
NUMBERS	30	30

Table-2 Gender Distribution

GENDER	GROUP-A	GROUP-B	TOTAL
MALE	15	15	30
FEMALE	15	15	30
TOTAL	30	30	60

Table-3 Pre-treatment

	Group-A		Group-B		P-value
6MWD	MEAN	SD	MEAN	SD	
	367	43.5	322	49.2	>0.05

Table-4 MWD (Six Minute Walk Distance) Pre And Post

Group	PRE		POST		P - Value
	MEAN	SD	MEAN	SD	
GROUP - A	367	43	383	37.7	< 0.05
GROUP - B	322	50	332	47.3	> 0.05

Table-5 Comparison Between Group A- B

GROUP	MEAN	SD	P- Value
GROUP - A	367	43.13	
GROUP - B	322	49.2	<0.05

CASE STUDY

Worldwide approximately 400,000 people have undergone CABG in 2021-2022. Thus, vast numbers of patients are facing reduced endurance after surgery. With the help of this study, the resultant significant treatment can be beneficial to help vast number of patients with endurance problem. (4)(5)(6)

CONCLUSIONS

According to this study, Aerobic exercise is better than deep breathing exercise with positive expiratory pressure breathing exercise in post CABG patients in recovery phase. SUMMARY This study compared aerobic exercise and deep breathing exercise with positive expiratory pressure breathing exercise in post CABG patients in recovery phase. They were randomly allocated into groups or outcome was measured pre and post after 4 to 8 weeks of intervention. Both treatments were significantly effective in post CABG patients in the recovery phase but, more effective was in group A.

Limitations Limited age group may be applicable to larger age group. Limited sample size. Before recovery phase further study done with different age group geriatric group population. Future recommendation Further study can be done with large sample size. Study can be done with long term follow up.

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"ASSOCIATION OF FORWARD HEAD POSTURE WITH PAIN AND CERVICAL RANGE OF MOTION IN DESK USERS"

Physiotherapy

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ABSTRACT

Background: Forward head posture afflicts a large percentage of population and can cause significant neck pain, the estimated 1-year incidence of neck pain ranges between 10.4 and 21.3%, and the overall prevalence of neck pain in general population can be as high as 86.8%. Strong evidence was found to relate neck pain with female gender, older age, being an ex-smoker, high job demands, and low social or work support. Regarding physical work factors, neck pain was significantly associated with holding the neck in a forward bent posture for a prolonged time and making repetitive movements. **Methodology:** Individuals selected according to inclusion/exclusion criteria and were explained regarding the study. Total 100 participants (Age 30 years and above) were included in the study. Subject were assessed for Forward Head Posture, Pain and Cervical ROM. **Result:** Association testing were done using pearsons Correlation method. Among a total of 100 office workers took part in the survey 73% were female. The mean age of participants was 39±8 years. Results shows Moderately positive Correlation of forward neck with reduction of ROM of Neck and moderately positive Correlation of Pain and forward head posture seen according to pearsons Correlation at the level of P<0.01. **Conclusion:** The present study demonstrated the Correlation of forward head posture with pain and cervical range of motion in desk users it shows moderately negative Correlation between pain and tragus to wall test and it shows positive Correlation between pain and cervical range of motion.

KEYWORDS

Forward Head Posture (FHP), Neck pain and disability scale (NPDS)

INTRODUCTION

Forward head posture (FHP) is the anterior positioning of the cervical spine, this posture is called as "text neck", "scholar's neck, "wearies neck", "reading neck". Forward head posture afflicts a large percentage of population and can cause significant neck pain, the estimated 1-year incidence of neck pain ranges between 10.4 and 21.3%, and the overall prevalence of neck pain in general population can be as high as 86.8%.[1]

Forward head posture (FHP) is the most common postural deformity seen in the sagittal plane. It can be defined as any alignment in which the external auditory meatus is positioned anterior to the plumb line through the shoulder joint. In FHP, head moves anteriorly and the peak of the increased cervical lordotic curve is a noticeable distance away from center of gravity.[2-3] FHP gradually leads to abnormal compression of zygapophyseal joint, posterior vertebral disks, narrowed intervertebral foramina and shortened posterior zygapophyseal joint capsule causing nerve root compression.[3]

The FHP could lead to muscle ischemia, muscle pain, fatigue, inflammation, reduced cervical range of motion and sometimes protrusion of nucleus pulpous, rotation of mandible which cause compression and irritation of retrodiscal pad. There are various methods to evaluate FHP but many studies have declared that Craniovertebral angle (CVA) is the best indicator to measure the FHP. CVA is measured by the angle between the imaginary line which passes through C7 and tragus and a horizontal line through C7.[4-5]

Neck pain is one of the very common musculoskeletal conditions in the general population. Neck pain can vary from a small discomfort to severe disabling pain making it one of the major health problems that carries important economic costs. Less severe neck pains occur due to poor posture, neck strains, occupational and sport injuries and mental state such as anxiety and depression, while mechanical and degenerative factors are more likely to develop chronic neck pain.[6]

Strong evidence was found to relate neck pain with female gender, older age, being an ex- smoker, high job demands, and low social or work support. Regarding physical work factors, neck pain was significantly associated with holding the neck in a forward bent posture for a prolonged time and making repetitive movements.[7] In addition, the increasing use of new information and communication technologies has led to an increase in time spent texting messages on mobile phones or using computers, which might have a long-term impact on neck pain, potentially due to prolonged periods of neck flexion.

The increasing use of new information and communication technologies has led to an increase in time spent texting messages on mobile phones or using computers, which might have a long-term impact on neck pain, potentially due to prolonged periods of neck flexion. Neck flexion may facilitate forward head posture (FHP), which refers to forward placement of the head in relation to the shoulder.[8] This is the most common cervical postural fault in the sagittal plane that is found with different severity levels in almost all populations. Greater FHP has been associated with greater deficits in cervical range of motion (ROM), particularly neck rotation and flexion.[9]

There exist several methods for the evaluation of the spinal posture i.e. radiography, 3D motion analysis via electromagnetic and optical tools, raster stereography, photographic postural analysis and in manual methods (Universal goniometer). Among which Universal goniometer has excellent reliability and is cost effective.

This change in posture can lead to a spatial change between the spine and the line of gravity, causing an overload on muscles and connective tissues[10]. Neck pain or neck dysfunction is a musculoskeletal disorder caused by improper posture with physical impairment or functional limitation. The FHP is known as an internal factor that causes dysfunction with shoulder and neck pain [11]. A FHP results in a posture in which the extended head and upper cervical, and the lower cervical vertebrae flex[12].

This increases the length of the external moment (the arm) by moving the gravitational center (the head) ahead of the load bearing axis [12]. The exposure to this constant load on the craniovertebral extension muscles and the noncontractile structures causes a change in the biomechanical movement, and this increased stress can cause musculoskeletal damage or pain [13]. In addition, FHP can also limit the functional movement in the head and neck area [14]. These limitations are caused by irregular rotation and gliding movement inside the articular capsule whilst moving the joint. Moreover, it was reported that extended periods of FHP can result in a decreased number of sarcomere, as well as shortening of the muscle fibers, which can affect muscular contraction.

With normal flexion of the cervical region, there is separation of the posterior structures with an increase of the intervertebral foramina [15] However, the altered mechanics associated with forward head posture may lead to excessive compression on the facet joints and posterior surfaces of the vertebral bodies[16]. in the forward head position, there is an overriding of the articular processes and narrowing of the

intervertebral space of the mid cervical region which approaches the relationship observed in cervical extension.

The use of computers has increased dramatically over the past decade in various offices so that staffs spend a lot of time sitting behind the computer. These rapid changes may be accompanied by increased prevalence of poor posture and resultant neck pain. FHP (forward head posture) and rounded shoulders are defined as protrusion of the head and shoulders in the sagittal plane.[17]

Early diagnosis of forward head posture will help to minimize the consequences. This study aims to investigate the incidence of forward head posture in desk users using Goniometer and its association with pain and range of motion of cervical spine.[18] The objective of this study is to find the percentage of forward head posture in desk users using Goniometer and to find the associated problems of forward head posture in desktop users on Neck Pain and Disability Scale and Cervical Range of Motion.

METHODOLOGY

Research Design: Observational Study

Study Population: 30 years and above.

Source of Data: Miscellaneous

Sample Size: 100 participants

Inclusion Criteria:
- Individuals who work for >3hrs/day on Desktop for 1 year.
- Both males and females age group 30 and above.

Exclusion Criteria:
- Cervical vertebrae fracture, Deformity of spine like scoliosis\kyphosis, Medical condition like vertigo, tumor in cervical region were excluded.

Materials:
- Consent form
- Goniometer
- Ruler scale
- Pen and pencil
- Mobile phone

Outcome Measures
- Neck Pain and Disability (NDI) Scale
- Cervical Range of Motion (ROM)
- TWT (Tragus to Wall Test)

Neck Pain and Disability Scale (NPDS):
- The NPDS is a 20-item measure that was specifically developed for patients with neck pain. It measures the intensity of pain; its interference with vocational, recreational, social, and functional aspects of living; and the extent of associated emotional factors. Patients responded to each item by marking along a 10-cm visual analogue scale. Item scores range from 0 to 5, and the total score is the sum of the item scores [possible range 0 (no pain)–100 (maximal pain)].
- High test - retest reliability is 0.93
- Time Required: 5 minutes

Cervical Range of Motion

Goniometers are the measuring tool to measure the range of motion in grades base on the landmarks. For example, goniometer are myrin goniometer, Spring-T goniometer and cervical range of motion instrument.

Procedure:

i) Cervical Flexion:
- Center fulcrum of the goniometer over the external auditory meatus.
- Align proximal arm so that it is either perpendicular or parallel to the ground.
- Align distal arm with the base of the nares.

ii) Cervical Extension:
- Center fulcrum of the goniometer over the external auditory meatus.
- Align proximal arm so that it is either perpendicular or parallel to the ground.
- Align distal arm with the base of the nares.

iii) Cervical Lateral Flexion:
- Center fulcrum of the goniometer over the spinous process of the C7 vertebra.
- Align proximal arm with the spinous processes of the thoracic vertebrae so that the arm is perpendicular to the ground.
- Align distal arm with the dorsal midline of the head, using the occipital protuberance for reference.

iv) Cervical Rotation:
- Center fulcrum of the goniometer over the center of the cranial aspect of the head.
- Align proximal arm parallel to an imaginary line between the left and right acromial processes.
- Align distal arm with the tip of the nose.

Tragus to Wall Test
- To objectively measure the cervical mobility of an individual.
- Shipe et al (2013) describe the measuring the tragus to wall distance (TWD) as: "the horizontal distance between the tragus, the auricular cartilaginous flap anterior to the external auditory meatus, and a wall
- The TWD can be measured as cued or relaxed, i.e the clinician prompts the individual to assume as close to an anatomical posture as possible e.g "Stand tall.", or the clinician measures the individual in their usual or presenting posture.
- The measurement can be done standing or sitting and it is worth documenting which position has been used.
- The TWD can be measured on both the individual's right and left, and then an average can be calculated.
- Reliability: In AS, test-retest correlations have been reported at between 0.93 and 0.95. Inter-tester reliability has also been reported as "excellent" in individuals with PD.
- Validity: In PD, the TWD has shown convergent validity with similar measures (occiput to wall status, C7 to wall distance, photographically derived trunk flexion angle, and inclinometric Thoracic Hyperkyphosis measure). It has also shown the ability to discriminate between groups (those who could touch occiput to wall when prompted to stand tall) and conditions (cued or relaxed).

Procedure Of The Study:

After getting approval from Institutional Ethical Committee (IEC)., individuals selected according to inclusion/exclusion criteria and were explained regarding the study. After explaining about the study, informed consent form were taken from the participants who were willing to participate in the study. Subject were assessed for Forward Head Posture, Pain and Cervical ROM.

RESULTS

All statistical analysis was done using SPSS 25.0 software for windows. Descriptive analysis was used to obtain mean and stanard deviations. Correlation testing were done using pearsons correlation method. Among a total of 100 office workers took part in the survey 73% were female. The mean age of participants was 39±8 years.

Descriptive Statistics:

Table 1: Mean Values and Standard Deviation

Variable	Mean	Standard Deviation	N
NPDS	22.4500	12.19155	100
TWD	9.4400	1.61633	100
FLEXION	70.9500	5.73026	100
EXTENSION	59.9700	6.40463	100
LSF	34.2400	7.22526	100
RSF	31.5000	7.51093	100
LR	68.1400	9.97676	100
RR	68.1800	10.68122	100

Table 2: Correlation of NPDS with TWD, Neck ROM parameters

NPDS	Correlation	TWD	Flexion	Extension	Side Flexion (Rt)	Side Flexion (Lt)	Rotation (Rt)	Rotation (Lt)
		-0.145	-0.009	0.190	0.004	-0.43	0.069	0.077
	Significance	0.149	-.926	0.058	0.967	0.670	0.498	0.444

Correlation between NPDS and TWD and Neck ROM parameters. The

correlations between NPDS and TWD were moderate negative significant correlation (r = -0.145, p = 0.149). The correlations between NPDS and NECK ROM is moderately positive correlation is seen. (Table 2).

Table 3: Correlation of TWD with NPDS, Neck ROM parameters

TWD	Correlation	NPDS	Flexion	Extension	Side Flexion (Rt)	Side Flexion (Lt)	Rotation (Rt)	Rotation (Lt)
		-0.145	- 0.013	0.145	-0.128	-0.084	0.016	0.017
	Significance	0.149	0.899	0.151	0.204	0.404	0.871	0.863

Correlation between TWD and NPDS and Neck ROM parameters. The correlations between NPDS and TWD were moderate negative significant correlation (r = -0.145, p = 0.149), The correlations between TWD and NECK ROM moderately positive correlation is seen. (Table 3)

Table 4: Correlation of Flexion ROM with NPDS & TWD

Flexion	Correlation	NPDS	TWD
		-.009	-.013
	Significance	.926	.899

Correlation of flexion ROM with NPDS & TWD. The moderately negative correlation between flexion ROM with NPDS and TWD were not significant. ®= -0.009, p= 0.926) (r= -0.013, p = 0.899) (Table 4)

Table 5: Correlation of Extension ROM with NPDS & TWD

Extension	Correlation	NPDS	TWD
		.190	.145
	Significance	.058	.151

Table 6: Correlation of Right-Side Flexion ROM with NPDS & TWD

Side Flexion (Rt)	Correlation	NPDS	TWD
		.004	-.128
	Significance	.967	.204

Table 7: Correlation of Left Side Flexion ROM with NPDS & TWD

Side Flexion (Lt)	Correlation	NPDS	TWD
		-.043	- .084
	Significance	.670	.404

Table 8: Correlation of Left Rotation with NPDS & TWD

Rotation (Lt)	Correlation	NPDS	TWD
		.077	.017
	Significance	.444	.863

Table 9: Correlation of Right Rotation with NPDS & TWD

Rotation (Rt)	Correlation	NPDS	TWD
		.069	.016
	Significance	.498	.871

Correlation between cervical Flexion TWD and NPDS and Neck ROM parameters. The correlations between NPDS and TWD with cervical ROM is moderate positive significant correlation The correlations between TWD and NECK ROM moderately positive correlation is seen. (Table 5 to 9).

Results shows Moderately positive correlation of forward neck with reduction of ROM of Neck and moderately positive correlation of Pain and forward head posture seen according to pearsons correlation at the level of P<0.01.

RESULTS DISCUSSION

The results of the present study show that among 100 office workers who was working with computers there is positive Correlation between NPDS, TWG and Neck ROM parameters. The correlations between NPDS and TWD were moderate negative significant correlation (r = -0.145, p = 0.149), The correlations between NPDS and Neck ROM is moderately positive correlation is seen.

There is also Correlation between cervical Flexion, TWD and NPDS and Neck ROM parameters The correlations between NPDS and TWD with cervical ROM is moderate positive significant correlation and the correlations between TWD and Neck ROM moderately positive correlation is seen. Results shows Moderately positive correlation of forward neck with reduction of ROM of Neck and moderately positive correlation of Pain and forward head posture seen according to pearsons correlation at the level of P<0.01.

One of study demonstrate that the prevalence of neck pain among Iranian office workers versus office workers in other countries almost is comparable so that it was reported 64% and 36.1% in sudan and sri lanka respectively [19]. Comparing comparison between the prevalence of shoulder pain among Iranian employees and employees of other countries shows that it is less common among Iranian office workers (9.3% versus 41 % and 34.3 % in Sudan and Sri Lanka respectively). In a survey on Chinese adolescents in 2008, the prevalence of forward head posture was reported as high as 25% [8]. In reviewing the literature, no data was found on the relationship between head and spinal posture during work and chronic neck pain. According to our study, office workers using computer had more forward head, kyphosis and rounded shoulder posture.[20]

The improper posture of head, cervical and thoracic spine was more common in the symptomatic group comparing the asymptomatic group during computer working that is equivalent to the results of mentioned cross-sectional studies that showed a significant relationship between individual's posture and neck pain.

Duration of computer use may have an impact on the incidence of neck pain. According to results of other cross-sectional studies, it was found that there is positive correlation between duration of sitting and neck pain prevalence. Another study showed that sitting behind desk for over 5 hours per day, is considered a risk factor for neck pain. Despite of these studies, in a systematic review, it was found that there is no significant correlation between duration of sitting and neck pain.

According to our study, there was no relationship between the duration of working with computer and neck pain (p = 0.322). In a prospective study with a 3-year follow-up by ariens et al on over 1,334 employees, it was observed that there is a strong relationship between duration of sitting in working hours and neck pain in such a way that if one is in sitting position for over 95% of his working hours, the probability of suffering from neck pain is increased (rr= 2.01%).

According to results of some studies, it was observed that FHP is more prevalent in women compared to men, while in present study it was seen that there is no difference in FHP prevalence in men and women. Another systematic review indicated that there is no correlation between participation in various sport and recreational exercises and neck pain. In a research by dimberg et al, it was found that taking part in rocket sport is a negative risk factor for neck pains . Of course, in our research on university office workers it was seen that they have no regular sport activity and a few of them may exercise a particular kind of sport at the weekends occasionally which was negligible and no positive or negative correlation was found in this regard. It needs further studies in the future. Another factor investigated in most previous studies is the relationship between driving and prevalence of neck and shoulder pain.

One of the study have revealed that office employees had a more improper posture while working with a computer versus sitting with forward looking (not a working) position, and that the defective posture in the working position was more severe in the symptomatic group. It may be due to poor ergonomics of chair, desk, computers position and also lack of attention paid to body position during work. Lack of awareness of posture while working among employees is important in causing improper posture of head and neck; so paying attention to head and neck posture during work might be a good way to decrease the poor posture. It can be introduced into the office environment by feedback methods, mirror or alarming instruments.

According to the results of Cagnie et al. study, it has been found that there is a positive correlation between duration of computer work and neck pain. Other studies that were published before 2000 showed that if duration of sitting at a desk is longer than 5 hours per day, it is considered as a risk factor for neck pain. In contrast to these findings, a systematic review of the 3 studies has found that there was no significant relationship between the duration of sitting and neck pain.[21,22]Based on our findings, there was no relationship between hours of work with a computer and neck pain (p = 0.322).

CONCLUSION

The present study demonstrated the Association of forward head posture with pain and cervical range of motion in desk users. It shows moderately negative correlation between pain and tragus to wall test and it shows positive correlation between pain and cervical range of motion.

Abbreviations

FHP: Forward Head Posture, NPRS: Numerical pain rating scale , VAS: Visual Analogue scale, CVA: Craniovertebral angle, NPDS: Neck pain and disability scale , ROM: Range of Motion, TWT: Tragus to wall test, TWD: Targus to wall distance

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"THE EFFECTS OF ULTRASOUND AND CRYOTHERAPY ON RANGE OF MOTION AND DISABILITY IN PATIENT WITH FROZEN SHOULDER – A COMPARATIVE STUDY"

Physiotherapy

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ABSTRACT

Background: Frozen shoulder (FS) is signified by pain and stiffness in the shoulder joint; limited range of motion and pain are the most common symptoms. It is also known as adhesive capsulitis or periarthritis (PA). FS has a prevalence of approximately 2 to 5 % in the general population. The incidence among women is 1.6 to 4-fold higher than in men. Functional impairments caused by FS consist of Limited Reaching, particularly during Overhead or to the side activities. **Methodology:** Patients were analyzed pre and post treatment for frozen shoulder by SPADI and range of motion (ROM) of the shoulder joint by using goniometer. Total 40 Patients were taken and divided in two group. Group A received ultrasound with conventional physiotherapy and Group B received cryotherapy ultrasound with conventional physiotherapy for 6 days a week for 4 weeks. **Result:** The research was performed on 100 participants between the age of 20-40. There were 56 patients between the ages of 20 to 30, 44 patients between the age 31to 40. Moderately negative correlation seen in standing duration and pronation of foot. **Conclusions:** In conclusion the treatment program consisting of Ultrasound with Conventional Physiotherapy is more effective in frozen shoulder to reduce Pain, Functional disability and improve Shoulder range of motion.

KEYWORDS

Frozen shoulder, Ultrasound therapy, Cryotherapy, Rang of motion, Shoulder Pain And Disability Index

INTRODUCTION

1.1 Shoulder Complex

The shoulder joint, also known as the glenohumeral joint, is a dynamic articulation between the glenoid of the scapula and the proximal humerus, with functions like abduction, adduction, flexion, extension, and rotation. It is supported by the primary four rotator cuff muscles.[1,2] The shoulder joint is one of the most mobile joints in the human body due to its loose capsule and humeral head size. It is commonly dislocated due to its increased mobility. The upper extremity is connected to the axial skeleton via the sternoclavicular joint. The pectoral girdle consists of three joints.[3,4]

"Frozen shoulder" was first introduced by Codman in 1934, a painful shoulder condition with stiffness, difficulty sleeping, and reduced forward elevation and external rotation. This condition was formerly known as 'periarthritis' by Duplay in 1872, and later redefined as 'adhesive capsulitis' by Julius Naviaser in 1945. The disease is distinct from arthritis and preserves the joint.[5,6,7]

1.2 Frozen Shoulder

"Frozen shoulder" was first introduced by Codman in 1934, a painful shoulder condition with stiffness, difficulty sleeping, and reduced forward elevation and external rotation. This condition was formerly known as 'periarthritis' by Duplay in 1872, and later redefined as 'adhesive capsulitis' by Julius Naviaser in 1945. The disease is distinct from arthritis and preserves the joint.[5,6,7]

1.3 Etiology

Frozen shoulder (FS) is often associated with diabetes mellitus, affecting 10-36% of diabetics. Insulin-dependent diabetics are at the highest risk, and the primary cause is unknown, making them 2-4 times more likely to develop the condition.[8,9]

Frozen shoulder is common in thyroid disorders, Parkinson's disease, and cardiac and pulmonary diseases, often triggered by surgical procedures or shoulder injuries.[10,11]

1.4 Epidemiology:

Frozen Shoulder prevalence in general population is 2-5%, with increased rates in diabetics and thyroid gland pathologies, particularly hypothyroidism, up to 10-38%.[12,13]

Type 1 diabetes significantly increases the risk of developing FS, with a lifetime prevalence of 76%, particularly in patients over 45 years old.[14]

1.5 Pathophysiology:

FS is a condition characterized by synovial inflammation and capsular fibrosis, often resulting from cytokines like TNF-alpha and ILs. The cause is unclear, but potential triggers include chronic inflammation, tendon damage, Tendon Fiber rupture, or inflammatory mediators.[15,16,17] Figure 1 Summarizes the pathological event and pathogenesis of FS.[18]

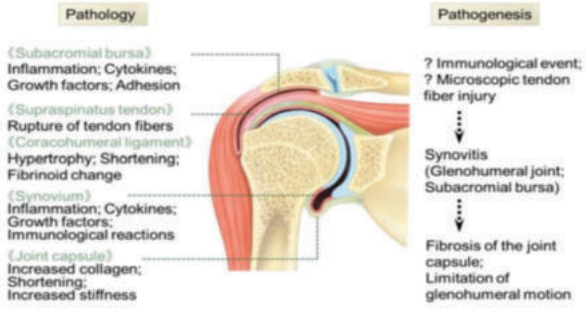


Fig. 1 Pathological event and Pathogenesis of FS

1.6 Stages:

Clinical presentation is typically in three overlapping phases: [19] The clinical presentation of a condition is divided into three phases: Stage 1, which is a gradual onset of pain with movement, Stage 2, which is persistent and intense pain, and Stage 3, which is pain only with movement, significant adhesions, and limited GH motions. Stage 4 of a joint condition, known as Thawing, involves minimal pain, no synovitis, but significant capsular restrictions from adhesions, with gradual motion improvement. The "freezing" stage of treatment for FS should focus on pain control, inflammation reduction, and patient education. Home self-exercise is effective, and daily programs should be given. Other treatments include anesthesia manipulation and surgical procedures.[5,20]

1.7 METHODOLOGY

STUDY DESIGN AND SETTING

Research Design: A COMPARATIVE STUDY

Population: Subjects with Frozen shoulder

Sample Design: Convenient sampling

Sample Size: The study was done on 40 patients. Subjects were divided in to 2 groups.

- Group 1=20 subjects (n=20)
- Group 2= 20 subjects (n=20)

Selection Criteria
Inclusive Criteria:
- Age between 30 to 60 year.
- Painful and limited passive shoulder joint mobility
- FS patients with and without type 2 diabetes mellitus
- More restricted lateral rotation relative to abduction and medial rotation.
- No clear sign (eg. painful arc, positive resistance testing, or loss of power)
- Illness time ranging between 2-15 months
- Stage of frozen shoulder: 1-3 stages

Exclusive Criteria:
- Any previous shoulder surgeries.
- Frozen shoulder Stage 4
- Glenohumeral or Acromioclavicular arthiritis.
- Any condition other than frozen shoulder
- Any Fracture around the shoulder complex
- Patient know to have uncontrolled diabetes mellitus or type 1, orthopedic condition or deformities around shoulder joint and any neuromuscular disorder.

OUTCOME MEASURES:
Shoulder Pain and Disability Index (SPADI) and Shoulder Range of Motion (ROM) Overview

SPADI:
- Self-administered questionnaire with 13 items assessing pain and functional activities.
- Assesses 5 questions on pain severity and 8 questions on difficulty with daily activities.
- High test-retest reliability of 0.92.
- Requires 5-10 minutes of time.

ROM:
- Measured using Universal Goniometer, a highly reliable tool conducted by the same therapist.
- Test-retest reliability of 0.94–0.98.

Patient Positioning and Movement Shoulder Flexibility:
- Patient is supine lying with shoulder and elbow 90º position.
- Axis: Greater tuberosity of the humerus.
- Movable arm placed over the midline of the lateral arm.
- Stable arm placed either perpendicular or parallel to the ground.

Shoulder Extension:
- Patient is prone lying with shoulder and elbow 90º position.
- Axis: One inch below the acromion process of the scapula.
- Movable arm placed over the midline of the anterior arm.
- Stable arm placed perpendicular or parallel to the clavicle.

Shoulder External & Internal Rotation:
- Patient is supine lying with shoulder and elbow 90º position.
- Axis: Olecranon process of the ulna.
- Movable arm placed over the midline of the posterior forearm.

Procedure:
- Approval from Institutional Ethical Committee (IEC) for study.
- Individuals selected based on inclusion/exclusion criteria.
- Informed consent form obtained from willing participants.
- Patients' anamnesis and demographic characteristics recorded.
- SPADI, VAS, and Shoulder joint ROM taken.
- Subjects assigned into two groups:

Group 1(n=20) Ultrasound with Conventional Physiotherapy and Group 2(n=20) Cryotherapy with Conventional Physiotherapy.

Outcome measures taken at baseline, after 2 weeks, and 4 weeks of treatment.

Statistical analysis using SPSS 25.0 software. P value less than 0.05 considered statistically significant.

RESULTS
The study used SPSS 25.0 software for Windows to compare the success of ultrasound and cryotherapy treatment for Frozen shoulder in 40 subjects, with 20 in each group meeting inclusion criteria.

Demographic Data
TABLE 1. Gender distribution

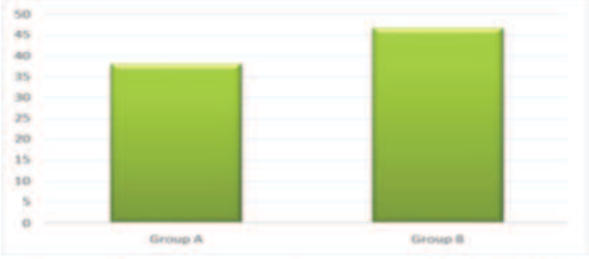
Graph 1: Graph of Gender distribution

Interpretation of Result:
1) Inter Group Analysis:
The table compares shoulder disability in Group A & B using independent T test. At baseline, no significant difference exists, but post-treatment p value of 0.03 suggests significant improvement between groups.

2) Intra Group Analysis:
The table compares shoulder disability in group A and B using paired t-test, showing significant differences in pain scores, indicating effective treatment for both groups.

Graph 2: Intragroup comparison of mean values of SPADI for Group A

Graph 3: Intragroup comparison of mean values of SPADI for Group B

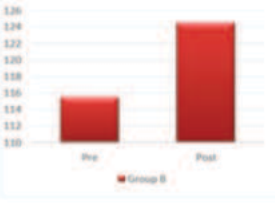


Graph 4: Intergroup comparison of mean values of SPADI

Interpretation of Results:
1) Inter group Analysis:
The study compared shoulder flexion ROM scores between Group A and B using an independent T test, finding no significant difference at baseline but significant improvement post-treatment.

2) Intra group analysis:
The table compares shoulder flexion ROM and pain scores in groups A and B, showing significant differences, indicating effective treatment for both groups.

Graph 5: Intragroup comparison of mean values of Flexion ROM for Group A



Graph 6: Intragroup comparison of mean values of Flexion ROM for Group B

Graph 7: Intergroup comparison of mean values of Flexion ROM

Interpretation of Results:

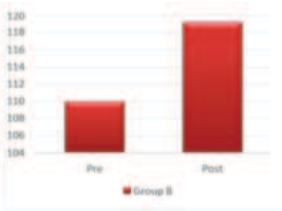
1) Inter group analysis:

The table compares shoulder Abduction ROM scores between Group A and B, showing no significant difference at baseline and a 0.03 post-treatment improvement.

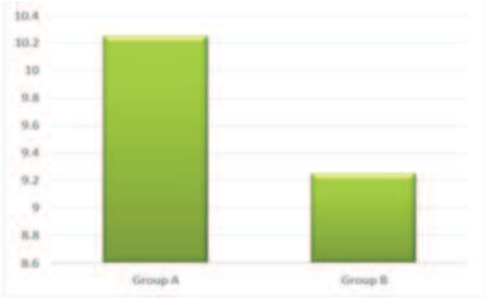
2) Intra group analysis:

The table compares shoulder abduction ROM and pain scores in groups A and B, showing significant differences, indicating effective treatment for both groups.

Graph 8: Intra group comparison of mean values of Abduction ROM for Group A



Graph 9: Intra group comparison of mean values of Abduction ROM for Group B



Graph 10: Intergroup comparison of mean values of Abduction ROM

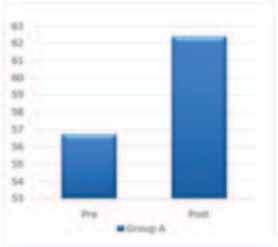
Interpretation of Result:

1) Inter group analysis:

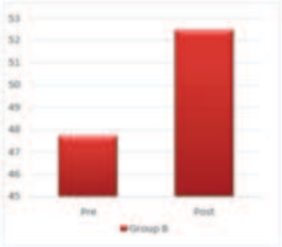
The table compares shoulder External ROM scores between Group A and B, showing no significant difference at baseline and a 0.04 post-treatment improvement.

2) Intra group analysis:

The table compares shoulder external ROM and pain scores in groups A and B, showing significant differences, indicating effective treatment for both groups.



Graph 11: Intragroup comparison of mean values of External rotation ROM for Group A



Graph 12: Intragroup comparison of mean values of External rotation ROM for Group B

Graph 13: Intergroup comparison of mean values of External rotation ROM

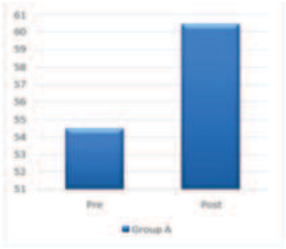
Interpretation of Result:

1) Inter group analysis:

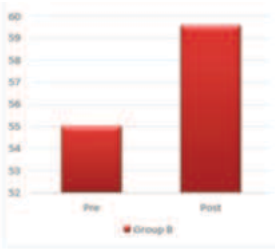
The table compares shoulder Internal ROM scores between Group A and B, showing no significant difference at baseline and a 0.03 post-treatment improvement, suggesting significant improvement between groups.

2) Intra group analysis:

The table compares shoulder Internal ROM and pain scores in group A and B, showing significant differences, indicating effective treatment for both groups.



Graph 14: Intragroup comparison of mean values of Internal Rotation ROM for Group A



Graph 15: Intragroup comparison of mean values of Internal Rotation ROM for Group B

Graph 16: Intergroup comparison of mean values of Internal Rotation ROM

DISCUSSION

The study investigates the effectiveness of ultrasound therapy and cryotherapy in reducing pain, range of motion, and disability in patients with frozen shoulder. Both groups received conventional physiotherapy for 4 weeks. Results showed significant differences in ROM improvement for both groups. However, the group receiving ultrasound therapy showed improvement in flexion extension, internal and external rotation, but not abduction and adduction ROM. The study highlights the self-limiting nature of frozen shoulder symptoms. [21,22] Ultrasound therapy reduces pain, increases blood flow, and aids tissue repair. It's used in rehabilitation for frozen shoulder patients. Connective tissue stretches promote elastic and plastic responses. Crystaltherapy controls pain by altering perception and controlling transmission to higher centers, making it useful for treating shoulder pain. [23] Cold exposure increases norepinephrine, providing calming effects. High-level mobilization improves frozen shoulder treatment in primary patients, while stretching programs relieve symptoms in stage 2 patients. [24,25] The study found that combining cryotherapy with conventional physiotherapy effectively reduced pain, functional disability scores, and improved range of motion in patients with frozen shoulder. Ultrasound therapy, produced using quartz, reduces pain,

increases blood flow, and aids in tissue repair. It's used in rehabilitation for frozen shoulder patients and promotes soft tissue healing. Connective tissue stretches promote elastic and plastic responses.

CONCLUSION

In conclusion the treatment program consisting of Ultrasound with Conventional Physiotherapy is more effective in frozen shoulder to reduce Pain, Functional disability and improve Shoulder range of motion.

Limitations:

✓ Small sample size

✓ No control group was included in the study

Future Recommendation:

✓ The study can be done on a larger number of populations.

✓ The study can be done with control group along with only conventional physiotherapy given in frozen shoulder

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ORIGINAL RESEARCH PAPER
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COMPARISON OF INTRINSIC VERSUS EXTRINSIC FOOT MUSCLE STRENGTHENING ON PAIN AND FUNCTION IN PLANTAR FASCIITIS: AN EXPERIMENTAL STUDY.

Physiotherapy

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ABSTRACT

Background: Plantar fasciitis is a prevalent condition affecting 10% of the general population, particularly active working adults aged 25 to 65. This study aimed to assess the efficacy of intrinsic and extrinsic muscle-strengthening exercises in individuals with plantar fasciitis, considering age-specific responses. **Methods:** A randomized controlled trial was conducted involving 30 participants (18 females, 12 males) aged above 18, distributed into Group-A (intrinsic exercises) and Group-B (extrinsic exercises) for a 4-week intervention. Age distribution mirrored the typical age range of plantar fasciitis patients. **Results:** In participants aged above 40, intrinsic exercises demonstrated a statistically significant improvement in foot function and pain reduction compared to extrinsic exercises. No significant differences were observed in participants below 40. Overall, intrinsic exercises showed superiority in both age groups. **Conclusion:** This study highlights the importance of tailoring exercise interventions for plantar fasciitis based on age. Intrinsic exercises, particularly for individuals above 40, proved more effective in enhancing foot function and reducing pain. These findings underscore the need for individualized rehabilitation plans and warrant further research to explore long-term effects and refine treatment strategies.

KEYWORDS

Planter Fasciitis, Ultrasound, Intrinsic Exercise, Extrinsic Exercise, Foot Function Index, Numeric Pain Rating Scale.

INTRODUCTION

BACKGROUND

- Plantar fasciitis is a prevalent source of heel pain among adults. The discomfort typically results from collagen degeneration, often mischaracterized as "chronic inflammation," occurring at the point where the plantar fascia originates on the medial tubercle of the calcaneus. This degeneration shares similarities with the persistent necrosis seen in tendonosis. Tendonosis is characterized by the loss of collagen continuity, heightened levels of ground substance (the connective tissue matrix), increased vascularity, and the presence of fibroblasts, in contrast to the inflammatory cells typically associated with the acute inflammation seen in tendonitis.[1,2]
- This condition commonly results from overuse, primarily attributed to repetitive strain causing micro-tears in the plantar fascia. However, it can also manifest due to trauma or a combination of various factors. Predisposing factors include pes planus, pes cavus, restricted ankle dorsiflexion, and abnormal pronation or supination. Pes planus may increase strain at the plantar fascia's origin, while pes cavus can impose excessive strain on the heel due to inadequate foot eversion and shock absorption.
- Tightness in the gastrocnemius, soleus, and other posterior leg muscles is frequently observed in individuals with this condition, potentially altering normal walking biomechanics. While around 50% of patients may exhibit heel spurs, these spurs are not the root cause but are often present. Plantar fasciitis is commonly associated with runners and older adults, with additional risk factors including obesity, heel pad atrophy, aging, occupations involving prolonged standing, and weight-bearing activities. Although there is an association with certain seronegative spondyloarthropathies, approximately 85% of cases do not have identifiable systemic factors.[3,4]

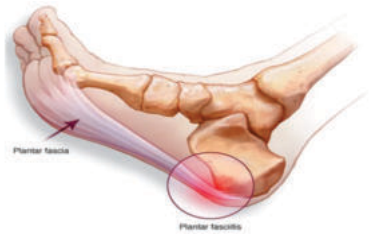


Figure 1: Diagram of Planter Fasciitis

Plantar fasciitis stands as the predominant cause of heel pain encountered in outpatient settings. While the precise incidence and prevalence across different age groups remain elusive, estimations suggest that approximately one million patient visits annually are attributed to plantar fasciitis. This condition contributes to around 10% of injuries related to running and necessitates professional medical care for 11% to 15% of all foot symptoms. It is believed to afflict approximately 10% of the general population, with the majority (83%) of affected individuals falling within the active working age group of 25 to 65 years. Bilateral presentation occurs in about a third of cases. Some literature indicates even higher prevalence rates, reaching up to 22%, particularly within populations of runners.[5,6]

- Management of plantar fasciitis involves a phased approach, with initial emphasis on conservative measures. Relative rest from the causative activity, tailored to the pain level, is recommended. Post-activity application of ice and the use of oral or topical NSAIDs can help alleviate pain.
- Patients are encouraged to modify work-related activities, and a night splint may be beneficial for those with persistent pain. Surgery is considered the final option and may involve fasciotomy through an open or endoscopic approach. However, it's important to note that surgical release does not guarantee a successful outcome. Potential complications include nerve injury, plantar fascia rupture, and flattening of the longitudinal arch. Careful consideration of the risks and benefits is imperative when contemplating surgical intervention for plantar fasciitis.[7,8,9]

Methodology

Study Place

OPD of Venus Institute of Physiotherapy, Bhoyan Rathod, Gandhinagar and Hi-Tech Multispecialty Hospital, Gandhinagar

Study Duration

4 weeks

Study Design

- Exprimental Study

Inclusion Criteria

1. Patients willing to participate
2. Both male and female subjects
3. Age between 25-60 years
4. Diagnosed with Plantar Fasciitis

Exclusion Criteria

1. Subjects with neurological disorders affecting the foot
2. Subjects with any previous heel or foot surgeries
3. Subjects with Peripheral Vascular disease
4. Subjects with pain at great toe and not around heel pain.

MATERIALS REQUIRED

Intervention

Intervention Group

1. Group A (Intrinsic Foot Muscle Strengthening + Ultrasound)
Participants will engage in a structured program including exercises such as toe curls, big toe extension *(Figure : 10)*, marble pick-up, towel gathering curls*(Figure : 9)*, toe spread, and tennis ball exercises. Each exercise is designed to target intrinsic foot muscles.
The intervention will include ultrasound therapy in addition to the exercise regimen.

2. Group B (Extrinsic Foot Muscle Strengthening + Ultrasound)
Participants in this group will follow exercises focused on extrinsic foot muscle strengthening, including calf muscle stretch*(Figure :5)*, resisted plantar flexion*(Figure : 6)*, foot supination-sitting, foot adduction, hip external rotation-side lying, and hip abduction.

Similar to Group A, participants in this group will receive ultrasound therapy *(Figure : 12)* as part of the intervention.

Exercise Protocol

Each exercise session will consist of 10–20 repetitions.
Participants will perform the exercises three times per day.

Figure 2 : Calf Muscle Stretching

Figure 3 : Resisted Plantar Flexion

Figure 4: Resisted Inversion Of Foot

Figure 5 : Abduction Of Foot Finger

Figure 6 : Towel Gathering (Curls) Exercise

Figure 7 : Big Toe Extension Exercise

Figure 8 : Big Toe Extension Exercise

Figure 9 : Apply Ultrasound Therapy

Outcome Measures

1. Foot Function Index (FFI) [13]

The FFI is a self-administered index comprising 23 items categorized into three subscales: pain, disability, and activity limitation. Participants rate each item on a scale from 0 (no pain or difficulty) to 10 (worst pain imaginable or requiring assistance) based on their foot condition over the past week. The pain subcategory consists of 9 items, disability subcategory consists of 9 items, and the activity limitation subcategory consists of 5 items. The FFI demonstrates good test-retest reliability for both total and subscale scores (ranging from 0.87 to 0.69) and high internal consistency (ranging from 0.96 to 0.73)

2. Numeric Pain Rating Scale (NPRS) [14]

The NPRS is a unidimensional measure of pain intensity in adults, comparable to the visual analogue scale (VAS). Administered verbally or graphically for self-completion, it employs a 10-point numeric scale ranging from 0 (no pain) to 10 (worst pain imaginable). Participants indicate the numeric value on the segmented scale that best describes their pain intensity. Higher scores signify greater pain intensity. The NPRS exhibits high test-retest reliability in literate and illiterate patients with rheumatoid arthritis (r=0.96 and 0.95, respectively). Additionally, for construct validity, the NPRS correlates highly with the VAS in patients with chronic pain conditions (ranging from 0.86 to 0.95). The scale provides a reliable and valid measure of pain intensity.

Data Collection

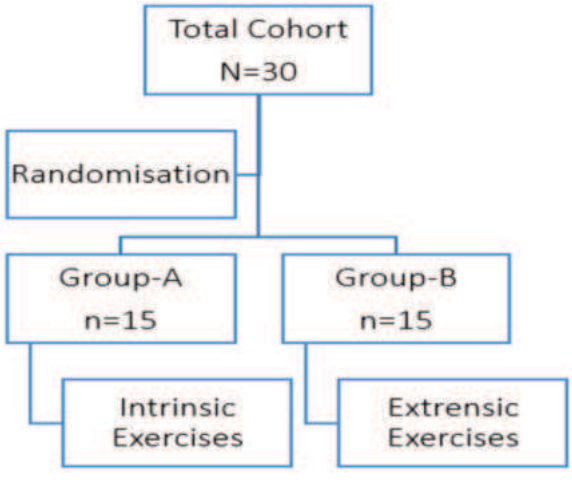
Data of all the patients were collected a data collection form.

Statistical Analysis

Descriptive statistics will be employed for demographic data, and inferential statistics will be used to compare changes in FFI and NPRS scores between the two intervention groups. The significance level will be set at $p < 0.05$.

RESULTS

This study involved a total of 30 patients diagnosed with plantar fasciitis were randomly allocated into two groups, Group-A and Group-B, each prescribed a distinct type of exercise regimen aimed at muscle strengthening—Intrinsic and Extrinsic, respectively—for a duration of 4 weeks. Among the total population, 18 patients were female and 12 were male, spanning ages from 18 to 59 years.



Baseline Characters

Table 1: Age group of Study Population

Age Group	Group-A		Group-B	
	Number	Percentage	Number	Percentage
20-29 Years	2	13.33%	2	13.33%
30-39 Years	6	40.00%	7	46.67%
40-49 Years	4	26.67%	6	40.00%
50-59 Years	3	20.00%	0	0.00%

The participant distribution across different age groups in Groups A and B, engaged in intrinsic and extrinsic exercises, respectively, reveals interesting insights. In the 20-29 age group, both groups have an equal representation of 13.33%. In the 30-39 age range, Group A constitutes 40.00% of participants, slightly less than the 46.67% in Group B. The 40-49 age group sees 26.67% in Group A compared to 40.00% in Group B. Notably, in the 50-59 age group, Group A has 20.00% representation, while Group B has none. These demographic variations underscore the importance of considering age differences in the interpretation of intervention outcomes, as the efficacy of intrinsic and extrinsic exercises may vary across different age cohorts.

Comparative Analysis of Group-A and Group-B

Table 2: Post-Baseline Full Set Descriptive Data (Group-A vs Group-B)

Post-Baseline Full Set Descriptive Data (Group-A vs Group-B)								
	Foot Function Index (FFI)				Numeric Pain Rating Scale (NPRS)			
	Group-A	Group-B	CFB	%CFB	Group-A	Group-B	CFB	%CFB
N	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00
Minimum	90.00	120.00	11.00	10.09	3.00	4.00	0.00	0.00
Maximum	110.00	138.00	38.00	40.00	5.00	6.00	3.00	100.00
Mean	99.07	126.90	27.87	28.57	3.67	4.73	1.07	32.78
SD	6.46	5.66	7.90	9.09	0.62	0.80	1.03	33.85
SEM	1.67	1.46	2.04	2.04	0.16	0.21	0.27	8.74
P-value	<0.0001				<0.05			
Note: CFB- Change From Baseline/ %CFB- Percentage Change From Baseline								

In the post-baseline full set analysis comparing Group-A (Intrinsic Exercises) to Group-B (Extrinsic Exercises), significant differences are observed in both the Foot Function Index (FFI) and Numeric Pain Rating Scale (NPRS). In terms of FFI, Group-A exhibited a mean score of 99.07, significantly lower than Group-B's mean of 126.90, resulting in a substantial change from baseline (CFB) of 27.87 and a percentage change (%CFB) of 28.57%. This indicates that participants in Group-A experienced a more significant improvement in foot function compared to Group-B. In the NPRS, Group-A also showed a lower mean pain score of 3.67 compared to Group-B's 4.73, resulting in a CFB of 1.07 and a %CFB of 32.78%. While both groups experienced improvements in pain, Group-A demonstrated a larger reduction. The statistical significance for both FFI and NPRS differences is indicated by p-values of <0.0001 and <0.05, respectively. These results suggest that intrinsic exercises (Group-A) may be more effective in improving foot function and reducing pain compared to extrinsic exercises (Group-B).

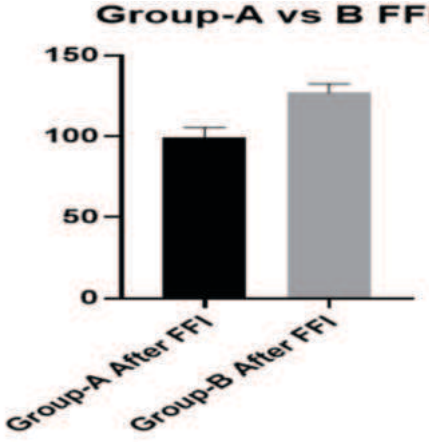


Figure 11: Post-Baseline Full Set Descriptive Data (Group-A vs Group-B)

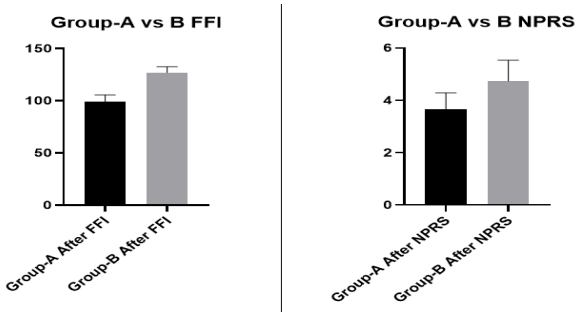


Figure 12: Post-Baseline Full Set Descriptive Data (Group-A vs Group-B)

DISCUSSION

Comparison with Previous Studies

The present study significantly contributes to our understanding of the relevance of intrinsic and extrinsic muscle strengthening in individuals diagnosed with plantar fasciitis [10]. The research cohort comprised a total of 30 participants, all above the age of 18, which aligns with the demographic characteristics of plantar fasciitis patients, a condition that notably affects around 10% of the general population. Within this demographic, a substantial majority consists of active working adults aged between 25 and 65 years, with a peak incidence occurring in the 40 to 60 years age range and a higher prevalence in women compared to men. Remarkably, a similar age distribution was observed in the present study, with the majority falling between the ages of 30 and 49[11].

Building on existing literature, a prior study involving 36 individuals focused on comparing the effectiveness of exercises targeting extrinsic and intrinsic foot muscles in enhancing the medial longitudinal arch, particularly in adolescents with flat feet. In this investigation, Group 1 engaged in intrinsic muscle exercises, while Group 2 performed extrinsic muscle exercises. The outcomes of this study resonate with the findings of the present research, where the group undertaking intrinsic exercises exhibited a statistically significant improvement compared to the group assigned extrinsic exercises for managing plantar fasciitis. These parallel results further support the notion that intrinsic exercises may be more effective than their extrinsic counterparts in addressing the complexities of plantar fasciitis. The implications of these findings are particularly relevant in informing targeted intervention strategies for individuals grappling with this prevalent foot condition [12].

CONCLUSION

In conclusion, the comprehensive analysis of participants undergoing intrinsic (Group-A) and extrinsic (Group-B) exercises, particularly when stratified by age, reveals noteworthy findings. Both intrinsic and extrinsic interventions resulted in statistically significant improvements in foot function and pain levels, with Group-A consistently demonstrating a more pronounced effect across various parameters. When examining age-specific data, the distribution of participants varies, with Group-B having a higher representation in the 30-39 age group, while Group-A displays a more balanced distribution across the 30-39, 40-49, and 50-59 age groups. Notably, Group-A consistently outperforms Group-B in improving foot function and reducing pain, especially among participants above 40 years. These results underscore the potential efficacy of intrinsic exercises, particularly for individuals above 40 years old, in enhancing foot function and alleviating pain. However, the diverse age distribution emphasizes the need for careful consideration of age-related factors in interpreting and applying these intervention outcomes. Further research and exploration of age-specific responses to intrinsic and extrinsic exercises would contribute to a more nuanced understanding of their effectiveness in improving foot health.

Limitations

- Despite the insightful findings, it is important to acknowledge several limitations in this study. Firstly, the relatively small sample size within each age group may limit the generalizability of the results to broader populations.
- The unequal distribution of participants across age groups could introduce potential bias, especially in the 50-59 age range where Group-B lacks representation. Additionally, the study's duration and follow-up period are crucial factors to consider, as they may

impact the long-term sustainability of the observed improvements. The lack of a control group or alternative intervention group further limits the ability to attribute the observed changes specifically to intrinsic or extrinsic exercises.

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INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

THE EFFECTIVENESS OF MATRIX RHYTHM THERAPY IN MUSCULOSKELETAL DISORDERS: AN EVIDENCE BASED STUDY

Physiotherapy

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ABSTRACT

Background: This study evaluates Matrix Rhythm Therapy (MRT) alongside traditional massage to assess their impact on peripheral circulation. While massage therapy is widely used to enhance blood flow and tissue healing, the effectiveness of MRT in this regard remains unclear. By comparing these modalities, the study aims to provide clarity on their therapeutic benefits, potentially guiding treatment choices in clinical practice. **Methods:** A systematic review following PRISMA guidelines will compare Matrix Rhythm Therapy (MRT) and traditional massage effects on peripheral circulation. Studies will be assessed using PEDro score and CEBM's Level of Evidence scale. Data synthesis, including potential meta-analysis, aims to inform clinical decisions on therapeutic interventions for peripheral circulation. **Results:** Matrix Rhythm Therapy (MRT) demonstrated significant efficacy across various conditions, including pain reduction, enhanced functional activities, and improved quality of life. Studies highlighted its effectiveness in addressing chronic low back pain, peripheral circulation, diabetic peripheral neuropathy, and hand pain in excessive smartphone users. While some comparisons favored alternative treatments like stretching exercises for specific conditions, overall, MRT emerged as a promising therapeutic modality with broad applicability in healthcare settings. **Conclusion:** Matrix Rhythm Therapy (MRT) shows significant promise in addressing a wide range of conditions, offering pain relief, improving functional outcomes, and enhancing quality of life.

KEYWORDS

Musculoskeletal disorder, Matrix Rhythm Therapy, Systematic review, pain reduction.

INTRODUCTION

Background

Patients experiencing musculoskeletal issues often activate anaerobic metabolism due to reduced blood circulation and microcirculation. The compromised regulation of microcirculation in muscles is associated with the generation of nociceptive pain. Circulation plays a crucial role in tissue healing, with enhanced blood circulation facilitating the delivery of proteins, nutrients, and oxygen, consequently promoting improved tissue healing Recent studies have focused on comparing the efficacy of various conservative treatment approaches on bloodstream dynamics.[1,2,3]

Massage, a widely adopted physiotherapeutic technique, is employed to enhance blood circulation. Defined as soft tissue manipulation for therapeutic purposes, massage therapy is administered by trained therapists. While some sports medicine practitioners advocate for the benefits of massage, including increased blood circulation, reduced muscle tension, and enhanced neural excitability, conflicting opinions exist in the literature. Some authors posit that massage positively impacts blood circulation, while others assert that it has no effect.[4,5,6,7]

Various massage techniques, such as effleurage, petrissage, tapotement, friction, and vibration, are employed.[8] Vibration massage, specifically, aims to enhance circulation and facilitate muscle relaxation. Mechanical devices allow for the safe and localized application of vibration treatment. Adjustable speed and frequency in vibration devices cater to diverse indications, with some used in beauty salons for fat burning, hand-held devices for musculoskeletal pain, and whole-body vibration devices for exercise.[9]

While hand-held devices exhibit a strong placebo effect, low-magnitude mechanical vibration is believed to boost local blood flow. Matrix Rhythm Therapy (MRT) represents a novel form of vibromassage utilized in various settings, including special education and rehabilitation centers, sports clubs, and neurologic, orthopedic, physical therapy, and rehabilitation centers.[10,11,12]

Limited studies and clinical experiences suggest the effectiveness of MRT, yet the evidence level is considered low. To elucidate the therapeutic efficacy of MRT, it is imperative to explore its impact on peripheral circulation. [13]As MRT is a novel vibromassage method, no studies have yet assessed its influence on circulation, and existing literature presents conflicting results regarding the effect of massage on peripheral circulation[14]. Notably, MRT requires a device for application, distinguishing it from traditional massage methods. If the findings of the current study reveal comparable increases in peripheral blood circulation between massage and MRT, it may suggest a preference for traditional massage over MRT. This approach deviates from previous studies that compared MRT to a placebo, as therapists have shown a preference for manual hand massage over handheld devices.[15]

MRT represents a groundbreaking approach in cellular therapy, utilizing rhythmic oscillations within the 8-12 Hz range to rejuvenate cellular energy metabolism and rebalance physiological functions.[16] By intricately stimulating cells and synchronizing tissue, it promotes heightened circulation, increased oxygenation, and enhanced ATP synthesis, fostering deep-seated muscle and tissue relaxation. This advanced technique orchestrates cellular regeneration and healing through precise micro-process modulation, ensuring enduring relaxation and optimized tissue metabolism, thereby offering comprehensive therapeutic benefits at the cellular level.

Figure 1: Matrix Rhythm Ther

Figure 2: Matrix Mobil Device

Figure 3: MRT for Back Pain

Figure 4: MRT for Knee Pain

Figure 5: MRT for Muscle Pain

Figure 6: MRT for Heel Pain

METHODOLOGY

Study Duration

6 - 8 Month.

Study Design

This will be an Evidence Based Study and will conduct according to PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-analysis) guidelines.

Figure 7: Flowchart for PRISMA

Figure 8 : Flowchart for Review Article

Inclusion Criteria

1. Articles published during last 10 years. (2012- May 2022)
2. Articles having study design as Systematic reviews, Meta-analysis and Randomized controlled trial.
3. Articles published in English.
4. Articles in which studies done on Human.

Exclusion Criteria

1. Articles having study design as case control or cohort.
2. Studies done on animals.
3. Studies design case reports.

Data Analysis

- ❖ Physiotherapy Evidence Database (PEDro)
  - ➢ It assesses methodological quality and consists of a checklist of 11criteria, 10 of which are scored.
  - ➢ For each criterion the study met, 1 point was awarded.
  - ➢ The points were presented as a score out of 10.
  - ➢ PEDro scores of 6 to 10 were considered high quality, of 4 to 5 were considered moderate quality, and of 0 to 3 were considered low quality

- ❖ Centre for Evidence-Based Medicine's (CEBM's) Levels of Evidence scale:
  - ➢ It assesses quality based on study design, which categorize the studies in a scale ranging from 1 to 5 with further subdivision for each.

Figure 09: Hierarchy of Evidence

RESULTS

The review article synthesized findings from multiple studies on Matrix Rhythm Therapy (MRT), highlighting its diverse applications and therapeutic efficacy across various pathological conditions. Dr. Sonali Shrivastava's review emphasized MRT's ability to induce oscillations within the physiological frequency range, thereby restoring disrupted rhythms at the cellular level and enhancing oxygen supply, leading to tissue relaxation and pain reduction.

Dr. med. Ulrich G. Randoll underscored MRT's successful application in rehabilitation, sports medicine, and veterinary medicine, noting its role in preventive measures and rehabilitation efforts, as well as its effectiveness in addressing various types of pain and degenerative diseases.

Nadir et al.'s study focused on chronic low back pain and found that MRT, when integrated into a comprehensive physiotherapy program, led to significant improvements in pain, disability, and quality of life compared to the control group.

Taspinar et al.'s research demonstrated MRT's ability to enhance peripheral blood circulation, particularly in young women, compared to massage therapy.

Figure 10: PEDro Score

- We have taken PEDro score for our study for MRT and concluded that approximately 76.8% of study from 2012 to 2023 were shows that MRT is more beneficial than conventional therapy.
- Evidence shows that MRT is more effective compare to conventional therapy such as Non-healing wounds, Arthritis, Osteoporosis, Spasticity, Ligaments tear, Tendinitis and Bone degeneration.

DISCUSSION

1. The study by F Taspinar et al. in the year (2013), "engages with the outcomes derived from a randomized, double-blind, controlled trial, investigating and contrasting the effects of matrix rhythm therapy and massage on peripheral blood circulation" in a cohort of fifteen healthy women aged 19–23 years. The interventions, administered as single 30-minute sessions on the left lower extremity with a minimum one-week interval, were executed by the same physiotherapist.[17]
2. Derya et al. in Dec, (2016), investigates "the comparative short-term effectiveness of Matrix Rhythm Therapy and stretching exercises in individuals with frozen shoulder." Forty-three patients, with an average age of 52.6 years, were randomly assigned to either the Matrix Rhythm Therapy or stretching exercises group, both undergoing a 6-week treatment accompanied by a similar home exercise program. Various outcome measures, including range of motion, Constant score, Disabilities of the Arm, Shoulder, and Hand score, Short Form Health Survey-36, and Global Rating of Change score, were assessed at different intervals.[18]
3. T. Palekar in the year (2019), proposes "Matrix Rhythm Therapy (MRT), an emerging electrotherapy modality, demonstrating effectiveness in managing pain and restoring cellular frequency" within the 8-12Hz range. This study focuses on evaluating the impact of MRT on hand pain in excessive smartphone users.[19]
4. Dr. Sonali Shrivastava's review (2019) highlights that "Matrix Rhythm Therapy induces oscillations within the physiological frequency range of 8-1 HZ. This frequency synchronization with the body aims to restore disrupted rhythms at the cellular level." The therapy demonstrates a positive impact on oxygen supply by enhancing microcirculation, consequently boosting energy production. Notably, immediate effects manifest as the relaxation of tissues, muscles, and fascia, with this relaxation enduring for an extended period.[20]
5. Dr. med. Ulrich G. Randoll (2019) underscores "the successful application of Matrix-Rhythm-Therapy, particularly in the realms of rehabilitation, high-performance sports, and veterinary medicine." The therapy has undergone rigorous testing and validation over the past decade, originating from the University of Erlangen. Its application is particularly noteworthy for both preventive measures, involving the prophylactic avoidance of disease development, and rehabilitation efforts, aimed at preventing and mitigating damages resulting from strain, trauma, accidents, and surgeries. Sports medicine, in particular, recognizes the therapy's merit in significantly expediting the regeneration time between training periods, especially after instances of hyper-distension, injuries, hardening, tendonitis, and other impairments. This acceleration allows for the intensification of training cycles and facilitates a swifter return to peak performance following injuries.[21]
6. In the experimental study published in (2019), by Naik et al., aimed to assess "the effectiveness of a single session of Matrix Rhythm Therapy (MaRhyThe) in individuals diagnosed with Plantar Fasciitis (PF), a prevalent musculoskeletal condition often associated with limitations in daily activities." Seventeen subjects within the age range of 18-35 years participated in the study, receiving one session of MaRhyThe targeting the calf and plantar aspect of the foot, lasting 45–60 minutes. The pre and post-intervention outcomes were measured using a pressure algometer (PPA) for pain assessment, a non-contact infrared thermometer (IRT) for local skin temperature, and the Foot and Ankle Ability Measures (FAAM) scale for evaluating functional activities.[22]
7. Nadir et al. (2021) assess "the impact of Matrix Rhythm Therapy (MRT) on chronic low back pain, specifically concentrating on parameters such as pain intensity, levels of disability, and overall quality of life." A cohort of thirty-two participants underwent random assignment into either the intervention or control group. Both groups underwent a comprehensive ten-session combined physiotherapy program, with the intervention group receiving an additional six sessions of MRT.[23]
8. Anand et al. (2022) proposes diabetic peripheral neuropathy (DPN), a prevalent complication of diabetes, adversely impacting the quality of life by affecting balance and gait, leading to an increased risk of falls. Matrix Rhythm Therapy (MaRhyThe) is an innovative approach utilized in various musculoskeletal and neurological conditions to manage pain and enhance functionality.[24]
9. Taj Afreen Sheikh (Oct, 2022) underscores "the Matrix Rhythm Therapy (MRT) approach in the fundamental understanding that cellular processes, whether preventive, therapeutic, regenerative or degenerative, operate predominantly within the cellular environment." Crucial to these processes is the muscle pulsation frequency, identified at 8-12 Hertz, with deviations outside this range linked to ailments such as aches, muscle tension and broader health concerns.[25]
10. The study by Munjewar et al. in the year (2022), examines "the effectiveness of Matrix Rhythm Therapy (MRT) as a novel development in physiotherapy." MRT serves as a non-invasive method for relieving pain, enhancing microcirculation, promoting relaxation, and increasing blood oxygenation. Operated within a frequency range of 8-12 Hz, MRT stimulates the body's self-healing powers, employing vibromassage through a resonating head to release muscular tension.[26]

CONCLUSION

- MRT's non-invasive nature makes it a valuable therapeutic option with broad applications in musculoskeletal health, presenting opportunities for improved well-being.Matrix Rhythm Therapy (MRT) exhibits promising efficacy in managing various musculoskeletal disorders. Studies highlight its ability to induce physiological oscillations, restore disrupted cellular rhythms and enhance microcirculation, contributing to improved oxygen supply. Applications in rehabilitation, sports, and diverse musculoskeletal conditions demonstrate positive outcomes, including pain relief and functional improvements.
- Evidence shows that MRT is more effective compare to conventional therapy such as Non-healing wounds, Arthritis, Osteoporosis, Spasticity, Ligaments tear, Tendinitis and Bone degeneration.

Limitations

- Limitations of this study include potential constraints arising from the availability and quality of existing scientific data on Matrix Rhythm Therapy (MRT) in musculoskeletal disorders, as well as the heterogeneity of included studies in terms of design, participant characteristics, and outcome measures.
- The study's scope may be limited to the disorders covered in the available literature, potentially overlooking other musculoskeletal conditions.
- It includes other factors like patient comorbidities, and variations in practitioner expertise could act as confounders, influence on the effects of MRT.

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"PREVALENCE OF MUSCULOSKELETAL DYSFUNCTION DUE TO BACKPACKS IN STUDENTS WITH UPPER CROSS SYNDROME"

Physiotherapy

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ABSTRACT

Background: Increasing rate of musculoskeletal dysfunction due to backpack is matter of concern. Prevalence varies regionally as it depends on many variables. Heavy backpack is one of the important underlying causes. Adolescent spine is in the critical stage of development in the age group of 07-15 years. This study was carried out to decide regional cutoffs of heavy relative weights of backpacks in male and female children. **Methodology:** For this survey, a sample of students from Ahmedabad's New Education School was used. Every student who satisfies the inclusion requirements is welcome to take part in the research. Through the semi-structured questionnaire, the data were collected. The length of the trip, the type of vehicle, and the distance traveled, the posture taken while traveling, and the level of pain were all mentioned in the questionnaires. Every outcome that was measured was obtained at baseline. NDI, SPADI & NPRS. **Result:** In present study we found that from total 60 students 34 students shows highest upper cross syndrome and students with upper cross syndrome were having mean pain score of NPRS 4.52±2.18 and disability as per NDI & SPADI as 50.79 &51.28.overall prevalence of musculoskeletal dysfunction is 55.66%. **Conclusions:** Majority of the School going students are exposed to the risk of adopting poor postures which can lead to musculoskeletal dysfunction. The results of this study suggesting the importance of postural awareness among school going students.

KEYWORDS

Upper Cross Syndrome, Neck Disability Index, Shoulder Pain And Disability Index, Musculoskeletal Disorder.

INTRODUCTION

The World Health Organization states that musculoskeletal disorders—which are primarily linked to Students and cause headaches and chronic neck pain, which are the most common complaints worldwide—are one of the main causes of disability among persons between the ages of 20 and 50. It is acknowledged that disabilities result in severe medical conditions as well as socioeconomic problems; the loss of GDP from absenteeism and low productivity has been estimated to be as high as 2%. Numerous studies found that almost 90% of rehabilitation specialists suffer from musculoskeletal conditions, with 50% of physiotherapists reporting a tendency to develop Work-Related Musculoskeletal Disorders (WMSDs) throughout the course of their five-year careers. This might be because of the nature of their employment, which entails extended periods of sitting, standing, and lifting as well as the use of manual techniques in academic or clinical settings. The high prevalence (66%) in lower limb, particularly in the low back and neck region (61%), may be related to their line of work, which involves extended standing, sitting, lifting, or using manual procedures in clinical or academic settings[1].

Upper Cross Syndrome (UCS), also known as cervical cross syndrome, is defined as a pattern of alternative tightness and weakness of the neck's Serratus Anterior, Pectorals Major, Levator Scapulae, Rhomboids, and Deep Flexors, especially the Scalene muscles. This pattern is thought to be caused by improper body ergonomics, poor work habits, or low self-esteem. Rather than only affecting one muscle, Upper Cross Syndrome is typified by an imbalance in the activation and inhibition of skeletal muscles. Muscular insufficiencies arise from any inability of the tonic and phasic muscles to activate coherently. Thus, the most common symptom of UCS is neck and upper back pain, which is typically diagnosed as Cervicogenic Vertigo with shoulder pathology in a number of patients. This bad posture causes hypnosis, forward head posture, loss of cervical lordosis, and some postural patterning of the front shoulders[2]. The upper portion of the body experiences general pattern changes as a result of these anomalies.

This pattern alteration results in strain to the shoulder blade and muscle attachments of the shoulder, giving the impression of a rounded shoulder. While extended use of this position does not always result in pain, people frequently report upper back and neck pain various factors including musculoskeletal structures, body changes regarding age, cultural customs, motor performances and occupation affects the head position of the person while sitting. The patients may develop forward head posture because of this poor sitting posture along with rounded shoulder which occurs due to the increased hypnosis in thoracic region[2].

When seated, the forward head position causes the upper cervical region to extend, the lower cervical region to flex, and the shoulders to round. This reduces the length of muscle fibers on average, which causes extensor torque around the upper cervical region's joints. This aberrant state leads to a number of musculoskeletal problems, such as increased internal rotation, anterior tilt, and decreased scapular upward rotation. It makes it even harder to keep an erect posture[3].

Upper crossed syndrome is what occurs when rounded shoulders and forward head posture occur at the same time. Students enrolled in college typically adopt a range of positions throughout class and exams. Therefore, it is necessary to determine if these aberrant postures are learned or inherited. It is also necessary to ascertain whether any of the elements of a muscle imbalance are present at this point and to identify the reason for the change in upper back posture[4].

Work related segments, for instance, postponed static muscle load and dismal work might be a hotspot for hurt headway. Physical activity and masculinity are two further characteristics that may be linked to musculoskeletal pain. Issues with posture, vision, or mental health might also bring about musculoskeletal issue, particularly affecting the cervical and thoracic locale. As demonstrated by Janda's farsighted clarification of muscle ponderousness, significant cervical flexors and lower scapular stabilizers get the opportunity to be subdued in a foreseen illustration (upper crossed disorder)[5].

Proximal or shoulder support crossed confusion is another term used to describe Upper-Crossed Syndrome (UCS). Coziness of the levator scapula and upper trapezius on the dorsal side of the UCS intersects with coziness of the genuine and minor pectoralis muscles. Significant cervical flexor weakness ventrally crosses with insufficient middle and lower trapezius; this unevenness causes joint fractures, especially at the glen humeral joint, atlantooccipital joint, C4-5 area, cervicothoracic joint, and T4-T5[6].

Janda observed a discrepancy between these concentrated areas of discomfort inside the spine and the transitional zones where the morphology of the adjoining vertebrae changes. This study aimed to identify the key factors that contribute to students' upper-crossed issues changing. Certain particular postural motions are observed in upper cross problem, such as forward head carriage, thoracic hypnosis and extended cervical lordosis, elevated and developed shoulders, and

scapular winging and discontent. Due to Serratus front weakness, which causes the scapulae to grasp, turn, and wing, these postural movements decrease glen humeral quality by allowing the glenoid fosse to become more vertical[7].

Purpose Of the study to find Prevalence Musculoskeletal Dysfunction Due to backpacks in students with upper cross syndrome.

METHODOLOGY

Study Design: Observational study

Duration of Study: 6 months to 1 year.

Sample Size: 60 students (both male and female)

Selection Criteria

Inclusion criteria:

- Age of students (07 to 15) Years.
- Students suffering from Upper Cross Syndrome.
- Subject willing participate.

Exclusion criteria:

- Developmental disorders,
- Neurological disorders,
- Surgical interventions and previous spinal fractures

For this survey, a sample of students from Ahmedabad's New Education School was used.

Every student who satisfies the inclusion requirements is welcome to take part in the research. Through the semi-structured questionnaire, the data were collected. The student's posture, the weight of the bag, and the level of pain were all noted. Every outcome that was measured was obtained at baseline.

- SPADI
- NDI
- NPRS

RESULT:

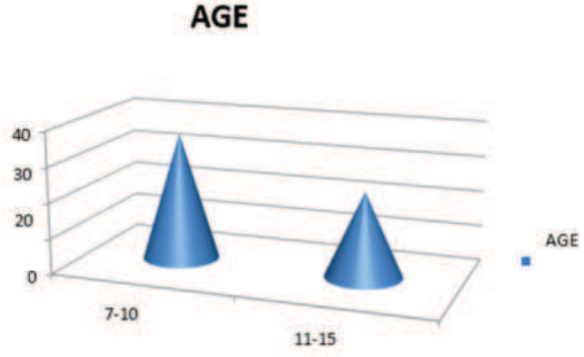
Descriptive analysis for Windows was used for all statistical studies. The mean and standard deviations were obtained using descriptive analysis. Demographic Data

AGE:

The research was performed on 60 participants between the age of 7-15 years. There were 36 participants between the ages of 7 to 10, 24 participants between the age 11 to 15.

Table1: Age Distribution

Age Distribution	
7-10 years	11-15 years
36	24

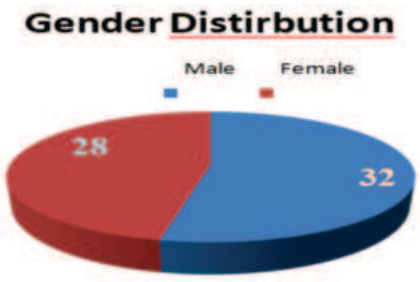


Graph 1: Age Distribution

Gender Distribution:

The research was performed on 60 students with upper cross syndrome, in which 32 Male & 28 Female.

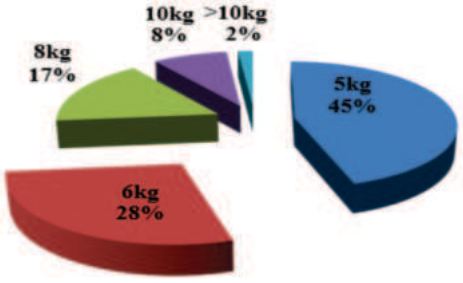
Gender Distribution	
Male	Female
32	28



Weight of bag:

Table 3: Weight of Bag.

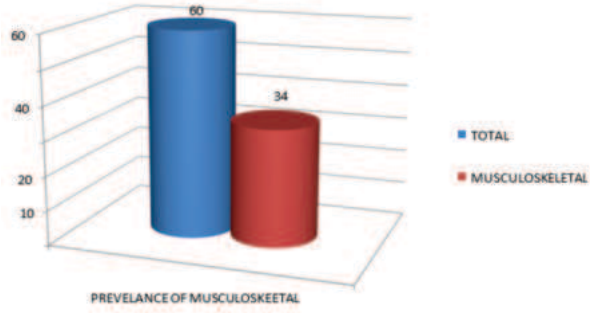
Mode	Number	Percentage
5Kg	27	45%
6Kg	17	28%
8Kg	10	17%
10Kg	5	8%
>10Kg	1	2%



Mean value of Outcome measures

Table 2: Mean value of Outcome measures

	Mean + SD
Age	9.6+4.46 years
NPRS	4.51+2.18
NDI	50.79 + 19.98
SPADI	51.28 ± 17.84



Graph 2: Prevelence Of Musculoskeletal Dysfunction

DISCUSSION:

The goal of the current study was to determine how common upper crossed syndrome is among school-age children. We had classified two diagonal muscles—the neck flexors and scapular retractors being weak, or the neck extensors and pectoralis minor being tight—as weak or tight for the purpose of the prevalence analysis. The cervical spine and shoulder girdle biomechanics may change as a result of a muscle imbalance in any one of the two diagonal muscles.

Present study conducted on 60 school going students with age of 07 to 15 years among that 34 students showed positive impact of musculoskeletal dysfunction with mean pain score 4.51±2.18, NDI mean & sd 50.79 ± 19.98 & SPADI 51.28 ± 17.84 Overall prevalence of musculoskeletal dysfunction is 55.66%.

A study on Neck, Shoulder, and Back Pain Associated with Carrying Heavy Backpacks among Spirit School Children in Lahore was undertaken by Rubina Khan et al. They came to the conclusion that children's back, shoulder, and neck pain was significantly correlated

with the weight of their school bags. Less symptoms were displayed by students who carried their bags over both shoulders and used twin straps[8].

Mayank Mohan et al done An experimental study on the Effect of backpack loading on cervical and shoulder posture in Indian school children and examining the effects of backpack loading on posture[9].

Sheir-Neiss, et al conducted study on The Association of Backpack Use and Back Pain in Adolescents and concluded that The use of backpacks during the school day and backpack weights are independently associated with back pain[10].

Mubeen et al done investigate on primary indicators of upper cross syndrome, which include forward head position, rounded shoulders, and neck stiffness and pain. The results of the study showed that 36.07% of students had neck pain when studying or using any kind of electronic device. Additionally, it was shown that 76.39% of students believed that when using a device or studying, they needed to support their head and upper back. However, 23.60% of the pupils felt otherwise.In their investigation on the prevalence of upper cross syndrome results showed that 52.1% of pupils found it challenging and 48.7% of students felt neck pain[11].

Clare Haselgrove et al had done study on Perceived school bag load, duration of carriage, and method of transport to school are associated with spinal pain in adolescents: an observational study and concluded that Neck pain is as common as back pain amongst adolescents. Perceived school bag load, duration of carriage and method of transport to school are associated with back and neck pain. Physical activity in the form of walking or riding to school may offset the potentially provocative effects of prolonged bag carriage and warrants further investigation.[12].

Therefore, it is imperative that people of all ages, especially students, take some action to improve their postural awareness.

CONCLUSION

Majority of the School going student are exposed to the risk of adopting poor postures which can lead to musculoskeletal dysfunctions. The results of this study suggesting the importance of postural awareness among school going students.

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TO FIND THE PREVALENCE OF CHRONIC NECK PAIN IN OLA/UBER DRIVER OF GUJARAT"

Physiotherapy

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ABSTRACT

Introduction: Chronic neck pain is a prevalent issue among Ola/Uber drivers in Gujarat, adversely impacting their daily functioning and overall well-being. Despite its significance, research focusing on the prevalence and impact of chronic neck pain in this occupational group remains limited. This study aims to address this gap by examining the prevalence, severity, and associated factors of chronic neck pain among Ola/Uber drivers in Gujarat. **Participants:** A total of 300 Ola/Uber drivers from various regions of Gujarat participated in the study, providing valuable insights into the prevalence and impact of chronic neck pain in this population. **Results:** Analysis of the data revealed that a significant proportion of Ola/Uber drivers experienced chronic neck pain, with 66% of the participants reporting some degree of disability according to the Neck Disability Index (NDI). Additionally, varying levels of pain intensity were observed, highlighting the considerable burden of chronic neck pain on the drivers' well-being and work performance. **Conclusion:** The findings underscore the urgent need for targeted interventions and ergonomic improvements to alleviate the burden of chronic neck pain among Ola/Uber drivers in Gujarat. By addressing the underlying factors contributing to neck pain and implementing strategies to improve driver well-being, we can enhance the overall quality of life and safety for Ola/Uber drivers in Gujarat.

KEYWORDS

Chronic Neck Pain, Ola/uber Drivers, Prevalence, Impact, Interventions.

INTRODUCTION:

About Anatomy Of Neck

The neck serves as a crucial anatomical region connecting the head to the trunk, housing vital structures responsible for various physiological functions. Understanding the intricate anatomy of the neck is fundamental for medical practitioners across multiple specialties.

The neck comprises several layers, including skin, superficial fascia, platysma muscle, deep cervical fascia, and numerous structures such as blood vessels, nerves, lymph nodes, and viscera. The cervical vertebrae provide structural support while facilitating movement of the head and neck.

Muscles:
Key muscles in the neck include the sternocleidomastoid, scalene, trapezius, and suprahyoid muscles. These muscles play crucial roles in head movement, respiration, swallowing, and speech.1

Blood Supply:
The neck receives arterial blood supply primarily from the common carotid arteries, which bifurcate into internal and external carotid arteries. The vertebral arteries also contribute to cerebral circulation, branching off from the subclavian arteries.

Nerves:
Nerves of the neck include the cervical plexus, brachial plexus, vagus nerve, phrenic nerve, and sympathetic chain. These nerves innervate various structures in the neck and regulate autonomic functions.2

Lymphatics:
The neck contains an extensive network of lymph nodes organized into chains, including the superficial and deep cervical lymph nodes. These nodes play a crucial role in immune surveillance and lymphatic drainage from the head and neck region.

Clinical Significance:
An understanding of neck anatomy is essential for diagnosing and treating various conditions, including neck trauma, infections, tumors, and neurological disorders. Surgical procedures in the neck region require precise knowledge of anatomy to minimize complications. 3951

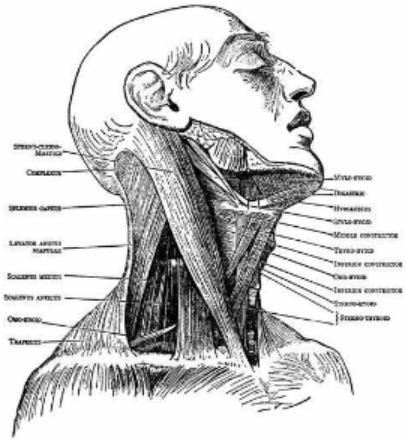


Fig: 1 Anatomy Of Neck

About Neck Pain

Neck pain is a common complaint encountered in clinical practice, affecting individuals of all ages and backgrounds. Understanding the various types of neck pain is essential for accurate diagnosis and appropriate management.

Types of Neck Pain:

1. Mechanical Neck Pain:

- Mechanical neck pain typically results from musculoskeletal causes such as poor posture, muscle strain, or degenerative changes in the cervical spine.
- It is often exacerbated by certain activities or positions and may improve with rest, activity modification, and physical therapy.4

2. Cervical Radiculopathy:

- Cervical radiculopathy occurs when a nerve root in the cervical spine becomes compressed or irritated, leading to pain, weakness, and sensory changes along the distribution of the affected nerve.
- Common causes include herniated discs, spinal stenosis, or foraminal narrowing.

3. Cervical Myelopathy:

- Cervical myelopathy refers to compression or injury to the spinal cord in the cervical region, resulting in motor, sensory, and reflex abnormalities.
- Causes include degenerative disc disease, cervical spondylosis, or spinal cord tumors.

4. Whiplash-Associated Disorder (WAD):
- WAD occurs following sudden acceleration-deceleration forces on the neck, commonly seen in motor vehicle accidents.
- Symptoms may include neck pain, stiffness, headache, and sometimes neurological deficits.5

5. Non-Specific Neck Pain:
- Non-specific neck pain refers to pain in the neck region without a specific identifiable cause.
- It may result from a combination of factors including poor posture, stress, muscle tension, and psychosocial factors.

Clinical Considerations:
- A thorough history and physical examination are essential for evaluating neck pain and determining its underlying cause.
- Diagnostic imaging studies such as X-rays, MRI, or CT scans may be indicated to further evaluate the cervical spine and surrounding structures.
- Treatment options for neck pain vary depending on the underlying cause and may include medications, physical therapy, injections, or surgical intervention in severe 6

Neck Pain Due To Bad Posture And Stress

Neck pain attributed to bad posture and stress is a common complaint encountered in clinical practice, affecting individuals of all ages and occupations. Understanding the underlying mechanisms and management strategies for this type of neck pain is essential for healthcare professionals.

Etiology:

1. Bad Posture:
- Prolonged periods of sitting or standing with poor posture can lead to excessive strain on the muscles, ligaments, and joints of the neck.
- Common postural deviations contributing to neck pain include forward head posture, rounded shoulders, and excessive cervical lordosis.

2. Over Stress:
- Psychological stress and tension can manifest physically as muscle tightness and increased muscle tone in the neck and shoulder region.
- Chronic stress can lead to the development of trigger points, muscle imbalances, and reduced pain threshold, exacerbating neck pain symptoms.

Pathophysiology:
- Poor posture and stress can result in muscular imbalances, leading to altered biomechanics of the cervical spine and surrounding structures.
- Chronic tension and strain on the neck muscles can cause microtrauma, inflammation, and decreased blood flow, contributing to the development of neck pain.7

Neck Disability Index

The Neck Disability Index (NDI) is a validated tool used to assess the impact of neck pain on daily functioning and quality of life. It consists of 10 items covering various aspects of physical and functional impairment related to neck pain. 8

Numeric Pain Rating Scale (NPRS)

The Numeric Pain Rating Scale (NPRS) is a commonly used tool for quantifying pain intensity on a numerical scale from 0 to 10, where 0 represents no pain and 10 represents the worst pain imaginable. It provides a quick and simple method for patients to communicate their pain levels to healthcare providers.9

AIM OF THE STUDY

The aim of this study is to investigate the prevalence and factors associated with chronic neck pain among Ola/Uber drivers in Gujarat, India.

Specifically, the study seeks to:
1. Determine the prevalence of chronic neck pain among Ola/Uber drivers in Gujarat.
2. Identify demographic, occupational, and psychosocial factors contributing to chronic neck pain in this population.
3. Assess the impact of chronic neck pain on the quality of life, work performance, and driving safety of Ola/Uber drivers.
4. Explore potential interventions and preventive strategies to alleviate neck pain and improve the overall well-being of Ola/Uber drivers in Gujarat.

This study aims to provide valuable insights into the burden of chronic neck pain among Ola/Uber drivers and inform the development of targeted interventions to address this occupational health issue.

Need Of The Study

The need for investigating the prevalence of chronic neck pain among Ola/Uber drivers in Gujarat arises from several key factors:
1. Occupational Health Concerns: Ola/Uber drivers spend prolonged periods driving, often in non-ergonomic positions, which may predispose them to musculoskeletal disorders such as chronic neck pain. Understanding the extent of this issue is crucial for addressing their occupational health needs.
2. Lack of Research: Despite the growing reliance on ridesharing services like Ola and Uber, there is limited research focusing on the musculoskeletal health of drivers, particularly regarding chronic neck pain. This study will fill a critical gap in the literature.
3. Impact on Quality of Life: Chronic neck pain can significantly impact the quality of life, work productivity, and overall well-being of individuals. Assessing the prevalence of neck pain among Ola/Uber drivers will shed light on the magnitude of this problem and its implications.
4. Driver Safety: Neck pain can impair mobility and concentration, potentially compromising driver safety and increasing the risk of accidents. Understanding the association between neck pain and driving performance is essential for ensuring road safety.
5. Intervention Development: By identifying the factors contributing to chronic neck pain among Ola/Uber drivers, this study will inform the development of targeted interventions and preventive measures to alleviate pain and improve the health outcomes of drivers.

In summary, there is a pressing need to investigate the prevalence of chronic neck pain among Ola/Uber drivers in Gujarat to address their occupational health concerns, improve their quality of life, ensure driver safety, and inform the development of effective interventions.

Objective Of The Study

The objective of this study is to determine the prevalence of chronic neck pain among Ola/Uber drivers in Gujarat, India, and to explore associated risk factors and impact on drivers' quality of life and work performance. Specifically, the study aims to:
1. Assess the prevalence of chronic neck pain among Ola/Uber drivers in Gujarat through a cross-sectional survey.
2. Identify demographic, occupational, and psychosocial factors associated with chronic neck pain in this population.
3. Evaluate the impact of chronic neck pain on drivers' quality of life, work productivity, and driving safety.
4. Investigate coping strategies and healthcare-seeking behaviors adopted by Ola/Uber drivers in response to chronic neck pain.
5. Provide recommendations for interventions and preventive measures to alleviate neck pain and improve the overall well-being of Ola/Uber drivers in Gujarat.

Study Design And Study Setting

Study Design:

The study will employ a cross-sectional design to investigate the prevalence of chronic neck pain among Ola/Uber drivers in Gujarat.

Study Duration:

The study will be conducted over a period of 6 months, from [10 October, 2023] to [12 March, 2024].

Population:

The target population will consist of Ola and Uber drivers operating in various cities and towns across Gujarat.

Selection Criteria:

a. Inclusion Criteria:
1. Licensed Ola/Uber drivers.
2. Currently active in driving for Ola/Uber services.
3. Willing to participate in the study.
4. Able to understand and respond to the questionnaire in Gujarati or English.

b. Exclusion Criteria:
1. Drivers with a history of traumatic neck injury in the past 6 months.
2. Drivers currently undergoing treatment for neck-related disorders.
3. Drivers with pre-existing chronic conditions affecting the neck, such as cervical spondylosis or rheumatoid arthritis.

Sampling Method:
A convenience sampling method will be employed to recruit participants. Researchers will approach Ola/Uber drivers at various pick-up and drop-off points, rest areas, and driver hubs across different cities in Gujarat.

Sampling Size:
Based on previous studies and considering an estimated prevalence rate of chronic neck pain among Ola/Uber drivers in Gujarat, a sample size of 300 drivers will be targeted to achieve a sufficient level of statistical power and precision in estimating the prevalence rate with a 95% confidence interval and a 5% margin of error.

Outcome Measures:
Numeric Pain Rating Scale (NPRS)
Neck Disability Index (NDI)

METHODOLOGY

Table: 1 Flow Chart Of Procedure

1. Participant Recruitment:
- Identify and approach Ola/Uber drivers at various locations such as taxi stands, transportation hubs, and rest areas across different cities in Gujarat.
- Provide a brief explanation of the study aims, procedures, and benefits to potential participants.
- Obtain informed consent from eligible drivers willing to participate in the study.

2. Demographic Information:
- Collect demographic data including age, gender, educational level, years of driving experience, average daily driving hours, and any previous history of neck pain or related conditions.

3. Numeric Pain Rating Scale (NPRS):
- Explain the NPRS to participants, emphasizing that it is a simple tool used to assess the intensity of their neck pain on a scale from 0 to 10, with 0 representing no pain and 10 representing the worst possible pain.
- Provide a numerical scale to the participants.
- Ask participants to rate their current neck pain intensity by selecting a number on the scale that best represents their level of pain.
- Record the participant's NPRS score.

4. Neck Disability Index (NDI) Scale:
- Introduce the NDI scale to participants, explaining that it is a questionnaire designed to assess the impact of neck pain on their daily activities and functioning.
- Provide a printed or electronic copy of the NDI questionnaire to participants.
- Instruct participants to read each question carefully and select the response that best reflects their current level of disability or limitation due to neck pain.
- Assist participants in completing the questionnaire if necessary, ensuring that they understand each item.
- Collect the completed NDI questionnaire from the participants.

5. Data Collection and Recording:
- Enter the demographic information, NPRS scores, and NDI questionnaire responses into a secure database or electronic spreadsheet.
- Ensure accuracy and consistency in data entry by double-checking entries against the original forms.
- Assign unique identifiers or codes to participants to maintain confidentiality and anonymity of their data.

IMAGE: 2 DATA COLLECTION

IMAGE: 3 DATA COLLECTION

6. Quality Control:
- Periodically review a subset of data entries to identify any errors or inconsistencies.
- Address any discrepancies by verifying the original data sources and making necessary corrections.
- Conduct regular checks to ensure compliance with ethical guidelines and data protection regulations.

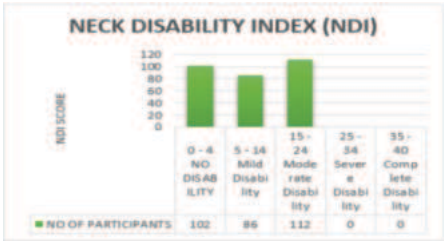
7. Data Analysis:
- Analyze the collected data using appropriate statistical methods to determine the prevalence of chronic neck pain among Ola/Uber drivers in Gujarat.
- Calculate descriptive statistics such as mean NPRS scores, NDI scores, and prevalence rates of neck pain severity and disability.
- Explore potential associations between demographic variables, driving characteristics, and neck pain outcomes using inferential statistics if applicable.

8. Reporting and Dissemination:
- Prepare a comprehensive report summarizing the study findings, methodology, and conclusions

RESULT

1. Neck Disability Index (NDI) Scores:
- No Disability (0-4 score): 102 participants
- Mild Disability (5-14 score): 86 participants
- Moderate Disability (15-24 score): 112 participants
- Severe Disability (25-34 score): 0 participants
- Complete Disability (35-40 score): 0 participants

Table : 2 Neck Disability Score



2. Numeric Pain Rating Scale (NPRS) Scores:
- Score 1: 0 participants
- Score 2: 66 participants
- Score 3: 36 participants
- Score 4: 86 participants
- Score 5: 60 participants
- Score 6: 52 participants
- Score 7, 8, 9, 10: 0 participants

Table: 3 Numeric Pain Rating Scale Score

3. Individuals with Disability:
- Individuals with disability: 198 participants (66%)
- Individuals without disability: 102 participants (34%)
- Total number of participants: 300

Table: 4 Disability Evaluation

The prevalence of chronic neck pain among Ola/Uber drivers in Gujarat is significant, with a total of 198 participants (66%) reporting some level of disability according to the Neck Disability Index (NDI). Among these, the majority exhibit moderate disability, indicating a considerable impact on daily functioning. Numeric Pain Rating Scale (NPRS) scores reveal varying levels of pain intensity, with a notable proportion of participants reporting scores ranging from 2 to 6. These findings underscore the need for targeted interventions and ergonomic improvements to mitigate the burden of chronic neck pain among Ola/Uber drivers in Gujarat and enhance their overall well-being.

DISCUSSION

Chronic neck pain is a complex and multifaceted issue that poses significant challenges for Ola/Uber drivers in Gujarat. This comprehensive discussion will delve into the various facets of chronic neck pain among this occupational group, including its prevalence, impact, contributing factors, and potential avenues for intervention.

Prevalence and Impact of Chronic Neck Pain:

The findings of this study underscore the high prevalence and considerable impact of chronic neck pain among Ola/Uber drivers in Gujarat. **With 66% of participants reporting some degree of disability** according to the Neck Disability Index (NDI), it is evident that chronic neck pain significantly affects the daily functioning of these drivers. Moreover, the distribution of NDI scores highlights the diverse spectrum of disability experienced by drivers, ranging from mild to moderate impairment in performing daily activities. This not only impacts their ability to work effectively but also has implications for their overall quality of life and well-being.

Factors Contributing to Chronic Neck Pain:

Several factors contribute to the development and exacerbation of chronic neck pain among Ola/Uber drivers. Prolonged periods of driving, often in non-ergonomic conditions, can lead to muscle fatigue, tension, and poor posture, all of which are known risk factors for neck pain. Additionally, the repetitive nature of driving, combined with frequent use of mobile devices and navigation systems, can further strain the neck muscles and exacerbate existing pain. Furthermore, psychosocial factors such as stress, anxiety, and job dissatisfaction may also play a role in the development and persistence of chronic neck pain among drivers.

Impact on Work Performance and Well-being:

Chronic neck pain not only affects the physical health of Ola/Uber drivers but also has significant implications for their work performance and overall well-being. The moderate to severe pain intensity reported by a substantial proportion of drivers, as indicated by Numeric Pain Rating Scale (NPRS) scores, can impair their ability to concentrate, make quick decisions, and react to changing road conditions, thereby compromising driving safety. Moreover, the discomfort and disability associated with chronic neck pain may lead to decreased job satisfaction, increased absenteeism, and financial strain, further exacerbating the drivers' overall stress and dissatisfaction.

Potential Avenues for Intervention:

Addressing the burden of chronic neck pain among Ola/Uber drivers requires a multifaceted approach that addresses both individual and systemic factors. Ergonomic improvements in vehicle design, including adjustable seats, lumbar support, and headrests, can help alleviate strain on the neck muscles and promote better posture during driving. Additionally, education and training programs on proper ergonomics, stretching exercises, and relaxation techniques can empower drivers to proactively manage their neck pain and prevent its recurrence. Furthermore, access to timely and affordable healthcare services, including physiotherapy, chiropractic care, and pain management interventions, is essential to address the underlying causes of neck pain and improve the drivers' overall musculoskeletal health

CONCLUSION

In conclusion, the findings of this study shed light on the significant prevalence and impact of chronic neck pain among Ola/Uber drivers in Gujarat. The high percentage of drivers reporting some degree of disability underscores the profound burden of neck pain on their daily functioning and overall quality of life. Moreover, the varying levels of pain intensity reported by drivers further emphasize the complexity of this issue and the urgent need for effective interventions to alleviate their suffering. Addressing the multifaceted factors contributing to chronic neck pain, including ergonomic improvements, education on proper posture and stretching techniques, and access to healthcare services, is paramount to improving the musculoskeletal health and well-being of Ola/Uber drivers in Gujarat.

Moving forward, concerted efforts from policymakers, healthcare professionals, and stakeholders in the transportation industry are essential to implement sustainable solutions that prioritize the health and safety of Ola/Uber drivers. By addressing the root causes of chronic neck pain and promoting proactive measures to mitigate its impact, we can create a supportive environment that empowers drivers to manage their pain effectively and continue their vital role in providing transportation services to the community. Ultimately, by prioritizing the musculoskeletal health of Ola/Uber drivers, we can enhance their overall well-being and contribute to a safer and more sustainable transportation system in Gujarat.

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WORK RELATED MUSCULOSKELETAL DISORDER AMONG RECREATIONAL CRICKET PLAYERS: - A CROSS-SECTIONAL STUDY

Physiotherapy & Rehabilitation

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ABSTRACT

Background: This research focuses on assessing work-related musculoskeletal disorder among recreational cricket players using modified Nordic musculoskeletal questionnaire. Using MNMQs, the aim is to gather detailed information on the prevalence, severity and location of musculoskeletal problems experienced by recreational cricket players during their participation in the sport. **Methods:** A Cross sectional study was carried out on 105 recreational cricket players using Modified Nordic Musculoskeletal Questionnaire to find the prevalence of work-related Musculoskeletal disorder among recreational cricket players. **Results:** Out of 105 cricket players 73 (69.5%) players experienced work-related musculoskeletal problem in last 12 months. Shoulder, low back and Hips/thighs were the most common areas of problem in last 12 months. Hips/thighs, low back were the most common areas of problem in last 12 months in Batsmen. Shoulder and Ankles/feet were the most common areas of problem in last 12 months in bowlers. Low back, shoulders were the most common area of problem in last 12 months in All-rounders. Sprain (38%) and Strain (33%) were the most common type of injury among recreational cricket players. **Conclusion:** This study concludes that the work-related musculoskeletal disorder in recreational cricket players were more. Shoulders and Lower back were the most common injured body parts followed by Hips/thighs, Ankles/Feet and Knees. According to role of cricket, Bowlers were more affected than Batsmen and All-rounder. The study conclude that Hips/thighs and low back are the common site of injury in batsmen. Shoulder and Ankles/feet are the common site of injury in bowlers and Low back and shoulder were the most common site of injury in All-rounders. The study also concludes that due to the Low back Injury or pain players had affected from doing their daily activity of living in last 12 months. This research findings indicate that sprain and strains rank as the predominant injuries experienced by cricket players.

KEYWORDS

Work-related musculoskeletal disorder, Modified Nordic Musculoskeletal Questionnaire, recreational cricket players.

INTRODUCTION

Work-related injuries pose a significant burden on individuals, organizations, and society at large, with musculoskeletal disorders (MSDs) being one of the primary causes and contributors to workers' compensation claims. The lack of specific data on work-related musculoskeletal diseases in developing nations complicates efforts to identify prevalent issues and occupations at high risk, though occupations requiring heavy physical exertion, such as construction, stone work, mining, and cleaning, are likely the most vulnerable. Additionally, musculoskeletal disorders (MSDs) are defined as soft tissue disorders not resulting from sudden events, and are deemed work-related when the work environment significantly contributes to their development. [1]

Cricket is a major international sport played in more than 60 countries. The laws of cricket were drawn up by the London Club in 1944 formalizing a game that had been played for a hundred of years ago.[2] Cricket is regarded as a leisurely, gentlemen's game.[3] In cricket, bowlers deliver a hard ball at a high speed directly to the batsman.[4] Now cricket is played in more than sixty countries and regarded as major international team sport. Cricket also played in many commonwealth countries as popular sport. Cricket is the most popular team sport in Indian subcontinent that consists India, Pakistan, Afghanistan, Bangladesh, Sri Lanka. The popularity for cricket in India was started after its success in 1983 world cup in which it was the champion; this led to a greater number of people participating in cricket. There are various clubs and centres with skilful coaches to train them. Injuries are inevitable when one player is training and compete. There are numerous studies available at international level, but in India there is a lack of research in cricket.[5]

The ICC Trophies Won by India:

India's cricket legacy began with the 1983 ICC Cricket World Cup victory, where Kapil Dev's team triumphed against the odds, defeating Clive Lloyd's West Indies, marking India's first ICC trophy. Until then, the Indian cricket team held little significance in the sporting world, but this underdog victory transformed the perception of cricket in India. The 2002 Champions Trophy stands as a unique event in ICC history, being the solitary tournament where a definitive champion wasn't determined, resulting in Sri Lanka and India being declared joint winners. This marked a significant milestone, breaking a nearly two-decade drought for India in ICC trophy victories. Sri Lanka, considered pre-tournament favourites, secured their spot in the final through dominant performances in the group stage, culminating in a convincing seven-wicket win over Ricky Ponting's formidable Australian team. Conversely, India, fielding a relatively youthful squad, earned their place in the final after a hard-fought 10-run victory against South Africa. However, unforeseen rain disruptions plagued the finals, forcing two washouts and ultimately leading to both Asian cricket powerhouses sharing the trophy. The inaugural ICC T20 World Cup introduced both a new competition and a fresh captain, sparking apprehension over India's performance. With MS Dhoni, then 26 years old, assuming leadership, following Rahul Dravid, Sourav Ganguly, and Sachin Tendulkar's self-exclusion from T20I cricket's premier event in 2007, the team faced the challenge with a predominantly inexperienced roster. As a result, the burden fell on Dhoni, hailing from Ranchi, to orchestrate a remarkable feat. India's 28-year wait for another ICC Cricket World Cup ended in 2011, with MS Dhoni's iconic six in the final against Sri Lanka, while Yuvraj Singh's stellar performance anchored the victorious campaign, marking a fitting farewell for cricket legends Sachin Tendulkar and Virender Sehwag. The 2013 edition of the ICC Champions Trophy, India beat England in finals and MS Dhoni becomes only captain in world cricket to will all three ICC trophies. Currently the men's Indian cricket team is ranked 1st in test cricket, 1st in one-day international and 1st in T20 (as of 26/03/2024 - ICC rankings). There is a lot of crazes for cricket in India. Many children here like or even play cricket. There is a big cricket player in every street here. People love cricket a lot. Cricket is not just a sport but an emotion for the children of India. There is no shortage of talent in India, there is a dangerous player in every street regarding cricket. Every child here dreams of becoming a successful cricketer and playing for his country.[6]

Cricket, characterized by its dynamism, encompasses a plethora of abstract skills and movements. To refine these intricacies, many players prioritize maintaining peak physical fitness and strength. The game's three distinct facets (bowling, batting, and fielding) each pose unique injury risks. [7,8,9] Musculoskeletal discomfort may manifest in diverse scenarios during cricket matches, including impacts from balls or bats, swift rotational actions, sliding and diving maneuvers, collisions with fellow players, and the cumulative effects of overuse. [10,11,12,13]

Running is a common thing in cricket, whether it is batting or bowling or fielding, running has to be done by all, hence lower limb is more

affected in cricket. After that, the second task is to throw the ball because all the players do field and hence upper limb injuries also occur. After that, injuries to the upper and lower trunk occur, due to twisting or overstretch of the trunk.

The stance of a batsman while batting is somewhat like this, it can be differed from batsmen to batsmen. This is a normal stance of the batsman, after that the bowler bowls the ball and the batsman hits the stroke according to the ball. The posture of batsmen is different in every stroke, sometimes extra force is applied on the body or if the body gets twisted too much than the injury can occur. And also, when the batsmen take run, he will run fast so the batsmen have chances to get injured while running. That's why batsmen suffer more injuries to their back and hips.

The ideal bowling action of the player. While bowling, a bowler runs, then makes a jump, rotates his arm in a circular motion and delivers the ball. And experts believe that while delivering the ball, 7 to 8 times more force is applied to the bowler's ankles/feet and the repetitive movement of the shoulder is happens while bowling. That's why bowlers suffer more ankle/feet and shoulder injuries.

Fielding is another role in cricket. So, while doing this, a player gives extra efforts to save runs for the team. During this, his chances of getting injured are increased because he runs, slides, dives, throws and catches the ball and players even collide with each other. Therefore, fielders are at greater risk of hip/thigh injuries, knee injuries, low back and shoulder injuries.

According to Sathya et al., 61% of players encountered musculoskeletal issues linked to cricket. Stretch et al.'s findings indicated that South African cricketers predominantly suffered lower limb injuries (50%), followed by upper limb (23%) and back/trunk injuries (23%). [14] Musculoskeletal pain (Injury) is defined as 'A sensation of agony that inhibits the individual from participating in cricket or practice for a minimum of 24 hours'[15]

There are many studies available at domestic and international level on injuries faced by cricket players. Thus, the purpose of the study is to find the work-related musculoskeletal disorder among recreational cricket players.

Methodology

Study Place

Tanman Cricket Ground, Galaxy Cricket Ground, Samarpan Cricket Ground, Norada 108 Cricket Ground.

Sampling Design

Convenience sampling

Study Design

A cross-sectional survey studies.

Duration of Study

6 months

Sample Size: 105

Inclusion Criteria

- Male cricket players of age 19-27 years
- Playing experience of minimum 3-4 years with regular practices

Exclusion Criteria

- Recent fracture or injury.
- Any recent cardiovascular surgery.
- Any Neurological condition.
- Alter mental illness.
- Players who do not play regularly

Materials Required

- Consent form
- Assessment form
- Modified Nordic Musculoskeletal Questionnaire (MNMQ)
- Pen

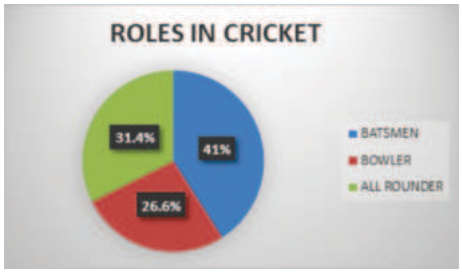
Method

- A sample of cricket players was taken in this survey from various cricket ground located in Ahmedabad.
- All players who meet the inclusion criteria were eligible to participate in the study.
- The data collection was done involving the questionnaire is based on MNMQs.
- Firstly, players were made aware about the purpose of the study. Each component of Modified Nordic Musculoskeletal Questionnaire was explained to each and every player. And consent of each player was taken.
- Then, General demographic data was taken Name, age, gender, occupation, role they play in cricket from the player and asked them to recall their injuries from last one year from April 2023 to March 2024.
- Afterward, the questionnaire content six component.
- The questionnaire content binary questions and player have to fill the answers respectively.
- Then data was collected from 105 player and analyzed in simple percentage and graphs.

RESULTS

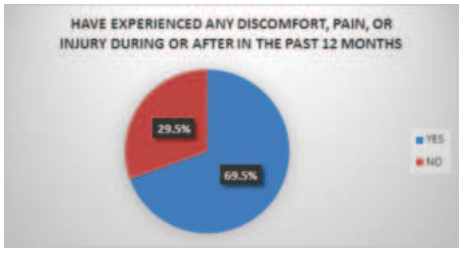
- The analysis was done using excel.
- Total 105 player are taken for the study

A. The above graph shows, out of 105 players 43(41%) were batsmen, 28(26.6%) were bowler, 34(31.4%) were all-rounder.



Graph 1

B. The above graph shows, out of 105 players, 73(69.5%) players had experienced any discomfort, pain, or injury during or after cricket activities in the past 12 months.

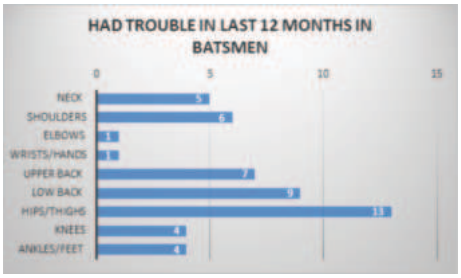


Graph 2

C. The above Graph show the trouble held to cricket players during the last 12 months according to anatomical site. The commonest site for pain or injury among the players is Shoulder and low back (41%) followed by Upper back and Hips/thighs (35%), Ankles/feet (31%), Neck (23%), Wrists/hands (16%), Knees (15%), Elbows (11%).

Graph 3

D. The above graph shows the trouble held to Batsmen during last 12 months according to anatomical site. Out of 43 batsmen 24 (55%) experienced pain or discomfort during or after cricket in last 12 months. The commonest site for batsmen is Hips/Thighs (54%), followed by low back (37%), upper back (29%), shoulder (25%), Neck (20%), Knees and Ankles/Feet (16%), Elbow and Wrists/Hands (4%).



Graph 4

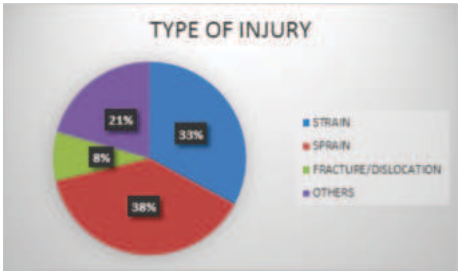
E. The above graph shows the trouble held to Bowler during last 12 months according to anatomical site. Out of 28 bowlers 23 (82%) experienced pain or discomfort during or after cricket in last 12 months. The commonest site for bowler is Shoulders and Ankles/Feet (60%) followed by Wrists/Hand (30%), Hips/Thighs (26%), Neck (21%), Elbows and Kness (17%), Low back (13%), Upper back (8%)

Graph 5

F. The above graph shows the trouble held to All-rounder during last 12 months according to anatomical site. Out of 34 all-rounder 25 (73%) experienced pain or discomfort during or after cricket in last 12 months. The commonest site for all-rounder is Low back (72%), followed by Shoulder (48%), Upper back (36%), Neck and Hips/Thighs (28%), Ankles/feet (20%), Wrists/Hands (16%), Elbows (12%), Knees (8%).

Graph 6

G. The above graph shows types of injuries in cricket players. Out of 105 players investigated 73 (69.5%) experienced work-related musculoskeletal problem within last 12 months. Out of 73 players 28 (38%) had Sprain, 24 (33%) had strain, 15 (21%) had other injuries and 6 (8%) had fracture/dislocation.



Graph 7

DISCUSSION

The study was done on 105 recreational cricket players (males) of age group of 19-27 years with minimum experience of 3-4 years. The Aim and objective of the study was to find work-related musculoskeletal disorder among recreational cricket player. Modified Nordic Musculoskeletal Questionnaire was used to find the work-related musculoskeletal problem in recreational cricket players in last one year. Out of 105 players 73 (69.5%) experienced work -related musculoskeletal problem. According to Graph -3, the most common site of injury or pain is in shoulders and low back (41%), followed by Ankles/feet, upper back, hips/thighs. Because of repetitive movement of shoulder and trunk. Fielder throws the ball, bowler runs and deliver the ball with maximum effort so the movement of shoulder is much more that's why the risk of shoulder injuries is more on other hand repetitive hyperextension, rotation of trunk while batting or deliver the ball by bowlers.

The Graph-4 shows the prevalence of work-related musculoskeletal problem in last 12 months in Batsmen. Out of 43 batsmen 24 (55%) experienced musculoskeletal problem. Hips/thighs, low back, upper back these 4 sites are most commonly affected in batsmen because more use of trunk and lower extremities is there. That's why trunk and lower limb is most commonly affected. The Graph-5 shows the prevalence of work-related musculoskeletal problem in last 12 months in Bowler. Out of 28 bowler 23 (82%) experienced musculoskeletal problem. Shoulder, Ankles/Feet these 3 sites are most commonly affected in bowler because of repetitive movement of shoulder for delivering the ball and also when the bowler delivers the ball, the whole weight of the body came to ankles/feet. Hence shoulder, ankles/feet are most commonly affected. The Graph-6 shows the prevalence of work-related musculoskeletal problem in last 12 months in All-rounder. Out of 34 All-rounder 25 (73%) experienced musculoskeletal problem. Low back, Shoulder, Upper back, Hips/thighs these 4 are the most common site of injury or pain in all-rounder because they have to play all the roles in cricket (Batting, Bowling and Fielding).

Player who prevented from doing normal work in the last 12 months due to work-related musculoskeletal problem: The most common site for preventing from doing normal work during last 12 months are Low back and Upper back followed by Shoulder. Player who had trouble at any time during last 7 days: The most common site causing trouble in last 7 days are Hips/Thighs followed by Upper back and Low back. Out of 105 players only 18 (17%) players had ever hurt themselves body part in an accident. Shoulder and Ankle/feet are hurt more in an accident followed by Hips/thighs and Knees. When the players were asked about the total length of time that had trouble during the last 12 months. The most common answered was 1-7 days followed by 8-30 days and very few were for more than 30 days. The last component of the MNMQs was about the type of the Injury. As the Graph 7 shows, 28 players were affected with Sprain, 24 Players were affected with Strain and 21 players were affected with Other and Fracture/dislocation.

Chandrasekhar Bodanki et al. conducted a study on Prevalence of cricket-related musculoskeletal pain among Indian junior club cricketers and finds that CIPP should be implemented and strictly followed from the early stages of sports life. Pre-training warm-up and post-training cool-down sessions into their regular training regimen is essential. It's crucial to steer clear of overuse, such as prolonged play beyond scheduled times, and to refrain from disregarding any pain experienced during practice or matches. A supervised training and regular screening of players by orthopaedician or sports physician will keep them fit to play with full potential.[16]

P. Sathya et al. conducted a study on Prevalence of Musculoskeletal Problems in Cricket Players and finds that the findings revealed a 61% prevalence of musculoskeletal problems among cricket players. The lower back emerged as the most frequently affected area, followed by ankles/feet, knees, and hips/thighs. Musculoskeletal problems were more prevalent among all-rounders than batsmen and bowlers. Specifically, ankles/feet were frequently affected in all-rounders, while bowlers and batsmen commonly experienced issues in the low back area, alongside other regions. Furthermore, strain and sprain were identified as the predominant types of injuries among cricket players, regardless of their specific role in the game. [14]

Sumit Kumar et al. conducted a study on One year prevalence of musculoskeletal disorder among cricket Players in Haryana: A retrospective study: - Injury data was gathered using a modified Nordic Musculoskeletal Injury Questionnaire. Frequency of musculoskeletal injuries is more among cricket players. Conditioning by coaches and early rehabilitation by physiotherapists are essential to reduce the

injury rate in this population. [5]

Present study was conducted on 105 recreational cricket player and the prevalence of Musculoskeletal problem was 69.5% and shoulder and Low back (41%) were the most commonly injured body part followed by Ankles/feet, upper back, hips/thighs.

CONCLUSION

This study concludes that the work-related musculoskeletal disorder in recreational cricket players were more. Shoulders and Lower back were the most common injured body parts followed by Hips/thighs, Ankles/Feet and Knees. According to role of cricket, Bowlers were more affected than Batsmen and All-rounder. The study conclude that Hips/thighs and low back are the common site of injury in batsmen. Shoulder and Ankles/feet are the common site of injury in bowlers and Low back and shoulder were the most common site of injury in All-rounders. The study also concludes that due to the Low back Injury or pain players had affected from doing their daily activity of living in last 12 months. This research findings indicate that sprain and strains rank as the predominant injuries experienced by cricket players.

Limitations

- Collecting accurate data in recreational cricket player is difficult due to factors such as player recall bias on injuries and the absence of official records or statistics.
- This study is only conducted on male cricket players.

Future Recommendation

- Future studies can be done with a larger sample size to get the more appropriate result.
- The study should be conduct specially for professional cricket players.
- Explore the use of technology, such as mobile applications, to collect real-time data on recreational cricket gameplay.
- The study can be done on another sports like football, volley ball, Tennis, etc.
- The study can be conducted on Female cricket players.

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PREVALENCE OF WORK-RELATED MUSCULOSKELETAL DISORDER AND ITS ASSOCIATION WITH MENTAL HEALTH AMONG CLINICAL PHYSIOTHERAPIST: A CROSS SECTIONAL STUDY.

Physiotherapy

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ABSTRACT

Background: Given that physiotherapists receive education on injury prevention and body mechanics as part of their entry-level training, it might be expected that their rates of work-related musculoskeletal disorders (WRMSDs) would be lower compared to other professionals who perform patient handling tasks, such as nurses and massage therapists. Previous research has shown that psychosocial working conditions significantly affect mental distress and overall well-being.[10] Based on the literature, occupational stress has been identified as having a detrimental impact on the development of work-related musculoskeletal disorders (WRMSDs), with these cases posing substantial risks to both physical and mental health. Therefore, this study was undertaken to investigate the prevalence of WRMSDs and their correlation with mental health. **Methodology:** Subjects were qualified physiotherapists those who were based on the inclusion & exclusion criteria and participants who willingly wants to participate. 2 Questionnaire was used in this study for the outcome measures were: (1) Nordic musculoskeletal questionnaire to assess the WRMSD, (2) General health questionnaire (GHQ-12) for the assessment of the mental health. The form was administered through Email or WhatsApp to physiotherapists across the city. **Results:** There is 67% prevalence of musculoskeletal disorders among physiotherapists and there is perfect negative correlation with WRMSD with their mental health. **Conclusion:** WRMSDs are exacerbated by patient handling and demanding work conditions, not only affect physical health but also impact therapists' mental well-being. Despite the significant prevalence, many therapists do not seek timely treatment or take necessary breaks, potentially exacerbating their conditions. Addressing ergonomic practices, reducing repetitive tasks, and enhancing support systems are crucial steps in mitigating WRMSDs and promoting overall occupational health in the physiotherapy profession.

KEYWORDS

Musculoskeletal disorders, Physiotherapists, Mental Health, Nordic Musculoskeletal Questionnaire, Working Posture

INTRODUCTION

Background

According to the World Health Organization, work-related musculoskeletal disorders (WRMSDs) are defined as injuries encompassing a broad spectrum of inflammatory or degenerative diseases and disorders that lead to pain or functional impairment.[1] These disorders affect the muscles, tendons, ligaments, joints, peripheral nerves, and supporting blood vessels.[2] They include clinical conditions like tendon inflammations (such as tenosynovitis, epicondylitis, bursitis), nerve compression disorders (like carpal tunnel syndrome, sciatica), and osteoarthrosis. Additionally, they cover less well-defined conditions such as myalgia, low back pain, and other regional pain syndromes that cannot be attributed to known pathology.[3]

Physiotherapists have already taken advantage of opportunities to take on new responsibilities, including more advanced and initial practitioner roles. While they are well-positioned to tackle future healthcare challenges, there is a need for unified support within the profession to embrace significant changes in practice, including a reassessment of their role. Healthcare workers who have direct contact with patients experience the highest rates of work-related diseases, attributed to the demands of their profession and the physical positions they must maintain throughout the day.[4]

The main risk factors associated with WRMSDs include repetitive tasks, uncomfortable postures, and high levels of force. Physiotherapists frequently undertake tasks like transferring dependent patients, assisting with mat activities, and lifting heavy equipment, which increase their susceptibility to both acute and chronic work-related musculoskeletal disorders (WRMSDs).[5] A considerable number of physiotherapists suffer from work-related musculoskeletal disorders, with upper back pain, lower back pain, and hip pain being the most common issues they face.[6]

According to the results of a longitudinal study investigating the effects of musculoskeletal pain on work performance, regular musculoskeletal discomfort was associated with decreased performance. Work-related factors contributing to this include job dissatisfaction, job strain (involving psychologically demanding tasks with time pressure and low job control), time constraints, high mental pressure, relationships with coworkers, support at work, and overall stress levels [7,8].

A Literature has highlighted that high-level workplace stress can negatively impact both the body and mind, leading to reduced productivity, absenteeism, job changes, and exhaustion. Stress arising from pain or discomfort can also affect an individual's mental well-being and quality of life. [9] According to Karasek's model, which has been prominent in research on WRMSDs, four key work-related psychosocial factors high psychological job demands, low decision-making authority, inadequate social support, and job insecurity—contribute to psychological strain. This strain increases the likelihood of stress-related health issues.[12]

Methodology

Study Place

Government and private hospitals and clinics of Gandhinagar and Ahmedabad

Study Duration

1 Year

Study Design

A Cross sectional Study

Inclusion Criteria

1. Willing to participate
2. Clinical working Physiotherapist
3. Age group (25-55 years)
4. Both male and female
5. Minimum 5-6 hours of working
6. Physiotherapist with minimum 6 months - 1 year of clinical work experience

Exclusion Criteria

1. Physiotherapists who are in the administrative duty
2. Academics or performing non-clinical work

3. Female physiotherapists who are pregnant
4. Recent trauma or surgery
5. Physiotherapists who have full time working assistants

Materials required

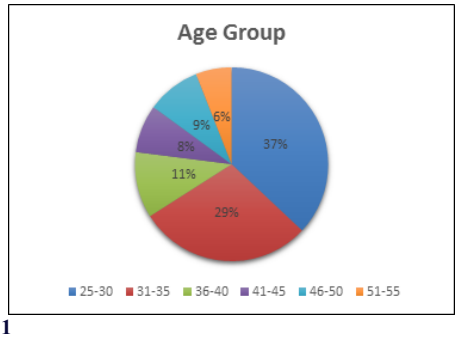
1. Mobile Phone
2. Consent form
3. Assessment form

METHOD

- Subjects were qualified physiotherapists those who meet inclusion and exclusion criteria and who are willing to participate.
- The consent was taken from all the subjects and detailed explanation of the study was also given to the subjects.
- 2 questionnaire was used in the study for the outcome measures were:
- Nordic Musculoskeletal Questionnaire (NMQ) to assess the WRMSD
- General Health Questionnaire (GHQ-12) for the assessment of the mental health
- The 1ST questionnaire consists of 2 parts. In the first part each subject were required to fill the assessment form consisting of question regarding their basic demographic details, professional details such as job/position, experience, weekly working hours and health information and the second part will consist of questions to measure the existence of musculoskeletal pain using modified Nordic musculoskeletal questionnaire.
- The 2nd questionnaire was GH-12 to assess the Mental Health. The General Health Questionnaire (GHQ-12) comprises 12 items, each evaluating the severity of mental issues over recent weeks using a 4-point scale (ranging from 0 to 3). Scores from these items are totaled to produce a score ranging from 0 to 36, where higher scores indicate more severe conditions.
- The form was administered through email or WhatsApp to physiotherapist across the city.
- A total of 410 physiotherapists were invited across Gandhinagar and Ahmedabad, among whom 276 responded. These data were analyzed based on eligibility criteria, and a total of 156 physiotherapists participated in the study.

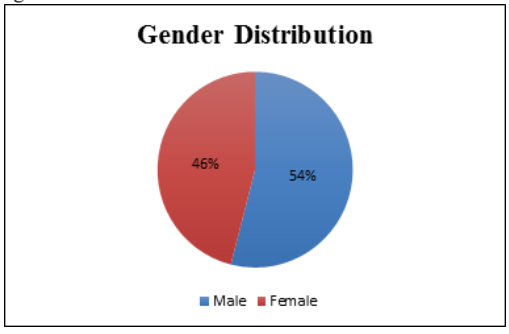
RESULTS

The analysis was done using excel.Total 156 physiotherapists are taken for the study



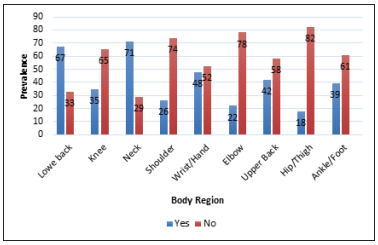
Graph 1

Graph 1 shows the age group of subjects were between 25-55 years and among them 37% were between 25-30 years, 29% were between 31-35 years, 11% were between 36-40 years, 8% were between 41-45 years, 9% were between 46-50 years and 6% were between 51-55 years. Among them 54% were female and 46% were male



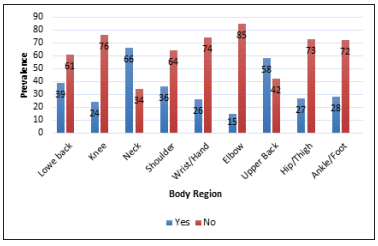
Graph 2

Graph 2 shows the gender distribution of males and females, among them 54% were male and 46% were female.



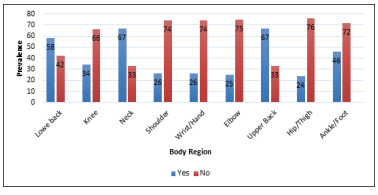
Graph 3

Graph 3 shows the prevalence in 67% suffered from lower back pain, 35% suffered from knee pain, 71% suffered from neck pain, 26% suffered from shoulder pain, 48% suffered from wrist/hand pain, 22% suffered from elbow pain, 42% suffered from upper back pain, 18% suffered from hip/thigh pain and 39% suffered from ankle/foot pain region among Physiotherapists in the last 12 months



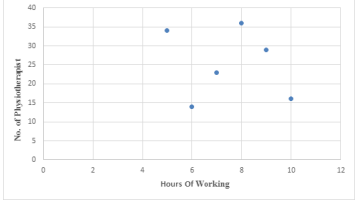
Graph 4

Graph 4 shows the prevalence in 39% suffered from knee pain, 24% suffered from lower back pain, 66% suffered from neck pain, 26% suffered from shoulder pain, 26% suffered from wrist/hand pain, 15% suffered from elbow pain, 58% suffered from upper back pain, 27% suffered from hip/thigh pain and 28% suffered from ankle/foot pain region among physiotherapists which prevented them last 12 months.



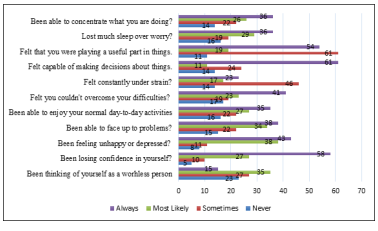
Graph 5

Graph 5 shows the prevalence in 58% are suffered from lower back pain, 34% suffered from knee pain, 67% suffered from neck pain, 26% suffered from shoulder pain, 26% suffered from wrist/hand pain, 25% suffered from elbow pain, 67% suffered from upper back pain, 24% suffered from hip/thigh pain and 46% suffered from ankle/ foot pain region among last 7 days.



Graph 6

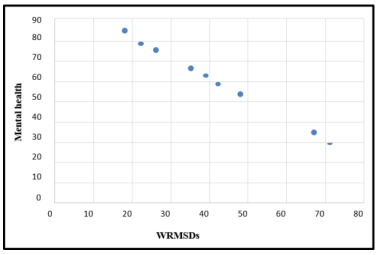
Graph 6 shows that 34 physiotherapist works for 5 hours, 14 works for 6 hours, 23 works for 7 hours, 36 works for 8 hours, 29 works for 9 hours and 16 physiotherapist works for 10 hours per week.



Graph 7

Graph 7 shows the responses of the question asked to the physiotherapist to assess the mental health related to the occupation and workplace with the help of General Health Questionnaire-12 (GH-12)

Graph 8



Graph 8 shows perfect negative correlation of Work-related musculoskeletal disorders and affection of mental health.

DISCUSSION

This study was focused on physiotherapists to investigate the prevalence of Work-related Musculoskeletal Disorders (WRMSDs) and their connection to mental health. It found that many physiotherapists, dealing with patient overload and poor posture, frequently suffer from these disorders, which can also affect their mental well-being. Out of 156 respondents, 102 physiotherapists reported experiencing work-related musculoskeletal issues, resulting in a prevalence rate of 67%. All participants completed standard Nordic Questionnaires and were interviewed about their work hours. Interestingly, despite experiencing WRMSDs, many therapists did not seek treatment, take time off work, or seek evaluation. Most therapists worked 7 hours or more daily, with some making home visits nearby. Female therapists reported more musculoskeletal problems than males, possibly due to their height and leverage issues during manual therapy. The most affected areas were the neck, lower back, and upper back, attributed to handling numerous patients, lifting dependent individuals, and working despite injuries.

The study also examined how these musculoskeletal disorders correlate with mental health, revealing a significant negative impact likely linked to their professional demands. Some therapists had developed coping strategies to manage these challenges. Psychosocial factors were also explored, revealing dissatisfaction with their profession, lack of team cooperation, poor interaction with physicians, and inadequate support from supervisors, although these associations were not statistically strong. Nonetheless, the study confirmed a 67% prevalence of musculoskeletal disorders among physiotherapists. It underscores the importance for physiotherapists to follow ergonomic guidelines, reduce repetitive tasks, or consider alternative treatments to alleviate the effects of WRMSDs.

CONCLUSION

WRMSDs are exacerbated by patient handling and demanding work conditions, not only affect physical health but also impact therapists' mental well-being. Despite the significant prevalence, many therapists do not seek timely treatment or take necessary breaks, potentially exacerbating their conditions. Addressing ergonomic practices, reducing repetitive tasks, and enhancing support systems are crucial steps in mitigating WRMSDs and promoting overall occupational health in the physiotherapy profession.

Limitations

Despite the insightful findings, it is important to acknowledge several limitations in this study Firstly, the relatively small sample size. Other factors not for affection of mental health were not taken into consideration.

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PREVALENCE OF ACHILLES TENDON INJURY IN FOOTBALL PLAYERS

Physiotherapy

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ABSTRACT

Background: Achilles tendinopathy (AT) is a clinical condition characterized by pain and swelling in and around the Achilles tendon, mainly arising from overuse. Achilles tendinopathy (AT) or Tendon injury is one of the most common injuries in physical exercise (PE), especially happens to athletes who are always engaged in long-term, continuous and high-intensity competition or training. Even after surgical treatment, AT may still occur repeatedly and the recurrence rate is as high as 44%. It is not easy to be diagnosed in the early stage of disease because of its long incubation period. So, the need of Achilles Tendon injury when participating in Exercise, and on the basis of that we can find out estimated risks of Achilles Tendon injury for different ages, genders, sport events, characteristics of subjects, training years, and regions in Ahmedabad city. **Methodology:** This study included 100 male and female football players with convenient sampling method. Subjects were assessed for Achilles Tendon injury via Royal London test and if positive directed to Victorian Institute of Sports Assessment-Achilles (VISA-A) questionnaire to find out prevalence of Achilles Tendon Injury in football players. **Result And Conclusion:** This study shows that there is Age group of 16-25 having prevalence of 68% and age group of 26-35 having prevalence of 24%.Prevalence of Achilles tendon injury in football players.

KEYWORDS

Prevalence, Achilles Tendinopathy, Football

INTRODUCTION

The clinical symptoms of pain, swelling, and impaired physical function of Achilles tendon are common in sports and daily life. Traditionally, many terms have been used to describe the disorders, including tendinitis, tendinosis, and paratenonitis. However, recent histopathological studies have found these disorders as a result of a failed healing response, which may cause degenerative changes in the tendon. The failed healing response includes three different and continuous stages (reactive tendinopathy, tendon disrepair, and degenerative tendinopathy) [1][2][3]. However, inflammatory response is not found in the three stages. In 1998, Maffulli et al. suggested to use the term tendinopathy in order to describe these intratendinous disorders [4].

The two main categories of Achilles tendinopathy are classified according to anatomical location and broadly include insertional (at the calcaneus-Achilles tendon junction) and noninsertional (2 to 6 cm proximal to the insertion of the Achilles tendon into the calcaneus) tendinopathy [5].

Achilles tendinopathy is one of the most frequently ankle and foot overuse injuries [6]. This disorder is more likely to be found in the individuals who participate in the physical activities such as running and jumping. It may affect 9% of recreational runners and cause up to 5% of professional athletes to end their careers [7]. In an epidemiologic investigation of 1394 nonathletes, Achilles tendinopathy was found in 5.6% of the subjects (4% insertional, 3.6% noninsertional, and 1.9% both forms) [8]. In another research, Kvist found that 20% to 25% of Achilles tendinopathy patients had insertional disorder, 66% had noninsertional, and 23% had either retrocalcaneal bursitis or insertional tendinopathy [9].

Chronic Achilles tendinopathy is more common in older people than in young people. In Kvist's study, among 470 patients who had Achilles tendinopathy, only 25% of the patients were young athletes and 10% were younger than 14 years [9]. Moreover, insertional tendinopathy tends to occur in more active persons, whereas noninsertional tendon injury tends to occur in older, less active, and overweight persons.

The risk factors of Achilles tendinopathy can be divided into intrinsic and extrinsic factors, either alone or combination. Intrinsic factors include biomechanical abnormalities of the lower extremity such as leg length discrepancy hyperpronation, varus deformity of the forefoot, pes cavus and limited mobility of the subtalar joint[10], and systemic conditions such as increasing age [11][12] , inflammatory arthropathies, corticosteroid use, diabetes, hypertension, obesity, gout, hyperostotic conditions [13][14] [15] [16]lipidaemias, aromatase inhibitors, and quinolone antibiotics[17]. Extrinsic factors include excessive mechanical overload and training errors such as increased interval training, abrupt changes in scheduling, excessive hill training, training on hard or sloping surfaces, increased mileage, increased repetitive loading, poor shock absorption, and wedging from uneven wear.

Sports injuries have been found to inhibit optimal sports' performance and these injuries, which can have both long and short term harmful effects, causes lasting physical damage or disability[1], affect quality of life, thus could result in reduced physical activity participation. Every sport comes with risk of injury that is peculiar. The occurrence of sports injuries and its associated problems are on the increase [2]. In association football, commonly known as soccer, injuries have been identified to result from multiple risk factors and ankle injuries are one of the most common injuries[3].Ankle injuries in soccer may give rise to problems like reduced performance, time away from competition and possibly disability[4]. The bones that make up the ankle joint are a regular site of injury and often times, bending and twisting forces can precipitate these injuries [5], with the most common being ankle sprain, fracture, and tendinopathy.

Achilles tendinopathy is a clinical condition characterized by pain and swelling in and around the Achilles tendon, mainly arising from overuse[6]. It is often a result of increase in training load. The Achilles tendon is the strongest tendon in the body serving both the gastrocnemius and soleus muscles originating near the mid-calf and inserts posteriorly at the calcaneus [7]. Achilles tendinopathy commonly happens in the mid-substance of the tendon or less commonly at its insertion in the calcaneus[8]. Previous observational studies have proved that competitive athletes have a 24% lifetime incidence of Achilles tendinopathy.

Soccer is widely recognized to be the world's most popular sport [14], and is played at different levels, worldwide, national, state, universities and even secondary schools. It is played by players in over 200 countries, making it the world's most popular sport [14]. Soccer involves several crafts that demand complex movements making the athletes susceptible to injuries, and tendinopathy is one of the most recorded overuse sports injuries in modern societies [15].

Participation in soccer is a worldwide event with tremendous health and economic benefits [16], increased self-esteem, peer socialization, general fitness, as well as reducing various diseases risks, crime rate and poverty [17]. A lot of attention has been given to elite soccer players

while in university soccer players, there are higher numbers of participants who began playing early and continue for a longer period. For some of them, their gears are not always suitable for the sport, thereby increasing the threat of tendinopathy [9]. The average university soccer players play soccer at least three (3) times a week, and Achilles tendinopathy occurs as a result of overuse. The increase in the popularity of soccer and expectations from players make meaningful numbers of soccer injuries conceivable. University soccer players also go through rigorous physical training, preparing for inter-club competition, inter- school competition. They are not professionals, so much attention is not given to them, but the trainings and constant field activity also makes them susceptible to sports injuries like Achilles tendinopathy. Also, intrinsic factors inherent in individual's physiology could also influence susceptibility to Achilles tendinopathy [9]

METHODOLOGY

Study Design, Setting And Sampling

Study Design: A Cross-sectional Study

Study Setting: Football academies of Ahmedabad city

Sampling Technique: Convenient Sampling

Population: Football players

Sample Size: 100 subjects, based on following formula:

$N = Z^2 P(1-P) / d^2$

Where, N= Sample size

Z= Level of confidence (95%)

P=Expected Prevalence (Previous researches) d=Precision (Corresponding Effect size)

Selection Criteria

Inclusion Criteria:

- Athletes who are willing to take participate in the survey.
- Age group 16 to 35 years.
- Male and Female football players.
- Playing football more than 2 years.

Exclusion Criteria:

- Athletes who are not willing to take part in survey
- Participants who actively engaged in other sports like basketball, sprinting were excluded because these sports could make them prone to Achilles tendinopathy.
- Any lower extremity trauma or injury in past 5 years.
- Subjects having connective tissue disorder
- Subjects having any neuromuscular disoder

MATERIALS REQUIRED

- Assessment form
- Consent form
- Pen, Pencil and Paper
- Mat and Plinth

METHODOLOGY

Ethical approval was obtained from Institutional Ethical Committee of Venus institute of physiotherapy, Gandhinagar. A letter of introduction from the Department of physiotherapy, Venus institute of physiotherapy, Gandhinagar was given to the coaches of the various teams seeking for permission to carry out the research with their teams. Informed consent was obtained from all participants and assuring them of confidentiality of their information.

The Royal London test, a psychometrically sound instrument, was used for assessing Achilles tendinopathy [18][19]. To start the test, the participant lay prone on the plinth with the feet hanging outside the table. The ankle was in neutral position and the Achilles tendon was palpated for tenderness.

The participant was asked to dorsiflex and the ankle was palpated on dorsiflexion. Results were classified as tenderness present on dorsiflexion or absent. In patients with Achilles tendinopathy, tenderness was felt on palpation with the ankle in neutral position, but on dorsiflexion tenderness was absent or reduced.

Figure 1: Flowchart of the study procedure

OUTCOME MEASURE

VISA–A Scale:

the Victorian Institute of Sports Assessment-Achilles (VISA-A) questionnaire was administered; it is a valid, reliable, and user-friendly index of the severity of Achilles tendinopathy, which contains eight questions that covers the 3 domains of pain (questions 1 to 3), function (questions 4 to 6), and activity (questions 7 and 8). Questions 1 to 7 are scored over 10, and question 8 carries a maximum of 30. Scores are summed to give a total of 100. An asymptomatic person would score 100. For question 8 which has three part (A, B, C), participants must answer only one part; A, B, or C that relates to the person's reality. If the participant experiences pain when performing sport, he or she automatically loses at least 10, and possibly 20, points.

Reliability And Validity of Visa-A:

J M Robinson The VISA-A questionnaire: a valid and reliable index of the clinical severity of Achilles tendinopathy: To develop and test a questionnaire based instrument that would serve as an index

of severity of Achilles tendinopathy. Item generation, item reduction, item scaling, and pretesting were used to develop a questionnaire to assess the severity of Achilles tendinopathy. The final version consisted of eight questions that measured the domains of pain, function in daily living, and sporting activity. Results range from 0 to 100, where 100 represents the perfect score. Its validity and reliability were then tested in a population of non-surgical patients with Achilles tendinopathy (n = 45), presurgical patients with Achilles tendinopathy (n = 14), and two normal control populations (total n = 87). The VISA-A questionnaire had good test-retest (r = 0.93), intrarater (three tests, r = 0.90), and interrater (r = 0.90) reliability as well as good stability when compared one week apart (r = 0.81). The mean (95% confidence interval) VISA-A score in the non-surgical patients was 64 (59-69), in presurgical patients 44 (28-60), and in control subjects it exceeded 96 (94-99). Thus the VISA-A score was higher in non-surgical than presurgical patients (p = 0.02) and higher in control subjects than in both patient populations (p<0.001). The VISA-A questionnaire is reliable and displayed construct validity when means were compared in patients with a range of severity of Achilles tendinopathy and control subjects.

RESULT

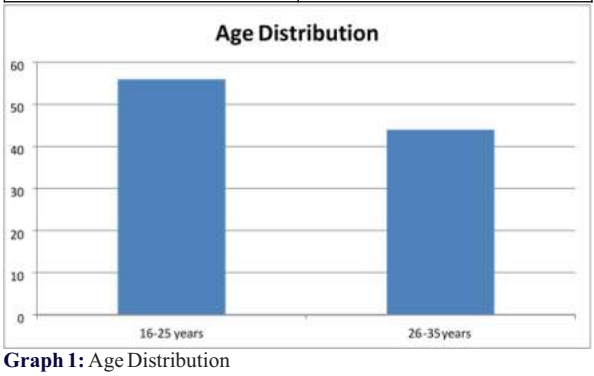
All statistical analysis was done using SPSS 25.0 software for windows. Descriptive analysiswas used to obtain mean and standard deviations.

Demographic Data

Age: The research was performed on 100 participants between the age of 16-35. There were 56 patients between the ages of 16 to 25, 44 patients between the age 26 to 35.

Table 1: Age Distribution

Age Distribution	
16-25 years	26-35 years
56	44

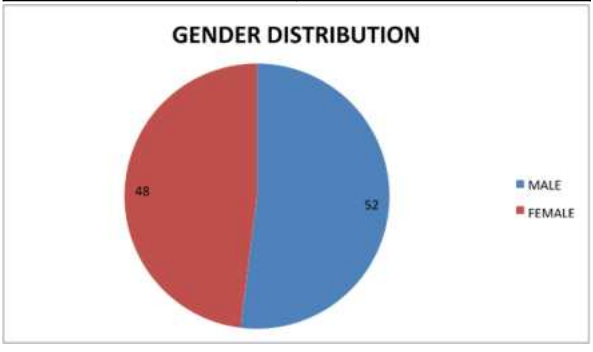


Graph 1: Age Distribution

GENDER DISTRIBUTION

Table 2: Gender Distribution

Gender Distribution	
Male	Female
52	48



Graph 2: Gender Distribution

Table 3: Hours Of Training

Mode	Number	Percentage
3 hours	48	48%
4 hours	27	27%
5 hours	14	14%
6 hours	07	7%
>6 hours	03	3%

Table 4: Distance

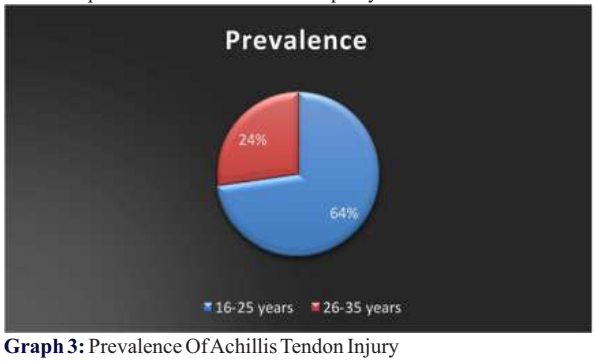
Distance	Number	Percentage
3 years	68	68%
4 years	25	25%
>4 years	07	7%

Age group of 16-25 having prevalence of 68% and age group of 26-35 having prevalenceof 24%.

Table 5: Mean Value Of VISA-A Score

	Mean + SD
Age	23.25±4.46
SF36	64.51±12.18
VISA-A	50.79 ± 19.98

VISA-A score less then 60 is seen in person with tendinopathy and SF-36 is considered goodas score high here mean value of VISa –A is less then 60 in persons with Achillis tendinopathy.



Graph 3: Prevalence Of Achillis Tendon Injury

The VISA-A questionnaire: An index of the severity of Achilles tendinopathy

IN THIS QUESTIONNAIRE, THE TERM PAIN REFERS SPECIFICALLY PAIN IN THE ACHILLESTENDON

REGION

1. For how many minutes do you have stiffness in the Achilles region on first getting up?

100mins ☐☐☐☐☐☐☐☐☐☐☐ 0 mins

0 1 2 3 4 5 6 7 8 9 10

POINTS

2. Once you are warmed up for the day, do you have pain when stretching the Achilles tendon fully over the edge of a step? (keeping knee straight)

strong severe pain ☐☐☐☐☐☐☐☐☐☐☐ POINTS no pain

0 1 2 3 4 5 6 7 8 9 10

3. After walking on flat ground for 30 minutes, do you have pain within the next 2 hours? (If unable to walk on flat ground for 30 minutes because of pain, score 0 for this question).

strong severe pain ☐☐☐☐☐☐☐☐☐☐☐ POINTS no pain

0 1 2 3 4 5 6 7 8 9 10

The VISA-A questionnaire: An index of the severity of Achilles tendinopathy

IN THIS QUESTIONNAIRE, THE TERM PAIN REFERS SPECIFICALLY PAIN IN THE ACHILLESTENDON

REGION

4. For how many minutes do you have stiffness in the Achilles region on first getting up?

100 mins POINTS 0 mins

0 1 2 3 4 5 6 7 8 9 10

5. Once you are warmed up for the day, do you have pain when stretching the Achilles tendon fully over the edge of a step? (keeping knee straight)

strong severe pain POINTS no pain

0 1 2 3 4 5 6 7 8 9 10

6. After walking on flat ground for 30 minutes, do you have pain within the next 2 hours? (If unable to walk on flat ground for 30 minutes because of pain, score 0 for this question).

strong severe pain POINTS no pain

0 1 2 3 4 5 6 7 8 9 10

7. Do you have pain walking downstairs with a normal gait cycle?

strong severe pain POINTS no pain

0 1 2 3 4 5 6 7 8 9 10

8. Do you have pain during or immediately after doing 10 (single leg) heel raises from a flat surface?

strong severe pain POINTS no pain

0 1 2 3 4 5 6 7 8 9 10

9. How many single leg hops can you do without pain?

0 POINTS 10

0 1 2 3 4 5 6 7 8 9 10

10.Are you currently undertaking sport or other physical activity?

0 Not at all POINTS

4 Modified training ± modified competition

7 Full training ± competition but not at same level as when symptoms began

10 Competing at the same or higher level as when symptoms began

11. Please complete **EITHER A, B or C** in this question.

• If you have **no pain while undertaking Achilles tendon loading sports** please complete **Q8a only**.

• If you have **pain while undertaking Achilles tendon loading sports but it does not stop you from completing the activity**, please complete **Q8b only**.

• If you have **pain that stops you from completing Achilles tendon loading sports**, please complete **Q8c only**.

A. If you have **no pain** while undertaking **Achilles tendon loading sports**, for how long can you train/practise?

POINTS

NIL	1-10 mins	11-20 mins	21-30mins	>30 mins
0	7	14	21	30

OR

B. If you have some pain while undertaking **Achilles tendon loading sport**, but it does not stop you from completing your training/practice for how long can you train/practise?

POINTS

NIL	1-10 mins	11-20 mins	21-30mins	>30 mins
0	4	10	14	20

OR

C. If you have **pain that stops you** from completing your training/practice in **Achilles tendon loading sport**, for how long can you train/practise?

NIL	1-10 mins	11-20 mins	21-30mins	>30 mins	POINTS
0	2	5	7	10	

TOTAL SCORE (/100) %

DISCUSSION

The overall incidence rate is 1.85 per 1,000 registered persons per year, and for the adult population it is 2.35. There are no other studies on the incidence rates of Achilles tendinopathy in the general population to compare these results with. The prevalence rate was higher than that for another tendinopathy like lateral epicondylitis of 1.3% (men) and 1.1% (women) in 9,696 persons registered at two general practitioners.10 The incidence rates in our study are lower than the incidence of 2.98 found in the military population4 and than the annual incidence 7% and 9% in top-level runners.2 3 While it seems plausible that the incidence rate of Achilles tendon injuries is higher in athletes than within a more general population, only in 35% of the cases in our study was a relationship with sports activity described. Intrinsic risk factors such as body weight and insulin resistance might also play a role.11 Although we could not assess information on body weight, the diagnosis of Diabetes Mellitus (DM) was available from the medical records.

The minor difference between the incidence and prevalence rate suggests that most patients only visit their General Practitioner (GP) once with their Achilles tendon problems. This might be because of a short duration of symptoms or that the patients go to a physiotherapist or sports physician afterwards.

This cross-sectional study has some limitations, due to which the actual incidence of Achilles tendinopathy is probably higher than observed in this study. Firstly, not every person with a certain complaint will visit a healthcare professional. In a cross-sectional population-based study, Picavet et al reported that approximately 50% of the patients with musculoskeletal complaints visited a healthcare professional. However, those with severe or persistent complaints will probably seek healthcare. Second, while most patients in the Dutch healthcare system will visit their GP before being referred to a therapist or specialist, since 2006 patients can visit a physiotherapist or sports physician without referral by a GP. It would be interesting to know the incidence rates of Achilles tendinopathy within the patient population of the Dutch physiotherapists and sports physicians as well, but since the denominators of these populations are unknown, no exact incidence rates could be obtained. Finally, because there is no specific registration code available for Achilles tendinopathy, GPs register this injury using other or more general codes.

In concordance with other studies,13 most cases were encountered in the middle-aged population (age group 41–60 years). At present, the prevalence of Achilles tendon rupture in PE is not clear, a study showed that the incidence of Achilles tendon rupture was higher in sedentary men aged 29–48. It was speculated that the relationship between AT and age may be due to the changes of mechanical properties of Achilles tendon with age. Recently, Sprague et al. found that there was a positive correlation between age and viscosity of uninjured Achilles tendon. Aging was usually associated with reduced cellular structure, increased glycoamine polysaccharide content, and decreased fibrous tissue, all of which can lead to degenerative changes in the Achilles tendon. At the same time, the aging tendon loses elasticity, forcing the muscle to work harder, eventually leading to changes in tendon structure.

Consistent with the previous study, we found that the prevalence of AT in football players was significantly higher than in other sports. This may be related to the high training intensity of football players and the heavy load on Achilles tendon. Some reviews showed that the prevalence of Achilles tendon injury in running and track and field sports is the highest. Ball games generally require athletes to make a rapid judgment according to the competition form in a short time, such as repeated bounce, dribble pass, back and forth quick start and other technical actions with a large load on the Achilles tendon. These technical actions need the support of the Achilles tendon, which also lays a huge hidden danger for its injury.

CONCLUSION

This study was conducted among Football players of Ahmedabad city and it revealed that players those are having long training hours prone to developing tendinopathy. This study shows that there is Age group

of 16-25 having prevalence of 68% and age group of 26-35 having prevalence of 24%.

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COMPARATIVE STUDY OF MYOFASCIAL RELEASE AND HOT PACK IN UPPER TRAPEZIUS SPASM.

Physiotherapy

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ABSTRACT

Background: Neck pain commonly seen in back of neck and between the bases of neck to shoulder mainly indicates the involvement of upper trapezius muscle . About two third of people will experience neck pain at some point in their lives. A considerable proportion of patients with upper trapezius spasm had been treated with medical and physical therapy interventions. The study aims to compare the effectiveness of Myofascial Release technique (MFR) versus hot pack in relieving pain, improving cervical ROM and pressure pain threshold in upper trapezius spasm patients. **Methodology:** Total 60 subjects will be assessed which will be divided into 2 groups A and B and then they'll be given MFR and Hot pack treatment respectively to both groups . They'll be assessed and monitored throughout the treatment and their NPRS pain intensity scale will be recorded week by week. **Result:** Out of 60 participants 15 were eliminated because of various conditions which wasn't applicable for the study. 27 were females and 18 were males in them. In this comparison the MFR seems to be slightly more effective than Hot pack in upper trapezius spasm. **Conclusions:** The study shows that although both techniques are effective in depletion of symptoms and associated disability in upper trapezius muscle spasm, Myofascial Release Technique gave better results as compared to Hot pack.

KEYWORDS

NPRS (Numeric Pain Rating Scale), Tenderness Grading Scale, MFR and Hot pack.

INTRODUCTION

The trapezius muscle is a large superficial back muscle that resembles a trapezoid . It extends from the external protuberance of the occipital bone to the lower thoracic vertebrae and laterally to the spine of the scapula . The trapezius has upper , middle , and lower groups of fibers.

The trapezius is a shawl muscle or musculus calculate"(shaped like a monk"s hood) because of its shape and location. The low – level activity of the upper trapezius is frequently found during sitting and standing which is related to head posture and is a common source of tension and neck pain in people who work at a desk and computers or who spend many hours driving (1)

Neck pain is very common in the region of the upper trapezius muscle. About two - thirds of people experience neck pain at some point in their lives . In middle age , Prevalence is highest and women are more affected than men.

Myofascial release is a soft tissue mobilization technique, defined as “the facilitation of mechanical, neural and psychophysiological adaptive potential as interfaced via the myofascial system. (2)

By MFR there is a change in the viscosity of the ground substance to a more fluid state which eliminates the fascia's excessive pressure on the pain – sensitive structure and restores proper alignment. (2)

Only a few studies have looked at the impact of myofascial release (MFR) techniques on the primary metrics of patient outcomes.

Myofascial release is a form of manual therapy that aims to release tension and tightness in the fascia , which is the connective tissue that surrounds and supports muscles and organs . It involves applying sustained pressure to specific points on the body to release tension and improve circulation . Myofascial release has been shown to be effective in reducing pain and improving range of motion in people with a variety of musculoskeletal conditions , including neck and shoulder pain.

Upper trapezius spasm , on the other hand , is a condition that is often treated with stretching and massage of the affected muscle . Stretching and massage can help to relieve tension and reduce pain in the upper trapezius muscle . However , the effectiveness of these treatments may vary depending on the severity of the spasm and the underlying cause of the condition.

In this study , we aim to compare the effectiveness of myofascial release and upper trapezius spasm in reducing pain and Improving range of motion in people with upper trapezius spasm . We will be looking at factors such as pain intensity , range of motion , and functional status to determine which treatment is more effective for this condition .

Previous research has shown that MFR Improves ROM and decreases pain. Furthermore , Kain et al. reported significant improvements in shoulder joint ROM among healthy recipients of either MFR or hot pack therapy (HPT).

The post - treatment effects of MFR intervention have been postulated to parallel those of massage and soft tissue mobilization techniques. These effects include circulatory changes, blood flow changes, capillary dilatation, cutaneous temperature changes, and changes in metabolism. These changes are reflected in increased ROM, improved biomechanics of the joint, increased Extensibility of tissues, improved flexibility, muscle relaxation, reduction of spasm, decreased tone, reduction of edema and analgesia.

The purpose of this study was to compare end results spasm, after MFR techniques and hot pack application. Heat in its various forms has been a popular longstanding modality used to facilitate healing. Transmission of heat, either by conduction, convection, radiation, and / or conversion, comprises the most common methods of heat usage.

Hot packs are designed to deliver moist heat to the affected area, promoting muscle relaxation, increased blood flow, and pain relief. The heat penetrates deep into the muscle tissue, helping to relax tense muscles, decrease muscle spasms, and improve flexibility. Additionally, the increased blood flow to the area can aid in the removal of metabolic waste and promote the delivery of oxygen and nutrients, accelerating the healing process.

The application of a hot pack on the upper trapezius typically involves wrapping the pack in a towel or using a specialized cover to protect the skin from direct heat. The pack is then placed on the affected area for a specific duration , usually around 15-20 minutes. It's important to ensure that the temperature is comfortable and not too hot to avoid burns or skin irritation.

For this study, hot packs were chosen as our comparative modality for a number of reasons :

(1) The simplicity of access to the modality
(2) The ease of application
(3) The accepted usage within the field of rehabilitation
(4) Minimal contraindications
(5) Standardization of application.

Methodology

Study Design and Setting

Study Design: COMPARATIVE STUDY
Study Duration: 4 weeks (5 sessions per week)

Population
 Subjects with upper trapezius spasm between 20 - 40 years of both sexes.

Selection Critaria
Inclusion Critarea
- AGE : 20 - 40 years
- Patient complains of pain in upper trapezius for more than 1 month.
- Subjects are willing to participate .

Exclusion Critarea
- Patients taking 3 or more tablets of 500 mg. paracetamol in a day for pain relief.
- Neurological disorders .
- Any other condition than upper trapezius spasm .
- Any other therapy for trapezius spasm .

Sampling Method and Sample Size
Sampling Method: Simple random sampling
Sample Size: 60

Procedure
A therapist assessed patients at the orthopedic and sports physiotherapy department who had been recommended by an orthopedic physician . The included patients ranged in age from 20 to 40 years old , had neck pain from at least one month , both male and female , displayed the jump sign , which is characterized by patient vocalization or retreat , and had a palpable painful site in the upper trapezius muscle . If they had a history of latent trigger points , healing fractures over the neck and upper back , dermatitis over the upper back , clotting disorders , wounds over the neck region , shoulder pathology , or a degenerative cervical spine , cervical radiculopathy or myelopathy they were eliminated.

The exercises' procedures will be shown, and the subjects will be given instructions on what to do and what not to do .

60 Subjects will be selected according to the selection criteria and the informed consent will be obtained from them . They will be assessed with Neck disability index , NPRS and Tenderness and their respective scores will be documented . The selected subjects will be randomly divided into 2 groups A and B group with nearly same subjects in each group .

All 60 subjects will be randomly assigned to 1 of 2 treatment groups :
- Group - A (n=20) MFR + exercises ,
- Group - B (n=20) Hot pack + exercises ,
- Hot pack : position – Sitting
- Duration – 20 minutes

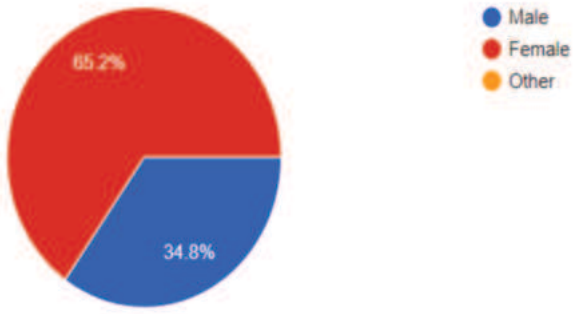
Figure 1 illustrates the screening results , which revealed that 15 people were eliminated , 8 did not give consent , and 2 had cervical radiculopathy and 5 had wounds over the neck region

In this study , 45 participants - 27 females and 18 males – aged 20 to 40 years were enrolled . A consent form was signed by everyone and They were then randomly allocated , using sealed envelopes , into three groups , group B .

Outcome Measures
1. NPRS (NUMERICAL PAIN RATING SCALE): This scale is for assessing the pain score of a patient on different week throughout the treatment.
2. Neck Disability Index.
3. Tenderness Grading.

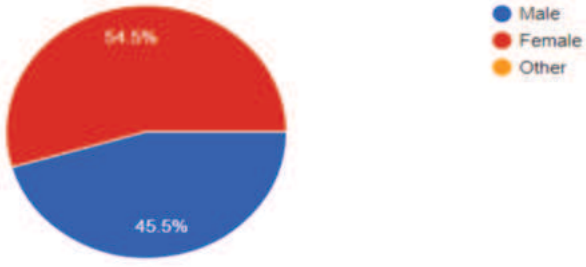
RESULTS
1. Gender Distribution
- There was total 45 participants which was participated in the treatment. They were nearly equally divided in 2 groups A and B.
- 23 patients were in Group A which had MFR in the sessions. 22 patients were in a Group B which had Hot pack therapy.
- Total 27 females and 18 males participated in the treatment.

Group (A) Gender Distribution for MFR



(1.1)

Group (B) Gender Distribution for Hot pack



(1.2)

- Chart 1.1 and 1.2 represents the Gender distribution for both Group A and B respectively.

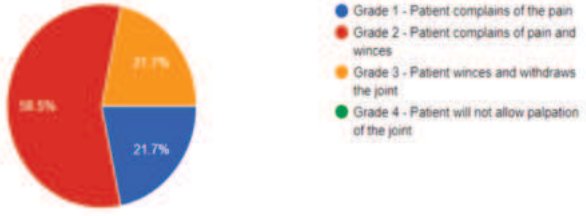
2. Age Distribution
- The mean age of MFR treatment for participants was 30.038 contains 23 people.
- The mean age of Hot pack treatment participants was 31.045 contains 22 people.

(2.1) Age Distribution for both group

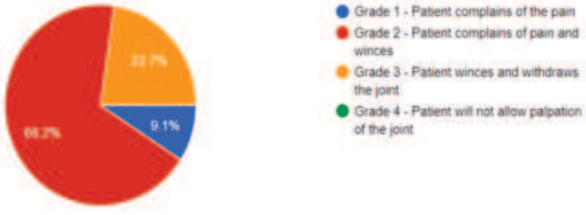
3. Tender Grading Scale Distribution

Measures	Mean
Group A	30.038
Group B	31.045

- Tenderness scale for every patient recorded before pretreatment.



3.1 Group A Tender Grading Scale Distribution



3.2 Group B Tenderness Grading Scale Distribution
- These 2 pie charts 3.1 and 3.2 represents the tenderness grading scale of participants from Group A and Group B respectively.

4. Pain Intensity Comparison
- Numeric pain rating scale measured for pretreatment and then week by week for both treatments.
- Here presenting tables and graphs for NPRS scale.

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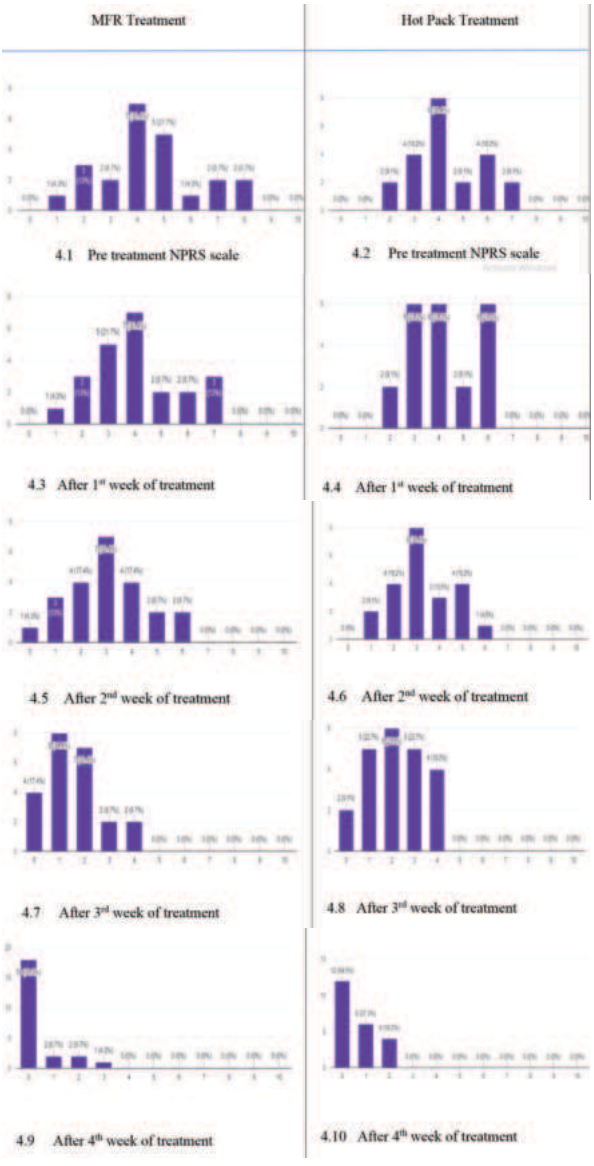

- Graph 4.1 and 4.2 represents the pain intensity of participants before treatment.
- Graph 4.3 and 4.4 represents the pain intensity of participants after 1st week treatment of MFR and Hot pack respectively.
- Graph 4.5 and 4.6 represents the pain intensity of participants after 2nd week treatment of MFR and Hot pack respectively.
- Graph 4.7 and 4.8 represents the pain intensity of participants after 3rd week treatment of MFR and Hot pack respectively.
- Graph 4.9 and 4.10 represents the pain intensity of participants after 4th week treatment of MFR and Hot pack respectively.

Differences Between Pain Intensity Throughout The Different Treatments Accordingly.

Measures	Mean value of Pain	Difference Of pain intensity	
	Pre treatment	Post	
Group A	5.06	0.42	4.64
Group B	4.46	0.65	3.81

(4.11) Mean value difference for both treatment

- This table 4.11 represents the difference between pretreatment pain intensity and post treatment of participants.
- Pretreatment pain intensity in Group A was 5.06 and post treatment value was 0.42 which occurs the difference of 4.46.
- Pretreatment pain intensity in Group B was 4.46 and post treatment value was 0.65 which occurs the difference of 3.81.

DISCUSSION

- His was a comparative study to evaluate the efficacy of hot pack and MFR on trapezius muscle pain due to spasm, the most found musculoskeletal disorder.
- The treatment time duration was 5 sessions per week for 4 weeks for both of Group A and B which had 23 and 22 participants in respective Group.
- After analysis of baseline data and post treatment scores, it reveals significant improvement ($p<0.05$) in group A after 4 weeks treatment session.
- There was significant difference ($p<0.05$) in post treatment comparison between MFR and hot pack group. The findings of this study suggested both MFR and hot pack along with shoulder girdle and cervical exercises were effective in the treatment of upper trapezius.
- The results revealed that both methods of treatment applications provided a similar physiological response on the spasm of trap muscle. The hot pack inducing an increase of blood circulation in the superficial tissue and leading to fluid distribution in the trigger point area and therefore decreasing tissue density.
- Thermal effect further induced blood circulation toward the treated area, resulting in physiological changes and clinical outcomes such as reduced muscle spasm, altered threshold of receptors, minimizing hypoxia, alleviating pain and promoting the healing process.

Whereas, in MFR the stretch is applied to the fascia, which being the superficial structure has the direct effect. Muscle being the deeper structure will have an indirect effect. So, instant effect in terms of relief in the pain and spasm will be seen immediately following treatment, but it may not last for long period. Multiple sessions may be required to have the cumulative effect and sustained relief.

CONCLUSION

As the study shows that although both techniques are effective in depletion of symptoms and associated disability in upper trapezius muscle spasm, Myofascial Release Technique gave better results as compared to Hot pack.

Limitations

- Ergonomical advices and posture correction not employed.
- Limited Age Group , may applicable to larger age group.
- The study had a small sample size.
- No follow up taken after 4 weeks to see the sustained effect of therapy.
- Side specific involvement as per the dominancy was not considered for analysis.
- Short duration of the study.

Future Recomendentions

- It is believed that the conclusion of present study utilizes in the future researches. There is a need for long term studies on efficacy of treatments in reducing symptoms of trap muscle spasm using advanced techniques.
- Thus future studies should use the multidimensional approach regarding the treatments. By this study a good treatment plan can be made for better recovery of patient.
- This study can be further investigated with a large number of samples in relation with lifestyle modification and physiotherapy intervention.

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INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

TO FIND THE PREVALENCE OF CHRONIC NECK PAIN IN OLA/UBER DRIVER OF GUJARAT"

Physiotherapy

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ABSTRACT

Introduction: Chronic neck pain is a prevalent issue among Ola/Uber drivers in Gujarat, adversely impacting their daily functioning and overall well-being. Despite its significance, research focusing on the prevalence and impact of chronic neck pain in this occupational group remains limited. This study aims to address this gap by examining the prevalence, severity, and associated factors of chronic neck pain among Ola/Uber drivers in Gujarat. **Participants:** A total of 300 Ola/Uber drivers from various regions of Gujarat participated in the study, providing valuable insights into the prevalence and impact of chronic neck pain in this population. **Results:** Analysis of the data revealed that a significant proportion of Ola/Uber drivers experienced chronic neck pain, with 66% of the participants reporting some degree of disability according to the Neck Disability Index (NDI). Additionally, varying levels of pain intensity were observed, highlighting the considerable burden of chronic neck pain on the drivers' well-being and work performance. **Conclusion:** The findings underscore the urgent need for targeted interventions and ergonomic improvements to alleviate the burden of chronic neck pain among Ola/Uber drivers in Gujarat. By addressing the underlying factors contributing to neck pain and implementing strategies to improve driver well-being, we can enhance the overall quality of life and safety for Ola/Uber drivers in Gujarat.

KEYWORDS

Chronic Neck Pain, Ola/uber Drivers, Prevalence, Impact, Interventions.

INTRODUCTION:

About Anatomy Of Neck

The neck serves as a crucial anatomical region connecting the head to the trunk, housing vital structures responsible for various physiological functions. Understanding the intricate anatomy of the neck is fundamental for medical practitioners across multiple specialties.

The neck comprises several layers, including skin, superficial fascia, platysma muscle, deep cervical fascia, and numerous structures such as blood vessels, nerves, lymph nodes, and viscera. The cervical vertebrae provide structural support while facilitating movement of the head and neck.

Muscles:
Key muscles in the neck include the sternocleidomastoid, scalene, trapezius, and suprahyoid muscles. These muscles play crucial roles in head movement, respiration, swallowing, and speech.1

Blood Supply:
The neck receives arterial blood supply primarily from the common carotid arteries, which bifurcate into internal and external carotid arteries. The vertebral arteries also contribute to cerebral circulation, branching off from the subclavian arteries.

Nerves:
Nerves of the neck include the cervical plexus, brachial plexus, vagus nerve, phrenic nerve, and sympathetic chain. These nerves innervate various structures in the neck and regulate autonomic functions.2

Lymphatics:
The neck contains an extensive network of lymph nodes organized into chains, including the superficial and deep cervical lymph nodes. These nodes play a crucial role in immune surveillance and lymphatic drainage from the head and neck region.

Clinical Significance:
An understanding of neck anatomy is essential for diagnosing and treating various conditions, including neck trauma, infections, tumors, and neurological disorders. Surgical procedures in the neck region require precise knowledge of anatomy to minimize complications. 3951

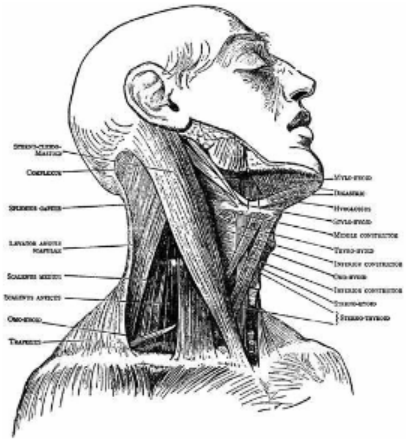


Fig: 1 Anatomy Of Neck

About Neck Pain

Neck pain is a common complaint encountered in clinical practice, affecting individuals of all ages and backgrounds. Understanding the various types of neck pain is essential for accurate diagnosis and appropriate management.

Types of Neck Pain:

1. Mechanical Neck Pain:

- Mechanical neck pain typically results from musculoskeletal causes such as poor posture, muscle strain, or degenerative changes in the cervical spine.
- It is often exacerbated by certain activities or positions and may improve with rest, activity modification, and physical therapy.4

2. Cervical Radiculopathy:

- Cervical radiculopathy occurs when a nerve root in the cervical spine becomes compressed or irritated, leading to pain, weakness, and sensory changes along the distribution of the affected nerve.
- Common causes include herniated discs, spinal stenosis, or foraminal narrowing.

3. Cervical Myelopathy:

- Cervical myelopathy refers to compression or injury to the spinal cord in the cervical region, resulting in motor, sensory, and reflex abnormalities.
- Causes include degenerative disc disease, cervical spondylosis, or spinal cord tumors.

4. Whiplash-Associated Disorder (WAD):
- WAD occurs following sudden acceleration-deceleration forces on the neck, commonly seen in motor vehicle accidents.
- Symptoms may include neck pain, stiffness, headache, and sometimes neurological deficits.5

5. Non-Specific Neck Pain:
- Non-specific neck pain refers to pain in the neck region without a specific identifiable cause.
- It may result from a combination of factors including poor posture, stress, muscle tension, and psychosocial factors.

Clinical Considerations:
- A thorough history and physical examination are essential for evaluating neck pain and determining its underlying cause.
- Diagnostic imaging studies such as X-rays, MRI, or CT scans may be indicated to further evaluate the cervical spine and surrounding structures.
- Treatment options for neck pain vary depending on the underlying cause and may include medications, physical therapy, injections, or surgical intervention in severe 6

Neck Pain Due To Bad Posture And Stress

Neck pain attributed to bad posture and stress is a common complaint encountered in clinical practice, affecting individuals of all ages and occupations. Understanding the underlying mechanisms and management strategies for this type of neck pain is essential for healthcare professionals.

Etiology:

1. Bad Posture:
- Prolonged periods of sitting or standing with poor posture can lead to excessive strain on the muscles, ligaments, and joints of the neck.
- Common postural deviations contributing to neck pain include forward head posture, rounded shoulders, and excessive cervical lordosis.

2. Over Stress:
- Psychological stress and tension can manifest physically as muscle tightness and increased muscle tone in the neck and shoulder region.
- Chronic stress can lead to the development of trigger points, muscle imbalances, and reduced pain threshold, exacerbating neck pain symptoms.

Pathophysiology:
- Poor posture and stress can result in muscular imbalances, leading to altered biomechanics of the cervical spine and surrounding structures.
- Chronic tension and strain on the neck muscles can cause microtrauma, inflammation, and decreased blood flow, contributing to the development of neck pain.7

Neck Disability Index

The Neck Disability Index (NDI) is a validated tool used to assess the impact of neck pain on daily functioning and quality of life. It consists of 10 items covering various aspects of physical and functional impairment related to neck pain. 8

Numeric Pain Rating Scale (NPRS)

The Numeric Pain Rating Scale (NPRS) is a commonly used tool for quantifying pain intensity on a numerical scale from 0 to 10, where 0 represents no pain and 10 represents the worst pain imaginable. It provides a quick and simple method for patients to communicate their pain levels to healthcare providers.9

AIM OF THE STUDY

The aim of this study is to investigate the prevalence and factors associated with chronic neck pain among Ola/Uber drivers in Gujarat, India.

Specifically, the study seeks to:
1. Determine the prevalence of chronic neck pain among Ola/Uber drivers in Gujarat.
2. Identify demographic, occupational, and psychosocial factors contributing to chronic neck pain in this population.
3. Assess the impact of chronic neck pain on the quality of life, work performance, and driving safety of Ola/Uber drivers.
4. Explore potential interventions and preventive strategies to alleviate neck pain and improve the overall well-being of Ola/Uber drivers in Gujarat.

This study aims to provide valuable insights into the burden of chronic neck pain among Ola/Uber drivers and inform the development of targeted interventions to address this occupational health issue.

Need Of The Study

The need for investigating the prevalence of chronic neck pain among Ola/Uber drivers in Gujarat arises from several key factors:
1. Occupational Health Concerns: Ola/Uber drivers spend prolonged periods driving, often in non-ergonomic positions, which may predispose them to musculoskeletal disorders such as chronic neck pain. Understanding the extent of this issue is crucial for addressing their occupational health needs.
2. Lack of Research: Despite the growing reliance on ridesharing services like Ola and Uber, there is limited research focusing on the musculoskeletal health of drivers, particularly regarding chronic neck pain. This study will fill a critical gap in the literature.
3. Impact on Quality of Life: Chronic neck pain can significantly impact the quality of life, work productivity, and overall well-being of individuals. Assessing the prevalence of neck pain among Ola/Uber drivers will shed light on the magnitude of this problem and its implications.
4. Driver Safety: Neck pain can impair mobility and concentration, potentially compromising driver safety and increasing the risk of accidents. Understanding the association between neck pain and driving performance is essential for ensuring road safety.
5. Intervention Development: By identifying the factors contributing to chronic neck pain among Ola/Uber drivers, this study will inform the development of targeted interventions and preventive measures to alleviate pain and improve the health outcomes of drivers.

In summary, there is a pressing need to investigate the prevalence of chronic neck pain among Ola/Uber drivers in Gujarat to address their occupational health concerns, improve their quality of life, ensure driver safety, and inform the development of effective interventions.

Objective Of The Study

The objective of this study is to determine the prevalence of chronic neck pain among Ola/Uber drivers in Gujarat, India, and to explore associated risk factors and impact on drivers' quality of life and work performance. Specifically, the study aims to:
1. Assess the prevalence of chronic neck pain among Ola/Uber drivers in Gujarat through a cross-sectional survey.
2. Identify demographic, occupational, and psychosocial factors associated with chronic neck pain in this population.
3. Evaluate the impact of chronic neck pain on drivers' quality of life, work productivity, and driving safety.
4. Investigate coping strategies and healthcare-seeking behaviors adopted by Ola/Uber drivers in response to chronic neck pain.
5. Provide recommendations for interventions and preventive measures to alleviate neck pain and improve the overall well-being of Ola/Uber drivers in Gujarat.

Study Design And Study Setting

Study Design:

The study will employ a cross-sectional design to investigate the prevalence of chronic neck pain among Ola/Uber drivers in Gujarat.

Study Duration:

The study will be conducted over a period of 6 months, from [10 October, 2023] to [12 March, 2024].

Population:

The target population will consist of Ola and Uber drivers operating in various cities and towns across Gujarat.

Selection Criteria:

a. Inclusion Criteria:
1. Licensed Ola/Uber drivers.
2. Currently active in driving for Ola/Uber services.
3. Willing to participate in the study.
4. Able to understand and respond to the questionnaire in Gujarati or English.

b. Exclusion Criteria:
1. Drivers with a history of traumatic neck injury in the past 6 months.
2. Drivers currently undergoing treatment for neck-related disorders.
3. Drivers with pre-existing chronic conditions affecting the neck, such as cervical spondylosis or rheumatoid arthritis.

Sampling Method:
A convenience sampling method will be employed to recruit participants. Researchers will approach Ola/Uber drivers at various pick-up and drop-off points, rest areas, and driver hubs across different cities in Gujarat.

Sampling Size:
Based on previous studies and considering an estimated prevalence rate of chronic neck pain among Ola/Uber drivers in Gujarat, a sample size of 300 drivers will be targeted to achieve a sufficient level of statistical power and precision in estimating the prevalence rate with a 95% confidence interval and a 5% margin of error.

Outcome Measures:
Numeric Pain Rating Scale (NPRS)
Neck Disability Index (NDI)

METHODOLOGY

Table: 1 Flow Chart Of Procedure

1. Participant Recruitment:
- Identify and approach Ola/Uber drivers at various locations such as taxi stands, transportation hubs, and rest areas across different cities in Gujarat.
- Provide a brief explanation of the study aims, procedures, and benefits to potential participants.
- Obtain informed consent from eligible drivers willing to participate in the study.

2. Demographic Information:
- Collect demographic data including age, gender, educational level, years of driving experience, average daily driving hours, and any previous history of neck pain or related conditions.

3. Numeric Pain Rating Scale (NPRS):
- Explain the NPRS to participants, emphasizing that it is a simple tool used to assess the intensity of their neck pain on a scale from 0 to 10, with 0 representing no pain and 10 representing the worst possible pain.
- Provide a numerical scale to the participants.
- Ask participants to rate their current neck pain intensity by selecting a number on the scale that best represents their level of pain.
- Record the participant's NPRS score.

4. Neck Disability Index (NDI) Scale:
- Introduce the NDI scale to participants, explaining that it is a questionnaire designed to assess the impact of neck pain on their daily activities and functioning.
- Provide a printed or electronic copy of the NDI questionnaire to participants.
- Instruct participants to read each question carefully and select the response that best reflects their current level of disability or limitation due to neck pain.
- Assist participants in completing the questionnaire if necessary, ensuring that they understand each item.
- Collect the completed NDI questionnaire from the participants.

5. Data Collection and Recording:
- Enter the demographic information, NPRS scores, and NDI questionnaire responses into a secure database or electronic spreadsheet.
- Ensure accuracy and consistency in data entry by double-checking entries against the original forms.
- Assign unique identifiers or codes to participants to maintain confidentiality and anonymity of their data.

IMAGE: 2 DATA COLLECTION

IMAGE: 3 DATA COLLECTION

6. Quality Control:
- Periodically review a subset of data entries to identify any errors or inconsistencies.
- Address any discrepancies by verifying the original data sources and making necessary corrections.
- Conduct regular checks to ensure compliance with ethical guidelines and data protection regulations.

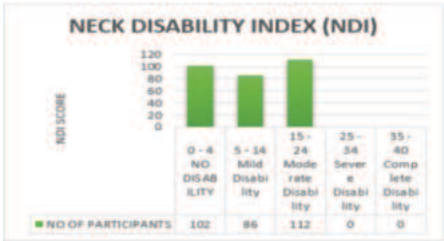
7. Data Analysis:
- Analyze the collected data using appropriate statistical methods to determine the prevalence of chronic neck pain among Ola/Uber drivers in Gujarat.
- Calculate descriptive statistics such as mean NPRS scores, NDI scores, and prevalence rates of neck pain severity and disability.
- Explore potential associations between demographic variables, driving characteristics, and neck pain outcomes using inferential statistics if applicable.

8. Reporting and Dissemination:
- Prepare a comprehensive report summarizing the study findings, methodology, and conclusions

RESULT

1. Neck Disability Index (NDI) Scores:
- No Disability (0-4 score): 102 participants
- Mild Disability (5-14 score): 86 participants
- Moderate Disability (15-24 score): 112 participants
- Severe Disability (25-34 score): 0 participants
- Complete Disability (35-40 score): 0 participants

Table : 2 Neck Disability Score



2. Numeric Pain Rating Scale (NPRS) Scores:
- Score 1: 0 participants
- Score 2: 66 participants
- Score 3: 36 participants
- Score 4: 86 participants
- Score 5: 60 participants
- Score 6: 52 participants
- Score 7, 8, 9, 10: 0 participants

Table: 3 Numeric Pain Rating Scale Score

3. Individuals with Disability:
- Individuals with disability: 198 participants (66%)
- Individuals without disability: 102 participants (34%)
- Total number of participants: 300

Table: 4 Disability Evaluation

The prevalence of chronic neck pain among Ola/Uber drivers in Gujarat is significant, with a total of 198 participants (66%) reporting some level of disability according to the Neck Disability Index (NDI). Among these, the majority exhibit moderate disability, indicating a considerable impact on daily functioning. Numeric Pain Rating Scale (NPRS) scores reveal varying levels of pain intensity, with a notable proportion of participants reporting scores ranging from 2 to 6. These findings underscore the need for targeted interventions and ergonomic improvements to mitigate the burden of chronic neck pain among Ola/Uber drivers in Gujarat and enhance their overall well-being.

DISCUSSION

Chronic neck pain is a complex and multifaceted issue that poses significant challenges for Ola/Uber drivers in Gujarat. This comprehensive discussion will delve into the various facets of chronic neck pain among this occupational group, including its prevalence, impact, contributing factors, and potential avenues for intervention.

Prevalence and Impact of Chronic Neck Pain:

The findings of this study underscore the high prevalence and considerable impact of chronic neck pain among Ola/Uber drivers in Gujarat. **With 66% of participants reporting some degree of disability** according to the Neck Disability Index (NDI), it is evident that chronic neck pain significantly affects the daily functioning of these drivers. Moreover, the distribution of NDI scores highlights the diverse spectrum of disability experienced by drivers, ranging from mild to moderate impairment in performing daily activities. This not only impacts their ability to work effectively but also has implications for their overall quality of life and well-being.

Factors Contributing to Chronic Neck Pain:

Several factors contribute to the development and exacerbation of chronic neck pain among Ola/Uber drivers. Prolonged periods of driving, often in non-ergonomic conditions, can lead to muscle fatigue, tension, and poor posture, all of which are known risk factors for neck pain. Additionally, the repetitive nature of driving, combined with frequent use of mobile devices and navigation systems, can further strain the neck muscles and exacerbate existing pain. Furthermore, psychosocial factors such as stress, anxiety, and job dissatisfaction may also play a role in the development and persistence of chronic neck pain among drivers.

Impact on Work Performance and Well-being:

Chronic neck pain not only affects the physical health of Ola/Uber drivers but also has significant implications for their work performance and overall well-being. The moderate to severe pain intensity reported by a substantial proportion of drivers, as indicated by Numeric Pain Rating Scale (NPRS) scores, can impair their ability to concentrate, make quick decisions, and react to changing road conditions, thereby compromising driving safety. Moreover, the discomfort and disability associated with chronic neck pain may lead to decreased job satisfaction, increased absenteeism, and financial strain, further exacerbating the drivers' overall stress and dissatisfaction.

Potential Avenues for Intervention:

Addressing the burden of chronic neck pain among Ola/Uber drivers requires a multifaceted approach that addresses both individual and systemic factors. Ergonomic improvements in vehicle design, including adjustable seats, lumbar support, and headrests, can help alleviate strain on the neck muscles and promote better posture during driving. Additionally, education and training programs on proper ergonomics, stretching exercises, and relaxation techniques can empower drivers to proactively manage their neck pain and prevent its recurrence. Furthermore, access to timely and affordable healthcare services, including physiotherapy, chiropractic care, and pain management interventions, is essential to address the underlying causes of neck pain and improve the drivers' overall musculoskeletal health

CONCLUSION

In conclusion, the findings of this study shed light on the significant prevalence and impact of chronic neck pain among Ola/Uber drivers in Gujarat. The high percentage of drivers reporting some degree of disability underscores the profound burden of neck pain on their daily functioning and overall quality of life. Moreover, the varying levels of pain intensity reported by drivers further emphasize the complexity of this issue and the urgent need for effective interventions to alleviate their suffering. Addressing the multifaceted factors contributing to chronic neck pain, including ergonomic improvements, education on proper posture and stretching techniques, and access to healthcare services, is paramount to improving the musculoskeletal health and well-being of Ola/Uber drivers in Gujarat.

Moving forward, concerted efforts from policymakers, healthcare professionals, and stakeholders in the transportation industry are essential to implement sustainable solutions that prioritize the health and safety of Ola/Uber drivers. By addressing the root causes of chronic neck pain and promoting proactive measures to mitigate its impact, we can create a supportive environment that empowers drivers to manage their pain effectively and continue their vital role in providing transportation services to the community. Ultimately, by prioritizing the musculoskeletal health of Ola/Uber drivers, we can enhance their overall well-being and contribute to a safer and more sustainable transportation system in Gujarat.

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INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

"THE EFFECTS OF ULTRASOUND AND CRYOTHERAPY ON RANGE OF MOTION AND DISABILITY IN PATIENT WITH FROZEN SHOULDER – A COMPARATIVE STUDY"

Physiotherapy

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ABSTRACT

Background: Frozen shoulder (FS) is signified by pain and stiffness in the shoulder joint; limited range of motion and pain are the most common symptoms. It is also known as adhesive capsulitis or periarthritis (PA). FS has a prevalence of approximately 2 to 5 % in the general population. The incidence among women is 1.6 to 4-fold higher than in men. Functional impairments caused by FS consist of Limited Reaching, particularly during Overhead or to the side activities. **Methodology:** Patients were analyzed pre and post treatment for frozen shoulder by SPADI and range of motion (ROM) of the shoulder joint by using goniometer. Total 40 Patients were taken and divided in two group. Group A received ultrasound with conventional physiotherapy and Group B received cryotherapy ultrasound with conventional physiotherapy for 6 days a week for 4 weeks. **Result:** The research was performed on 100 participants between the age of 20-40. There were 56 patients between the ages of 20 to 30, 44 patients between the age 31to 40. Moderately negative correlation seen in standing duration and pronation of foot. **Conclusions:** In conclusion the treatment program consisting of Ultrasound with Conventional Physiotherapy is more effective in frozen shoulder to reduce Pain, Functional disability and improve Shoulder range of motion.

KEYWORDS

Frozen shoulder, Ultrasound therapy, Cryotherapy, Rang of motion, Shoulder Pain And Disability Index

INTRODUCTION

1.1 Shoulder Complex

The shoulder joint, also known as the glenohumeral joint, is a dynamic articulation between the glenoid of the scapula and the proximal humerus, with functions like abduction, adduction, flexion, extension, and rotation. It is supported by the primary four rotator cuff muscles.[1,2] The shoulder joint is one of the most mobile joints in the human body due to its loose capsule and humeral head size. It is commonly dislocated due to its increased mobility. The upper extremity is connected to the axial skeleton via the sternoclavicular joint. The pectoral girdle consists of three joints.[3,4]

"Frozen shoulder" was first introduced by Codman in 1934, a painful shoulder condition with stiffness, difficulty sleeping, and reduced forward elevation and external rotation. This condition was formerly known as 'periarthritis' by Duplay in 1872, and later redefined as 'adhesive capsulitis' by Julius Naviaser in 1945. The disease is distinct from arthritis and preserves the joint.[5,6,7]

1.2 Frozen Shoulder

"Frozen shoulder" was first introduced by Codman in 1934, a painful shoulder condition with stiffness, difficulty sleeping, and reduced forward elevation and external rotation. This condition was formerly known as 'periarthritis' by Duplay in 1872, and later redefined as 'adhesive capsulitis' by Julius Naviaser in 1945. The disease is distinct from arthritis and preserves the joint.[5,6,7]

1.3 Etiology

Frozen shoulder (FS) is often associated with diabetes mellitus, affecting 10-36% of diabetics. Insulin-dependent diabetics are at the highest risk, and the primary cause is unknown, making them 2-4 times more likely to develop the condition.[8,9]

Frozen shoulder is common in thyroid disorders, Parkinson's disease, and cardiac and pulmonary diseases, often triggered by surgical procedures or shoulder injuries.[10,11]

1.4 Epidemiology:

Frozen Shoulder prevalence in general population is 2-5%, with increased rates in diabetics and thyroid gland pathologies, particularly hypothyroidism, up to 10-38%.[12,13]

Type 1 diabetes significantly increases the risk of developing FS, with a lifetime prevalence of 76%, particularly in patients over 45 years old.[14]

1.5 Pathophysiology:

FS is a condition characterized by synovial inflammation and capsular fibrosis, often resulting from cytokines like TNF-alpha and ILs. The cause is unclear, but potential triggers include chronic inflammation, tendon damage, Tendon Fiber rupture, or inflammatory mediators.[15,16,17] Figure 1 Summarizes the pathological event and pathogenesis of FS.[18]

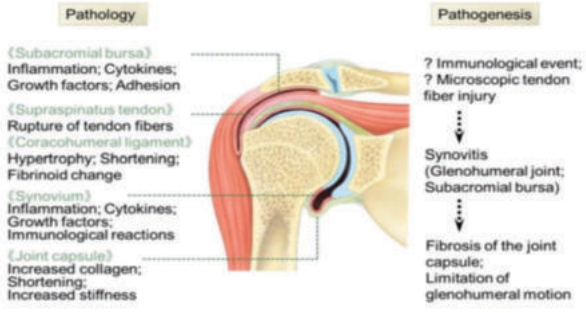


Fig. 1 Pathological event and Pathogenesis of FS

1.6 Stages:

Clinical presentation is typically in three overlapping phases: [19] The clinical presentation of a condition is divided into three phases: Stage 1, which is a gradual onset of pain with movement, Stage 2, which is persistent and intense pain, and Stage 3, which is pain only with movement, significant adhesions, and limited GH motions. Stage 4 of a joint condition, known as Thawing, involves minimal pain, no synovitis, but significant capsular restrictions from adhesions, with gradual motion improvement. The "freezing" stage of treatment for FS should focus on pain control, inflammation reduction, and patient education. Home self-exercise is effective, and daily programs should be given. Other treatments include anesthesia manipulation and surgical procedures.[5,20]

1.7 METHODOLOGY

STUDY DESIGN AND SETTING

Research Design: A COMPARATIVE STUDY

Population: Subjects with Frozen shoulder

Sample Design: Convenient sampling

Sample Size: The study was done on 40 patients. Subjects were divided in to 2 groups.

- Group 1=20 subjects (n=20)
- Group 2= 20 subjects (n=20)

Selection Criteria
Inclusive Criteria:
- Age between 30 to 60 year.
- Painful and limited passive shoulder joint mobility
- FS patients with and without type 2 diabetes mellitus
- More restricted lateral rotation relative to abduction and medial rotation.
- No clear sign (eg. painful arc, positive resistance testing, or loss of power)
- Illness time ranging between 2-15 months
- Stage of frozen shoulder: 1-3 stages

Exclusive Criteria:
- Any previous shoulder surgeries.
- Frozen shoulder Stage 4
- Glenohumeral or Acromioclavicular arthiritis.
- Any condition other than frozen shoulder
- Any Fracture around the shoulder complex
- Patient know to have uncontrolled diabetes mellitus or type 1, orthopedic condition or deformities around shoulder joint and any neuromuscular disorder.

OUTCOME MEASURES:
Shoulder Pain and Disability Index (SPADI) and Shoulder Range of Motion (ROM) Overview

SPADI:
- Self-administered questionnaire with 13 items assessing pain and functional activities.
- Assesses 5 questions on pain severity and 8 questions on difficulty with daily activities.
- High test-retest reliability of 0.92.
- Requires 5-10 minutes of time.

ROM:
- Measured using Universal Goniometer, a highly reliable tool conducted by the same therapist.
- Test-retest reliability of 0.94–0.98.

Patient Positioning and Movement Shoulder Flexibility:
- Patient is supine lying with shoulder and elbow 90º position.
- Axis: Greater tuberosity of the humerus.
- Movable arm placed over the midline of the lateral arm.
- Stable arm placed either perpendicular or parallel to the ground.

Shoulder Extension:
- Patient is prone lying with shoulder and elbow 90º position.
- Axis: One inch below the acromion process of the scapula.
- Movable arm placed over the midline of the anterior arm.
- Stable arm placed perpendicular or parallel to the clavicle.

Shoulder External & Internal Rotation:
- Patient is supine lying with shoulder and elbow 90º position.
- Axis: Olecranon process of the ulna.
- Movable arm placed over the midline of the posterior forearm.

Procedure:
- Approval from Institutional Ethical Committee (IEC) for study.
- Individuals selected based on inclusion/exclusion criteria.
- Informed consent form obtained from willing participants.
- Patients' anamnesis and demographic characteristics recorded.
- SPADI, VAS, and Shoulder joint ROM taken.
- Subjects assigned into two groups:

Group 1(n=20) Ultrasound with Conventional Physiotherapy and Group 2(n=20) Cryotherapy with Conventional Physiotherapy.

Outcome measures taken at baseline, after 2 weeks, and 4 weeks of treatment.

Statistical analysis using SPSS 25.0 software. P value less than 0.05 considered statistically significant.

RESULTS
The study used SPSS 25.0 software for Windows to compare the success of ultrasound and cryotherapy treatment for Frozen shoulder in 40 subjects, with 20 in each group meeting inclusion criteria.

Demographic Data
TABLE 1. Gender distribution

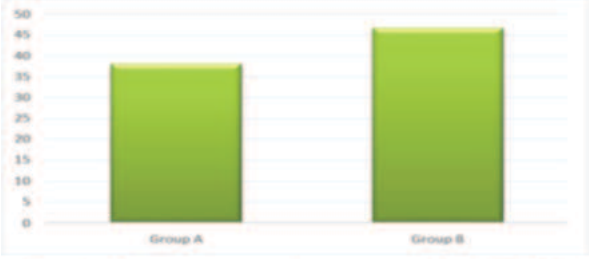
Graph 1: Graph of Gender distribution

Interpretation of Result:
1) Inter Group Analysis:
The table compares shoulder disability in Group A & B using independent T test. At baseline, no significant difference exists, but post-treatment p value of 0.03 suggests significant improvement between groups.

2) Intra Group Analysis:
The table compares shoulder disability in group A and B using paired t-test, showing significant differences in pain scores, indicating effective treatment for both groups.

Graph 2: Intragroup comparison of mean values of SPADI for Group A

Graph 3: Intragroup comparison of mean values of SPADI for Group B

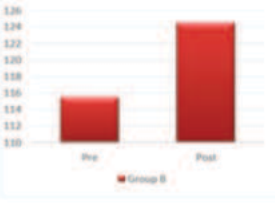


Graph 4: Intergroup comparison of mean values of SPADI

Interpretation of Results:
1) Inter group Analysis:
The study compared shoulder flexion ROM scores between Group A and B using an independent T test, finding no significant difference at baseline but significant improvement post-treatment.

2) Intra group analysis:
The table compares shoulder flexion ROM and pain scores in groups A and B, showing significant differences, indicating effective treatment for both groups.

Graph 5: Intragroup comparison of mean values of Flexion ROM for Group A



Graph 6: Intragroup comparison of mean values of Flexion ROM for Group B

Graph 7: Intergroup comparison of mean values of Flexion ROM

Interpretation of Results:

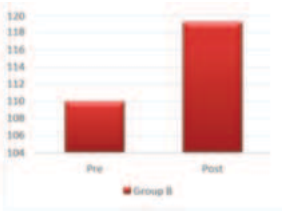
1) Inter group analysis:

The table compares shoulder Abduction ROM scores between Group A and B, showing no significant difference at baseline and a 0.03 post-treatment improvement.

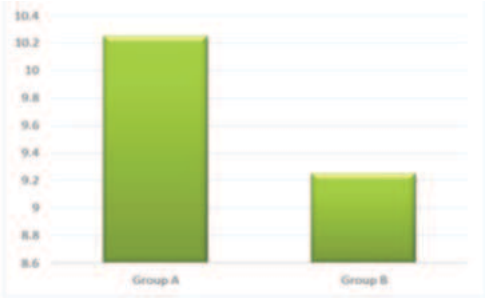
2) Intra group analysis:

The table compares shoulder abduction ROM and pain scores in groups A and B, showing significant differences, indicating effective treatment for both groups.

Graph 8: Intra group comparison of mean values of Abduction ROM for Group A



Graph 9: Intra group comparison of mean values of Abduction ROM for Group B



Graph 10: Intergroup comparison of mean values of Abduction ROM

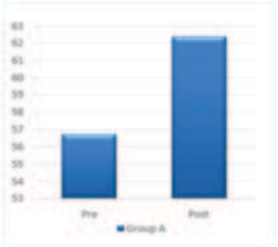
Interpretation of Result:

1) Inter group analysis:

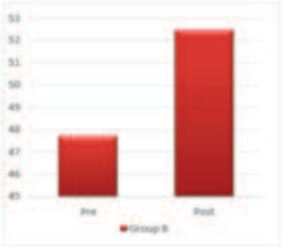
The table compares shoulder External ROM scores between Group A and B, showing no significant difference at baseline and a 0.04 post-treatment improvement.

2) Intra group analysis:

The table compares shoulder external ROM and pain scores in groups A and B, showing significant differences, indicating effective treatment for both groups.



Graph 11: Intragroup comparison of mean values of External rotation ROM for Group A



Graph 12: Intragroup comparison of mean values of External rotation ROM for Group B

Graph 13: Intergroup comparison of mean values of External rotation ROM

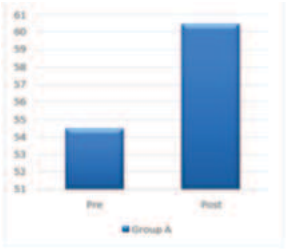
Interpretation of Result:

1) Inter group analysis:

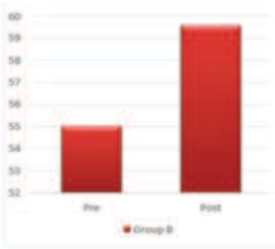
The table compares shoulder Internal ROM scores between Group A and B, showing no significant difference at baseline and a 0.03 post-treatment improvement, suggesting significant improvement between groups.

2) Intra group analysis:

The table compares shoulder Internal ROM and pain scores in group A and B, showing significant differences, indicating effective treatment for both groups.



Graph 14: Intragroup comparison of mean values of Internal Rotation ROM for Group A



Graph 15: Intragroup comparison of mean values of Internal Rotation ROM for Group B

Graph 16: Intergroup comparison of mean values of Internal Rotation ROM

DISCUSSION

The study investigates the effectiveness of ultrasound therapy and cryotherapy in reducing pain, range of motion, and disability in patients with frozen shoulder. Both groups received conventional physiotherapy for 4 weeks. Results showed significant differences in ROM improvement for both groups. However, the group receiving ultrasound therapy showed improvement in flexion extension, internal and external rotation, but not abduction and adduction ROM. The study highlights the self-limiting nature of frozen shoulder symptoms. [21,22] Ultrasound therapy reduces pain, increases blood flow, and aids tissue repair. It's used in rehabilitation for frozen shoulder patients. Connective tissue stretches promote elastic and plastic responses. Crystaltherapy controls pain by altering perception and controlling transmission to higher centers, making it useful for treating shoulder pain. [23] Cold exposure increases norepinephrine, providing calming effects. High-level mobilization improves frozen shoulder treatment in primary patients, while stretching programs relieve symptoms in stage 2 patients. [24,25] The study found that combining cryotherapy with conventional physiotherapy effectively reduced pain, functional disability scores, and improved range of motion in patients with frozen shoulder. Ultrasound therapy, produced using quartz, reduces pain,

increases blood flow, and aids in tissue repair. It's used in rehabilitation for frozen shoulder patients and promotes soft tissue healing. Connective tissue stretches promote elastic and plastic responses.

CONCLUSION

In conclusion the treatment program consisting of Ultrasound with Conventional Physiotherapy is more effective in frozen shoulder to reduce Pain, Functional disability and improve Shoulder range of motion.

Limitations:

✓ Small sample size

✓ No control group was included in the study

Future Recommendation:

✓ The study can be done on a larger number of populations.

✓ The study can be done with control group along with only conventional physiotherapy given in frozen shoulder

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"PREVALENCE OF MUSCULOSKELETAL DYSFUNCTION DUE TO BACKPACKS IN STUDENTS WITH UPPER CROSS SYNDROME"

Physiotherapy

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ABSTRACT

Background: Increasing rate of musculoskeletal dysfunction due to backpack is matter of concern. Prevalence varies regionally as it depends on many variables. Heavy backpack is one of the important underlying causes. Adolescent spine is in the critical stage of development in the age group of 07-15 years. This study was carried out to decide regional cutoffs of heavy relative weights of backpacks in male and female children. **Methodology:** For this survey, a sample of students from Ahmedabad's New Education School was used. Every student who satisfies the inclusion requirements is welcome to take part in the research. Through the semi-structured questionnaire, the data were collected. The length of the trip, the type of vehicle, and the distance traveled, the posture taken while traveling, and the level of pain were all mentioned in the questionnaires. Every outcome that was measured was obtained at baseline. NDI, SPADI & NPRS. **Result:** In present study we found that from total 60 students 34 students shows highest upper cross syndrome and students with upper cross syndrome were having mean pain score of NPRS 4.52±2.18 and disability as per NDI & SPADI as 50.79 &51.28.overall prevalence of musculoskeletal dysfunction is 55.66%. **Conclusions:** Majority of the School going students are exposed to the risk of adopting poor postures which can lead to musculoskeletal dysfunction. The results of this study suggesting the importance of postural awareness among school going students.

KEYWORDS

Upper Cross Syndrome, Neck Disability Index, Shoulder Pain And Disability Index, Musculoskeletal Disorder.

INTRODUCTION

The World Health Organization states that musculoskeletal disorders—which are primarily linked to Students and cause headaches and chronic neck pain, which are the most common complaints worldwide—are one of the main causes of disability among persons between the ages of 20 and 50. It is acknowledged that disabilities result in severe medical conditions as well as socioeconomic problems; the loss of GDP from absenteeism and low productivity has been estimated to be as high as 2%. Numerous studies found that almost 90% of rehabilitation specialists suffer from musculoskeletal conditions, with 50% of physiotherapists reporting a tendency to develop Work-Related Musculoskeletal Disorders (WMSDs) throughout the course of their five-year careers. This might be because of the nature of their employment, which entails extended periods of sitting, standing, and lifting as well as the use of manual techniques in academic or clinical settings. The high prevalence (66%) in lower limb, particularly in the low back and neck region (61%), may be related to their line of work, which involves extended standing, sitting, lifting, or using manual procedures in clinical or academic settings[1].

Upper Cross Syndrome (UCS), also known as cervical cross syndrome, is defined as a pattern of alternative tightness and weakness of the neck's Serratus Anterior, Pectorals Major, Levator Scapulae, Rhomboids, and Deep Flexors, especially the Scalene muscles. This pattern is thought to be caused by improper body ergonomics, poor work habits, or low self-esteem. Rather than only affecting one muscle, Upper Cross Syndrome is typified by an imbalance in the activation and inhibition of skeletal muscles. Muscular insufficiencies arise from any inability of the tonic and phasic muscles to activate coherently. Thus, the most common symptom of UCS is neck and upper back pain, which is typically diagnosed as Cervicogenic Vertigo with shoulder pathology in a number of patients. This bad posture causes hypnosis, forward head posture, loss of cervical lordosis, and some postural patterning of the front shoulders[2]. The upper portion of the body experiences general pattern changes as a result of these anomalies.

This pattern alteration results in strain to the shoulder blade and muscle attachments of the shoulder, giving the impression of a rounded shoulder. While extended use of this position does not always result in pain, people frequently report upper back and neck pain various factors including musculoskeletal structures, body changes regarding age, cultural customs, motor performances and occupation affects the head position of the person while sitting. The patients may develop forward head posture because of this poor sitting posture along with rounded shoulder which occurs due to the increased hypnosis in thoracic region[2].

When seated, the forward head position causes the upper cervical region to extend, the lower cervical region to flex, and the shoulders to round. This reduces the length of muscle fibers on average, which causes extensor torque around the upper cervical region's joints. This aberrant state leads to a number of musculoskeletal problems, such as increased internal rotation, anterior tilt, and decreased scapular upward rotation. It makes it even harder to keep an erect posture[3].

Upper crossed syndrome is what occurs when rounded shoulders and forward head posture occur at the same time. Students enrolled in college typically adopt a range of positions throughout class and exams. Therefore, it is necessary to determine if these aberrant postures are learned or inherited. It is also necessary to ascertain whether any of the elements of a muscle imbalance are present at this point and to identify the reason for the change in upper back posture[4].

Work related segments, for instance, postponed static muscle load and dismal work might be a hotspot for hurt headway. Physical activity and masculinity are two further characteristics that may be linked to musculoskeletal pain. Issues with posture, vision, or mental health might also bring about musculoskeletal issue, particularly affecting the cervical and thoracic locale. As demonstrated by Janda's farsighted clarification of muscle ponderousness, significant cervical flexors and lower scapular stabilizers get the opportunity to be subdued in a foreseen illustration (upper crossed disorder)[5].

Proximal or shoulder support crossed confusion is another term used to describe Upper-Crossed Syndrome (UCS). Coziness of the levator scapula and upper trapezius on the dorsal side of the UCS intersects with coziness of the genuine and minor pectoralis muscles. Significant cervical flexor weakness ventrally crosses with insufficient middle and lower trapezius; this unevenness causes joint fractures, especially at the glen humeral joint, atlantooccipital joint, C4-5 area, cervicothoracic joint, and T4-T5[6].

Janda observed a discrepancy between these concentrated areas of discomfort inside the spine and the transitional zones where the morphology of the adjoining vertebrae changes. This study aimed to identify the key factors that contribute to students' upper-crossed issues changing. Certain particular postural motions are observed in upper cross problem, such as forward head carriage, thoracic hypnosis and extended cervical lordosis, elevated and developed shoulders, and

scapular winging and discontent. Due to Serratus front weakness, which causes the scapulae to grasp, turn, and wing, these postural movements decrease glen humeral quality by allowing the glenoid fosse to become more vertical[7].

Purpose Of the study to find Prevalence Musculoskeletal Dysfunction Due to backpacks in students with upper cross syndrome.

METHODOLOGY

Study Design: Observational study

Duration of Study: 6 months to 1 year.

Sample Size: 60 students (both male and female)

Selection Criteria

Inclusion criteria:

- Age of students (07 to 15) Years.
- Students suffering from Upper Cross Syndrome.
- Subject willing participate.

Exclusion criteria:

- Developmental disorders,
- Neurological disorders,
- Surgical interventions and previous spinal fractures

For this survey, a sample of students from Ahmedabad's New Education School was used.

Every student who satisfies the inclusion requirements is welcome to take part in the research. Through the semi-structured questionnaire, the data were collected. The student's posture, the weight of the bag, and the level of pain were all noted. Every outcome that was measured was obtained at baseline.

- SPADI
- NDI
- NPRS

RESULT:

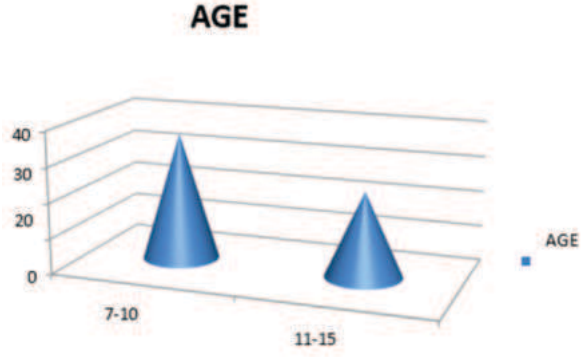
Descriptive analysis for Windows was used for all statistical studies. The mean and standard deviations were obtained using descriptive analysis. Demographic Data

AGE:

The research was performed on 60 participants between the age of 7-15 years. There were 36 participants between the ages of 7 to 10, 24 participants between the age 11 to 15.

Table1: Age Distribution

Age Distribution	
7-10 years	11-15 years
36	24

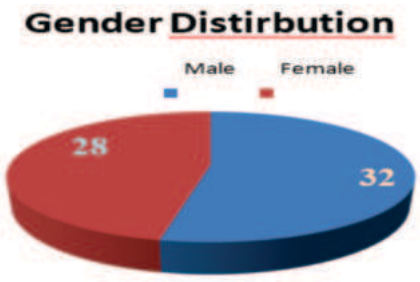


Graph 1: Age Distribution

Gender Distribution:

The research was performed on 60 students with upper cross syndrome, in which 32 Male & 28 Female.

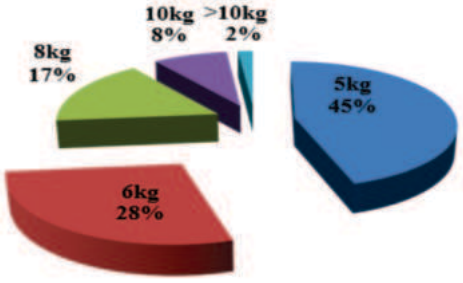
Gender Distribution	
Male	Female
32	28



Weight of bag:

Table 3: Weight of Bag.

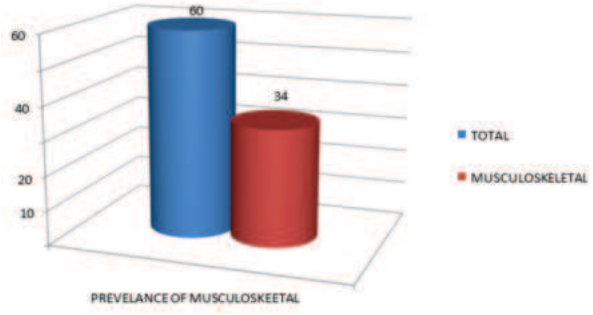
Mode	Number	Percentage
5Kg	27	45%
6Kg	17	28%
8Kg	10	17%
10Kg	5	8%
>10Kg	1	2%



Mean value of Outcome measures

Table 2: Mean value of Outcome measures

	Mean + SD
Age	9.6+4.46 years
NPRS	4.51+2.18
NDI	50.79 + 19.98
SPADI	51.28 ± 17.84



Graph 2: Prevelence Of Musculoskeletal Dysfunction

DISCUSSION:

The goal of the current study was to determine how common upper crossed syndrome is among school-age children. We had classified two diagonal muscles—the neck flexors and scapular retractors being weak, or the neck extensors and pectoralis minor being tight—as weak or tight for the purpose of the prevalence analysis. The cervical spine and shoulder girdle biomechanics may change as a result of a muscle imbalance in any one of the two diagonal muscles.

Present study conducted on 60 school going students with age of 07 to 15 years among that 34 students showed positive impact of musculoskeletal dysfunction with mean pain score 4.51±2.18, NDI mean & sd 50.79 ± 19.98 & SPADI 51.28 ± 17.84 Overall prevalence of musculoskeletal dysfunction is 55.66%.

A study on Neck, Shoulder, and Back Pain Associated with Carrying Heavy Backpacks among Spirit School Children in Lahore was undertaken by Rubina Khan et al. They came to the conclusion that children's back, shoulder, and neck pain was significantly correlated

with the weight of their school bags. Less symptoms were displayed by students who carried their bags over both shoulders and used twin straps[8].

Mayank Mohan et al done An experimental study on the Effect of backpack loading on cervical and shoulder posture in Indian school children and examining the effects of backpack loading on posture[9].

Sheir-Neiss, et al conducted study on The Association of Backpack Use and Back Pain in Adolescents and concluded that The use of backpacks during the school day and backpack weights are independently associated with back pain[10].

Mubeen et al done investigate on primary indicators of upper cross syndrome, which include forward head position, rounded shoulders, and neck stiffness and pain. The results of the study showed that 36.07% of students had neck pain when studying or using any kind of electronic device. Additionally, it was shown that 76.39% of students believed that when using a device or studying, they needed to support their head and upper back. However, 23.60% of the pupils felt otherwise.In their investigation on the prevalence of upper cross syndrome results showed that 52.1% of pupils found it challenging and 48.7% of students felt neck pain[11].

Clare Haselgrove et al had done study on Perceived school bag load, duration of carriage, and method of transport to school are associated with spinal pain in adolescents: an observational study and concluded that Neck pain is as common as back pain amongst adolescents. Perceived school bag load, duration of carriage and method of transport to school are associated with back and neck pain. Physical activity in the form of walking or riding to school may offset the potentially provocative effects of prolonged bag carriage and warrants further investigation.[12].

Therefore, it is imperative that people of all ages, especially students, take some action to improve their postural awareness.

CONCLUSION

Majority of the School going student are exposed to the risk of adopting poor postures which can lead to musculoskeletal dysfunctions. The results of this study suggesting the importance of postural awareness among school going students.

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WORK RELATED MUSCULOSKELETAL DISORDER AMONG RECREATIONAL CRICKET PLAYERS: - A CROSS-SECTIONAL STUDY

Physiotherapy & Rehabilitation

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ABSTRACT

Background: This research focuses on assessing work-related musculoskeletal disorder among recreational cricket players using modified Nordic musculoskeletal questionnaire. Using MNMQs, the aim is to gather detailed information on the prevalence, severity and location of musculoskeletal problems experienced by recreational cricket players during their participation in the sport. **Methods:** A Cross sectional study was carried out on 105 recreational cricket players using Modified Nordic Musculoskeletal Questionnaire to find the prevalence of work-related Musculoskeletal disorder among recreational cricket players. **Results:** Out of 105 cricket players 73 (69.5%) players experienced work-related musculoskeletal problem in last 12 months. Shoulder, low back and Hips/thighs were the most common areas of problem in last 12 months. Hips/thighs, low back were the most common areas of problem in last 12 months in Batsmen. Shoulder and Ankles/feet were the most common areas of problem in last 12 months in bowlers. Low back, shoulders were the most common area of problem in last 12 months in All-rounders. Sprain (38%) and Strain (33%) were the most common type of injury among recreational cricket players. **Conclusion:** This study concludes that the work-related musculoskeletal disorder in recreational cricket players were more. Shoulders and Lower back were the most common injured body parts followed by Hips/thighs, Ankles/Feet and Knees. According to role of cricket, Bowlers were more affected than Batsmen and All-rounder. The study conclude that Hips/thighs and low back are the common site of injury in batsmen. Shoulder and Ankles/feet are the common site of injury in bowlers and Low back and shoulder were the most common site of injury in All-rounders. The study also concludes that due to the Low back Injury or pain players had affected from doing their daily activity of living in last 12 months. This research findings indicate that sprain and strains rank as the predominant injuries experienced by cricket players.

KEYWORDS

Work-related musculoskeletal disorder, Modified Nordic Musculoskeletal Questionnaire, recreational cricket players.

INTRODUCTION

Work-related injuries pose a significant burden on individuals, organizations, and society at large, with musculoskeletal disorders (MSDs) being one of the primary causes and contributors to workers' compensation claims. The lack of specific data on work-related musculoskeletal diseases in developing nations complicates efforts to identify prevalent issues and occupations at high risk, though occupations requiring heavy physical exertion, such as construction, stone work, mining, and cleaning, are likely the most vulnerable. Additionally, musculoskeletal disorders (MSDs) are defined as soft tissue disorders not resulting from sudden events, and are deemed work-related when the work environment significantly contributes to their development. [1]

Cricket is a major international sport played in more than 60 countries. The laws of cricket were drawn up by the London Club in 1944 formalizing a game that had been played for a hundred of years ago.[2] Cricket is regarded as a leisurely, gentlemen's game.[3] In cricket, bowlers deliver a hard ball at a high speed directly to the batsman.[4] Now cricket is played in more than sixty countries and regarded as major international team sport. Cricket also played in many commonwealth countries as popular sport. Cricket is the most popular team sport in Indian subcontinent that consists India, Pakistan, Afghanistan, Bangladesh, Sri Lanka. The popularity for cricket in India was started after its success in 1983 world cup in which it was the champion; this led to a greater number of people participating in cricket. There are various clubs and centres with skilful coaches to train them. Injuries are inevitable when one player is training and compete. There are numerous studies available at international level, but in India there is a lack of research in cricket.[5]

The ICC Trophies Won by India:

India's cricket legacy began with the 1983 ICC Cricket World Cup victory, where Kapil Dev's team triumphed against the odds, defeating Clive Lloyd's West Indies, marking India's first ICC trophy. Until then, the Indian cricket team held little significance in the sporting world, but this underdog victory transformed the perception of cricket in India. The 2002 Champions Trophy stands as a unique event in ICC history, being the solitary tournament where a definitive champion wasn't determined, resulting in Sri Lanka and India being declared joint winners. This marked a significant milestone, breaking a nearly two-decade drought for India in ICC trophy victories. Sri Lanka, considered pre-tournament favourites, secured their spot in the final through dominant performances in the group stage, culminating in a convincing seven-wicket win over Ricky Ponting's formidable Australian team. Conversely, India, fielding a relatively youthful squad, earned their place in the final after a hard-fought 10-run victory against South Africa. However, unforeseen rain disruptions plagued the finals, forcing two washouts and ultimately leading to both Asian cricket powerhouses sharing the trophy. The inaugural ICC T20 World Cup introduced both a new competition and a fresh captain, sparking apprehension over India's performance. With MS Dhoni, then 26 years old, assuming leadership, following Rahul Dravid, Sourav Ganguly, and Sachin Tendulkar's self-exclusion from T20I cricket's premier event in 2007, the team faced the challenge with a predominantly inexperienced roster. As a result, the burden fell on Dhoni, hailing from Ranchi, to orchestrate a remarkable feat. India's 28-year wait for another ICC Cricket World Cup ended in 2011, with MS Dhoni's iconic six in the final against Sri Lanka, while Yuvraj Singh's stellar performance anchored the victorious campaign, marking a fitting farewell for cricket legends Sachin Tendulkar and Virender Sehwag. The 2013 edition of the ICC Champions Trophy, India beat England in finals and MS Dhoni becomes only captain in world cricket to will all three ICC trophies. Currently the men's Indian cricket team is ranked 1st in test cricket, 1st in one-day international and 1st in T20 (as of 26/03/2024 - ICC rankings). There is a lot of crazes for cricket in India. Many children here like or even play cricket. There is a big cricket player in every street here. People love cricket a lot. Cricket is not just a sport but an emotion for the children of India. There is no shortage of talent in India, there is a dangerous player in every street regarding cricket. Every child here dreams of becoming a successful cricketer and playing for his country.[6]

Cricket, characterized by its dynamism, encompasses a plethora of abstract skills and movements. To refine these intricacies, many players prioritize maintaining peak physical fitness and strength. The game's three distinct facets (bowling, batting, and fielding) each pose unique injury risks. [7,8,9] Musculoskeletal discomfort may manifest in diverse scenarios during cricket matches, including impacts from balls or bats, swift rotational actions, sliding and diving maneuvers, collisions with fellow players, and the cumulative effects of overuse. [10,11,12,13]

Running is a common thing in cricket, whether it is batting or bowling or fielding, running has to be done by all, hence lower limb is more

affected in cricket. After that, the second task is to throw the ball because all the players do field and hence upper limb injuries also occur. After that, injuries to the upper and lower trunk occur, due to twisting or overstretch of the trunk.

The stance of a batsman while batting is somewhat like this, it can be differed from batsmen to batsmen. This is a normal stance of the batsman, after that the bowler bowls the ball and the batsman hits the stroke according to the ball. The posture of batsmen is different in every stroke, sometimes extra force is applied on the body or if the body gets twisted too much than the injury can occur. And also, when the batsmen take run, he will run fast so the batsmen have chances to get injured while running. That's why batsmen suffer more injuries to their back and hips.

The ideal bowling action of the player. While bowling, a bowler runs, then makes a jump, rotates his arm in a circular motion and delivers the ball. And experts believe that while delivering the ball, 7 to 8 times more force is applied to the bowler's ankles/feet and the repetitive movement of the shoulder is happens while bowling. That's why bowlers suffer more ankle/feet and shoulder injuries.

Fielding is another role in cricket. So, while doing this, a player gives extra efforts to save runs for the team. During this, his chances of getting injured are increased because he runs, slides, dives, throws and catches the ball and players even collide with each other. Therefore, fielders are at greater risk of hip/thigh injuries, knee injuries, low back and shoulder injuries.

According to Sathya et al., 61% of players encountered musculoskeletal issues linked to cricket. Stretch et al.'s findings indicated that South African cricketers predominantly suffered lower limb injuries (50%), followed by upper limb (23%) and back/trunk injuries (23%). [14] Musculoskeletal pain (Injury) is defined as 'A sensation of agony that inhibits the individual from participating in cricket or practice for a minimum of 24 hours'[15]

There are many studies available at domestic and international level on injuries faced by cricket players. Thus, the purpose of the study is to find the work-related musculoskeletal disorder among recreational cricket players.

Methodology

Study Place

Tanman Cricket Ground, Galaxy Cricket Ground, Samarpan Cricket Ground, Norada 108 Cricket Ground.

Sampling Design

Convenience sampling

Study Design

A cross-sectional survey studies.

Duration of Study

6 months

Sample Size: 105

Inclusion Criteria

- Male cricket players of age 19-27 years
- Playing experience of minimum 3-4 years with regular practices

Exclusion Criteria

- Recent fracture or injury.
- Any recent cardiovascular surgery.
- Any Neurological condition.
- Alter mental illness.
- Players who do not play regularly

Materials Required

- Consent form
- Assessment form
- Modified Nordic Musculoskeletal Questionnaire (MNMQ)
- Pen

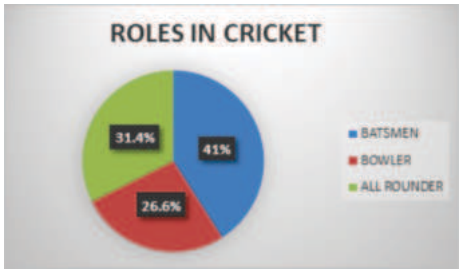
Method

- A sample of cricket players was taken in this survey from various cricket ground located in Ahmedabad.
- All players who meet the inclusion criteria were eligible to participate in the study.
- The data collection was done involving the questionnaire is based on MNMQs.
- Firstly, players were made aware about the purpose of the study. Each component of Modified Nordic Musculoskeletal Questionnaire was explained to each and every player. And consent of each player was taken.
- Then, General demographic data was taken Name, age, gender, occupation, role they play in cricket from the player and asked them to recall their injuries from last one year from April 2023 to March 2024.
- Afterward, the questionnaire content six component.
- The questionnaire content binary questions and player have to fill the answers respectively.
- Then data was collected from 105 player and analyzed in simple percentage and graphs.

RESULTS

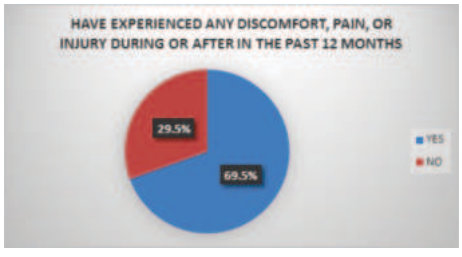
- The analysis was done using excel.
- Total 105 player are taken for the study

A. The above graph shows, out of 105 players 43(41%) were batsmen, 28(26.6%) were bowler, 34(31.4%) were all-rounder.



Graph 1

B. The above graph shows, out of 105 players, 73(69.5%) players had experienced any discomfort, pain, or injury during or after cricket activities in the past 12 months.

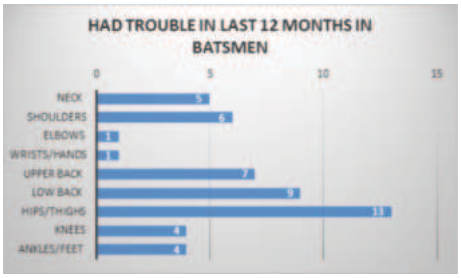


Graph 2

C. The above Graph show the trouble held to cricket players during the last 12 months according to anatomical site. The commonest site for pain or injury among the players is Shoulder and low back (41%) followed by Upper back and Hips/thighs (35%), Ankles/feet (31%), Neck (23%), Wrists/hands (16%), Knees (15%), Elbows (11%).

Graph 3

D. The above graph shows the trouble held to Batsmen during last 12 months according to anatomical site. Out of 43 batsmen 24 (55%) experienced pain or discomfort during or after cricket in last 12 months. The commonest site for batsmen is Hips/Thighs (54%), followed by low back (37%), upper back (29%), shoulder (25%), Neck (20%), Knees and Ankles/Feet (16%), Elbow and Wrists/Hands (4%).



Graph 4

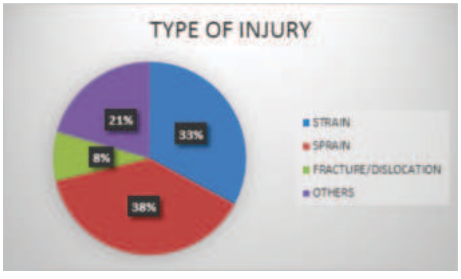
E. The above graph shows the trouble held to Bowler during last 12 months according to anatomical site. Out of 28 bowlers 23 (82%) experienced pain or discomfort during or after cricket in last 12 months. The commonest site for bowler is Shoulders and Ankles/Feet (60%) followed by Wrists/Hand (30%), Hips/Thighs (26%), Neck (21%), Elbows and Kness (17%), Low back (13%), Upper back (8%)

Graph 5

F. The above graph shows the trouble held to All-rounder during last 12 months according to anatomical site. Out of 34 all-rounder 25 (73%) experienced pain or discomfort during or after cricket in last 12 months. The commonest site for all-rounder is Low back (72%), followed by Shoulder (48%), Upper back (36%), Neck and Hips/Thighs (28%), Ankles/feet (20%), Wrists/Hands (16%), Elbows (12%), Knees (8%).

Graph 6

G. The above graph shows types of injuries in cricket players. Out of 105 players investigated 73 (69.5%) experienced work-related musculoskeletal problem within last 12 months. Out of 73 players 28 (38%) had Sprain, 24 (33%) had strain, 15 (21%) had other injuries and 6 (8%) had fracture/dislocation.



Graph 7

DISCUSSION

The study was done on 105 recreational cricket players (males) of age group of 19-27 years with minimum experience of 3-4 years. The Aim and objective of the study was to find work-related musculoskeletal disorder among recreational cricket player. Modified Nordic Musculoskeletal Questionnaire was used to find the work-related musculoskeletal problem in recreational cricket players in last one year. Out of 105 players 73 (69.5%) experienced work -related musculoskeletal problem. According to Graph -3, the most common site of injury or pain is in shoulders and low back (41%), followed by Ankles/feet, upper back, hips/thighs. Because of repetitive movement of shoulder and trunk. Fielder throws the ball, bowler runs and deliver the ball with maximum effort so the movement of shoulder is much more that's why the risk of shoulder injuries is more on other hand repetitive hyperextension, rotation of trunk while batting or deliver the ball by bowlers.

The Graph-4 shows the prevalence of work-related musculoskeletal problem in last 12 months in Batsmen. Out of 43 batsmen 24 (55%) experienced musculoskeletal problem. Hips/thighs, low back, upper back these 4 sites are most commonly affected in batsmen because more use of trunk and lower extremities is there. That's why trunk and lower limb is most commonly affected. The Graph-5 shows the prevalence of work-related musculoskeletal problem in last 12 months in Bowler. Out of 28 bowler 23 (82%) experienced musculoskeletal problem. Shoulder, Ankles/Feet these 3 sites are most commonly affected in bowler because of repetitive movement of shoulder for delivering the ball and also when the bowler delivers the ball, the whole weight of the body came to ankles/feet. Hence shoulder, ankles/feet are most commonly affected. The Graph-6 shows the prevalence of work-related musculoskeletal problem in last 12 months in All-rounder. Out of 34 All-rounder 25 (73%) experienced musculoskeletal problem. Low back, Shoulder, Upper back, Hips/thighs these 4 are the most common site of injury or pain in all-rounder because they have to play all the roles in cricket (Batting, Bowling and Fielding).

Player who prevented from doing normal work in the last 12 months due to work-related musculoskeletal problem: The most common site for preventing from doing normal work during last 12 months are Low back and Upper back followed by Shoulder. Player who had trouble at any time during last 7 days: The most common site causing trouble in last 7 days are Hips/Thighs followed by Upper back and Low back. Out of 105 players only 18 (17%) players had ever hurt themselves body part in an accident. Shoulder and Ankle/feet are hurt more in an accident followed by Hips/thighs and Knees. When the players were asked about the total length of time that had trouble during the last 12 months. The most common answered was 1-7 days followed by 8-30 days and very few were for more than 30 days. The last component of the MNMQs was about the type of the Injury. As the Graph 7 shows, 28 players were affected with Sprain, 24 Players were affected with Strain and 21 players were affected with Other and Fracture/dislocation.

Chandrasekhar Bodanki et al. conducted a study on Prevalence of cricket-related musculoskeletal pain among Indian junior club cricketers and finds that CIPP should be implemented and strictly followed from the early stages of sports life. Pre-training warm-up and post-training cool-down sessions into their regular training regimen is essential. It's crucial to steer clear of overuse, such as prolonged play beyond scheduled times, and to refrain from disregarding any pain experienced during practice or matches. A supervised training and regular screening of players by orthopaedician or sports physician will keep them fit to play with full potential.[16]

P. Sathya et al. conducted a study on Prevalence of Musculoskeletal Problems in Cricket Players and finds that the findings revealed a 61% prevalence of musculoskeletal problems among cricket players. The lower back emerged as the most frequently affected area, followed by ankles/feet, knees, and hips/thighs. Musculoskeletal problems were more prevalent among all-rounders than batsmen and bowlers. Specifically, ankles/feet were frequently affected in all-rounders, while bowlers and batsmen commonly experienced issues in the low back area, alongside other regions. Furthermore, strain and sprain were identified as the predominant types of injuries among cricket players, regardless of their specific role in the game. [14]

Sumit Kumar et al. conducted a study on One year prevalence of musculoskeletal disorder among cricket Players in Haryana: A retrospective study: - Injury data was gathered using a modified Nordic Musculoskeletal Injury Questionnaire. Frequency of musculoskeletal injuries is more among cricket players. Conditioning by coaches and early rehabilitation by physiotherapists are essential to reduce the

injury rate in this population. [5]

Present study was conducted on 105 recreational cricket player and the prevalence of Musculoskeletal problem was 69.5% and shoulder and Low back (41%) were the most commonly injured body part followed by Ankles/feet, upper back, hips/thighs.

CONCLUSION

This study concludes that the work-related musculoskeletal disorder in recreational cricket players were more. Shoulders and Lower back were the most common injured body parts followed by Hips/thighs, Ankles/Feet and Knees. According to role of cricket, Bowlers were more affected than Batsmen and All-rounder. The study conclude that Hips/thighs and low back are the common site of injury in batsmen. Shoulder and Ankles/feet are the common site of injury in bowlers and Low back and shoulder were the most common site of injury in All-rounders. The study also concludes that due to the Low back Injury or pain players had affected from doing their daily activity of living in last 12 months. This research findings indicate that sprain and strains rank as the predominant injuries experienced by cricket players.

Limitations

- Collecting accurate data in recreational cricket player is difficult due to factors such as player recall bias on injuries and the absence of official records or statistics.
- This study is only conducted on male cricket players.

Future Recommendation

- Future studies can be done with a larger sample size to get the more appropriate result.
- The study should be conduct specially for professional cricket players.
- Explore the use of technology, such as mobile applications, to collect real-time data on recreational cricket gameplay.
- The study can be done on another sports like football, volley ball, Tennis, etc.
- The study can be conducted on Female cricket players.

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PREVALENCE OF ACHILLES TENDON INJURY IN FOOTBALL PLAYERS

Physiotherapy

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ABSTRACT

Background: Achilles tendinopathy (AT) is a clinical condition characterized by pain and swelling in and around the Achilles tendon, mainly arising from overuse. Achilles tendinopathy (AT) or Tendon injury is one of the most common injuries in physical exercise (PE), especially happens to athletes who are always engaged in long-term, continuous and high-intensity competition or training. Even after surgical treatment, AT may still occur repeatedly and the recurrence rate is as high as 44%. It is not easy to be diagnosed in the early stage of disease because of its long incubation period. So, the need of Achilles Tendon injury when participating in Exercise, and on the basis of that we can find out estimated risks of Achilles Tendon injury for different ages, genders, sport events, characteristics of subjects, training years, and regions in Ahmedabad city. **Methodology:** This study included 100 male and female football players with convenient sampling method. Subjects were assessed for Achilles Tendon injury via Royal London test and if positive directed to Victorian Institute of Sports Assessment-Achilles (VISA-A) questionnaire to find out prevalence of Achilles Tendon Injury in football players. **Result And Conclusion:** This study shows that there is Age group of 16-25 having prevalence of 68% and age group of 26-35 having prevalence of 24%.Prevalence of Achilles tendon injury in football players.

KEYWORDS

Prevalence, Achilles Tendinopathy, Football

INTRODUCTION

The clinical symptoms of pain, swelling, and impaired physical function of Achilles tendon are common in sports and daily life. Traditionally, many terms have been used to describe the disorders, including tendinitis, tendinosis, and paratenonitis. However, recent histopathological studies have found these disorders as a result of a failed healing response, which may cause degenerative changes in the tendon. The failed healing response includes three different and continuous stages (reactive tendinopathy, tendon disrepair, and degenerative tendinopathy) [1][2][3]. However, inflammatory response is not found in the three stages. In 1998, Maffulli et al. suggested to use the term tendinopathy in order to describe these intratendinous disorders [4].

The two main categories of Achilles tendinopathy are classified according to anatomical location and broadly include insertional (at the calcaneus-Achilles tendon junction) and noninsertional (2 to 6 cm proximal to the insertion of the Achilles tendon into the calcaneus) tendinopathy [5].

Achilles tendinopathy is one of the most frequently ankle and foot overuse injuries [6]. This disorder is more likely to be found in the individuals who participate in the physical activities such as running and jumping. It may affect 9% of recreational runners and cause up to 5% of professional athletes to end their careers [7]. In an epidemiologic investigation of 1394 nonathletes, Achilles tendinopathy was found in 5.6% of the subjects (4% insertional, 3.6% noninsertional, and 1.9% both forms) [8]. In another research, Kvist found that 20% to 25% of Achilles tendinopathy patients had insertional disorder, 66% had noninsertional, and 23% had either retrocalcaneal bursitis or insertional tendinopathy [9].

Chronic Achilles tendinopathy is more common in older people than in young people. In Kvist's study, among 470 patients who had Achilles tendinopathy, only 25% of the patients were young athletes and 10% were younger than 14 years [9]. Moreover, insertional tendinopathy tends to occur in more active persons, whereas noninsertional tendon injury tends to occur in older, less active, and overweight persons.

The risk factors of Achilles tendinopathy can be divided into intrinsic and extrinsic factors, either alone or combination. Intrinsic factors include biomechanical abnormalities of the lower extremity such as leg length discrepancy hyperpronation, varus deformity of the forefoot, pes cavus and limited mobility of the subtalar joint[10], and systemic conditions such as increasing age [11][12] , inflammatory arthropathies, corticosteroid use, diabetes, hypertension, obesity, gout, hyperostotic conditions [13][14] [15] [16]lipidaemias, aromatase inhibitors, and quinolone antibiotics[17]. Extrinsic factors include excessive mechanical overload and training errors such as increased interval training, abrupt changes in scheduling, excessive hill training, training on hard or sloping surfaces, increased mileage, increased repetitive loading, poor shock absorption, and wedging from uneven wear.

Sports injuries have been found to inhibit optimal sports' performance and these injuries, which can have both long and short term harmful effects, causes lasting physical damage or disability[1], affect quality of life, thus could result in reduced physical activity participation. Every sport comes with risk of injury that is peculiar. The occurrence of sports injuries and its associated problems are on the increase [2]. In association football, commonly known as soccer, injuries have been identified to result from multiple risk factors and ankle injuries are one of the most common injuries[3].Ankle injuries in soccer may give rise to problems like reduced performance, time away from competition and possibly disability[4]. The bones that make up the ankle joint are a regular site of injury and often times, bending and twisting forces can precipitate these injuries [5], with the most common being ankle sprain, fracture, and tendinopathy.

Achilles tendinopathy is a clinical condition characterized by pain and swelling in and around the Achilles tendon, mainly arising from overuse[6]. It is often a result of increase in training load. The Achilles tendon is the strongest tendon in the body serving both the gastrocnemius and soleus muscles originating near the mid-calf and inserts posteriorly at the calcaneus [7]. Achilles tendinopathy commonly happens in the mid-substance of the tendon or less commonly at its insertion in the calcaneus[8]. Previous observational studies have proved that competitive athletes have a 24% lifetime incidence of Achilles tendinopathy.

Soccer is widely recognized to be the world's most popular sport [14], and is played at different levels, worldwide, national, state, universities and even secondary schools. It is played by players in over 200 countries, making it the world's most popular sport [14]. Soccer involves several crafts that demand complex movements making the athletes susceptible to injuries, and tendinopathy is one of the most recorded overuse sports injuries in modern societies [15].

Participation in soccer is a worldwide event with tremendous health and economic benefits [16], increased self-esteem, peer socialization, general fitness, as well as reducing various diseases risks, crime rate and poverty [17]. A lot of attention has been given to elite soccer players

while in university soccer players, there are higher numbers of participants who began playing early and continue for a longer period. For some of them, their gears are not always suitable for the sport, thereby increasing the threat of tendinopathy [9]. The average university soccer players play soccer at least three (3) times a week, and Achilles tendinopathy occurs as a result of overuse. The increase in the popularity of soccer and expectations from players make meaningful numbers of soccer injuries conceivable. University soccer players also go through rigorous physical training, preparing for inter-club competition, inter- school competition. They are not professionals, so much attention is not given to them, but the trainings and constant field activity also makes them susceptible to sports injuries like Achilles tendinopathy. Also, intrinsic factors inherent in individual's physiology could also influence susceptibility to Achilles tendinopathy [9]

METHODOLOGY

Study Design, Setting And Sampling

Study Design: A Cross-sectional Study

Study Setting: Football academies of Ahmedabad city

Sampling Technique: Convenient Sampling

Population: Football players

Sample Size: 100 subjects, based on following formula:

$N = Z^2 P(1-P) / d^2$

Where, N= Sample size

Z= Level of confidence (95%)

P=Expected Prevalence (Previous researches) d=Precision (Corresponding Effect size)

Selection Criteria

Inclusion Criteria:

- Athletes who are willing to take participate in the survey.
- Age group 16 to 35 years.
- Male and Female football players.
- Playing football more than 2 years.

Exclusion Criteria:

- Athletes who are not willing to take part in survey
- Participants who actively engaged in other sports like basketball, sprinting were excluded because these sports could make them prone to Achilles tendinopathy.
- Any lower extremity trauma or injury in past 5 years.
- Subjects having connective tissue disorder
- Subjects having any neuromuscular disoder

MATERIALS REQUIRED

- Assessment form
- Consent form
- Pen, Pencil and Paper
- Mat and Plinth

METHODOLOGY

Ethical approval was obtained from Institutional Ethical Committee of Venus institute of physiotherapy, Gandhinagar. A letter of introduction from the Department of physiotherapy, Venus institute of physiotherapy, Gandhinagar was given to the coaches of the various teams seeking for permission to carry out the research with their teams. Informed consent was obtained from all participants and assuring them of confidentiality of their information.

The Royal London test, a psychometrically sound instrument, was used for assessing Achilles tendinopathy [18][19]. To start the test, the participant lay prone on the plinth with the feet hanging outside the table. The ankle was in neutral position and the Achilles tendon was palpated for tenderness.

The participant was asked to dorsiflex and the ankle was palpated on dorsiflexion. Results were classified as tenderness present on dorsiflexion or absent. In patients with Achilles tendinopathy, tenderness was felt on palpation with the ankle in neutral position, but on dorsiflexion tenderness was absent or reduced.

Figure 1: Flowchart of the study procedure

OUTCOME MEASURE

VISA–A Scale:

the Victorian Institute of Sports Assessment-Achilles (VISA-A) questionnaire was administered; it is a valid, reliable, and user-friendly index of the severity of Achilles tendinopathy, which contains eight questions that covers the 3 domains of pain (questions 1 to 3), function (questions 4 to 6), and activity (questions 7 and 8). Questions 1 to 7 are scored over 10, and question 8 carries a maximum of 30. Scores are summed to give a total of 100. An asymptomatic person would score 100. For question 8 which has three part (A, B, C), participants must answer only one part; A, B, or C that relates to the person's reality. If the participant experiences pain when performing sport, he or she automatically loses at least 10, and possibly 20, points.

Reliability And Validity of Visa-A:

J M Robinson The VISA-A questionnaire: a valid and reliable index of the clinical severity of Achilles tendinopathy: To develop and test a questionnaire based instrument that would serve as an index

of severity of Achilles tendinopathy. Item generation, item reduction, item scaling, and pretesting were used to develop a questionnaire to assess the severity of Achilles tendinopathy. The final version consisted of eight questions that measured the domains of pain, function in daily living, and sporting activity. Results range from 0 to 100, where 100 represents the perfect score. Its validity and reliability were then tested in a population of non-surgical patients with Achilles tendinopathy (n = 45), presurgical patients with Achilles tendinopathy (n = 14), and two normal control populations (total n = 87). The VISA-A questionnaire had good test-retest (r = 0.93), intrarater (three tests, r = 0.90), and interrater (r = 0.90) reliability as well as good stability when compared one week apart (r = 0.81). The mean (95% confidence interval) VISA-A score in the non-surgical patients was 64 (59-69), in presurgical patients 44 (28-60), and in control subjects it exceeded 96 (94-99). Thus the VISA-A score was higher in non-surgical than presurgical patients (p = 0.02) and higher in control subjects than in both patient populations (p<0.001). The VISA-A questionnaire is reliable and displayed construct validity when means were compared in patients with a range of severity of Achilles tendinopathy and control subjects.

RESULT

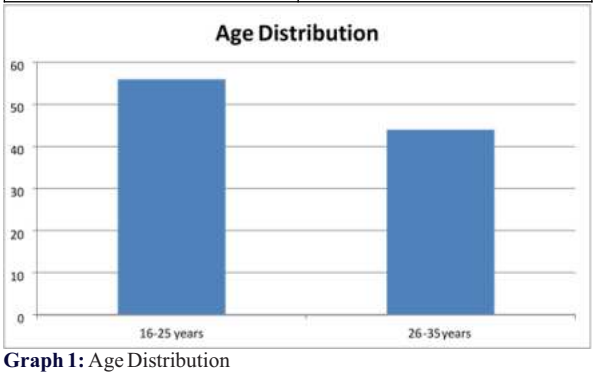
All statistical analysis was done using SPSS 25.0 software for windows. Descriptive analysiswas used to obtain mean and standard deviations.

Demographic Data

Age: The research was performed on 100 participants between the age of 16-35. There were 56 patients between the ages of 16 to 25, 44 patients between the age 26 to 35.

Table 1: Age Distribution

Age Distribution	
16-25 years	26-35 years
56	44

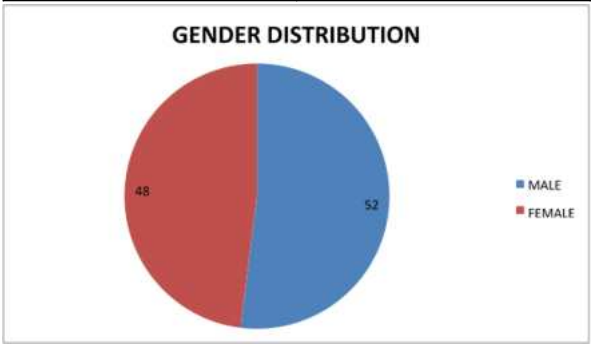


Graph 1: Age Distribution

GENDER DISTRIBUTION

Table 2: Gender Distribution

Gender Distribution	
Male	Female
52	48



Graph 2: Gender Distribution

Table 3: Hours Of Training

Mode	Number	Percentage
3 hours	48	48%
4 hours	27	27%
5 hours	14	14%
6 hours	07	7%
>6 hours	03	3%

Table 4: Distance

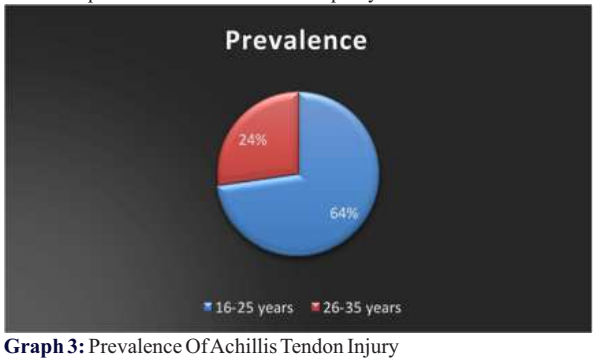
Distance	Number	Percentage
3 years	68	68%
4 years	25	25%
>4 years	07	7%

Age group of 16-25 having prevalence of 68% and age group of 26-35 having prevalenceof 24%.

Table 5: Mean Value Of VISA-A Score

	Mean + SD
Age	23.25±4.46
SF36	64.51±12.18
VISA-A	50.79 ± 19.98

VISA-A score less then 60 is seen in person with tendinopathy and SF-36 is considered goodas score high here mean value of VISa –A is less then 60 in persons with Achillis tendinopathy.



Graph 3: Prevalence Of Achillis Tendon Injury

The VISA-A questionnaire: An index of the severity of Achilles tendinopathy

IN THIS QUESTIONNAIRE, THE TERM PAIN REFERS SPECIFICALLY PAIN IN THE ACHILLESTENDON

REGION

1. For how many minutes do you have stiffness in the Achilles region on first getting up?

100mins ☐☐☐☐☐☐☐☐☐☐☐ 0 mins

0 1 2 3 4 5 6 7 8 9 10

POINTS

2. Once you are warmed up for the day, do you have pain when stretching the Achilles tendon fully over the edge of a step? (keeping knee straight)

strong severe pain ☐☐☐☐☐☐☐☐☐☐☐ POINTS no pain

0 1 2 3 4 5 6 7 8 9 10

3. After walking on flat ground for 30 minutes, do you have pain within the next 2 hours? (If unable to walk on flat ground for 30 minutes because of pain, score 0 for this question).

strong severe pain ☐☐☐☐☐☐☐☐☐☐☐ POINTS no pain

0 1 2 3 4 5 6 7 8 9 10

The VISA-A questionnaire: An index of the severity of Achilles tendinopathy

IN THIS QUESTIONNAIRE, THE TERM PAIN REFERS SPECIFICALLY PAIN IN THE ACHILLESTENDON

REGION

4. For how many minutes do you have stiffness in the Achilles region on first getting up?

100 mins POINTS 0 mins

0 1 2 3 4 5 6 7 8 9 10

5. Once you are warmed up for the day, do you have pain when stretching the Achilles tendon fully over the edge of a step? (keeping knee straight)

strong severe pain POINTS no pain

0 1 2 3 4 5 6 7 8 9 10

6. After walking on flat ground for 30 minutes, do you have pain within the next 2 hours? (If unable to walk on flat ground for 30 minutes because of pain, score 0 for this question).

strong severe pain POINTS no pain

0 1 2 3 4 5 6 7 8 9 10

7. Do you have pain walking downstairs with a normal gait cycle?

strong severe pain POINTS no pain

0 1 2 3 4 5 6 7 8 9 10

8. Do you have pain during or immediately after doing 10 (single leg) heel raises from a flat surface?

strong severe pain POINTS no pain

0 1 2 3 4 5 6 7 8 9 10

9. How many single leg hops can you do without pain?

0 POINTS 10

0 1 2 3 4 5 6 7 8 9 10

10.Are you currently undertaking sport or other physical activity?

0 Not at all POINTS

4 Modified training ± modified competition

7 Full training ± competition but not at same level as when symptoms began

10 Competing at the same or higher level as when symptoms began

11. Please complete **EITHER A, B or C** in this question.

• If you have **no pain while undertaking Achilles tendon loading sports** please complete **Q8a only**.

• If you have **pain while undertaking Achilles tendon loading sports but it does not stop you from completing the activity**, please complete **Q8b only**.

• If you have **pain that stops you from completing Achilles tendon loading sports**, please complete **Q8c only**.

A. If you have **no pain** while undertaking **Achilles tendon loading sports**, for how long can you train/practise?

POINTS

NIL	1-10 mins	11-20 mins	21-30mins	>30 mins
0	7	14	21	30

OR

B. If you have some pain while undertaking **Achilles tendon loading sport**, but it does not stop you from completing your training/practice for how long can you train/practise?

POINTS

NIL	1-10 mins	11-20 mins	21-30mins	>30 mins
0	4	10	14	20

OR

C. If you have **pain that stops you** from completing your training/practice in **Achilles tendon loading sport**, for how long can you train/practise?

NIL	1-10 mins	11-20 mins	21-30mins	>30 mins	POINTS
0	2	5	7	10	

TOTAL SCORE (/100) %

DISCUSSION

The overall incidence rate is 1.85 per 1,000 registered persons per year, and for the adult population it is 2.35. There are no other studies on the incidence rates of Achilles tendinopathy in the general population to compare these results with. The prevalence rate was higher than that for another tendinopathy like lateral epicondylitis of 1.3% (men) and 1.1% (women) in 9,696 persons registered at two general practitioners.10 The incidence rates in our study are lower than the incidence of 2.98 found in the military population4 and than the annual incidence 7% and 9% in top-level runners.2 3 While it seems plausible that the incidence rate of Achilles tendon injuries is higher in athletes than within a more general population, only in 35% of the cases in our study was a relationship with sports activity described. Intrinsic risk factors such as body weight and insulin resistance might also play a role.11 Although we could not assess information on body weight, the diagnosis of Diabetes Mellitus (DM) was available from the medical records.

The minor difference between the incidence and prevalence rate suggests that most patients only visit their General Practitioner (GP) once with their Achilles tendon problems. This might be because of a short duration of symptoms or that the patients go to a physiotherapist or sports physician afterwards.

This cross-sectional study has some limitations, due to which the actual incidence of Achilles tendinopathy is probably higher than observed in this study. Firstly, not every person with a certain complaint will visit a healthcare professional. In a cross-sectional population-based study, Picavet et al reported that approximately 50% of the patients with musculoskeletal complaints visited a healthcare professional. However, those with severe or persistent complaints will probably seek healthcare. Second, while most patients in the Dutch healthcare system will visit their GP before being referred to a therapist or specialist, since 2006 patients can visit a physiotherapist or sports physician without referral by a GP. It would be interesting to know the incidence rates of Achilles tendinopathy within the patient population of the Dutch physiotherapists and sports physicians as well, but since the denominators of these populations are unknown, no exact incidence rates could be obtained. Finally, because there is no specific registration code available for Achilles tendinopathy, GPs register this injury using other or more general codes.

In concordance with other studies,13 most cases were encountered in the middle-aged population (age group 41–60 years). At present, the prevalence of Achilles tendon rupture in PE is not clear, a study showed that the incidence of Achilles tendon rupture was higher in sedentary men aged 29–48. It was speculated that the relationship between AT and age may be due to the changes of mechanical properties of Achilles tendon with age. Recently, Sprague et al. found that there was a positive correlation between age and viscosity of uninjured Achilles tendon. Aging was usually associated with reduced cellular structure, increased glycoamine polysaccharide content, and decreased fibrous tissue, all of which can lead to degenerative changes in the Achilles tendon. At the same time, the aging tendon loses elasticity, forcing the muscle to work harder, eventually leading to changes in tendon structure.

Consistent with the previous study, we found that the prevalence of AT in football players was significantly higher than in other sports. This may be related to the high training intensity of football players and the heavy load on Achilles tendon. Some reviews showed that the prevalence of Achilles tendon injury in running and track and field sports is the highest. Ball games generally require athletes to make a rapid judgment according to the competition form in a short time, such as repeated bounce, dribble pass, back and forth quick start and other technical actions with a large load on the Achilles tendon. These technical actions need the support of the Achilles tendon, which also lays a huge hidden danger for its injury.

CONCLUSION

This study was conducted among Football players of Ahmedabad city and it revealed that players those are having long training hours prone to developing tendinopathy. This study shows that there is Age group

of 16-25 having prevalence of 68% and age group of 26-35 having prevalence of 24%.

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THE EFFECTIVENESS OF MATRIX RHYTHM THERAPY IN MUSCULOSKELETAL DISORDERS: AN EVIDENCE BASED STUDY

Physiotherapy

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ABSTRACT

Background: This study evaluates Matrix Rhythm Therapy (MRT) alongside traditional massage to assess their impact on peripheral circulation. While massage therapy is widely used to enhance blood flow and tissue healing, the effectiveness of MRT in this regard remains unclear. By comparing these modalities, the study aims to provide clarity on their therapeutic benefits, potentially guiding treatment choices in clinical practice. **Methods:** A systematic review following PRISMA guidelines will compare Matrix Rhythm Therapy (MRT) and traditional massage effects on peripheral circulation. Studies will be assessed using PEDro score and CEBM's Level of Evidence scale. Data synthesis, including potential meta-analysis, aims to inform clinical decisions on therapeutic interventions for peripheral circulation. **Results:** Matrix Rhythm Therapy (MRT) demonstrated significant efficacy across various conditions, including pain reduction, enhanced functional activities, and improved quality of life. Studies highlighted its effectiveness in addressing chronic low back pain, peripheral circulation, diabetic peripheral neuropathy, and hand pain in excessive smartphone users. While some comparisons favored alternative treatments like stretching exercises for specific conditions, overall, MRT emerged as a promising therapeutic modality with broad applicability in healthcare settings. **Conclusion:** Matrix Rhythm Therapy (MRT) shows significant promise in addressing a wide range of conditions, offering pain relief, improving functional outcomes, and enhancing quality of life.

KEYWORDS

Musculoskeletal disorder, Matrix Rhythm Therapy, Systematic review, pain reduction.

INTRODUCTION

Background

Patients experiencing musculoskeletal issues often activate anaerobic metabolism due to reduced blood circulation and microcirculation. The compromised regulation of microcirculation in muscles is associated with the generation of nociceptive pain. Circulation plays a crucial role in tissue healing, with enhanced blood circulation facilitating the delivery of proteins, nutrients, and oxygen, consequently promoting improved tissue healing Recent studies have focused on comparing the efficacy of various conservative treatment approaches on bloodstream dynamics.[1,2,3]

Massage, a widely adopted physiotherapeutic technique, is employed to enhance blood circulation. Defined as soft tissue manipulation for therapeutic purposes, massage therapy is administered by trained therapists. While some sports medicine practitioners advocate for the benefits of massage, including increased blood circulation, reduced muscle tension, and enhanced neural excitability, conflicting opinions exist in the literature. Some authors posit that massage positively impacts blood circulation, while others assert that it has no effect.[4,5,6,7]

Various massage techniques, such as effleurage, petrissage, tapotement, friction, and vibration, are employed.[8] Vibration massage, specifically, aims to enhance circulation and facilitate muscle relaxation. Mechanical devices allow for the safe and localized application of vibration treatment. Adjustable speed and frequency in vibration devices cater to diverse indications, with some used in beauty salons for fat burning, hand-held devices for musculoskeletal pain, and whole-body vibration devices for exercise.[9]

While hand-held devices exhibit a strong placebo effect, low-magnitude mechanical vibration is believed to boost local blood flow. Matrix Rhythm Therapy (MRT) represents a novel form of vibromassage utilized in various settings, including special education and rehabilitation centers, sports clubs, and neurologic, orthopedic, physical therapy, and rehabilitation centers.[10,11,12]

Limited studies and clinical experiences suggest the effectiveness of MRT, yet the evidence level is considered low. To elucidate the therapeutic efficacy of MRT, it is imperative to explore its impact on peripheral circulation. [13]As MRT is a novel vibromassage method, no studies have yet assessed its influence on circulation, and existing literature presents conflicting results regarding the effect of massage on peripheral circulation[14]. Notably, MRT requires a device for application, distinguishing it from traditional massage methods. If the findings of the current study reveal comparable increases in peripheral blood circulation between massage and MRT, it may suggest a preference for traditional massage over MRT. This approach deviates from previous studies that compared MRT to a placebo, as therapists have shown a preference for manual hand massage over handheld devices.[15]

MRT represents a groundbreaking approach in cellular therapy, utilizing rhythmic oscillations within the 8-12 Hz range to rejuvenate cellular energy metabolism and rebalance physiological functions.[16] By intricately stimulating cells and synchronizing tissue, it promotes heightened circulation, increased oxygenation, and enhanced ATP synthesis, fostering deep-seated muscle and tissue relaxation. This advanced technique orchestrates cellular regeneration and healing through precise micro-process modulation, ensuring enduring relaxation and optimized tissue metabolism, thereby offering comprehensive therapeutic benefits at the cellular level.

Figure 1: Matrix Rhythm Ther

Figure 2: Matrix Mobil Device

Figure 3: MRT for Back Pain

Figure 4: MRT for Knee Pain

Figure 5: MRT for Muscle Pain

Figure 6: MRT for Heel Pain

METHODOLOGY

Study Duration

6 - 8 Month.

Study Design

This will be an Evidence Based Study and will conduct according to PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-analysis) guidelines.

Figure 7: Flowchart for PRISMA

Figure 8 : Flowchart for Review Article

Inclusion Criteria

1. Articles published during last 10 years. (2012- May 2022)
2. Articles having study design as Systematic reviews, Meta-analysis and Randomized controlled trial.
3. Articles published in English.
4. Articles in which studies done on Human.

Exclusion Criteria

1. Articles having study design as case control or cohort.
2. Studies done on animals.
3. Studies design case reports.

Data Analysis

- ❖ Physiotherapy Evidence Database (PEDro)
  - ➢ It assesses methodological quality and consists of a checklist of 11criteria, 10 of which are scored.
  - ➢ For each criterion the study met, 1 point was awarded.
  - ➢ The points were presented as a score out of 10.
  - ➢ PEDro scores of 6 to 10 were considered high quality, of 4 to 5 were considered moderate quality, and of 0 to 3 were considered low quality

- ❖ Centre for Evidence-Based Medicine's (CEBM's) Levels of Evidence scale:
  - ➢ It assesses quality based on study design, which categorize the studies in a scale ranging from 1 to 5 with further subdivision for each.

Figure 09: Hierarchy of Evidence

RESULTS

The review article synthesized findings from multiple studies on Matrix Rhythm Therapy (MRT), highlighting its diverse applications and therapeutic efficacy across various pathological conditions. Dr. Sonali Shrivastava's review emphasized MRT's ability to induce oscillations within the physiological frequency range, thereby restoring disrupted rhythms at the cellular level and enhancing oxygen supply, leading to tissue relaxation and pain reduction.

Dr. med. Ulrich G. Randoll underscored MRT's successful application in rehabilitation, sports medicine, and veterinary medicine, noting its role in preventive measures and rehabilitation efforts, as well as its effectiveness in addressing various types of pain and degenerative diseases.

Nadir et al.'s study focused on chronic low back pain and found that MRT, when integrated into a comprehensive physiotherapy program, led to significant improvements in pain, disability, and quality of life compared to the control group.

Taspinar et al.'s research demonstrated MRT's ability to enhance peripheral blood circulation, particularly in young women, compared to massage therapy.

Figure 10: PEDro Score

- We have taken PEDro score for our study for MRT and concluded that approximately 76.8% of study from 2012 to 2023 were shows that MRT is more beneficial than conventional therapy.
- Evidence shows that MRT is more effective compare to conventional therapy such as Non-healing wounds, Arthritis, Osteoporosis, Spasticity, Ligaments tear, Tendinitis and Bone degeneration.

DISCUSSION

1. The study by F Taspinar et al. in the year (2013), "engages with the outcomes derived from a randomized, double-blind, controlled trial, investigating and contrasting the effects of matrix rhythm therapy and massage on peripheral blood circulation" in a cohort of fifteen healthy women aged 19–23 years. The interventions, administered as single 30-minute sessions on the left lower extremity with a minimum one-week interval, were executed by the same physiotherapist.[17]
2. Derya et al. in Dec, (2016), investigates "the comparative short-term effectiveness of Matrix Rhythm Therapy and stretching exercises in individuals with frozen shoulder." Forty-three patients, with an average age of 52.6 years, were randomly assigned to either the Matrix Rhythm Therapy or stretching exercises group, both undergoing a 6-week treatment accompanied by a similar home exercise program. Various outcome measures, including range of motion, Constant score, Disabilities of the Arm, Shoulder, and Hand score, Short Form Health Survey-36, and Global Rating of Change score, were assessed at different intervals.[18]
3. T. Palekar in the year (2019), proposes "Matrix Rhythm Therapy (MRT), an emerging electrotherapy modality, demonstrating effectiveness in managing pain and restoring cellular frequency" within the 8-12Hz range. This study focuses on evaluating the impact of MRT on hand pain in excessive smartphone users.[19]
4. Dr. Sonali Shrivastava's review (2019) highlights that "Matrix Rhythm Therapy induces oscillations within the physiological frequency range of 8-1 HZ. This frequency synchronization with the body aims to restore disrupted rhythms at the cellular level." The therapy demonstrates a positive impact on oxygen supply by enhancing microcirculation, consequently boosting energy production. Notably, immediate effects manifest as the relaxation of tissues, muscles, and fascia, with this relaxation enduring for an extended period.[20]
5. Dr. med. Ulrich G. Randoll (2019) underscores "the successful application of Matrix-Rhythm-Therapy, particularly in the realms of rehabilitation, high-performance sports, and veterinary medicine." The therapy has undergone rigorous testing and validation over the past decade, originating from the University of Erlangen. Its application is particularly noteworthy for both preventive measures, involving the prophylactic avoidance of disease development, and rehabilitation efforts, aimed at preventing and mitigating damages resulting from strain, trauma, accidents, and surgeries. Sports medicine, in particular, recognizes the therapy's merit in significantly expediting the regeneration time between training periods, especially after instances of hyper-distension, injuries, hardening, tendonitis, and other impairments. This acceleration allows for the intensification of training cycles and facilitates a swifter return to peak performance following injuries.[21]
6. In the experimental study published in (2019), by Naik et al., aimed to assess "the effectiveness of a single session of Matrix Rhythm Therapy (MaRhyThe) in individuals diagnosed with Plantar Fasciitis (PF), a prevalent musculoskeletal condition often associated with limitations in daily activities." Seventeen subjects within the age range of 18-35 years participated in the study, receiving one session of MaRhyThe targeting the calf and plantar aspect of the foot, lasting 45–60 minutes. The pre and post-intervention outcomes were measured using a pressure algometer (PPA) for pain assessment, a non-contact infrared thermometer (IRT) for local skin temperature, and the Foot and Ankle Ability Measures (FAAM) scale for evaluating functional activities.[22]
7. Nadir et al. (2021) assess "the impact of Matrix Rhythm Therapy (MRT) on chronic low back pain, specifically concentrating on parameters such as pain intensity, levels of disability, and overall quality of life." A cohort of thirty-two participants underwent random assignment into either the intervention or control group. Both groups underwent a comprehensive ten-session combined physiotherapy program, with the intervention group receiving an additional six sessions of MRT.[23]
8. Anand et al. (2022) proposes diabetic peripheral neuropathy (DPN), a prevalent complication of diabetes, adversely impacting the quality of life by affecting balance and gait, leading to an increased risk of falls. Matrix Rhythm Therapy (MaRhyThe) is an innovative approach utilized in various musculoskeletal and neurological conditions to manage pain and enhance functionality.[24]
9. Taj Afreen Sheikh (Oct, 2022) underscores "the Matrix Rhythm Therapy (MRT) approach in the fundamental understanding that cellular processes, whether preventive, therapeutic, regenerative or degenerative, operate predominantly within the cellular environment." Crucial to these processes is the muscle pulsation frequency, identified at 8-12 Hertz, with deviations outside this range linked to ailments such as aches, muscle tension and broader health concerns.[25]
10. The study by Munjewar et al. in the year (2022), examines "the effectiveness of Matrix Rhythm Therapy (MRT) as a novel development in physiotherapy." MRT serves as a non-invasive method for relieving pain, enhancing microcirculation, promoting relaxation, and increasing blood oxygenation. Operated within a frequency range of 8-12 Hz, MRT stimulates the body's self-healing powers, employing vibromassage through a resonating head to release muscular tension.[26]

CONCLUSION

- MRT's non-invasive nature makes it a valuable therapeutic option with broad applications in musculoskeletal health, presenting opportunities for improved well-being.Matrix Rhythm Therapy (MRT) exhibits promising efficacy in managing various musculoskeletal disorders. Studies highlight its ability to induce physiological oscillations, restore disrupted cellular rhythms and enhance microcirculation, contributing to improved oxygen supply. Applications in rehabilitation, sports, and diverse musculoskeletal conditions demonstrate positive outcomes, including pain relief and functional improvements.
- Evidence shows that MRT is more effective compare to conventional therapy such as Non-healing wounds, Arthritis, Osteoporosis, Spasticity, Ligaments tear, Tendinitis and Bone degeneration.

Limitations

- Limitations of this study include potential constraints arising from the availability and quality of existing scientific data on Matrix Rhythm Therapy (MRT) in musculoskeletal disorders, as well as the heterogeneity of included studies in terms of design, participant characteristics, and outcome measures.
- The study's scope may be limited to the disorders covered in the available literature, potentially overlooking other musculoskeletal conditions.
- It includes other factors like patient comorbidities, and variations in practitioner expertise could act as confounders, influence on the effects of MRT.

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COMPARISON OF INTRINSIC VERSUS EXTRINSIC FOOT MUSCLE STRENGTHENING ON PAIN AND FUNCTION IN PLANTAR FASCIITIS: AN EXPERIMENTAL STUDY.

Physiotherapy

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ABSTRACT

Background: Plantar fasciitis is a prevalent condition affecting 10% of the general population, particularly active working adults aged 25 to 65. This study aimed to assess the efficacy of intrinsic and extrinsic muscle-strengthening exercises in individuals with plantar fasciitis, considering age-specific responses. **Methods:** A randomized controlled trial was conducted involving 30 participants (18 females, 12 males) aged above 18, distributed into Group-A (intrinsic exercises) and Group-B (extrinsic exercises) for a 4-week intervention. Age distribution mirrored the typical age range of plantar fasciitis patients. **Results:** In participants aged above 40, intrinsic exercises demonstrated a statistically significant improvement in foot function and pain reduction compared to extrinsic exercises. No significant differences were observed in participants below 40. Overall, intrinsic exercises showed superiority in both age groups. **Conclusion:** This study highlights the importance of tailoring exercise interventions for plantar fasciitis based on age. Intrinsic exercises, particularly for individuals above 40, proved more effective in enhancing foot function and reducing pain. These findings underscore the need for individualized rehabilitation plans and warrant further research to explore long-term effects and refine treatment strategies.

KEYWORDS

Planter Fasciitis, Ultrasound, Intrinsic Exercise, Extrinsic Exercise, Foot Function Index, Numeric Pain Rating Scale.

INTRODUCTION

BACKGROUND

- Plantar fasciitis is a prevalent source of heel pain among adults. The discomfort typically results from collagen degeneration, often mischaracterized as "chronic inflammation," occurring at the point where the plantar fascia originates on the medial tubercle of the calcaneus. This degeneration shares similarities with the persistent necrosis seen in tendonosis. Tendonosis is characterized by the loss of collagen continuity, heightened levels of ground substance (the connective tissue matrix), increased vascularity, and the presence of fibroblasts, in contrast to the inflammatory cells typically associated with the acute inflammation seen in tendonitis.[1,2]
- This condition commonly results from overuse, primarily attributed to repetitive strain causing micro-tears in the plantar fascia. However, it can also manifest due to trauma or a combination of various factors. Predisposing factors include pes planus, pes cavus, restricted ankle dorsiflexion, and abnormal pronation or supination. Pes planus may increase strain at the plantar fascia's origin, while pes cavus can impose excessive strain on the heel due to inadequate foot eversion and shock absorption.
- Tightness in the gastrocnemius, soleus, and other posterior leg muscles is frequently observed in individuals with this condition, potentially altering normal walking biomechanics. While around 50% of patients may exhibit heel spurs, these spurs are not the root cause but are often present. Plantar fasciitis is commonly associated with runners and older adults, with additional risk factors including obesity, heel pad atrophy, aging, occupations involving prolonged standing, and weight-bearing activities. Although there is an association with certain seronegative spondyloarthropathies, approximately 85% of cases do not have identifiable systemic factors.[3,4]

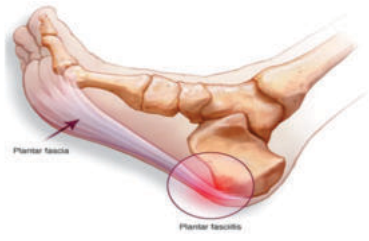


Figure 1: Diagram of Planter Fasciitis

Plantar fasciitis stands as the predominant cause of heel pain encountered in outpatient settings. While the precise incidence and prevalence across different age groups remain elusive, estimations suggest that approximately one million patient visits annually are attributed to plantar fasciitis. This condition contributes to around 10% of injuries related to running and necessitates professional medical care for 11% to 15% of all foot symptoms. It is believed to afflict approximately 10% of the general population, with the majority (83%) of affected individuals falling within the active working age group of 25 to 65 years. Bilateral presentation occurs in about a third of cases. Some literature indicates even higher prevalence rates, reaching up to 22%, particularly within populations of runners.[5,6]

- Management of plantar fasciitis involves a phased approach, with initial emphasis on conservative measures. Relative rest from the causative activity, tailored to the pain level, is recommended. Post-activity application of ice and the use of oral or topical NSAIDs can help alleviate pain.
- Patients are encouraged to modify work-related activities, and a night splint may be beneficial for those with persistent pain. Surgery is considered the final option and may involve fasciotomy through an open or endoscopic approach. However, it's important to note that surgical release does not guarantee a successful outcome. Potential complications include nerve injury, plantar fascia rupture, and flattening of the longitudinal arch. Careful consideration of the risks and benefits is imperative when contemplating surgical intervention for plantar fasciitis.[7,8,9]

Methodology

Study Place

OPD of Venus Institute of Physiotherapy, Bhoyan Rathod, Gandhinagar and Hi-Tech Multispecialty Hospital, Gandhinagar

Study Duration

4 weeks

Study Design

- Exprimental Study

Inclusion Criteria

1. Patients willing to participate
2. Both male and female subjects
3. Age between 25-60 years
4. Diagnosed with Plantar Fasciitis

Exclusion Criteria

1. Subjects with neurological disorders affecting the foot
2. Subjects with any previous heel or foot surgeries
3. Subjects with Peripheral Vascular disease
4. Subjects with pain at great toe and not around heel pain.

MATERIALS REQUIRED

Intervention

Intervention Group

1. Group A (Intrinsic Foot Muscle Strengthening + Ultrasound)
Participants will engage in a structured program including exercises such as toe curls, big toe extension *(Figure : 10)*, marble pick-up, towel gathering curls*(Figure : 9)*, toe spread, and tennis ball exercises. Each exercise is designed to target intrinsic foot muscles.
The intervention will include ultrasound therapy in addition to the exercise regimen.

2. Group B (Extrinsic Foot Muscle Strengthening + Ultrasound)
Participants in this group will follow exercises focused on extrinsic foot muscle strengthening, including calf muscle stretch*(Figure :5)*, resisted plantar flexion*(Figure : 6)*, foot supination-sitting, foot adduction, hip external rotation-side lying, and hip abduction.

Similar to Group A, participants in this group will receive ultrasound therapy *(Figure : 12)* as part of the intervention.

Exercise Protocol

Each exercise session will consist of 10–20 repetitions.
Participants will perform the exercises three times per day.

Figure 2 : Calf Muscle Stretching

Figure 3 : Resisted Plantar Flexion

Figure 4: Resisted Inversion Of Foot

Figure 5 : Abduction Of Foot Finger

Figure 6 : Towel Gathering (Curls) Exercise

Figure 7 : Big Toe Extension Exercise

Figure 8 : Big Toe Extension Exercise

Figure 9 : Apply Ultrasound Therapy

Outcome Measures

1. Foot Function Index (FFI) [13]

The FFI is a self-administered index comprising 23 items categorized into three subscales: pain, disability, and activity limitation. Participants rate each item on a scale from 0 (no pain or difficulty) to 10 (worst pain imaginable or requiring assistance) based on their foot condition over the past week. The pain subcategory consists of 9 items, disability subcategory consists of 9 items, and the activity limitation subcategory consists of 5 items. The FFI demonstrates good test-retest reliability for both total and subscale scores (ranging from 0.87 to 0.69) and high internal consistency (ranging from 0.96 to 0.73)

2. Numeric Pain Rating Scale (NPRS) [14]

The NPRS is a unidimensional measure of pain intensity in adults, comparable to the visual analogue scale (VAS). Administered verbally or graphically for self-completion, it employs a 10-point numeric scale ranging from 0 (no pain) to 10 (worst pain imaginable). Participants indicate the numeric value on the segmented scale that best describes their pain intensity. Higher scores signify greater pain intensity. The NPRS exhibits high test-retest reliability in literate and illiterate patients with rheumatoid arthritis (r=0.96 and 0.95, respectively). Additionally, for construct validity, the NPRS correlates highly with the VAS in patients with chronic pain conditions (ranging from 0.86 to 0.95). The scale provides a reliable and valid measure of pain intensity.

Data Collection

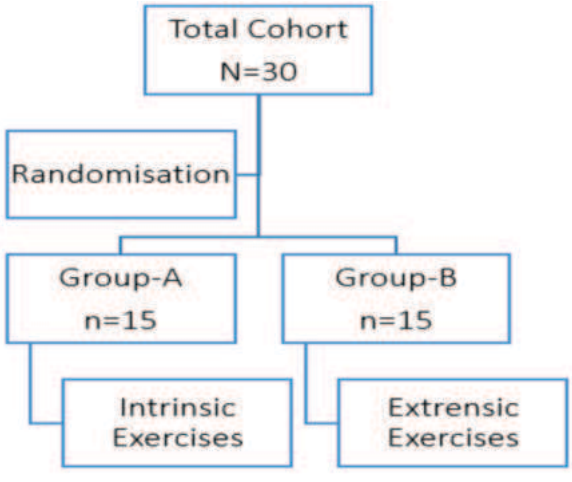
Data of all the patients were collected a data collection form.

Statistical Analysis

Descriptive statistics will be employed for demographic data, and inferential statistics will be used to compare changes in FFI and NPRS scores between the two intervention groups. The significance level will be set at $p < 0.05$.

RESULTS

This study involved a total of 30 patients diagnosed with plantar fasciitis were randomly allocated into two groups, Group-A and Group-B, each prescribed a distinct type of exercise regimen aimed at muscle strengthening—Intrinsic and Extrinsic, respectively—for a duration of 4 weeks. Among the total population, 18 patients were female and 12 were male, spanning ages from 18 to 59 years.



Baseline Characters

Table 1: Age group of Study Population

Age Group	Group-A		Group-B	
	Number	Percentage	Number	Percentage
20-29 Years	2	13.33%	2	13.33%
30-39 Years	6	40.00%	7	46.67%
40-49 Years	4	26.67%	6	40.00%
50-59 Years	3	20.00%	0	0.00%

The participant distribution across different age groups in Groups A and B, engaged in intrinsic and extrinsic exercises, respectively, reveals interesting insights. In the 20-29 age group, both groups have an equal representation of 13.33%. In the 30-39 age range, Group A constitutes 40.00% of participants, slightly less than the 46.67% in Group B. The 40-49 age group sees 26.67% in Group A compared to 40.00% in Group B. Notably, in the 50-59 age group, Group A has 20.00% representation, while Group B has none. These demographic variations underscore the importance of considering age differences in the interpretation of intervention outcomes, as the efficacy of intrinsic and extrinsic exercises may vary across different age cohorts.

Comparative Analysis of Group-A and Group-B

Table 2: Post-Baseline Full Set Descriptive Data (Group-A vs Group-B)

Post-Baseline Full Set Descriptive Data (Group-A vs Group-B)								
	Foot Function Index (FFI)				Numeric Pain Rating Scale (NPRS)			
	Group-A	Group-B	CFB	%CFB	Group-A	Group-B	CFB	%CFB
N	15.00	15.00	15.00	15.00	15.00	15.00	15.00	15.00
Minimum	90.00	120.00	11.00	10.09	3.00	4.00	0.00	0.00
Maximum	110.00	138.00	38.00	40.00	5.00	6.00	3.00	100.00
Mean	99.07	126.90	27.87	28.57	3.67	4.73	1.07	32.78
SD	6.46	5.66	7.90	9.09	0.62	0.80	1.03	33.85
SEM	1.67	1.46	2.04	2.04	0.16	0.21	0.27	8.74
P-value	<0.0001				<0.05			
Note: CFB- Change From Baseline/ %CFB- Percentage Change From Baseline								

In the post-baseline full set analysis comparing Group-A (Intrinsic Exercises) to Group-B (Extrinsic Exercises), significant differences are observed in both the Foot Function Index (FFI) and Numeric Pain Rating Scale (NPRS). In terms of FFI, Group-A exhibited a mean score of 99.07, significantly lower than Group-B's mean of 126.90, resulting in a substantial change from baseline (CFB) of 27.87 and a percentage change (%CFB) of 28.57%. This indicates that participants in Group-A experienced a more significant improvement in foot function compared to Group-B. In the NPRS, Group-A also showed a lower mean pain score of 3.67 compared to Group-B's 4.73, resulting in a CFB of 1.07 and a %CFB of 32.78%. While both groups experienced improvements in pain, Group-A demonstrated a larger reduction. The statistical significance for both FFI and NPRS differences is indicated by p-values of <0.0001 and <0.05, respectively. These results suggest that intrinsic exercises (Group-A) may be more effective in improving foot function and reducing pain compared to extrinsic exercises (Group-B).

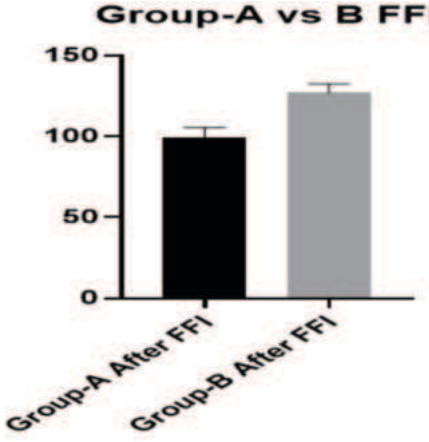


Figure 11: Post-Baseline Full Set Descriptive Data (Group-A vs Group-B)

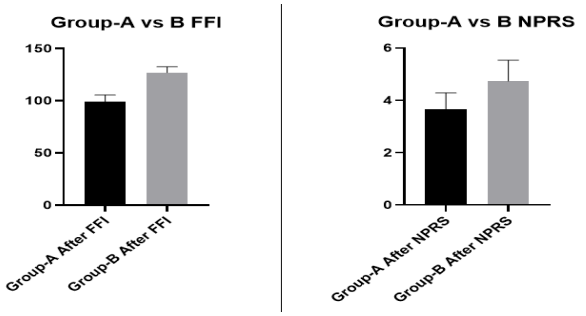


Figure 12: Post-Baseline Full Set Descriptive Data (Group-A vs Group-B)

DISCUSSION

Comparison with Previous Studies

The present study significantly contributes to our understanding of the relevance of intrinsic and extrinsic muscle strengthening in individuals diagnosed with plantar fasciitis [10]. The research cohort comprised a total of 30 participants, all above the age of 18, which aligns with the demographic characteristics of plantar fasciitis patients, a condition that notably affects around 10% of the general population. Within this demographic, a substantial majority consists of active working adults aged between 25 and 65 years, with a peak incidence occurring in the 40 to 60 years age range and a higher prevalence in women compared to men. Remarkably, a similar age distribution was observed in the present study, with the majority falling between the ages of 30 and 49[11].

Building on existing literature, a prior study involving 36 individuals focused on comparing the effectiveness of exercises targeting extrinsic and intrinsic foot muscles in enhancing the medial longitudinal arch, particularly in adolescents with flat feet. In this investigation, Group 1 engaged in intrinsic muscle exercises, while Group 2 performed extrinsic muscle exercises. The outcomes of this study resonate with the findings of the present research, where the group undertaking intrinsic exercises exhibited a statistically significant improvement compared to the group assigned extrinsic exercises for managing plantar fasciitis. These parallel results further support the notion that intrinsic exercises may be more effective than their extrinsic counterparts in addressing the complexities of plantar fasciitis. The implications of these findings are particularly relevant in informing targeted intervention strategies for individuals grappling with this prevalent foot condition [12].

CONCLUSION

In conclusion, the comprehensive analysis of participants undergoing intrinsic (Group-A) and extrinsic (Group-B) exercises, particularly when stratified by age, reveals noteworthy findings. Both intrinsic and extrinsic interventions resulted in statistically significant improvements in foot function and pain levels, with Group-A consistently demonstrating a more pronounced effect across various parameters. When examining age-specific data, the distribution of participants varies, with Group-B having a higher representation in the 30-39 age group, while Group-A displays a more balanced distribution across the 30-39, 40-49, and 50-59 age groups. Notably, Group-A consistently outperforms Group-B in improving foot function and reducing pain, especially among participants above 40 years. These results underscore the potential efficacy of intrinsic exercises, particularly for individuals above 40 years old, in enhancing foot function and alleviating pain. However, the diverse age distribution emphasizes the need for careful consideration of age-related factors in interpreting and applying these intervention outcomes. Further research and exploration of age-specific responses to intrinsic and extrinsic exercises would contribute to a more nuanced understanding of their effectiveness in improving foot health.

Limitations

- Despite the insightful findings, it is important to acknowledge several limitations in this study. Firstly, the relatively small sample size within each age group may limit the generalizability of the results to broader populations.
- The unequal distribution of participants across age groups could introduce potential bias, especially in the 50-59 age range where Group-B lacks representation. Additionally, the study's duration and follow-up period are crucial factors to consider, as they may

impact the long-term sustainability of the observed improvements. The lack of a control group or alternative intervention group further limits the ability to attribute the observed changes specifically to intrinsic or extrinsic exercises.

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PREVALENCE OF WORK-RELATED MUSCULOSKELETAL DISORDER AND ITS ASSOCIATION WITH MENTAL HEALTH AMONG CLINICAL PHYSIOTHERAPIST: A CROSS SECTIONAL STUDY.

Physiotherapy

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ABSTRACT

Background: Given that physiotherapists receive education on injury prevention and body mechanics as part of their entry-level training, it might be expected that their rates of work-related musculoskeletal disorders (WRMSDs) would be lower compared to other professionals who perform patient handling tasks, such as nurses and massage therapists. Previous research has shown that psychosocial working conditions significantly affect mental distress and overall well-being.[10] Based on the literature, occupational stress has been identified as having a detrimental impact on the development of work-related musculoskeletal disorders (WRMSDs), with these cases posing substantial risks to both physical and mental health. Therefore, this study was undertaken to investigate the prevalence of WRMSDs and their correlation with mental health. **Methodology:** Subjects were qualified physiotherapists those who were based on the inclusion & exclusion criteria and participants who willingly wants to participate. 2 Questionnaire was used in this study for the outcome measures were: (1) Nordic musculoskeletal questionnaire to assess the WRMSD, (2) General health questionnaire (GHQ-12) for the assessment of the mental health. The form was administered through Email or WhatsApp to physiotherapists across the city. **Results:** There is 67% prevalence of musculoskeletal disorders among physiotherapists and there is perfect negative correlation with WRMSD with their mental health. **Conclusion:** WRMSDs are exacerbated by patient handling and demanding work conditions, not only affect physical health but also impact therapists' mental well-being. Despite the significant prevalence, many therapists do not seek timely treatment or take necessary breaks, potentially exacerbating their conditions. Addressing ergonomic practices, reducing repetitive tasks, and enhancing support systems are crucial steps in mitigating WRMSDs and promoting overall occupational health in the physiotherapy profession.

KEYWORDS

Musculoskeletal disorders, Physiotherapists, Mental Health, Nordic Musculoskeletal Questionnaire, Working Posture

INTRODUCTION

Background

According to the World Health Organization, work-related musculoskeletal disorders (WRMSDs) are defined as injuries encompassing a broad spectrum of inflammatory or degenerative diseases and disorders that lead to pain or functional impairment.[1] These disorders affect the muscles, tendons, ligaments, joints, peripheral nerves, and supporting blood vessels.[2] They include clinical conditions like tendon inflammations (such as tenosynovitis, epicondylitis, bursitis), nerve compression disorders (like carpal tunnel syndrome, sciatica), and osteoarthrosis. Additionally, they cover less well-defined conditions such as myalgia, low back pain, and other regional pain syndromes that cannot be attributed to known pathology.[3]

Physiotherapists have already taken advantage of opportunities to take on new responsibilities, including more advanced and initial practitioner roles. While they are well-positioned to tackle future healthcare challenges, there is a need for unified support within the profession to embrace significant changes in practice, including a reassessment of their role. Healthcare workers who have direct contact with patients experience the highest rates of work-related diseases, attributed to the demands of their profession and the physical positions they must maintain throughout the day.[4]

The main risk factors associated with WRMSDs include repetitive tasks, uncomfortable postures, and high levels of force. Physiotherapists frequently undertake tasks like transferring dependent patients, assisting with mat activities, and lifting heavy equipment, which increase their susceptibility to both acute and chronic work-related musculoskeletal disorders (WRMSDs).[5] A considerable number of physiotherapists suffer from work-related musculoskeletal disorders, with upper back pain, lower back pain, and hip pain being the most common issues they face.[6]

According to the results of a longitudinal study investigating the effects of musculoskeletal pain on work performance, regular musculoskeletal discomfort was associated with decreased performance. Work-related factors contributing to this include job dissatisfaction, job strain (involving psychologically demanding tasks with time pressure and low job control), time constraints, high mental pressure, relationships with coworkers, support at work, and overall stress levels [7,8].

A Literature has highlighted that high-level workplace stress can negatively impact both the body and mind, leading to reduced productivity, absenteeism, job changes, and exhaustion. Stress arising from pain or discomfort can also affect an individual's mental well-being and quality of life. [9] According to Karasek's model, which has been prominent in research on WRMSDs, four key work-related psychosocial factors high psychological job demands, low decision-making authority, inadequate social support, and job insecurity—contribute to psychological strain. This strain increases the likelihood of stress-related health issues.[12]

Methodology

Study Place

Government and private hospitals and clinics of Gandhinagar and Ahmedabad

Study Duration

1 Year

Study Design

A Cross sectional Study

Inclusion Criteria

1. Willing to participate
2. Clinical working Physiotherapist
3. Age group (25-55 years)
4. Both male and female
5. Minimum 5-6 hours of working
6. Physiotherapist with minimum 6 months - 1 year of clinical work experience

Exclusion Criteria

1. Physiotherapists who are in the administrative duty
2. Academics or performing non-clinical work

3. Female physiotherapists who are pregnant
4. Recent trauma or surgery
5. Physiotherapists who have full time working assistants

Materials required

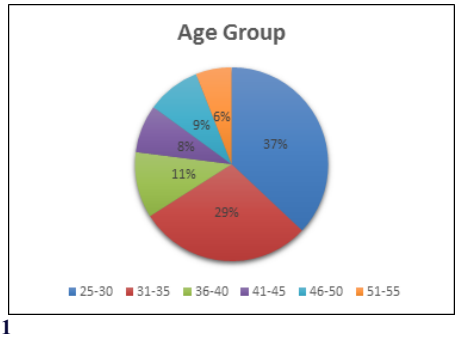
1. Mobile Phone
2. Consent form
3. Assessment form

METHOD

- Subjects were qualified physiotherapists those who meet inclusion and exclusion criteria and who are willing to participate.
- The consent was taken from all the subjects and detailed explanation of the study was also given to the subjects.
- 2 questionnaire was used in the study for the outcome measures were:
- Nordic Musculoskeletal Questionnaire (NMQ) to assess the WRMSD
- General Health Questionnaire (GHQ-12) for the assessment of the mental health
- The 1ST questionnaire consists of 2 parts. In the first part each subject were required to fill the assessment form consisting of question regarding their basic demographic details, professional details such as job/position, experience, weekly working hours and health information and the second part will consist of questions to measure the existence of musculoskeletal pain using modified Nordic musculoskeletal questionnaire.
- The 2nd questionnaire was GH-12 to assess the Mental Health. The General Health Questionnaire (GHQ-12) comprises 12 items, each evaluating the severity of mental issues over recent weeks using a 4-point scale (ranging from 0 to 3). Scores from these items are totaled to produce a score ranging from 0 to 36, where higher scores indicate more severe conditions.
- The form was administered through email or WhatsApp to physiotherapist across the city.
- A total of 410 physiotherapists were invited across Gandhinagar and Ahmedabad, among whom 276 responded. These data were analyzed based on eligibility criteria, and a total of 156 physiotherapists participated in the study.

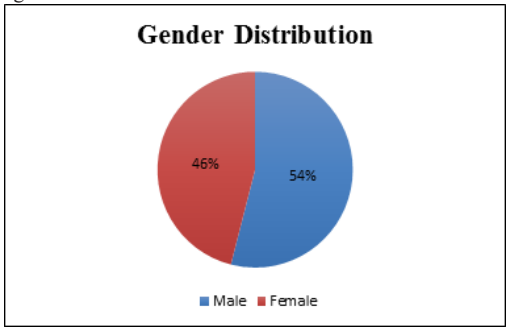
RESULTS

The analysis was done using excel.Total 156 physiotherapists are taken for the study



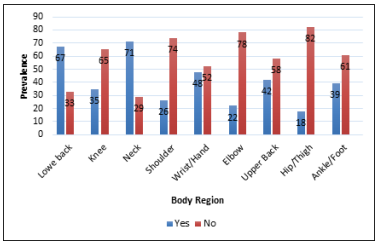
Graph 1

Graph 1 shows the age group of subjects were between 25-55 years and among them 37% were between 25-30 years, 29% were between 31-35 years, 11% were between 36-40 years, 8% were between 41-45 years, 9% were between 46-50 years and 6% were between 51-55 years. Among them 54% were female and 46% were male



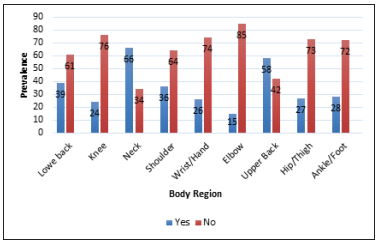
Graph 2

Graph 2 shows the gender distribution of males and females, among them 54% were male and 46% were female.



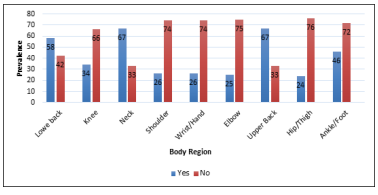
Graph 3

Graph 3 shows the prevalence in 67% suffered from lower back pain, 35% suffered from knee pain, 71% suffered from neck pain, 26% suffered from shoulder pain, 48% suffered from wrist/hand pain, 22% suffered from elbow pain, 42% suffered from upper back pain, 18% suffered from hip/thigh pain and 39% suffered from ankle/foot pain region among Physiotherapists in the last 12 months



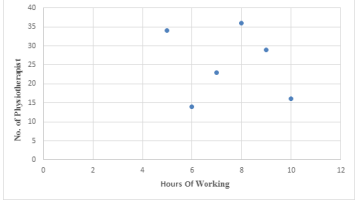
Graph 4

Graph 4 shows the prevalence in 39% suffered from knee pain, 24% suffered from lower back pain, 66% suffered from neck pain, 26% suffered from shoulder pain, 26% suffered from wrist/hand pain, 15% suffered from elbow pain, 58% suffered from upper back pain, 27% suffered from hip/thigh pain and 28% suffered from ankle/foot pain region among physiotherapists which prevented them last 12 months.



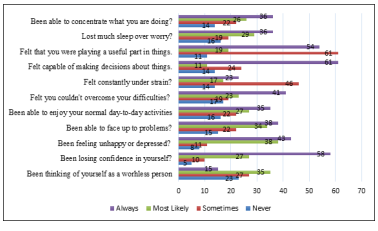
Graph 5

Graph 5 shows the prevalence in 58% are suffered from lower back pain, 34% suffered from knee pain, 67% suffered from neck pain, 26% suffered from shoulder pain, 26% suffered from wrist/hand pain, 25% suffered from elbow pain, 67% suffered from upper back pain, 24% suffered from hip/thigh pain and 46% suffered from ankle/ foot pain region among last 7 days.



Graph 6

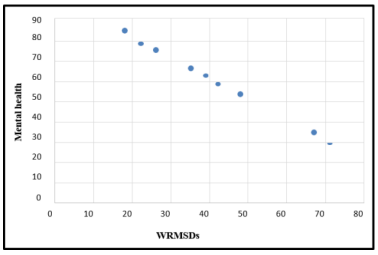
Graph 6 shows that 34 physiotherapist works for 5 hours, 14 works for 6 hours, 23 works for 7 hours, 36 works for 8 hours, 29 works for 9 hours and 16 physiotherapist works for 10 hours per week.



Graph 7

Graph 7 shows the responses of the question asked to the physiotherapist to assess the mental health related to the occupation and workplace with the help of General Health Questionnaire-12 (GH-12)

Graph 8



Graph 8 shows perfect negative correlation of Work-related musculoskeletal disorders and affection of mental health.

DISCUSSION

This study was focused on physiotherapists to investigate the prevalence of Work-related Musculoskeletal Disorders (WRMSDs) and their connection to mental health. It found that many physiotherapists, dealing with patient overload and poor posture, frequently suffer from these disorders, which can also affect their mental well-being. Out of 156 respondents, 102 physiotherapists reported experiencing work-related musculoskeletal issues, resulting in a prevalence rate of 67%. All participants completed standard Nordic Questionnaires and were interviewed about their work hours. Interestingly, despite experiencing WRMSDs, many therapists did not seek treatment, take time off work, or seek evaluation. Most therapists worked 7 hours or more daily, with some making home visits nearby. Female therapists reported more musculoskeletal problems than males, possibly due to their height and leverage issues during manual therapy. The most affected areas were the neck, lower back, and upper back, attributed to handling numerous patients, lifting dependent individuals, and working despite injuries.

The study also examined how these musculoskeletal disorders correlate with mental health, revealing a significant negative impact likely linked to their professional demands. Some therapists had developed coping strategies to manage these challenges. Psychosocial factors were also explored, revealing dissatisfaction with their profession, lack of team cooperation, poor interaction with physicians, and inadequate support from supervisors, although these associations were not statistically strong. Nonetheless, the study confirmed a 67% prevalence of musculoskeletal disorders among physiotherapists. It underscores the importance for physiotherapists to follow ergonomic guidelines, reduce repetitive tasks, or consider alternative treatments to alleviate the effects of WRMSDs.

CONCLUSION

WRMSDs are exacerbated by patient handling and demanding work conditions, not only affect physical health but also impact therapists' mental well-being. Despite the significant prevalence, many therapists do not seek timely treatment or take necessary breaks, potentially exacerbating their conditions. Addressing ergonomic practices, reducing repetitive tasks, and enhancing support systems are crucial steps in mitigating WRMSDs and promoting overall occupational health in the physiotherapy profession.

Limitations

Despite the insightful findings, it is important to acknowledge several limitations in this study Firstly, the relatively small sample size. Other factors not for affection of mental health were not taken into consideration.

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REVIEW ARTICLE Mar-Apr 2020

A critical review on *Karanja* (*Pongamia pinnata*) & its medicinal properties

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ABSTRACT

Karanja (*Pongamia pinnata* Linn.) an ancient plant described in Veda, Samhita, and almost in all Nighantu. Nature has been a good source of medicinal plants since immemorial time and an impressive number of modern drugs have been isolated from plant sources, many based on their use in traditional medicine. *Karanja* has been recognized in Ayurveda - a traditional system of medicine for the treatment of various diseases of human beings. Different parts of this plant are traditionally used for the treatment of various ailments including *Kushta, Arsha, Prameha, Yonidosha,* etc. Despite the overwhelming influences and our dependence on modern medicines and tremendous advances in synthetic drugs, an outsized segment of the planet population still likes drugs of plant origin. Of the 2,50,000 higher plant species on earth, quite 80,000 are medicinal. However, only 7000-7500 species are used for his or her medicinal values by traditional communities. Therefore, the present review study reveals the overall information of *Pongamia pinnata* with various scientifically documented pharmacologically activities, traditional uses along its non-therapeutic importance.

Key words: *Karanja, Pongamia pinnata, Ayurveda.*

INTRODUCTION

Karanja [*Pongamia pinnata*(Linn.) Merr.] is one of the popular and extensively used herbs in Ayurvedic medicine. It belongs to family Fabaceae. The references of *Karanja* are found in Rugveda and Atharvaveda. In Rigveda the term *Karanja* is used as the name of *Rakshasa* (Demon) and in Atharvaveda *Karanja* is used as the Mantra. In Kalpasutra *Karanja* is used as a name of plant.[1]

In Charak Samhita it is quoted for *Dhantadhavan*.[2]

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Karanja is mentioned among the *Kandughna Varga* by Charaka. Sushruta highlighted the utility of *Karanja Taila* in *Krimi, Kushta, Prameha* and *Siroroga* and quoted it as *Kapha-Vathara, Shothahara, Kandughna* (anti-itch) and *Bhedana*.[3]

It contains Karanjin, pongapin, Karanja chromen. It shows antibacterial, hypoglycaemic activity. The essential oil from *P. pinnata* showed mild antifungal activity. Another importance of *Karanja* is because of its oil-containing seeds. The *Pongamia pinnata* seeds contain about 40% oil, which can be converted to biodiesel by transesterification method (Meher *et al.* 2006).

In the present article information on various aspects of *Pongamia pinnata* and its medicinal properties are reviewed.

Vernacular Names

Karanja [*Pongamia pinnata* (Linn.)] is commonly known as Indian beech in English and Dithouriin Hindi, *Karanja* in Sanskrit, Marathi and in Gujrathi, Dahar

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Karanja in Bengal, Pongum in Tamil, Punagu in Telagu.[4]

The plant *Pongamia pinnata* (Linn) is known as *Karanja* because when it grows on the banks of stream imparts bluish color to the water, with flowers scattered there in (*Udakirya*). Which are shaped like a nail (Karaj) or parched paddy (*Lajapushpak*) in bunches (*Gucchapushpak*) and blooming in the night (*Naktamal*). The leaves are glossy (*Snighdhapatra*), the leaves look like they are oozing *Ghruta* (*Ghrutparnak*). The seeds yield oil like ghee (*Ghrutpurna*). It is an effective drug for filaria (*Sleepada*).[5]

Table 1: Showing different synonyms.

Synonyms	Charak [6-11]	Sushrut [12-16]	Vagbhat [17-18]	Bhavprakash [19]
Karanja	+	+	+	+
Karanjika	-	+	+	-
Udakirya	+	+	+	+
Ghrutapoora	-	-	-	+
Chirbilva	+	+	+	+
Putika	+	+	+	+
Putikaranja	-	-	-	+
Naktamala	+	+	+	+
Naktahwa	-	-	+	-
Prakirna	+	+	+	+
Sharangeshta	-	+	-	-
Somavalka	-	-	-	+

Botanical Description

It is a medium-sized glabrous almost evergreen tree, growing up to 18m height and 1.5m in girth.

Leaves: 8-10inch long, pale green, imparipinnate; leaflets 5-7, oblong or ovate, obtuse or shortly acuminate, 2-4-inch-long, sub coriaceous, midrib and lateral nerves rather prominent beneath.

Flowers: in simple peduncle axillary racemes nearly as long as the leaves; nodes tumid bearing 2-4 pedicels; rachis and pedicels sparsely puberulous; pedicels with 2 bracteoles at the base and with 2 others, towards the apex. Calyx widely campanulate, mouth truncate. Corella ½ inch or less, white tinged with violet or pink; standard orbicular, silky on the back, subcordate and2 auriculate at the ace. The ovary is finely pubescent.

Fruit: Pod 1 ½ -2inch long, with a short decurved point, turgid, woody, glabrous, brownish-green, 1-rarely 2-seeded.

Seeds: 1-2, elliptic or reniform, wrinkled, white, marbled with brownish lines.

Bark: Thin grey to greyish brown and yellow on the inside.[20]

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Distribution

This tree is found all over India, up to an altitude of 1200m. Commonly found in the coasts of South India and also found in river banks, Central eastern Himalayas and its foothills (Shivalik and Others).[21]

Classical References

- In Rugveda the term *Karanja* is used as the name of the *Rakshasa*. In Atharva Veda, *Karanja* is used as the Mantra.
- In Kalpasutra, *Karanja* is used as the name of the plant.
- In Kouthumgruhyasutra Samhita stated that *Karanja* should not be used in Yagnya and it is also mentioned that this is useful in Dantadhavan.[22]
- Depending upon the drug origin, morphology, property, pharmacodynamics, and therapeutics values, the ancient text has classified the drugs into *Mahakashaya, Gana, Varga* and *Skanda*.

Samhita	Gana/Varga
Charak Samhita	*Kandughna Mahakashaya* *Virechan Dravya* *Snehayoni* *Katu Skandha* *Tikta Skandha*[23]
Sushruta Samhita	*Tikta Skandha* *Kapha Samshaman Varga* *Aaragvadhadi* *Varunadi* *Salsaradi* *Arkadi* *Shyamadi* [23]
Ashtanga Hrudaya	*Vamana Dravya* *Kapha Samshaman Dravya* *Aargvadhadi* *Varunadi* *Arkadi*
	Shyamadi [17],[18],[24],[25]

- Almost all the Nighantu have mentioned *Karanja* in there text.

Text	Varga
Bhavprakash Nighantu	*Guduchyadi Varga* [19]
Dhanvantari Nighantu	*Aamradi Varga*[26]
Madanpal Nighantu	*Vatadi Varga*[27]
Kaiydev Nighantu	*Aushadhi Varga*[28]
Shodhal Nighantu	*Aamradi Varga*[29]
Raj Nighantu	*Prabhadradi Varga*[30]

Chemical Constituents

The plant *P. pinata* has been subjected to chemical investigations extensively and several chemical constituents belonging to the different groups, viz. alkaloids, tannins, glycosides, steroids, saponins, flavonoids have been reported. The plant mainly contains alkaloids, protein, fatty oil, tannins, and a mixture of fatty acids.

Phyto-chemistry

a) Contents of Seeds[31-32]

Component	Percentage
Fatty oil	27.5%
Protein	17.4%
Starch	6.6%
Crude fiber	7.3%
Moisture	19%
Ash	2.4%

- Alkaloids demethoxy-kanugin
- Gamatay
- Glabrin
- Glabrosaponin

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- Kaempferol
- Kankone
- Kanugin
- Karangin
- Neoglabrin
- Pinnatin
- Pongamol
- Pongapin
- Quercitin
- Saponin
- β-sitosterol
- Tannin

b) Contents of Bark[33]

- Contains a bitter alkaloid
- Resin
- Mucilage
- Sugar

From the stem bark of *Pongamia pinnata*, two new compounds

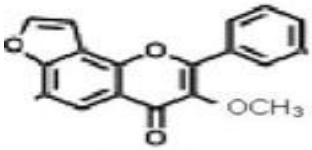
- 3-methoxy-(3,4-dihydro- 3-hydroxy-4-acetoxy)-2,2-dimethylpyrano- (7,8:5,6)-flavone
- 3-methoxy-(3,4-dihydro-4- hydroxy-3-acetoxy)-2,2-dimethylpyrano-(7,8:5,6)-flavone
- Caryophyllene oxide
- Obovatachalcone
- 8-hydroxy-6-methoxy-3-pentyl-1Hisochromen-1-one,6,7,2,2- dimethylchromono-8
- Dimethylallylflavanone
- Isolonchocarpin
- Ovaliflavanone A

c) Contents of Leaves[34]

- Alkaloids
- Carbohydrates
- Phytosterols
- Saponins
- Tannins
- Flavonoids

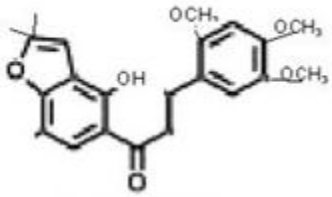
d) Contents of seed oil[35-37]

- Karanjin ($S_{18}H_{12}O_4$),



karangin

- Pongamol
- Pongapin
- Kanjone
- Glabrachalcone



Glybanchalcone

Folk Medicine

According to Hartwell (1967–1971), the fruits and sprouts are used in folk remedies for abdominal tumors in India, the seeds for keloid tumors in Sri Lanka, and a powder derived from the plant for tumors in Vietnam.

In India, seeds were used for skin ailments. Today the oil is used as a liniment for rheumatism. Leaves are active against *Micrococcus*; their juice is used for colds, coughs, diarrhea, dyspepsia, flatulence, gonorrhea, and leprosy. Roots are used for cleaning gums, teeth, and ulcers. The bark is used internally for bleeding piles. Juices from the plant, as well as the oil, are antiseptic. It is said to be an excellent remedy for the itch, herpes, and pityriasis Versicolor.

Powdered seeds are valued as a febrifuge, tonic, and bronchitis and whooping cough. Flowers are used for diabetes. Bark has been used for beriberi. Juice of the

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root is used for cleansing foul ulcers and closing fistulous sores. Young shoots have been recommended for rheumatism.[38]

Pharmacological Activity

- Anti-plasmodial activity - *Pongamia pinnata* shows anti-plasmodial activity against Plasmodium falciparum (Simonse et al. 2001).[39]
- Anti-inflammatory activity - It shows anti-inflammatory activity against different phases (acute, sub-acute and chronic) of inflammation was reported by the 70% ethanolic extract of *Pongamia pinnata* leaf (Srinivasan et al. 2001).[40]
- Anti-Microbial Effect - The anti-microbial effect of crude leaf extract of P. pinnata evaluates its effect on the production and action of enterotoxins. Its extraction has o anti-bacterial, anti-giardia, and anti-rotaviral activities but reduces the production of cholera toxin and bacterial invasion to epithelial cells. This indicates that the extraction of *Pongamia pinnata* has selective anti-diarrhoeal action with efficacy against cholera (Brijesh et al. 2006).[41]
- Anti-oxidant activity - P. pinnata leaf extracts show circulatory lipid peroxidation and antioxidant activity. It has been evaluated in ammonium chloride-induced hyper ammonium rats. That enhanced lipid peroxidation in the circulation of ammonium chloride-treated rats, resulting ina significant decrease in the levels of vitamin A, C, E which further reduces catalase glutathione, glutathione peroxides and superoxide dismutase (Essa and Subrahmanian.2006).[42]
- The methanolic extract of P. pinnata roots showed significant protection against aspirin and tends to decrease acetic acid-induced ulcer after 10 days of treatment. Having augmentation of mucosaldefensive factors like – mucin secretion, the life span of mucosal cells, mucosal cell glycoprotein's, cell proliferation and prevention oflipid peroxidation, the extract also shows ulcers protective effect (Prabha et al. 2003).[43]
- The oral administration of ethanolic extract of *Pongamia pinnata* flower shows significant anti-hyperglycemic and anti-lipid peroxidative effect and also enhance the antioxidant defense system in alloxan-induced diabetic rats. Hence suggestive that the treatment of P. pinnata extract could be used as a better and safe alternative anti-hyperglycemic drug for diabetic patients (Punitha and Manoharan, 2006).[44]

Ayurvedic Properties and Pharmacological Effect

Almost all the Aacharya have opined the properties of *Karanja* is *Tikta* (bitter), *Katu* (pungent) *Kashaya* (astringent) in *Rasa* (taste), *Laghu* (light) and *Tikshna* (sharpness) in *Guna* (properties), *Ushna* (hot) in *Virya* (potency) and *Katu* (pungent) in *Vipaka* (metabolism).

Due to these properties, it alleviates *Vata* & *Kapha Dosha.*

Author	*Rasa*	*Guna*	*Veerya*	*Vipaka*
C.S.[9]	*Tikta, Katu.*	-	*Ushna*	*Katu*
S. S.[45]	*Katu*	*Laghu Tikshna*	*Ushna*	*Katu*
B.N.[46]	*Katu*	*Tikshna*	*Ushna*	-
R.N.[30]	*Katu*	*Snigdha*	*Ushna*	-
K.N.[28]	*Katu,Tikta Kashaya.*	*Tikshna*	*Ushna*	*Katu*

The pharmacological effects of *Karanja* are *Kapha-Vathara, Shothahar* & *Bhedana*. It cures *Kustha* (skin diseases), *Arsha* (hemorrhoids), *Krimi* (worm infestation), *Visha* (Poisoning), *Kandu* (itching), *Yoniroga* (vaginal disease), *Apasmara* (epilepsy), *Unmada* (Insane), *Urusthamba* (wryneck), *Udawarta*, *Meha* (Urinary disorder), *Shiroroga* (Head diseases), *Indralupta* (alopecia), *Shleepad* (filariasis), *Hrudroga* (heart disease), *Gulma* (Tumours).[47]

Useful Parts[47]

Root

Bark

Leaves

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Seed

Steam Bark

Twigs (as toothbrush)

Seed oil

Dose[47]

Fresh juice 10-20ml,

Seed Powder 1-3gm,

Bark powder 3.5gm.

Therapeutic Uses

- In *Granthivisrpa* paste of *Karanja* bark may be applied locally.[48]
- *Karanja* leaves are fried in *Ghruta* and made it into powder. This powder is administered along with *Saktu* for *Anuloman*.[49]
- *Karanja* fruit mixed with *Saindhav, Danti, Marich, Pippali* and powdered it. This powder used in *Kushta* for *Nasya*.[50]
- *Karanja Patra* can be used for *Pradeha* in *Kushta*.[50]
- *Kasis* and tender leaves of *Karanja* pounded with the juice of *Kapitha* is useful in *Romasanjanan*.[51]
- Seed powder of *Karanja* should be given with sugar and honey in *Raktapitta*.[52]
- *Yavagu* prepared along with *Kwath* of leaves of *Karanja* is administered for all types of *Chardi*.[53]
- *Karanja* along with *Haritaki*, *Vidang, Sidharthak, Bakuchi, Haridra* is used for *Lepan* in *Kushta*.[54]
- *Karanja Taila* should be applied in *Vrana* due to *Kushta*.[55]
- For *Vrana Prakshalan Karanja* fresh juice can be used.[56]
- *Karanja* along with *Gomutra* should be used for *Lepana* in *Urusthamba*.[57]
- Tender leaves of *Karanja* fried in the mixture of oil and *Ghruta* and added with parched grain flour should be given. It acts as carminative and laxative.[58]
- The alkali of *Karanja* decanted with sour gruel etc. and added with *Bida* and *Pippali* powder should be used for splenomegaly.[59]
- In Pterygium after removing the bandage on the third day, it should be sprinkled with milk processed with *Karanja* Seed.[60]
- In Scorpion sting, the flowers of *Karanja*, *Arjun*, *Shleshmatak, Katabhi, Kutaj* and *Shirish* mixed with cured are applied as a paste on the spot.[61]

Non-Therapeutic Uses[62]

- The Pongamia tree is cultivated for two purposes, as an ornamental in gardens and along avenues and roadsides for its fragrant flowers and as a host plant for lac insects.
- Well decomposed flowers and leaf letters are used by gardeners as compost for plants requiring rich nutrients. The bark is used for making strings and ropes.
- The leaves are said to be a valuable lactagogue fodder, especially in arid regions. It is sometimes intercropped with pasture, the pasture grasses said to growwell in its shade.
- Dried pongam leaves are used in stored grains o repel insects. Leaves often ploughed green manure, thoughts to reduce nematode infestations.
- The wood is yellowish-white, coarse, hard and beautifully grained, but is not durable. The use of wood islimited to cabinet making, cartwheels, posts, and fuel.
- The seeds contain pongam oil, bitter, red-brown, thick, non-edible oil, which is used for tanning leather, soap making.
- Both the oil and residues are toxic. Still the press cake is described as a useful poultry feed.
- As a Source of Biodiesel - Biodiesel is expanding at a very rapid rate because of increasing demand, necessary policy support, and technological availability. India consumes approximately 40 million tons of biodiesel and ranked fifth in the

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world after the US, China, Russia and Japan in terms of fossil fuel consumption. Recently, the Government of India launched "National Mission on Bio-diesel" with a review to find a cheap and renewable liquid fuel based on vegetable oils. Biodiesel fuel can be defined as medium length (C16 ± C18) chains of fatty acids and is comprised mainly of monoalkyl fatty acid esters. It has the benefits of being non-toxic, biodegradable, and essentially free of sulfur and carcinogenic ring components (Yamane *et al.* 2001).

- The *Pongamia pinnata* is known for its multipurpose benefits and as a potential source of biodiesel (Naik et al. 2008).

Toxicity[63]

LD_{50} for Karanjin was found to be 14.32mg/kg and of pongamal 17.14mg/kg body weight. The pure oil did not show lethal effect even at 20ml/kg body weight. *Karanja* Oil is found to be most toxic and it is prepared to have an adverse effect on the body of mice. Karanjin and de-Meo-Karanjin are also reported to be toxic compounds.

CONCLUSION

Pongamia pinnata (*Karanja*) is one of the most important medicinal plants used in medicines of Ayurveda because of having several pharmacological as well as therapeutic properties and Industrial uses. Traditionally, this plant is used to treat a huge variety of health problems. The present review indicates the importance of Karanja as one of the important medicinal plants described for its pharmacological actions and indications in the Ayurvedic lexicons. The various researches have proved many of its activities mentioned in Ayurvedic classics and demonstrate its effective use in various diseases. The plant is widely studied for the subject of biodiesel. Although the results from this review are quite promising for the use of *Karanja* as a multi-purpose medicinal agent, several limitations currently exist in the current literature. While *Karanja* has been used successfully in Ayurvedic medicine for centuries, more clinical trials should be conducted to support its therapeutic use.

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A comparative pharmacognostical and prilimary phytochemical evaluation of *Bharangi* (*Clerodendrumserratum* (Linn) Kutz. and *Tarkari* (*Clerodendrum phlomidis* (Linn.) f. –root

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Abstract
Ayurveda describes numerous drugs in classics. *Bharangi* is very important drug describe in various classics of Ayurveda. Which is widely used in *Shwasa*, *Kasa*, *Granthi*, *Shotha* etc diseases. Due to increased demand of *Bharangi*, it is adulterated by different plant. Thus, substitution of this plant is necessary. The drugs which have similar morphology and property are included in same family. *Acharya Bhavprakash* said that if two drugs having similar *Rasapanchaka* then one can takes as alternative of original source. Here, both drugs are used broadly in clinical practise. *Clerodendrum phlomidis* (Linn) F. used for *Meda*, *Shopha*, *Shwayathu*, *Shwas*, *Kasa*, *Pratishyay* etc. Root of both drugs have been used. Consequently, *Clerodendrum serratum* L. and *Clerodendrum phlomidis* L. both drugs belong to the same family i.e. Lamiaceae and similar *Rasadipanchaka*. Therefore, it may be *Clerodendrum phlomidis* L. used as a substitute of *Bharangi*. The study includes comparative investigations macro and microscopic characters, preliminary phytochemical analysis, physicochemical parameters and HPTLC fingerprinting of both sample drugs. Based on present phytopharmacognostical study *Clerodendrum serratum* (Linn) kutz. may be used in the scarcity of *Clerodendrum phlomidis* (Linn) F.

Keywords: lamiaceae, clerodendrum serratum (linn) kutz, clerodendrum phlomidis (linn) f, pharmacognosy, prilimary phytochemical investigation, HPTLC

Introduction

Bharangi and *Tarkari* both drugs are mentioned in Ayurvedic classics. Botanical source of *Bharangi* is *Clerodendrum serratum* (Linn) kutz. and *Tarkari; Clerodendrum phlomidis* (Linn) F. according to standard references of API and database on medicinal plants belonging to the same family Lamiaceae and genus [1]. The blue flowered shrub *Bharangi* is grown in lower Himalaya from Kumauni eastwards and west Bengal, Bihar up to an altitude of 1200m. It is Reported to be rare and endangered in Gujrat.[2] Traditionally root, leaves and seed used for bronchitis, Asthma, wound, Blood purifier etc.[3] A large shrub or small tree of *Clerodendrum phlomidis* L. is distributed throughout the India, in sub-Himalaya tracts of Bihar, Gujrat, Konkan, Kolkata etc. *Bharangi* is broadly used for *Shwasa*, *Kasa*, *Jwara*, *Sotha*, *Vataja Granthi*, *Kaphaja Granthi*, *Raktagulma* etc [4, 5, 6]. While *Tarkari* is useful *Shwasa*, *Kasa*, *Jwara*, *Shwayathu*, *Medohara* etc [7]. Both plants used individually as well as in formulations. *Bharangi* root used for *Shwasa*, *Kasa* etc. *Tarkari patra* used as vegetable, external *lepa* etc [8]. Root *lepa* also done in inflammatory condition [9]. *Bharangi* is highly valued and important ingredient of many popular Ayurvedic formulations like *Bharangyadi leha*, *Kankasava*, *Dahmula-arista*, *Dashmula kwatha*, etc. *Tarkari* as ingredient of *Narayana Taila*, *Varunadi Kwatha*, *Vyaghriadi Kashaya* etc. Due to increased demand of *Bharangi*, there is concerning reduction in availability, it is adulterated by other spurious, inferior, defective, spoiled, useless other parts of same or different plant [10]. *Tarkari* and *Bharangi* both are belonging from same family and genus and classically also having similar *Rasadipanchaka*. Accordingly, *Tarkari* is may be used in place of *Bharangi*. The present study includes macro and microscopic characters, preliminary phytochemical analysis, physicochemical parameters and HPTLC fingerprinting of both plants root.

Materials and Methods

Collection and authentication of plant materials

The root of *C. serratum* were collected from Lumbini Bhesaj Udyan, Sri Nrusinghnath Ayurveda College & Research Institute, Paikmal, Odisha and *C. plomidis* roots were collected from hathijana Ahmedabad, Gujarat in January 2019. Both sample were identified by local vaidya and taxonomist and confirmed by studying the morphological characters comparing them with various characters described in different floras and books [11]. Both

specimens were authenticated by pharmacognosist. Herbarium of the samples has been deposited to institute's pharmacognosy laboratory and provided with authentication number (specimen no. phm/6291/18-19 & phm/6292/18-19)

Pharmacognostical studies

The macroscopy and microscopy of both the roots were studied as per standard procedures. Thin free hand transverse section of both the roots were observed under the microscope to evaluate microscopic characters. Photographs of the section were taken with the help of Quasmo binocular compound microscope in pharmacognosy laboratory. Powders (80#) of leaf was studied for organoleptic and microscopic characters after proper mounting and staining with different reagents [12].

Physico-chemical analysis

Organoleptic examination, macro, microscopy, and physicochemical studies, viz., Ash value, water-soluble ash, water and alcohol soluble extractive value, pH value, loss on drying at 110 C as per standardized methods.[13]

Phytochemical analysis

Qualitative analysis was performed to detect primary and secondary metabolites in water and alcohol extracts of leaf. Tests for carbohydrates, protein, amino acid, steroids, glycosides, saponins, alkaloids, tannins and flavonoids, [14, 15]

HPTLC study

Methanolic root extract of *C. serratum* and *C. phlomidis* were exposed to HPTLC study. The solvent system used for the study is toluene: Formic acid (7:3:0.3) Chromatographic conditions: Application mode was Camag Linomat V, Development Chamber used was of Camag Twin trough Chamber. Precoated Silica Gel GF254 Plates were used. Chamber saturation was done for 30 min and development time was 30 min. The plate was scanned in Camag Scanner III with Deuterium lamp, Tungstan Lamp as detectors and Wincats software was used for data analysis.

Results and Discussion

Morphology

Bharangi (*Clerodendrum serratum* L.) and *Tarkari* (*Clerodendrum phlomidis* L.) both the species had *Katu, Tikta Rasa* according to most of the nighantus. Colour whitish brown in *Clerodendrum serratum* L. and creamish yellow in *Clerodendrum phlomidis* L. and both perceived aromatic odour. Based on the morphology and microscopical study done by pharmacognostical methods

Microscopic characters

Transverse section of *Clerodendrum serratum* (Linn) kutz. (Fig. 1c to 1h)

The diagrammatic section of the root shows, outermost cork followed with cortex, phloem and central xylem. Details section shows cork consisting of 10-12 layers of thin walled tangentially arranged cells having wavy radial conjoining cell walls at places. Outermost layers observed with dark brown color, while the inner layers with alteration of lignified and simple cork tissues. Cortex appearances broad cortical zone made up of roundish to oval thick walled parenchymas. Stone cells and sclereids found scattered either isolated or in groups. The phloem composed of sieve tubes with compound sieve plates, companion cells, phloem rays and parenchyma. Xylem occupies almost ample central area and consists of vessels, tracheids, fibers, xylem rays and xylem parenchyma. Medullary rays bi to multi seriated. Prismatic and acicular crystals of calcium oxalate and simple and compound starch grains with hilum found throughout the section.

Transverse section of *Clerodendrum phlomidis* (Linn) F. (Fig. 2c to 2h) The diagrammatic section of the root shows, outermost cork followed with cortex, phloem and central xylem. Details section shows Cork consisting of 15-20 layers of thin walled tangentially arranged cells having wavy radial conjoining cell walls at places. Cortex demonstrations broad cortical zone made up of roundish to oval thick walled parenchyma embedded with prominent layer of Stone cells and sclereids especially three-sided thickened stone cells and sclereids found scattered either isolated or in groups almost filled with prismatic crystals of calcium oxalate. The phloem composed of sieve tubes with compound sieve plates, companion cells, phloem rays and parenchyma encircling central xylem. Xylem occupies central area and consists of vessels, tracheids, fibers, xylem rays and xylem parenchyma. Medullary rays mostly biseriated. Prismatic and acicular crystals of calcium oxalate and simple and compound starch grains with hilum found throughout the section.

Organoleptic characters and microscopic particulars:

***Clerodendrum serratum* L. Root:** powder was whitish brown in colour, bitter taste, strong aromatic odour and fibrous in touch. (Fig. 3a)

The presence of simple and compound starch grain, prismatic & acicular crystal, bordered pitted vessel, simple & compound starch grain with hilum, stone cell & sclereid and group of fibers observed during the powder microscopy of *Clerodendrum serratum* L. (Fig. 3b to 3j)

Clerodendrum phlomidis L. Root: powder was Creamish yellow in colour, astringent taste, Aromatic odour and fibrous in touch. (Fig. 4a)

Powder microscopy of *Clerodendrum phlomidis* L. found Starch grains, Prismatic crystals, Pitted vessel, Bordered Pitted vessel, fibers, Stone cells and sclereid, brownish coloured cork cell in surface view was observed. (Fig. 4b to 4j)

The study reveals that both the species shows almost similar characters. However, it can be differentiated by some characters. Macroscopically, the colour, size, and shape of

the roots are the only the differentiating characters of the both species. Differentiating key characters of both species observed as, in *Clerodendrum serratum* L. bi-multi seriated medullary rays, bordered pitted vessel and simple & compound starch grains with hilum while mostly bi-seriated medullary rays, simple & compound starch grains pitted vessel in *Clerodendrum phlomidis* L. root. The peculiar character like, three-sided thickened stone cells & sclereids was observed only for *Clerodendrum phlomidis* L. root. Starch grains, Prismatic crystals, Bordered Pitted vessel, fibers, Stone cells and sclereid were observed commonly in both the species root powder.(Fig. 3&4)

Phytochemical analysis

All the physicochemical analysis except Loss on drying were comparatively within negligible limits. Loss on drying in raw sample of *Clerodendrum serratum* (Linn) Kutz. Root was found 6.25%w/w. Which is significantly more than that of *Clerodendrum phlomidis* (Linn) F. (3.97%w/w) sample. It is suggested that *Clerodendrum serratum* (Linn) Kutz. Root having more water content than other sample of *Clerodendrum phlomidis* (Linn) F. (Table 2) Preliminary phytochemical analysis revealed that the presence of metabolic like glycoside, carbohydrates, steroids, flavonoids and tannins in both the samples while alkaloids, protein, amino acids and saponins are absent. (Table 3)

HPTLC profile

The observations are tabulated in table 4. At 254nm; root of *Clerodendrum serratum* L. found 14 spots where as 8 spots in case of *Clerodendrum phlomidis* L. respectively. *Clerodendrum serratum* L. root found 7 spots and also *Clerodendrum phlomidis* L. found 7 spots at 366 nm. Similar spots of Rf values 0.09 and 0.43 were detected in both the samples (Fig5). Common R_f values like 0.09 and 0.30 at 254nm, 0.09, 0.30 and 0.43 at 366 nm while 0.09 and 0.30 were found for both the samples at both the wavelengths observed similar indicating the presence of analogous type of components in both the species.(Fig. 5) This indicates the presence of same common chemical components as per the observed spots in different wavelengths like visual, 254nm and 366nm respectively, areas and graphical curves. This similarity might be present due to same family or genus of the plant materials. (Table 4)

Table 1: Macroscopic character of *C. serratum* and *C. phlomidis* Root (fig. 1a, 1b and 2a, 2b)

Average length	2 cm to 4 cm	8 cm to 10 cm
Touch	smooth or longitudinally striated or wrinkled, older somewhat rough	root bark thin, easily peal-able, tough, rough due to exfoliation, longitudinal striated in old one
Colour	Externally pale reddish brown easily peal-able outer skin, Internally yellowish brown	light brownish ashy in colour, inner surface whitish- yellow
Odour	Aromatic	Aromatic
Taste	Bitter, Astringent	Astringent
Fracture	Short	Hard with sound, Fibrous

Table 2: Physicochemical parameters of *C. serratum* and *C. phlomidis* root powder

Sr. no	Physico -chemical Parameters	*C. serratum* L	*C. phlomidis* L
1	Loss on drying(%w/w)	6.25	3.97
2	Ash Value(%w/w)	2.10	2.62
3	Water soluble extract(%w/w)	18.68	18.28
4	Methanol soluble extract (%w/w)	16.6	15.24
5	pH	6.2	6.5

Table 3: Result of qualitative tests of methanolic extract of *C. serratum* and *C. phlomidis* root.

Sr. no	Active constituent	Test	*C. serratum* L	*C. phlomidis* L
1	Alkaloids	Dragendorff's test	-	-
2	Steroids	Salkowaski reaction	+	+
3	Amino acids	Ninhydrin test	-	-
4	Carbohydrates	Molisch's test	+	+
5	Flavonoids	Lead acetate	+	+
6	Tannins	Lead acetate	+	+
7	Glycosides	Keller Killiani test	+	+
8	Saponins	Foam test	-	-

"+": Positive, "-": Negative

Table 4: HPTLC analysis of methanolic extract of *C. serratum* and *C. phlomidis* root.

Sample	Solvent system	254 nm (Short UV)		366 nm (Long UV)	
		No. of spots	Rf values	No. of spots	Rf values
C. serratum L	Toluene: Ethyl acetate: Formic acid (7:3:0.3)	14	0.02, 0.09, 0.15, 0.22, 0.31, 0.39, 0.45, 0.54, 0.61, 0.67, 0.72, 0.84, 0.91	7	0.02, 0.09, 0.24, 0.31, 0.36, 0.43, 0.61
C. phlomidis L		8	0.03, 0.10, 0.16, 0.30, 0.52, 0.70, 0.83, 0.90	7	0.2, 0.09, 0.14, 0.30, 0.43, 0.42, 0.84

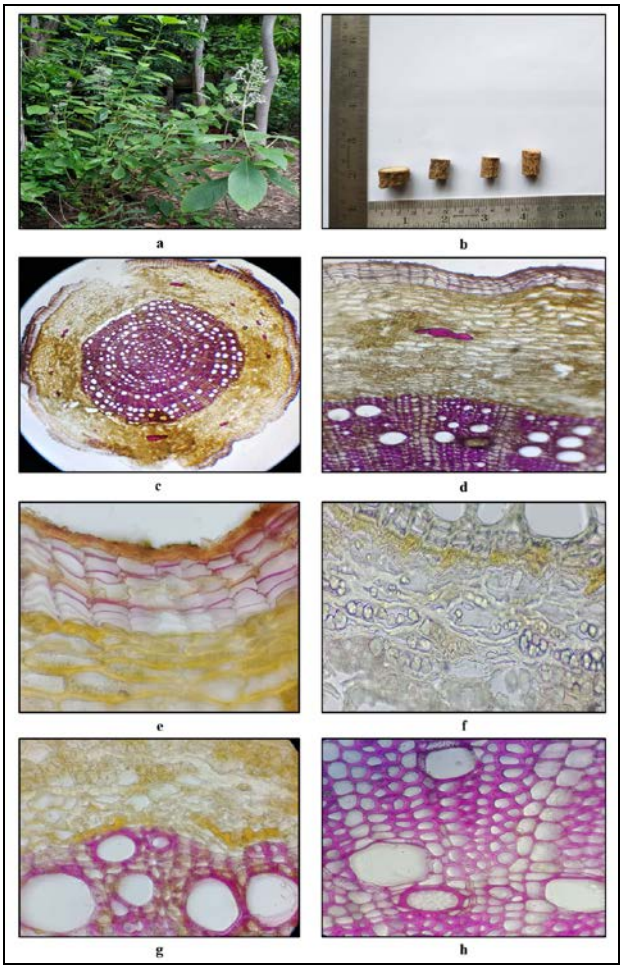

Fig 1: Macroscopic and study of C. serratum L.

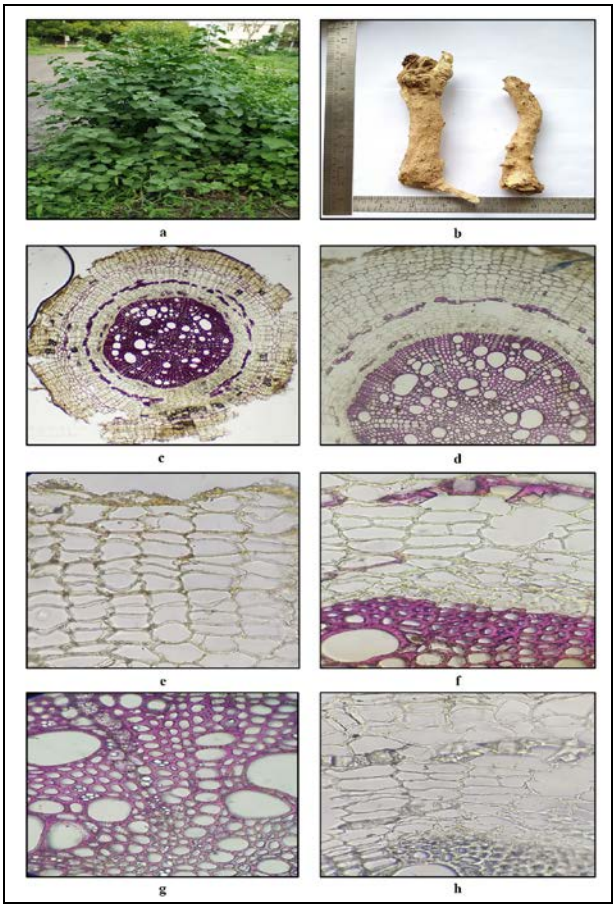

Fig 2: Macroscopic and Microscopic Study of C. Phlomidis L.

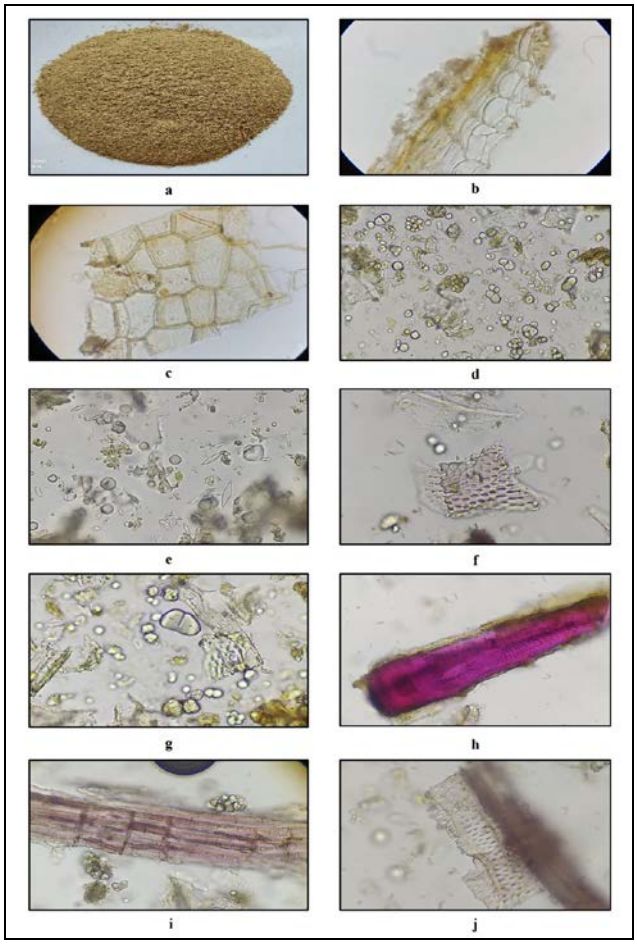

Fig 3: Powder Macroscopy and Microscopy of C. serrratum L.

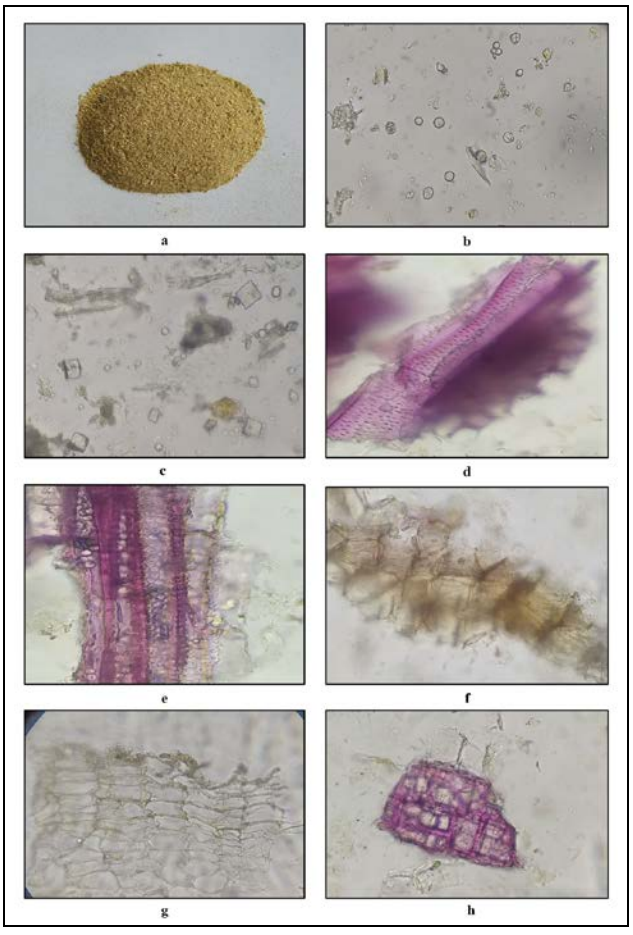

Fig 4: Powder Macroscopy and Microscopy of C. phlomidis L.

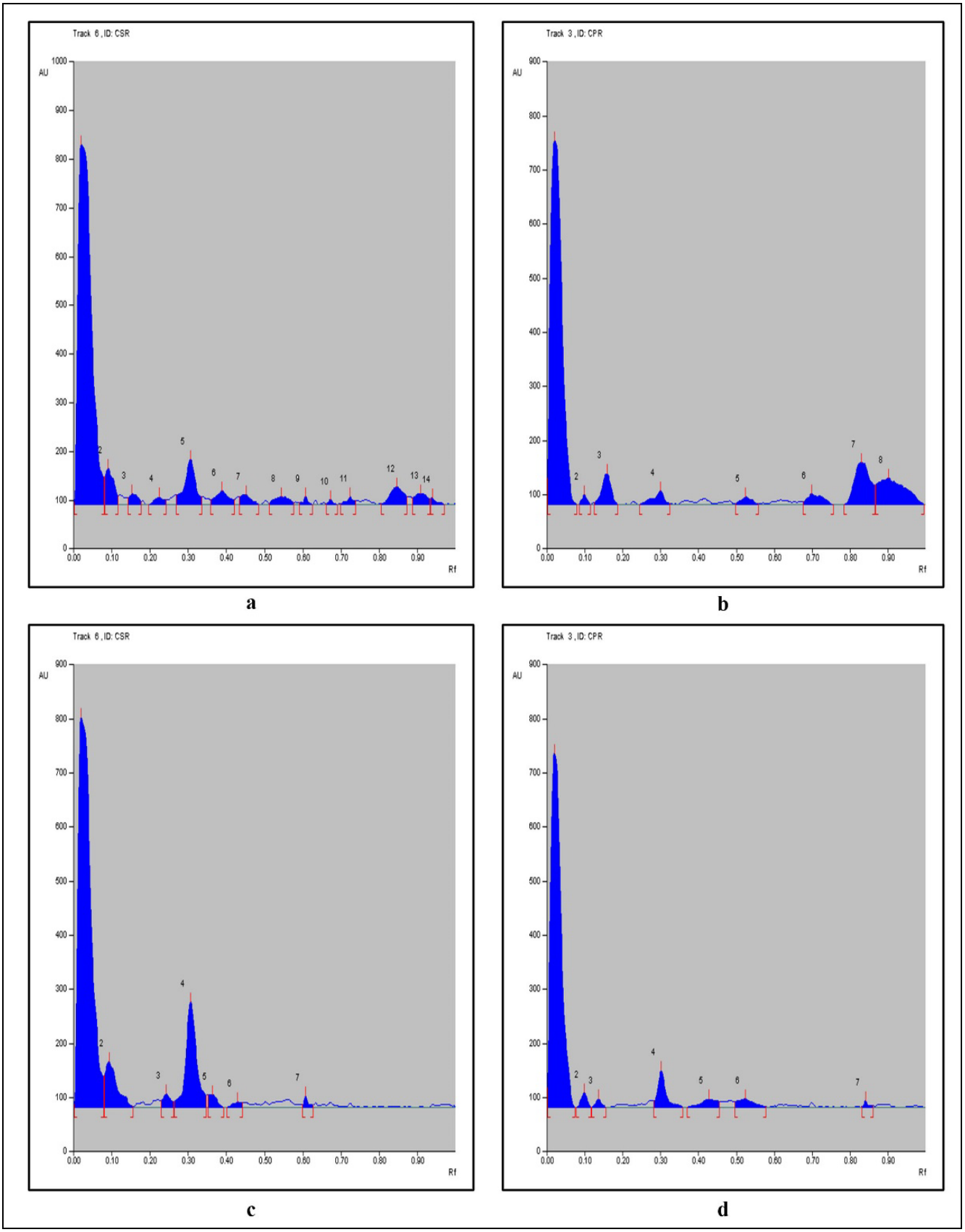

Fig 5: Densitometry chromatogram of C. serratum L. and C. phlomidis L. at 254 and 366 nm.

Conclusion

Bharangi is *Clerodendrum serratum* (Linn) Kutz. And *Tarkari; Clerodendrum phlomidis* (Linn) F. according to standard references API and database on medicinal plants belonging to the same genus and family Lamiaceae. According to conducted study of both plants, concluded that both the species shows the same *Katu, Tikta Rasa*. Both the plants have virtually similar morphological and microscopical characters as observed in pharmacognostic study. Consequently, it can be decisively concluded that *Clerodendrum phlomidis* (Linn) F. may be used in the scarcity of *Clerodendrum serratum* (Linn) Kutz. Based on

performed pharmacognostical study and physico-phytochemical study.

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A CLINICAL STUDY ON TAMAKA SHWASA (BRONCHIAL ASTHMA) AND ITS MANAGEMENT WITH DEVADARVYADI KWATHA AND VASADI KWATHA

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ABSTRACT

Background: - *Tamaka Shwasa* is a chronic inflammatory disorder of the lung airways. The current suffering population is looking hopefully towards *Ayurveda* for better life. *Ayurveda* has number of formulations to treat *Tamaka Shwasa* with route eradication and is in practice with proven efficacy. **Aims: -** To evaluate the efficacy of *Devadarvyadi Kwatha* and *Vasadi Kwatha* in the management of *Tamaka Shwasa*. **Material and Methods: -** 30 patients were registered into two groups; Group A was treated with *Devadarvyadi Kwatha*, while Group B was with *Vasadi Kwatha* at dose of 40 ml twice a day for the duration of 28 days. Follow up was done after 14 days. The results were assessed in terms of clinical recovery, symptomatic relief, and pulmonary function improvement. Effect of the treatment was assessed based on subjective and objective parameters. **Results:-** Significant improvement was observed in most of the cardinal and associated symptoms. Significant increase in peak expiratory flow rate, and increased E.S.R., decreased frequency of attacks, improved quality of life were the major observations noticed in both groups. **Conclusions: -**This study highlights the significance of traditional herbal formulations in *Tamaka Shwasa*, which can be used as an effective drug in place or along with modern drugs.

KEYWORDS: - *Tamaka Shwasa*; Bronchial Asthma; *Devadarvyadi Kwatha; Vasadi Kwatha.*

INTRODUCTION

According to WHO Asthma is one of the major non communicable diseases. It is a chronic disease of the air passage of the lungs which inflames and narrows them. Around 235 million people currently suffer from Asthma worldwide. It is common disease among children. Most Asthma related deaths occur in low and lower middle income countries.[1]

With the explosion of the knowledge in the 21st century a new concept of multi factorial causation of disease has arisen due to changing pattern of life styles, living standards, demographic factors, urbanization, over growth of industrialization and auto mobilization. Health emerges from highly complex interaction between factors intrinsic to the patient and environment. In today's environment there is so much pollution, which cannot be avoided because it mostly produced by vehicles and industries. This environment interaction is leading to many respiratory disorders among which one of the major distressing disease is Asthma which has been described in *Ayurveda* as *Shwasa.*

Devadarvyadi Kwatha[2] and *Vasadi Kwatha*[3] are herbal medicinal combinations used commonly in the treatment of various disease of *Pranavaha Srotodushti.* By looking at the individual herbal constituents and their pharmacological action as mentioned in Ayurvedic texts, it appears that these combinations should be very effective in combatting the attack of *Tamaka Shwasa.* Therefore in the current study it has been planned to evaluate clinical efficacy of *Devadarvyadi Kwatha* and *Vasadi Kwatha* in treatment of *Tamaka Shwasa.*

MATERIAL AND METHODS

- **Source of data**

30 patients were randomly selected irrespective of their age, sex, religion, occupation etc. from the OPD and IPD of Govt. Akhandanand Ayurved Hospital. The study obtained Institutional Ethics Committee clearance (No. college 94 dated 01/08/2018) and registered at Clinical Trial Registry of India (CTRI/2019/06/019643). A written informed consent from each patient was taken before enrolling in the clinical trial.

- **Inclusion criteria**

Patients with minimum symptoms like *Kasa, Kanthodhwansa, Kapha Nishthivanam, Pinasa, Shayane Shwasa Pidita, Asino Labhate Saukhyam, Ushna Abhinandaitam* with aged between 20 to 65 years and less than 10 years of chronicity of *Tamaka Shwasa* were selected.

- **Exclusion criteria**

The patients having asthma due to cardiac pathology and associated with complications like Tuberculosis, corpulmonale, Emphysema, malignancy and tumour, Hypertension, Diabetes Mellitus, and any other diseases which lead to fatal conditions had been excluded and also pregnant and lactating mothers were excluded.

- **Withdrawal criteria**

Patients with severity of more than 2 attacks per day had been withdrawal, Constant fatigue, Increased mucus production, Pneumonia, Severe chest pain, Underperformance or absence from work, Leading to other problem such as high blood pressure.

If patient would suitable as per inclusion criteria and already taking modern medicine then 2 weeks of wash out period had been given.

- **Investigation**

Blood: Hb%, differential count (Neutrophil, Eosinophils), erythrocyte sedimentation rate and pulmonary function test were carried out.

- **Diet**

Patients were advised to avoid causes and aggravating factors such as curd, cold drinks, fish and meat, tobacco chewing and smoking, alcohol, excessive physical work, day sleep, and exposure to dust, smoke, pets, and pollens. Patients were advised to use lukewarm water after meal and at bed time. They were also advised for light diet, breathing exercises such as *Pranayama*, use of mask while working, to avoid exposure to dust and smoke, etc.

- **Study design**

30 patients suffering from *Tamaka Shwasa* of either sex between the age group of 20 to 65 years were selected for the study. A special proforma was prepared with all points of history taking, physical signs and symptoms and laboratory investigations to confirm the diagnosis as mentioned in our classics as well as allied sciences. These patients were subjected to *Devadarvyadi Kwatha*[4] and *Vasadi Kwatha.*[5]

- **Grouping and Posology**

Devadarvyadi Kwatha, as described in *Yoagartnakara, Hikka-Shwasa Rogadhikara* was selected. The list of the herbs is as mentioned below:

Table 1: Drugs of *devadarvyadi kwatha.*

Sr. No.	Name of drug	Latin name	Part
1	*Devdaru*	*Cedrus Deodara Roxb.*	1 Part
2	*Vacha*	*Acorus Calamus Linn.*	1 Part
3	*Vyaghri*	*Solanum Surattence Burm F.*	1 Part
4	*Vishva*	*Zingiber Officinale Roxb. Rosb*	1 Part
5	*Katphala*	*Myrica Esculenta Buch. Ham. Ex. D. Don*	1 Part
6	*Pushkaramoola*	*Inula Racemora Hook F.*	1 Part

In other group, *Vasadi Kwatha* as mentioned in *Bhaishajya Ratnavali* in *Hikka-Shwasa Rogadhikara* (16/27) was selected. The ingredients are enlisted as below:

Table 2: Drugs of *vasadi kwatha.*

Sr. No.	Name of drug	Latin name	Part
1	*Vasa*	*Aghatoda Vasika Nees*	1 part
2	*Haridra*	*Curcuma Longa Linn.*	1 part
3	*Dhanika*	*Coriandrum Sativum Linn.*	1 part
4	*Guduchi*	*Tinospora Cordifolia Linn*	1 part
5	*Bharangi*	*Clerodendrum Serratum Linn.*	1 part
6	*Pippali*	*Piper Longum Linn.*	1 part
7	*Nagara*	*Zingiber Officinale Roxb.*	1 part
8	*Kantakari*	*Solanum Surattence Bunn F.*	1 part

A total of 30 patients were randomly grouped into A and B, in Group A (n = 15) received *Devadarvyadi Kwatha*, while Group B (n = 15) *Vasadi Kwatha* received; at dose of 40ml twice a day in the morning and evening for the duration of 28 days. Follow-up period was 14 days in both groups.

- **Criteria for Assessment**

The improvement in the patients was assessed on the basis of relief in the cardinal signs and symptoms of the disease. Improvement in the relief of *Srotodushti*, *Lakshana* of *Dosha*, *Dushya*, and *Srotasa* were taken into account. In addition, following laboratory assessment were carried out after treatment.

a) Haematological investigations after completion of treatment were reported.
b) Respiratory function tests were reported during the treatment by using Mini Peak flow meter.

All the signs and symptoms were given scores depending upon their severity before and after treatment.

- **Assessment of total effect of therapy**

The improvement in quality of life were considered in all the below mentioned categories for final assessment.

- Improved: 100% relief of signs and symptoms
- Markedly improved: Improvement between >75% and 99%
- Moderately improved: Improvement between >50% and 75%
- Mild improvement: Improvement between 25% and 50%
- Unchanged: No relief in signs and symptoms.

- **Statistical analysis**

The information gathered on the basis of observation was subjected to statistical analysis in terms of mean score (x), standard Deviation (S.D.) standard error (S.E.), Wilcoxon test, Mann Whitney Test, Unpaired 't' test, Paired t-test was carried out at the level of 0.05, 0.01, 0.001,0.0001 of P level. Insignificant P >0.05; Significant P < 0.05; Very Significant P < 0.001; Extremely Significant P < 0.0001

- **Observation**

Total 30 patients completed the course of treatment. Both groups' observation data are given as below:

Table 3: General observations.

Observation	Result (Max %)
Age (51- 65 years)	43.33%
Sex (Male)	66.66 %
Marital Status (Married)	83.33%
Religion *(Hindu*)	73.33%
Education (Higher Secondary)	33.33 %
Occupation (Service/Job)	36.66%
Socio-Economic Status (Middle Class)	73.33%
Desha (*Sadharana*)	100%
Onset (Gradual)	73.33%
Chronicity (2 - 5 Years)	66.66%
Postural Aggravation (Sleeping)	76.66%
Treatment History (Taken)	100%
Allopathy Drug History	100%
Past Illness (No)	90%
Family History (Positive)	66.66%
Nidra (*Khamdita*)	76.66%
Divaswapana	46.66%
Vyasana (Smoking)	26.66%

Agni (Mandagni)	46.66%
Sharirika Prakriti (Vata-Kapha)	46.66%
Manasika Prakriti (Raja-Tama)	40%
Vikriti (Lakshya Nimita)	73.33%
Dosha Parikshana (Kapha Dosha involvement*)*	41.94%
Srotodushti Parikshana (Pranavaha Srotodushti)	76%
Aharaja Nidana (Shita Ahara)	93.33%
Viharaja Nidana (Vegavidharana)	80%
Manasika Bhavaja	80%
Raja- Dhuma Nidana (Dust)	83.33%
Chief Complaint (*Shwasa Vega, Ativege Kasate, Kapha Nishthivanam*)	100%
Associated Symptoms (*Pinasa*)	100%

- **RESULTS**

Wilcoxon matched-paired signed-ranked test was applied to evaluate effect of therapy in individual group for subjective criteria. Mann –Whitney U-Statistic test applied for comparative effect of therapy in both group. Overall effect of therapy on each scale was calculated with reference to percentage improvement in all symptoms. Paired‘t’ test & Unpaired‘t’ test was applied in both groups for objective criteria. The obtained results have been interpreted as:

Table 4: Effect on chief complaints of Group A.

Symptoms	N	Mean		D.F.	% Relief	W	P	S
		BT	AT					
Shwasa Kashtata Vega	15	2.66	1	1.66	67.77%	120	.0001	ES
Duration of *Shwasa Kashtata Vega*	10	1.1	0.6	0.5	30%	15	.0625	NS
No. of Emergency Drug Used	13	1.61	0.84	0.76	36.66%	45	0.0039	VS
Ativege Kasate	15	2.2	0.93	1.26	61.11%	120	0.0001	ES
Kapha Nishthivanam	15	2.13	1	1.13	57.77%	120	0.0001	ES
Shleshma Vimokshyate Sukham	15	1.8	0.66	1.13	65.55%	91	0.0002	ES
Parsve Avagrihyate	08	1.75	0.625	1.125	33.33%	28	.0156	S
Ghurghurukam	12	2.083	1.75	0.33	13.33%	10	0.1250	NS

Table 5: Effect on chief complaints of Group B.

Symptoms	N	Mean		D.F.	% Relief	W	P	S
		BT	AT					
Shwasa Kashtata Vega	15	2.6	1.066	1.53	61.11%	120	.0001	ES
Duration of *Shwasa Kashtata Vega*	09	1.11	0.66	0.44	23.33%	10	0.125	NS

No. of Emergency Drug Used	13	1.61	0.76	0.84	46.66%	66	0.001	ES
Ativege Kasate	15	2.33	1	1.33	60%	120	0.0001	ES
Kapha Nishthivanam	15	2.13	1.067	1.067	52.22%	120	0.0001	ES
Shleshma Vimokshyate Sukham	13	1.69	0.92	0.76	32.22%	28	0.0156	S
Parsve Avagrihyate	14	1.92	0.928	1	44.44%	78	.0005	ES
Ghurghurukam	11	2.36	2.090	0.272	6.66%	78	0.2500	NS

Table 6: Comparative Effect of Both therapies on Chief Complaints by using Mann Whitney U-Statistic test.

Chief Complaints	Mean		% Relief		U	P	S
	Group A	Group B	Group A	Group B			
Shwasa Kashtata Vega	1.66	1.53	67.11%	61.11%	101	0.626	NS
Shwasa Kashtata Duration	0.55	0.44	30%	23.33%	42.5	0.8504	NS
No. of Emergency Drug Used	0.76	0.37	36.66%	46.66%	77	0.6426	NS
Ativege Kasate	1.26	1.33	61.11%	60%	100	0.5183	NS
Kapha Nishthivanam	1.33	1.06	57.77%	52.22%	105	0.715	NS
Shleshma Vimokshyate Sukham	1.33	0.76	65.55%	32.22%	71	0.1971	NS
Parsve Avagrihyate	1.125	1	33.33%	44.44%	50	0.648	NS
Ghurghurukam	0.33	0.27	13.335	6.66%	62	0.7871	NS

Table 7: Effect on associated complaints of Group A.

Associated Symptoms	N	Mean Score		D.F.	% Relief	W	P	S
		B.T.	A.T					
Pinasa	15	3.066	1.4	1.66	57.77%	120	0.0001	ES
Parshwashula	09	1.4	0.77	0.66	26.66%	21	0.0313	S
Anidra	14	1.85	1.07	0.78	43.33%	66	0.0010	VS
Shayane Shwasa Pidita	09	1.55	0.66	0.88	36.66%	36	0.0078	S
Asino Labhate Saukhyam	07	1.57	0.85	0.71	20%	15	0.0625	NS
Kanthodhwansa	13	1.15	0.5	0.615	46.66%	36	0.0078	VS
Vishushkasyata	09	1.11	0.77	0.33	16.66%	6	0.0025	NS

Table 8: Effect on associated complaints of Group B.

Associated Symptoms	N	Mean Score		D.F.	% Relief	W	P	
		B.T.	A.T					
Pinasa	15	3.13	1	2.13	71.66%	120	.0001	ES
Parshwashula	6	0.8333	0.3333	0.5	13.4%	6	0.2500	NS
Anidra	15	1.93	1.26	0.66	33.33%	55	0.002	VS
Shayane Shwasa Pidita	11	1.81	0.81	1	40%	55	0.002	VS
Asino Labhate Saukhyam	10	1.3	1	0.3	13.33%	6	0.2500	NS
Kanthodhwansa	15	1.53	0.866	0.66	37.77%	45	0.0039	VS
Vishushkasyata	11	1.09	0.63	0.45	26.66%	10	0.125	NS

Table 9: Comparative effect of both therapies on symptoms by using mann whitney U-Statistic test.

Associated Symptoms	Mean		% Relief		U	P	S
	Group A	Group B	Group A	Group B			
Pinasa	1.66	2.13	57.77%	71.66%	68	0.035	S
Parshwashula	0.66	0.5	26.66%	13.4%	22.5	0.5794	NS
Anidra	0.78	0.66	43.33%	33.33%	92.5	0.499	NS
Shayane Shwasa Pidita	0.88	1	36.66%	40%	44.5	0.582	NS
Asino Labhate Saukhyam	0.71	0.3	20%	13.33%	20.5	0.1147	NS
Kanthodhwansa	0.615	0.66	46.66%	37.77%	95	0.9155	NS
Vishushkasyata	0.33	0.45	16.66%	26.66%	46.5	0.82.4	NS

Table 10: Effect on *agnibala* of Group A.

Agnibala	N	Mean Score		D.F.	% Relief	W	P	S
		B.T.	A.T					
Abhyavaharana Shakti	14	1.78	0.71	1.07	69.04%	105	0.0001	ES
Jarana Shakti	15	2	1.06	0.93	47.77%	91	0.0002	ES
Aharakale Ruchi	10	1.8	0.9	0.9	36.11%	36	0.0078	VS
Vata-Mutra-Mala Mukti	11	1.09	0.27	0.81	77.27%	45	0.0039	VS

Table 11: Effect on *agnibala* of Group A.

Agnibala	N	Mean Score		D.F.	% Relief	W	P	S
		B.T.	A.T					
Abhyavaharana Shakti	15	1.73	0.66	1.066	66.66%	105	0.0001	ES
Jarana Shakti	15	2.4	1.46	0.93	40%	105	0.0001	ES
Aharakale Ruchi	11	1.81	0.63	1.18	54.44%	66	0.0010	VS
Vata-Mutra-Mala Mukti	6	1.16	0.5	0.66	23.33%	10	0.125	NS

Table 12: Comparative effect of both therapies on *agnibala* by using mann whitney U-Statistic test.

Agnibala	Mean		% Relief		U	P	S
	Group A	Group B	Group A	Group B			
Abhyavaharana Shakti	1.07	1.066	69.04%	66.66%	105	0.9709	NS
Jarana Shakti	0.93	0.93	47.77%	40%	112	0.9999	NS
Aharakale Ruchi	0.9	1.18	36.11%	54.44%	41.500	0.2193	NS
Vata-Mutra-Mala Mukti	0.81	0.66	77.27%	23.33%	28	0.5389	NS

Table 13: Effect on *dehabala* of Group A.

Dehabala	N	Mean Score		D.F.	% Relief	W	P	
		B.T.	A.T					
Balavriddhi	15	2	1.06	0.933	50%	105	0.0001	ES
Sharira Upachaya	6	0.66	0.33	0.33	26.66%	7	0.5625	NS
Swara-Varna Yoga	11	1.27	0.45	0.81	50%	36	0.0078	VS

Table 14: Effect on *dehabala* of Group B.

Dehabala	N	Mean Score		D.F.	% Relief	W	P	
		B.T.	A.T					
Balavriddhi	15	2.3	1.33	1	40%	91	0.0002	ES
Sharira Upachaya	0	0	0	0	0	0	0	NS
Swara-Varna Yoga	15	0.93	0.26	0.66	66.66%	65	0.0068	VS

Table 15: Comparative effect of both therapies on *dehabala* by using mann whitney U-Statistic test.

Dehabala	Mean		% Relief		U	P	S
	Group A	Group B	Group A	Group B			
Balavriddhi	0.933	1	50%	40%	106	0.7011	NS
Sharira Upachaya	0.33	0	26.66%	0	0	0	-
Swara-Varna Yoga	0.81	0.66	50%	66.66%	76	0.7008	NS

Table 16: Effect on *sattvabala* of Group A.

Sattvabala	N	Mean Score		D.F.	% Relief	W	P	
		B.T.	A.T					
Nidralabho Yathakalam	14	1.7	0.85	0.85	46.66%	78	0.0005	ES
Sukhena Cha Prabodhakam	15	1.93	1.06	0.86	47.77%	66	0.001	VS
Vaikaram Cha Swapana	14	0	0	0	0	0	0	NS

Adarshanam								
Mano Buddhindriya Avyapatti	15	1.46	0.6	0.86	60%	78	0.0001	ES

Table 17: Effect on *sattvabala* of Group B.

Sattvabala	**N**	**Mean Score**		**D.F.**	**% Relief**	**W**	**P**	**S**
		B.T.	**A.T**					
Nidralabho Yathakalam,	14	1.66	1	0.66	33%	0	00	NS
Sukhena Cha Prabodhakam	15	1.66	0.66	1	72.22%	105	0.001	ES
Vaikaram Cha Swapana Adarshanam	14	1.066	1.066	0	0	0	0	NS
Mano Buddhindriya Avyapatti	15	1.5	0.5	1	70%	0	0	NS

Table 18: Comparative effect of both therapies on *dehabala* by using mann whitney U-Statistic test.

Sattvabala	**Mean**		**% Relief**		**U**	**P**	**S**
	Group A	**Group B**	**Group A**	**Group B**			
Nidralabho Yathakalam	0.85	0.66	46.66%	33%	0	0	-
Sukhena Cha Prabodhakam	0.86	1	47.77%	72.22%	93	0.3286	NS
Vaikaram Cha Swapana Adarshanam	0	0	0	0	0	0	-
Mano Buddhindriya Avyapti	0.86	1	60%	70%	0	0	-

Table 19: Effect on the Hematological Values of 15 Patients of *Tamaka Shwasa* Group A.

Parameter	**Mean Score**			**% Relief**	**SD +/-**	**SE +/-**	**'t'**	**P**
	B.T	**A.T**	**D.F.**					
Hb	12.56	13.07	-0.5133	4.35%	0.45	0.11	4.35	0.0001
T.L.C.	7138.66	6469	642.66	9.21%	594.66	153.5	4.184	0.0009
Neutrophils	67.86	63.13	4.73	6.54%	5.79	1.49	3.161	0.0069
Eosinophils	4.26	2.6	1.66	35.52%	0.97	0.25	6.614	0.0001
E.S.R.	18.066	12.8	5.266	31.94%	1.032	0.266	19.75	0.0001

Table 20: Effect on the Hematological Values of 15 Patients of *Tamaka Shwasa* Group B.

Parameter	Mean Score			% Relief	SD +/-	SE +/-	't'	P
	B.T	A.T	D.F.					
Hb	12.74	13.11	-0.37	-3.28%	0.566	0.14	2.55	0.023
T.L.C.	7326.66	6629.33	697.33	9.37%	660.40	170.51	4.090	0.0011
Neutrophils	67.2	62.22	4.93	7.14%	5.39	1.39	3.54	0.0032
Eosinophils	4.866	3.13	1.73	33.023%	1.099	0.28	6.614	0.0001
E.S.R.	18.33	12.53	5.6	30.023%	2.06	0.53	10.512	0.0001

Table 21: Comparative effect of both therapies on haematological investigations by using Unpaired't' Test.

Lab. Findings	Mean		% Relief		F	't'	P	S
	Group A	Group B	Group A	Group B				
Hb	-0.5133	-0.37	-4.35%	-3.28%	1.539	0.4622	0.7455	NS
T.L.C.	642.66	697.33	9.21%	9.37%	1.233	0.2382	0.8135	NS
Neutrophils	4.73	4.93	6.54%	7.14%	1.157	0.0978	0.9228	NS
Eosinophil	1.66	1.73	35.52%	33.023%	1.270	0.1756	0.8619	NS
E.S.R	5.266	5.6	31.94%	30.023%	3.991	0.5595	0.5803	NS

Table 22: Effect on peak expiratory flow rate.

Group	Mean Score			% Relief	SD +/-	SE +/-	't'	P
	B.T	A.T	D.F.					
A	239.33	298	58.88	25.11%	29.24	7.55	7.77	0.0008
B	229.33	272.66	43.33	21.78%	18.38	4.74	9.127	0.0001

Table 23: Comparative Effect of Both therapies on P.E.F.R by using Unpaired't' Test.

Mean		% Relief		F	't'	P	S
Group A	Group B	Group A	Group B				
29.44	18.38	25.11%	21.78%	2.530	1.719	0.0966	NS

Table 24: Overall effect of therapy on 30 patients of *tamaka shwasa.*

Assessment	Group A		Group B	
	No. of Pt.'s	%	No. of Pt.'s	%
Complete Remission (100)	0	0	0	0
Markedly Improvement (76-99)	01	6.66%	0	0
Moderate Improvement (51-75)	07	46.66%	09	60%
Mild Improvement (26-50)	07	46.66%	06	40%
No Effect (25)	0	0	0	0

- **DISCUSSION**

The fundamentals of *Ayurvedic* pharmacology are capable to give a better scientific lead in mode of drug action. Pharmacology of *Ayurveda* is based on the theory of *Rasa, Guna, Virya,*

Vipaka and *Prabhava* which were the simplest parameters in those days to find out the action of the drug. *Samprapti Vighatana* is said to be the treatment. Therefore the action of a drug means to dismantle the *Samprapti Ghatakas* of the disease. Hence to explain the mode of action of a drug means to establish a relationship between the *Samprapti Ghatakas* of the disease and pent fold principles of *Rasa, Guna, Virya, Vipaka* and *Prabhava* of a drug.

Group A - *Devadarvyadi kwatha* was prepared by mixing equal quantities of 6 drugs i.e. *Devadaru, Vacha, Vishva, Vyaghri, Kataphala* and *Pushkaramoola.* The *Devadarvyadi Kwatha* in *Tamaka Shwasa* is expected to work on *Pranavaha-Udakavaha-Rasavaha* and *Annavaha Srotasa* and should provide *Dipana-Pachana, Vatanulomana, Anulomana, Vata-Kaphahara* property. All drugs of *Devadarvyadi Kwatha* has *Kaphashamaka* property by 83.33%, 83.33% *Tikta* and *Katu Rasa* respectively, 66.66% *Tikshna Guna*, 83.33% *Katu Vipaka. Vatashamaka* property by 33.33% *Snigdha Guna*, 100% *Ushna Virya* and 16.66 % *Madhura Vipaka*, 100% *Laghu Guna.*

Group B - *Vasadi kwatha* was prepared by mixing equal quantities of 8 drugs i.e. *Vasa, Dhanyaka, Haridra, Guduchi, Bharangi, Pippali, Sunthi* and *Kantakari. Vasadi Kwatha* was having *Katu Rasa, Tikta Rasa, Ushna Virya, Katu Vipaka* and *Kapha- Vata Shamaka,* properties which are effective in antagonizing the *Tamaka Shwasa Roga.* Here, in *Vasadi Kwatha, Vasa* have the property of *Kaphaghna & Kaphanisaraka* by *Tikta Rasa, Katu Rasa, Ushna Virya, Katu Vipaka* and *Kapha-Vata Shamaka* properties in nature. All drugs of *Vasadi Kwatha Yoga* has 77.77% *Kapha-Vatashamaka* and 77.77 % *Ushna Virya* property. This *Yoga* is dominated by 66.66% *Katu Rasa* and *Tikta Rasa*, so this *Yoga* has *Kapha Shamaka* Property by 66.66% *Katu Rasa*, 66.66% *Tikta Rasa, 55.55% Katu Vipaka* and *Vatashamana* property by 11.11% *Madhura Rasa*,77.77% *Ushna Virya* and 44.44% *Madhura Vipaka.* This is essential for treatment of *Tamaka Shwasa.*

By combine action of all these drugs improves *Jatharagni* as well as *Dhatvagni*. After the quality and quantity of *Rasa* and *Rakta Dhatu* improves, due to *Srotoshodhana* property of drugs, *Srotosanga* is decreased and *Dhatu* again Nourish all parts of body.

- **Discussion on overall effect of therapy**

Group-A:- Complete remission was not found in group of *Devadarvyadi Kwatha* though 6.66% of cases found marked relief while 46.66% of cases found moderate relief and mild relief in this group.

Group-B: - In this group also complete remission and marked relief was not found while 60% of cases found moderate relief and 40% of cases found mild relief.

No any patient was found with complete remission in both groups because of *Yapya* nature of *Tamaka Shwasa.*

The overall assessment considering the improvement in *Rogabala*, *Agnibala Dehabala*, and *Chetasabala* considering all the parameters outlined in the assessment criteria were 53.46%, 63.38, 52.77%, 42.58 respectively in Group A and 49.022%, 55.07%, 43.33%, 46.58% respectively in Group B.

So, Group A shows better result compare to Group B.

- **CONCLUSION**

Subsequent to methodical analysis, it may be concluded that *Devadarvyadi Kwatha* and *Vasadi Kwatha* are effective in the management of *Tamaka Shwasa* when *Doshas* are in morbid stage; and it can be adopted at any time when the patient needs. The *Kapha-Vatahara* drug used in the present study marvelous effect shows on *Tamaka Shwasa.*

- Comparing both Group A and B, in Group A total improvement was 53.37% and in Group B total improvement was 48.86%.
- At the end of this study conclude that null hypothesis (H0) is rejected and alternative hypothesis (H1) is accepted. i.e. *Devadarvyadi-Kwatha* will be more effective than *Vasadi-Kwatha* in management of *Tamaka Shwasa*.

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A CONCEPTUAL REVIEW OF HRIDAYARNAVA RASA

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ABSTRACT

Rasashastra and Bhaishajya Kalpana is the branch of Ayurved commonly termed as paraclinical branch which deals with production and standardization of Ayurvedic formulations. Rasaushadhis have always been considered a boon to these formulations due to their quick action, low dose, higher palatability and action even in dreadful conditions. Kharaliya Rasayan is the first type of Rasaushadhi which is comparatively easier to prepare and hence most extensively used by Ayurved practitioners in clinical practice. Hridayarnava Rasa is one such Kharaliya Rasayan which is found to be effective in ailments related to Heart. It has been extensively studied through various aspects. This paper aims to put forth its conceptual review in a critical format. As much as 9 books give reference of Hridayarnava Rasa, however the contents are more or less identical. Some texts opine to use it in all types of Heart diseases while some advice it in only Kapha Pradhan Heart disease. The design of Hridayarnava Rasa is comparatively easier to understand due to less number of contents and will definitely be helpful to understand larger formulations used in our day to day Ayurved clinical practice.

Keywords: Hridayarnava Rasa, Rasaushadhis, Kharaliya Rasayan, Heart diseases

INTRODUCTION –

Ayurved is termed as the science of Life. Moreover it is the way of leading a healthy life. As clearly depicted in its aims, the primary motto is always to keep the healthy in balanced state and then treat him if at all needed. But as days passed, the secondary motto has gained more significance as we today are less aware of being healthy all the time. The ignorance towards the basic considerations regarding our Prakruti, Kala, Bala, Dosha, Dushya, Mala, Agni, Vaya etc. which have to remembered each and every time have led to diseases now-a-days termed as Life Style Disorders. Diabetes, Hypertension, Obesity, Heart diseases, Stroke, Cancer etc. are some of the leading examples. According to the WHO, non-communicable diseases (NCD's) kill 41 million people each year, equivalent to 71% of all deaths globally[1]. Cardiovascular diseases account for most NCD deaths i.e. 17.9 million people die annually due to heart diseases worldwide[2]. As Ayurved is the science of life, we can come forward with solution to this ever increasing problem. This may come in the form of life style changes and also medicines. Hridayarnava Rasa is one such medicine which can be extensively used in management of Heart diseases i.e. Hridroga. It is an example of Kharaliya Rasayan and has few contents which are easily available. Kapha dosha according to Ayurved or obstructive pathology according to modern science is considered a prime pathological entity in Heart diseases.

METHOD

As much as 9 texts give reference of Hridayarnava Rasa with the same contents with changes in proportions or anupana in some instances. All the references have 3 main ingredients and 2 bhavana dravyas.

Table 1: List of ingredients of Hridayarnava Rasa

Sr. No.	Sanskrit Name	English Name	Part used	Parts taken
1.	Shuddha Parada	Mercury	Purified form	1
2.	Shuddha Gandhak	Sulphur	Purified form	1
3.	Tamra Bhasma	Copper	Incinerated form	1
4.	Triphala	3 Myrobalans	Fruits Decoction	Q.S.
5.	Kakmachi	Solanum nigrum	Leaves juice	Q.S.

Preparation

The ingredients as shown in **Table 1** are to be collected and authenticated. Parada and Gandhak should be purified. Tamra should be purified and incinerated by the process and Marana and has to be used only after it passes all the bhasma pariksha especially Amla pariksha. The herbal drugs viz. Triphala and Kakmachi should also be authenticated before use. Contents no. 1 to 3 are to be mixed properly using a Khalwa yantra. Triphala kwatha should be prepared for 1 bhavna to be given to the mixture. Kakmachi swaras should be prepared for the final bhavna process. The final product will have blackish color and should be stored in air tight container.

Dose

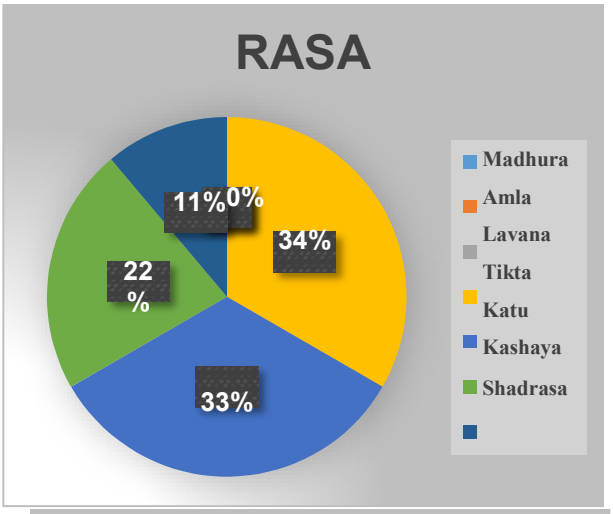
2 doses are found related to Hridayarnava Rasa in texts. One is "Chana matra"[3] which is translated to "Rakti matra" i.e. 120 to 125 mg dose. While Rasatarangini, the latest book on Rasashastra indicates "Gunjapada"[4] i.e $1/4^{th}$ Gunja or Rakti dose which comes to 30 to 31.25 mg. However dose fixation should always be done after proper examination of all the Dashavidha parikshas i.e. Dushya, Desha etc[5].

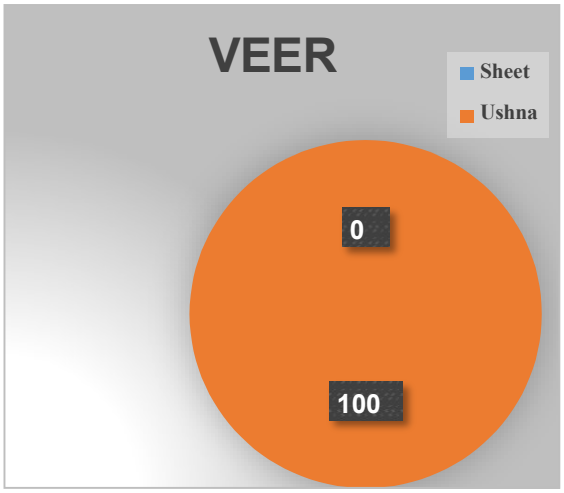
Anupana

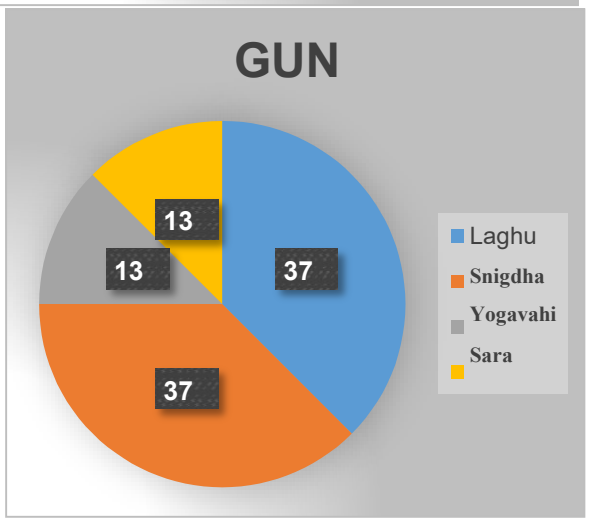
Out of 3 different references, 2 do not give any specific anupana. However, reference from **Rasachandanshu** gives a special kwatha as anupana for Hridayarnava Rasa. 1 karsha of Kakmachi is to be added to 1 pala of Triphala. 32 tolak water is to be added to this mixture and it should be reduced to $1/8^{th}$ proportion by mild heating. This 4 tolak (48 ml) dose is to be used as anupana for Hridyarnava Rasa.

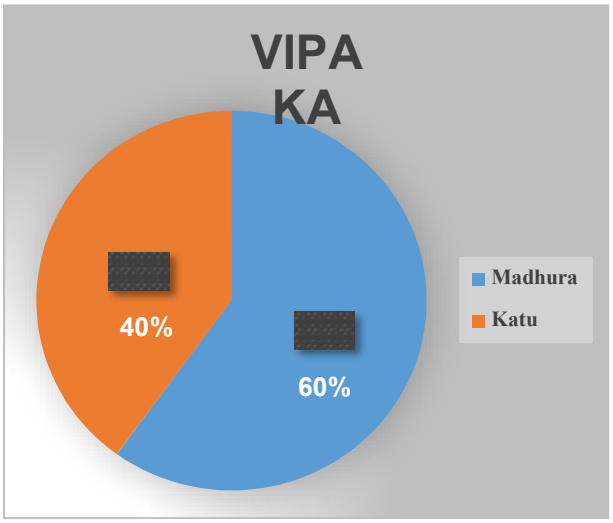
Table 2: Rasapanchak of ingredients of Hridayarnava Rasa

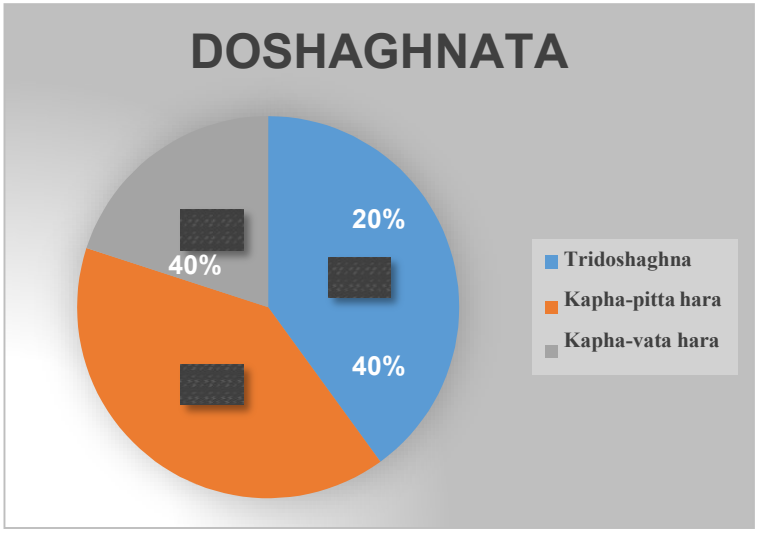
Sr. No.	Content	Rasa	Guna	Veerya	Vipaka	Karma
1.	Shuddha Parada	Shadrasa[6]	Yogavahi, Snigdha	Ushna	Madhura	Tridoshaghna, Rasayan, Vrishya, Balya, Sarvamayahar
2.	Shuddha Gandhak	Katu	Laghu	Ushna	Katu	Agnikari[7], Veeryavriddhi, Kushthahara etc.
3.	Tamra Bhasma	Tikta, Kashaya	Snigdha	Ushna	Madhura	Vishahara[8], Lekhana, Kapha-pitta rogahar
4.	Triphala Kwatha	Pancharasa (except lavana rasa)	Laghu	Ushna	Madhura	Rasayan, Kaphapitta hara, Ropan, Kleda, Meda, Meha nashak etc[9].
5.	Kakmachi Swaras	Tikta, Katu	Sara, snigdha, laghu	Ushna	Katu	Tridoshanghna, Swara-shukra kar, Rasayani etc[10].











Properties of Hridayarnava Rasa –

Rasa – Katu, Tikta Guna – Laghu, snigdha Veerya – Ushna Vipaka – Madhura

Karma – Rasayan, Lekhana

Hridayarnava rasa may be acting by virtue of its ushna veerya in heart diseases. It may be used in all types of heart diseases, however it may best act in Kaphaja hridroga due to the presence of contents like Tamra bhasma and Triphala kwatha bhavna.

DISCUSSION

Kharaliya rasayana are the most commonly used Rasayana. They are easier to prepare, require less dose and are palatable with more patient acceptability. Being in powder form, they are easily absorbed in the human body and start acting from the oral cavity itself. All the drugs are ushna veerya, making it the ideal drug of choice in Kaphaja Hridroga especially. Major drugs are Rasayan, hence may be used for a longer effect with continuous monitoring. The preclinical studies on anti-hyperlipidaemic activity of Hridayarnava Rasa[11] also show promising results on blood lipid levels which are considered as the prime cause of atherosclerosis leading to many further complications. Clinical evaluation of Hridayarnava Rasa[12] also showed promising results making it eligible enough to be used in patients of Heart diseases.

The reference of Rasatarangini advises to add Tamra bhasma in twice[13] the proportion of Parada and Gandhak. This may be the reason, he has reduced the dose to 1/4th gunja as compared to the previous books. Rasavagbhat also gives another formulation named as Kajjala Yoga[14] which has the same contents, but it has to be prepared in valuka yantra keeping it in sharava samputa.

Rasendrachintamani describes a similar formulation called Swacchand bhairava rasa with same constituents in Jwara Chikitsa adhyaya. He also describes Pliharnava rasa whose name matches with Hridayarnava rasa but is to be used in spleen disorders.

CONCLUSION

Hridayarnava Rasa is of the best rasayana prescribed to Hridroga patients. It has lesser contents which are easily available everywhere. The genotoxicity study done on Hridayarnava Rasa[14] also has shown no untoward effect on animals. Thus Hridayarnava Rasa can definitely act as a boon to the ever increasing patients of heart diseases globally especially in India where the number is peaking day by day.

CAUTION

Contents like Parada and Gandhak should be authenticated and thoroughly purified before using. Tamra bhasma should also be prepared with utmost care and all bhasma pariksha should be carried out before adding to the formulation.

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AN OVERVIEW ON CHARAKOKTA BHESHAJ PARIKSHA VIDHI W.S.R TO ADULTERATION AND SUBSTITUTION

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ABSTRACT

The present article deals with the concept of *Dravya Pariksha Vidhi* explained by *Acharya Charak* and their challenges like Adulteration, Substitution & Modern Guidelines of standardization of drugs etc. Which plays an important role in the identification, authentication, and yielding of good quality of required drugs along with preserving the natural resources. In 20th and 21th - century people become aware of the challenges of synthetic drugs, which made the world shift towards Ayurveda that result in more usage of Ayurvedic medicines, which created an increased demand for raw material. So to fulfil the demand the fast drop-off started in the natural resource. Plants growing in high altitude regions, many of them became endangered and rare, as well as costly. Some drugs like *Vatsnabh* (*Aconitum Chasmanthum* stapfex. Haimes), *Kutki* (*Picrorhiza kurroa* Royle ex Benth), *Kustha* (*Saussurea lappa* C.B.Clarke), *Riddhi* (*Hobenariainte media* D. Don), *Vriddhi* (*Habenariaedge worthii* Hook.f.ex.Collett), *Kakoli* (*Roseea purpurrea* Smith), *Kshirakakoli* (*Lilium polyphyllum* D. Don), *Jeevaka* (*Crepipiuma cumina* tum D. Don. Szlach.), *Meda* (*Polygonatum verticillatum* Linn.) Allioni), *Mahameda* (*Polygonatum cirrhifolium* (wall.) Royal) and (*Polygonatum Vertecillatum* Alloi), *Rakta Chandana*, *Sandal Surkh* (*Pterocarpus santalinus* Linn.), *Sweta Chandana* (*Santalum album* Linn.), *Kesar*(*Crocus sativus* Linn.) *etc*. completely entered the endangered zone and due to incorrect identification, collection intentionally or unintentionally, Herbal adulteration has become common malpractices in herbal raw material trade. Due to the addition of spurious drugs, faith in Ayurvedic medicines for their results has declined. So, it is a need of the hour for proper identification of drugs through standardization techniques along with preserving our natural resources. As well as to overcome these problems the Knowledge of *Vrikshayurved* is

also essential to get the better yield of the requirement along with proper plant care to fulfil the required needs genuinely. The biggest advantage of applying these methods is that we could find *Anukta dravya* (Extrapharmacopieal) new drugs, *Pratinidhi dravya* (Substitute) and help to find out the properties (Raspanchak, Exact pharmacological action) of adulterated drugs in the view of *Ayurveda*, like *Rasapanchaka, Guna, Karma, Prabhav*, etc. and thus, facilitate its use in Ayurvedic therapeutics.

INTRODUCTION

Ayurveda which literally means "The science of Life" is one of the most ancient medical sciences of the world. *Ayurveda* advocate a complete promotive, preventive and curative system of medicines. For achieving these benefits of *Ayurveda* four limbs of treatment are described and known as *Chikitsa Chatushpad*.

Among those *Chatushpaad Bheshaj/Dravya* is recognized as an important tool which should be known by *Bhishak* in treatment aspects. Hence it is known as *Bheshaj*. *Bheshaj* is essential in case of *Dravyabhut Yuktivyapashray Chikitsa*. *Aacharyas of Ayurved* gives importance to this because success of treatment depends on this factor, without this *Bhishak* is unable to treat patient.

Another example of importance given to *Bheshaj* is the concept of *Trisutra. Aacharya Charak* explained the concept of *Trisutra* i.e. *Hetu sutra, Linga Sutra* and *Aushad Sutra*. By this we understand how much *Dravya* is important to *Ayurved*.

In the current era the proper results are not achieved in *Dravyabhut chikitsa* due to more adulteration and substitution either intentionally or unintentionally or due to lack of medicine.

Hence standardisation of *Dravya* and adding of new drugs in *Ayurved* is a need of present situation, before use of drug the addition of new drug can be done by concept of *Bheshaj Pariksha Vidhi* of *Charak Samhita*.

Acharyas of *Ayurveda* have allowed the skilful use of similar *Dravyas* which are not explained by them in case of non-availability of the one mentioned in the text. Thus, in *Nighantu* period followed this concept and studied new drugs and explained them in their text. Thus, many drugs from other healthcare systems or which were not found in India were later assimilated in *Ayurveda*.

This has led to new additions. For example, *Aakarkarabh* and *Kumari* were originally from African region; *Chandrashur* and *Madyantika* were from Faras region (now Egypt) but we find their references as well as elaborate description in Classical texts of *Ayurveda*.

Thus, following this tradition, we must find out such commonly used as well as a folk medicine, which do not have mention in *Ayurvedic Samhitas*. Such time-tested drugs are needed to be studied by *Dravyaguna* researchers. In *Ayurveda*, this can be attained with the help *Dravya Pariksha Vidhi* in *Vimansthana* of *Charaka-Samhita*.

AIMS AND OBJECTIVES

- This article aims at proper understanding the concept of *Dravya Pariksha Vidhi*.
- The study is carried out with an aim to understand it thoroughly and find its applicability for standardization of adulterants and substitutes of drugs.
- Applicability for finding new drugs which can be used for *Chikitsa*.

MATERIALS AND METHODS

The study was carried out after studying Classical text like *Charak Samhita*, *Sushrut Samhita, Bhavprakash Nighantu*, various textbooks of *Dravyagun Vigyan* and online medical database and published research papers etc. related to the concept of Adulteration, Substitution and *Dravya Pariksha Vidhi*.

Concept of adulteration[1,2]

Adulteration it is a practice of substituting the original crude drug partially or fully with other substances which is either free from or inferior in therapeutic and chemical properties or addition of low grade or spoiled drugs or entirely different drug similar to that of original drug substituted with an intention of enhancement of profits.

1. **Types of adulterants**

1.1 Substitution with substandard commercial varieties: Adulterants resemble the original crude drug morphologically, chemically, therapeutically but are sub-standard in nature and cheaper in cost. E.g. Strychnos nux vomica seeds are adulterated with Strychnos nux-blanda or Strychnos potatorium seed.

1.2 Substitution with superficially similar but inferior drugs: Inferior drugs may or may not have any chemical or therapeutic value. They may resemble only morphologically, so due to its resemblance they are used as adulterants. Eg. Cloves with mother cloves.

1.3 Substitution with artificially manufactured substance: The drug is adulterated with the substance which has been prepared artificially. The artificially manufactured substance resembles the original drug. E.g. paraffin wax is adulterated with yellow bee wax.

1.4 Substitution with exhausted drug: The same drug is admixed but that drug is devoid of medicinally active substance as it has been extracted already. Mainly volatile oil containing drugs like clove, coriander, fennel, caraway are adulterated by this method.

1.5 Substitution with synthetic chemicals to enhance natural character: Synthetic chemicals are used to enhance natural character of the exhausted drug. Examples: citral is added to citrus oils like lemon and orange oils.

1.6 Presence of vegetative matter of same plant: Some miniature plants growing along with the medicinal plants are added due to their colour, odour, and constituents.

1.7 Harmful adulterants: Some are harmful materials as the adulterant, are collected from market waste materials and admixed with the drug. It is done for the liquid drugs.

1.8 Adulteration of powders: The drugs which are in the form of powders are frequently adulterated. Examples: dextrin is added in ipecacuanha, exhausted ginger in ginger, red sanders wood in capsicum powder and powdered bark adulterated with brick powder.

2. Reason of adulteration

2.1 Confusion in vernacular names: In *Ayurveda*, *Parpatta* refers to Fumaria parviflora Lam. In *Siddha*, *'Parpadagam'* refers to Mollugo pentaphylla L. Owing to the similarity in the names in traditional systems of medicine, these two herbs are often interchanged or adulterated or substituted.

2.2 Lack of knowledge about authentic source: *Nagakesar* is one of the important drugs in *Ayurveda*. The authentic source is Mesua ferrea L. However, market samples are adulterated with flowers of Calophyllum inophyllum Linn. Though the authentic plant is available in plenty throughout the Western Ghats and parts of Himalayas, suppliers are unaware of it. There may also be some restrictions in forest collection. Due to these reasons, C. inophyllum Linn. (Which is in the plains) is sold as *Nagakesar*.

2.3 Similarity in morphology: Mucuna pruriens (L.) DC. is adulterated with other similar Papilionaceae seeds having similarity in morphology. M. utilis (Ridl.) H.J.Lam (sold as white variety) and M. deeringiana (sold as bigger variety) are popular adulterants. Apart from this M. cochinchinensis (Lour.) Spreng., Canavalia virosa (Roxb.) Wight & Arn. and C. ensiformis (L.) DC. are also sold in Indian markets..

2.4 Lack of authentic plant: Hypericum perforatum L. is cultivated and sold in European markets. In India, availability of this species is very limited. However, the abundant Indo-Nepal species H. patulum, sold in the name of H. perforatum L. Market sample is a whole plant with flowers and it is easy to identify them taxonomically. Anatomically, transverse section of H. perforatum L. stem has compressed thin phloem, hollow pith and absence of calcium oxalate crystals. Whereas H. patulum has broader phloem, partially hollow pith and presence of calcium oxalate crystals.

2.5 Similarity in colour: It is well known that with course of time, drug materials get changed to or substituted with other plant species. *'Ratanjot'* is a recent day example. According to the suppliers and non-timer forest product (NTFP) contractors, in the past, roots of Ventilago madraspatana Gaertn. were collected from Western Ghats, as the only source *'Ratanjot'*. However, that has not been practiced now. It is clearly known that Arnebia euchroma (Royle) I.M.Johnst is the present source. Similarity is in yielding a red dye, A. euchroma (Royle) I.M. Johnst substitutes V. madraspatana Gaertn. Recently V. madraspatana Gaertn is not found in market. Whatever is available in the market, in the name of *Ratanjot* is originated from A. euchroma (Royle) I.M. Johnst.

2.6 Careless collection: Some of the herbal adulterations are due to the carelessness of herbal collectors and suppliers. Parmelia perlata (Huds.) Ach. is used in *Ayurveda*, *Unani* and *Siddha*. It is also used as grocery. Market samples showed it to be admixed with other species (P. perforate Bory.).

3. Concept of Substitution

Substitution is a replacement of equivalent drugs in place of original drugs on the basis of similar pharmacological actions and therapeutic uses. In Ayurveda, substitution is described by the name of Abhava Pratinidhi Dravya. During Samhita Period concept of adulteration and substitution was not existed but later on this practice come in existence. But Vagbhatta has mentioned that the dravya having similar Ras (taste), Guna(characteristic), Veerya (potency) and Vipaka should be used in absence of each other. So Abhava Pratinidhi Dravya is a replacement of original drug basically having similar Rasa, Guna, Veerya, Vipak and mostly on Karma. Description of Abahva Pratinidhi Dravyas are mentioned in Bhavaprakash Nighantu, Yogratnakar and Bhaishajya-Ratnawali.17-19 There are 47 drugs of plant origin (Sthavar Dravya), 2 drugs of animal origin (Jangam Dravya), 7 drugs Minerals-Metals origin (Bhoumya Dravya) and 5 food materials (Ahara Dravya) mentioned for Abhava Pratinidhi Dravya in Bhavaprakash Nighantu.[3]

4. Types of substitution[4]

4.1 Using totally different drug: *Bharangi* (Clerodendrum indicum L. Kuntze.) and *Kantakari*. *Bharangi* has bitter taste; *laghu* (light*), ruksha* (unctuous) *guna* (quality) and has *Kapha-vatahara* property. While *Kantakari* (Solanum xanthocarpam) has *katu vipaka* (pungent digestion) and *ushna virya* (hot potency). Both C. indicum L. Kuntze and S. xanthocarpam have shown antihistaminic activity. Both C. indicum L. Kuntze and S. xanthocarpam are commonly used in the diseases related to the respiratory system, which are usually associated with release of histamines and other autacoids.

4.2 Substitution of the species belonging to same family: The Datura metal L. and Datura stramonium L. can be considered here. Chemical constituents are alkaloids, scopalamine, atropin, hyocyamin, lyoscine. The alkaloids are proved as bronchodialatory and inhibitor of secretion of mucous membrane. The alcoholic extract of D. metal L. shows anthelmentic activity the alkaloid present in both the species are well proven bronchodilators and also, they inhibit the secretion of mucous membrane of the respiratory tract. Thus, as far as the diseases of the respiratory tract are concerned both D. metal L. and D. stramonium L. are beneficial, while as D. metal L. would be a better choice as it is a proven anthelmintic.

4.3 Using different species: Two types of *Gokshura* viz. Tribulus terrestris L. (Zygophylaceae) and Pedalium murex Linn. (Pedaliaceae) of which, T. terrestris L. has the chemical constituents like chlorogenin, diosgenin, rutin, rhamnose and alkaloids. While P.murex L. has sitosterol, ursolic acid, vanilin, flavonoids and alkaloids. Both the species are proved for nephroprotective, lithotriptic, diuretic and hepatoprotective activities. The clinical conditions where Gokshura is indicated i.e. *Mutrakrucchahara* (renal disorder), *Ashmarihar* (urinary calculi), *Prameha* (diabetes) etc, both T. terrestris L. and P.murex L. appear to be appropriate.

4.4 Using different parts of the plant: The root of Sida cordifolia Linn. and the whole plant of Sida cordifolia Linn. can be considered. Root has the chemical constituents such as sitoindoside, acylsteryglycoside, while the whole plant has alkaloid, hydrocarbons, fatty acids and ephedrine. Various extracts of the whole plant showed antibacterial, antioxidant, hypoglycemic, hepatoprotective and cardio tonic activities. Though it is the root which is mentioned as officinal part of S. cordifolia Linn. in the classics as *Balya* (promotes strength), *Shotahara* (reduce inflammation) etc. Modern researches prove that even the aerial parts are also equally effective.

4.5 Due to same in action: Embelica officinalis Gaertn. shows antioxident, hepatoprotective, antimicrobial, hypoglycemic and hypolipidemic action. Semecarpus anacardium Linn. shows anti-tumour, hypotensive, anticytotoxic and anticancerous properties etc. Both *Amalaki* and *Bhallataka* are *Rasayana* (rejuvenator) drugs. In current practice the *Rasayana* formulations are being employed as an adjuvant therapy in Chronic as well as Malignant diseases. *Amalaki* can be employed as *Rasayana* in Chronic debilitating diseases like bronchial asthma, diabetes etc, while *Bhallataka* would be better choice in malignant conditions, both in solid tumours and in leukaemia.

Reasons for substitution[5]

1) Non-availability of the drug: Sometimes there may be non-availability of drugs. E.g: *Astavarga dravyas* (group of 8 crude drugs).
2) Cost of the drug: It is very essential component for economy of the drug.eg. As *Kumkum* being costly drug can be substituted by *Kusumbha*.
3) Adverse reaction of the drug: Due to the adverse reaction of the drug on patient there is necessity of substitution. *Vasa* having abortificiant activity its use is limited for pregnant women besides that *Laksha, Ashoka* can be substituted.
4) Shelf life of the drug: Shelf life of the drug is also another reason for substitution e.g. no availability of old jagerry, new jagerry after heating in sun rays for four hours can be used.
5) Uncertain identity of the drug: Herb *Lakshmana* and different species such as Aralia quinquefolia L. and Ipomea sepiaria Koienig ex Roxb. etc. are considered.
6) Seasonal availability of drugs: Due to limited availability of the drug round the year, other available drugs, having similar actions are used. E.g. Trianthema portulacastrum Linn. can be used in seasonal absence of Boerhavia diffusa Linn.

Concept of bheshaj pariksha vidhi[6]

तस्यापीयं परीक्षा- इदमेवंप्रकृत्येवंगुणमेवंप्रभावमस्मिन देशे जातमस्मिन्नृतावेवं गृहीतमेवं निहितमेवमुपस्कृतमनया च मात्रया युक्तमस्मिन् व्याधावेवंविधस्य पुरुषस्येवतावन्तं दोषमपकर्षत्युपशमयति वा, यदन्यदपि च एवं विधं भेषजं भवेतच्चानेन विशेषेण युक्तमिति ॥

(च. वि. 8/87)

The standardization techniques were described in *Vimansthana* of *Charaka-Samhita,* by *acharya charaka*

1) ***Edam evam prakritim:*** *Dravya Prakriti*
2) ***Evam gunam*****:** Physical-*Rasa, Veerya, Gurvadi Gunas* and chemical Properties.
3) ***Evam prabhavm*****:** Therapeutic actions.
4) ***Asmin deshe jatam*****:** Botanical distribution
5) ***Ritu eva grihitam*****:** Time and method of collection.
6) ***Nihitam*****:** Method of preservation.
7) ***Upaskritam*****:** *Sanskar*, Pharmaceutical processing for its preparations.
8) ***Matra*****:** Dosage
9) ***Vyadhi*****:** Various diseases in which drug can be therapeutically used.
10) ***Evam vidham purushasya*****:** Clinical trials

1) *Edam evam prakritim*: (*Dravya prakriti*)

- It includes name, nature and morphology of *Dravya*. The biological nomenclature description of *Dravya* is described by *Narahari Pandit* in *Raj- Nighantu* as follows.[7]

1. *Rudhi* (Traditional use): *Aatarusaka, Tuntuka*
2. *Prabhava* (Effect): *Krimighna, Hayamara*
3. *Desyokti* (Habitat): *Magadhi, Kalinga*
4. *Lanchana* (Morphological character): *Rajiphala, Chitraparni*
5. *Upama* (Simile): *Salaparni, Ajakarna*
6. *Virya* (Potency): *Usana, Sita*
7. *Itarahvaya* (Due to other factors): *Sakravaha, Kakahva*

2) *Evam gunam*

The *Guna* of a *Dravya* is based on *Pancha-bhautikatwa* and on *Rasadi* properties.

A. On the basis of *Pancha-bhautikatwa*

Panchabhautik constitution of *Dravya* can be determined on the basis of predominant *Rasa* present in them as specific *Rasas* are having dominance of specific *Mahabhutas*.

Rasa	**Predominant *Mahabhuta* (Acco. to *Acharya Charak*)[8]**
Madhur	*Prithvi + Jala*
Amla	*Prithvi + Agni*
Lavan	*Jala+ Agni*
Katu	*Vayu + Agni*
Tikta	*Vayu + Akash*
Kashay	*Vayu + Pruthvi*

B. On the bases of *rasadi* properties

The term *Rasadi* properties refers to *Rasa, Guna, Veerya, Vipaka* and *Prabhava*. Which are as follows.

(i) Determination of *rasa*[9]

Rasa of a drug is gustatory appeal. It is told by *Acharya Charaka* that

"रसो निपाते द्रव्यानाम"

(च. सू.-26/66)

I.e. *Rasa* is perceived through the contact of *Dravya* with gustatory sense organ and is called gustatory perception. This is the best way to know about the *Rasa* of a *Dravya.*

- General sense of taste: By direct perception (*Pratyaksha*)
- Specific sense of taste: By inference (*Anumana*)
- Experimental knowledge of taste: By authoritative statement

(ii) Determination of *gunas*[10]

The term *Guna* literally means the properties or qualities of any substance or *Dravya*. But in *Ayurveda* it means physicochemical or pharmacological properties of the *Dravyas*. *Shareerika Gunas* and *Paradi Gunas* are considered very important in the concept of *Bheshaj*.

(iii)Determination of *veerya*[11]

Veerya is known as potency of the *Dravya* which is known by *Pratyaksha*, *Anumana* as well as by both. The *Virya* of some *Dravya* is known from *Nipata* (*Pratyaksha* e.g. – *Maricha*) which comes in direct contact with tongue or skin, some *Dravya* from *Adhivasa* (*Anumana*) e.g.- *Anupa mamsa* and some by both *Adhivasa* and *Nipata* e.g.-*Maricha*.

Kriya	**Pramana**	**Examples**
Nipata (contact with body)	*Pratyaksha* (perception)	*Maricha (Tikshna)*
Adhivasa (stay in body)	*Anuman* (inference)	*Anupa mamsa*
Nipata- Adhivasa	*Pratyaksha- Anumana*	*Maricha (Ushna)*

Classification of *ashtavidha veeryas*

- *Sheeta Ushna*
- *Guru Laghu*
- *Snigdha Ruksha*
- *Mrudu Teekshna*

(iv)Determination of *vipaka*[12]

End product of a *Dravya* which is the outcome of digestion/ metabolism is known as *Vipaka*. In Ayurveda, *Vipaka* is associated with the *Rasa* i.e. a fixed *Vipaka* is associated with corresponding *Rasa*.

कटुतिक्तकषायाणां विपाकः प्रायशः कटु। अम्लोऽम्लं पच्यते स्वादुर्मधुरं लवणस्तथा ।।

(च.सु.-26/58)

Thus, it can be assessed by the knowledge of *Rasa*. *Vipaka* of a drug is inferred by its properties after it has undergone digestive and metabolic transformations. Thus, *Vipaka* can also be assessed by its action produced on *Doshas*, *Dhatus* and *Malas*. It can also be assessed on the bases of the available literary information, regarding its properties and actions. It would be based upon the *Trividha Vipaka Vada* of Ayurveda.

(v) Determination of *prabhava*

Prabhav is a unique action of a drug. It can be defined as an action of a *Dravya* which we cannot attribute to any of its *Rasapanchaka*. Such examples are very few and no test parameters are available for its assessment. It is applicable only in case of few drugs.

3) *Evam prabhavm*

Prabhava here stands for Specific Action of a Drug. It is the property of drug which is responsible for peculiar action.

रसवीर्यविपाकानां सामान्यं यत्र लक्ष्यते। विशेषः कर्मणां चैव प्रभावस्तस्य स स्मृतः।। (च.सू.-26/67)

Prabhava is also quoted as *Achintya virya*. According to *Charaka* drug action is possible by means of three aspects[13]

a. Dravya prabhava

b. Guna prabhava

c. Dravya guna prabhava

- In modern *Prabhava* can be correlated with ‘Pharmacodynamics’ i.e. effects of a drug on body systems are studied.

4) Asmin deshe jatam

Here *Desha* is considered, the area where *Dravya* or the herb is grown which can be called habitat. The habitat is made up of Panchamahaboota and varies from place to place. Some of

the plants are grown only in specific area. Some of the *Dravyas* may be found everywhere but still the properties and their active principles differ as per the area and the ecological conditions. As per classical texts *Dravya* should be collected from *Prashasta Desh.*

- As a general opinion *Acharya Sharangdhar* says that all *Ushna Virya Dravya* are to be collected from Vindhya hills and *Shita Virya* are to be collected from Himalayan ranges.[14]

- The land may be categorized on the basis of *Pancha mahabhuta* predominance and drugs for different purposes are to be collected from soil of different *Mahabhuta* dominance as mentioned by *Maharshi Sushruta*.[15]

Dravya	**Collecting place (predominant Mahabhuta)**
Virechan Dravya	*Prithvi* and *Jala Mahabhuta*
Vamana dravya	*Agni, Akasha, Vayu*
Ubhayaja dravya	*Soil* of all *Mahabhuta* predominant
Samana dravya	*Akasha Mahabhuta*

- Plant grown near temples, *Valmika* (anthill soil), *Kutsita* (*Bibhatsa sthana*), *Anupa* (marshy land), *Smashana* (burial grounds), *Usara pradesha* (saline soil), *Marga* (walking lanes), *Jantu Pidita*, *Agni Dagdha* and *Himavyapata* are unfit for therapeutic use.[16]

5) *Ritu grihitam*

In Ayurveda, *Prashasta Ritu* and *Kala* for drug collection i.e., season, time of collection and storage method are well described (C.K.1/10). for the effective results**.** Modern science also states that a standard quality drug can be obtained only if it is collected by Good Collection Practise

Plant part	**Classical view**[17]
Moola (root and rhizome)	*Grishma* and *Shishir* (summer and late winter)
Kanda (bulb)	*Sharad* (autumn)
Twak (bark)	*Sharad* (autumn)
Shakha- Patra (leaves and stems)	*Vasanta* and *Varsha* (spring & rainy season)
Pushpa (flowers)	A/c to flowering season
Phala (fruits)	A/c season of maturity of food
Bija (seed)	———
Saar (heartwood)	*Hemanta* (early winter)
Niryas (latex)	*Sharad* (autumn)

6) *Nihitam*

Preservation methods for drugs are very essential for future use in treatment. The medicinal drug should not come in contact with insects, instruments, smoke, sunshine, air, fire, water and bacteria. The containers like vessels, jars, drums, etc, should be in a way that these should not affect the properties of drugs. The drugs which are to be used in fresh form should not be preserved. Some of the drugs like honey, Piper longum L., Embelia ribes Burm.f. are used after preserving them for 1 year. The main aim of preservation of drugs is to maintain its potency by conserving its properties and actions. A preservation technique varies from sample to sample.

7) *Upaskrit*

Pancha vida kashaya kalpana has told in *Bheshaja Kalpana*, like *Swarasa*, *Kasaya*, *Kwatha*, *Hima*, *Fanta*. Further the derivatives of these *Kashasy Kalpana* are also mentioned, which may be for single drug or for compound formulation. The formulations are prepared to make the drug more potent, to preserve for longer time, palatable and to get effective results.

8) *Matra*

Sharangadara stated there is no specific dosage for everyone. To decide the dose individually *Kala-Agni-Vayah-Bala-Prakriti-Dosha-Desha* are to be considered. Then only the dose is finalized.[18]

Deciding the dosage of a drug plays an important role in the treatment. Dosage must be decided on the basis of *Vyadhi Bala, Agni Bala* and *Rogi Bala*.

9) *Vyadhi*

The physician with all the knowledge of the *Dravya shastra* and *Vyadhi* with his *Yukti* he has to choose/select proper *Dravya* to the particular disease. Single *Dravya* can be used in various diseases depending upon its signs and symptoms.

10) *Evam vidham purushasya*

After going through the details of the above-mentioned concepts, it is safe to administer on the person i.e. clinical trial.

In ancient period *Aacharyas* used to prepare the formulations by themselves as per the requirement instantly, starting from identification process till its preparation, Due to rich heritage of natural resources. But in current era it is difficult. As well as adulteration and

substitution is also increased. So before going to clinical trial animal experiment has to be conducted by following the standardization techniques.

Analytical evaluation techniques in herbal drug[19]

The modern guide lines of standardization of drugs, to prove the identity and purity, the criteria such as the macroscopic evaluation, organoleptic evaluation, microscopic evaluation, chemical evaluation, physical evaluation, biological evaluation, chromatographic techniques, adulteration, contaminants, moisture, ash content and solvent residues have to be checked. The correct and proper identity of the herbal drug is of prime importance in establishing the quality control of herbal drugs.

Macroscopic and organoleptic evaluation

The organoleptic evaluation of a drug by means of sense organs or macroscopic evaluation is the evaluation of the drug by its colour, odour, taste, shape, size and touch, which is based on the study of morphological and sensory profile of the drug.

Microscopic evaluation

This examination of drug is used to identify the organized drugs by their histological features with the help of microscope. For detecting various cellular tissues, trichomes, stomata, starch cells, calcium oxalate crystals, etc.

Chemical evaluation

The qualitative chemical tests are used to identify certain drugs to test their purity, isolation, active constituents, purification and for detection of adulterants.

Physical evaluation

These include moisture content, specific gravity, refractive melting point, viscosity and solubility in different solvents. These criteria are useful in identification of constituent drugs present in the plants.

Biological evaluation

Some drugs have specific biological and pharmacological activity which is utilized for their evaluation especially in plant extract. Here the experiments are carried out on both intact and isolated organs of living animals. With the help of bioassays, strength of drug can be evaluated.[19-21]

Chromatographic techniques

Chromatography may be preparative or analytical. The purpose of preparative chromatography is to separate the component of a mixture for later use, and is thus a form of purification. Analytical chromatography is done normally with smaller amount of material and is for establishing the presence or measuring the relative proportions of analytes in a mixture. The techniques like

Column chromatography

Planar chromatography

Gas chromatography

Liquid chromatography

Supercritical fluid chromatography

Ion exchange chromatography

Size-exclusion chromatography

Expanded bed adsorption chromatography and many more are used.

Along with the above mentioned standardization techniques, Knowledge of *Vriksyaurveda* is also an essential science to over the difficulties. *Vṛkṣāyurveda-Surapāla's* text deals with arbori-horticulture and gives considerable information on the importance of trees, soil types, selection of suitable land, soil characteristics, classification of plants, seed, sowing, planting, plant protection recipes, nourishment, types of gardens, locating groundwater, and bio-indicators to decide the suitability of raising specific crops, examination and treatment of seeds, digging of planting pits, different methods of irrigation, plant nutrition, fertilizers, diseases of trees and their treatment, the wonders of horticulture, plant conservation etc.

For treating disorders, *Surapāla* suggests using a number of plant species that we know today have antimicrobial properties, including mustard paste and milk. *Svātī, Hasta, Rohiṇī, Śravaṇa* and *Mūla* are considered to be good stars for planting trees. The distance between trees should be minimum twenty rods. If the tree does not bear fruit, the stem should be examined by cutting with a knife. Then mix powdered vermifuge seeds with ghee and smear it on the cut. Then water the tree. Watering the trees with fish-water will make them yield fruits more quickly. Mixture of Vermifuge seed, fish and rice is a good manure. This manure is a good remedy for all diseases of trees.[21] (*Agni Purāṇa Chapter 281*).

CONCLUSION

This study can be concluded that both *Dravya Pariksha Vidhi* as per *Ayurvedic* perspective and modern Pharmacognostic are important for evaluation and standardization of a drug or any formulation. But in this era, it is high time to have a control over both intentional & unintentional adulteration. Substitutes may be used as per the requirement but not the *Pradhan Dravya*. To protect critically endangered, rare and costly medicinal plant species there is a great demand of using cell culture techniques development, propagation, conservation, cultivation, motivate farming and growing of endangered, rare species for large scale farming. For getting good yield of the required needs from the plants the knowledge of *Vrikshayurved* is also very important this is the branch of science deals with knowledge of plant life, in all aspects. Genetic engineering in agriculture becomes more efficient and resilient. By considering all the above factors, we can meet today's needful demand by preserving our cultural health care heritage and traditional, *Shastra oushadhee* therapy drug development to provide traditional original medicinal plant-based standard quality products to our nation.

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PHARMACEUTICAL STANDARDIZATION OF HARITAKYADI GUTIKA

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ABSTRACT

Haritakyadi Gutika is an important ayurvedic polyherbal formulation. It should be used in kasa (chronic cough), and shwasa (asthma). **Aim:** The objective was to exploit the standard manufacturing procedure (SMP) and quality standards of Haritakyadi Gutika. **Materials and Methods:** In this present study, Haritakyadi Gutika was prepared in three batches to produce SMP. **Results:** Ingredients of Haritakyadi Gutika in which average percentage yield of Haritaki Churna was 94.26%, Nagar Churna was 94.41%, Musta Churna 94.14 % and Guda Paka was 99.20%; Averagely 91% *Haritakyadi Gutika* was obtained from total ingredients. **Conclusion:** Pharmaceutical Standardization made re-genesis of drug and production of secure potent drugs and useful in scientific area of research in future.

KEYWORDS: *Haritakyadi Gutika*, *Churna* preparation, Standardization.

INTRODUCTION

Haritakyadi Gutika is an important formulation in Ayurveda under the category of Polyherbal Medicine mentioned in *Kasa* (Cough) *Chikitsa Prakarana* of *Chakradatta* 11th *Adhyaya.*[1]

Triumph by Ayurvedic Medicine was totally dependent on the quality of medicine prescribed to patient. In *Chatushpad*, All treatise of Ayurveda given importance to *Vaidya.*[2] An ancient time, *vaidya* used traditional method of preparation of medicine according to diseases. The herbal medication of Ayurved retrieve the Siddhant of ***'Sarvam Dravyam Panchbhautikam Asmin Arthe'.***[3] These *Haritakyadi Gutika* medicine was prepared by the method given in *Sharangdhar Samhita.*[4] The ingredients present in the *Haritakyadi Gutika* are *Haritaki churna (Terminalia chebula), Nagarchurna (Zingiber officinale), Musta churna (Cyperus rotundus), Guda (Saccharum officinarum).* As this yoga was indicated in *Kasa* (Chronic cough) *Chikitsa, Purana* (Old) *Guda* (Jaggery) was preferably used for present study. This *Gutika* also used in the treatment of *Shwasa* (Chronic asthma). The specific pharmaceutical homogenous mixture of these contents can result in a more significant formulation. Therefore the present study has been planned to standardize the method of preparation of *Haritakyadi Gutika* according to method explained in classical texts. *Vatak, Gutika, Vati, Modaka, Vatika, Pindi, Guda* and *Varti* are the synonyms of *vati.*[5] All these terminologies are used as synonyms for *vati* in different part of classics. *Gutika* is a rounded shaped pill being purposefully used for internal administration.

MATERIAL AND METHODS

Collection of raw materials.

Sr. No.	Raw Material	Latin Name	Part Used
1	*Haritaki*	*Terminalia chebula*	Fruit
2	*Nagar*	*Zingiber officinale*	Rhizome
3	*Musta*	*Cyperus rotundus*	Root
4	*Guda(Jaggery)*	*Saccharum officinarum*	-

Haritaki, Nagar, Musta and *Guda*were obtained from the local market of yeola, Dist. Nashik. Preparation of *Haritakyadi Gutika* with the reference of *Sharangadhar Samhita*, was carried out in the Department of Rasashastra & Bhaishajyakalpana, Matoshri Asarabai Darade Ayurved College, Babhulgaon, Tal-Yeola, Dist.-Nashik, Maharashtra.

Equipment Used

Khalwa (Stone Khalwayantra, Length 12 inch), Stainless steel container 3 litre capacity, Stainless steel tray (length – 24 inch, width – 24 inch), Ladle stainless steel length: 15 cm, Cloth: clean cotton cloth of 1 × 1 feet, measuring machine: 2 kg capacity, and gas burner with LPG cylinder (14.5 kg capacity) were used in making process of Gutika.

Pharmaceutical Preparation of *Haritakyadi Gutika*

Study was carried out in three stages

1) **Stage I** -*Haritaki*, *Nagar*, *Musta Churna* preparation.
2) **Stage II** - Liquefaction of *Guda* (Jaggery) as per symptoms of *Guda paka.*
3) **Stage III** - Preparation of homogenous mixture of all ingredients and making of *Haritakyadi Gutika*

Stage I

***Haritaki Churna* Preparation**

Ingredients :- Dry *Haritaki* Fruit - 100 g

Procedure :-Dried *Haritaki* checked for any external impurities then it taken and triturated into clean *khalwa yantra* and filtered through clean white cotton cloth to obtain very fine powder.[6]

Observation :-Brownish coloured *Haritaki Churna* was obtained.

***Nagar Churna* Preparation**

Ingredients :-Dry *Nagar* (Ginger) Rhizome 100 g.

Procedure :-Dried *Nagar* checked for any external impurities then it taken and triturated into clean *khalwa yantra* and filtered through clean white cotton cloth to obtain very fine powder.

Observation :-White or Slightly Brownish coloured *nagar* churna was obtained.

***Musta Churna* Preparation**

Ingredients:- Dry *Musta* root 100 g.

Procedure:- Dried *Musta* root checked for any external impurities then it taken and triturated into clean *khalwa yantra* and filtered through clean white cotton cloth to obtain very fine powder.

Observation:- Brownish coloured *musta* churna was obtained.

Stage 2 - Preparation of *Guda Paka*

After removal of external impurities, clean raw *Guda* should be taken in equal quantity of *churna* (about 300 g) into clean wide mouthed stainless steel vessel of 3 liter sizes. It is added with required 5 ml quantity of water, placed over mild fire and heated with frequent stirring.

Stage 3 -Preparation of homogenous mixture of all ingredients and making of *Haritakyadi Gutika*.

Preparation of homogenous mixture of all ingredients

When *Gudapaka* of suitable consistency was obtained then removed from fire and the fine powder of *haritaki*, *nagar*, *musta* was added one by one into the vessel containing *Guda paka*. Homogeneous mixture of all ingredients was formed.

Making of *Haritakyadi Gutika*

After Homogeneous mixture of all ingredients it left for self-cooling. After cooling of mixture, *Gutika* (Pills) were made by hand with equal shape, size and weight. The prepared *Haritakyadi Gutika* were later dried in shade and stored in airtight container.[7]

Images showing the preparation of *Haritakyadi Gutika*

1) Haritaki

3) Nagar

5) Musta

2) Haritaki Churna

4) Nagar Churna

6) Musta Churna

7) Khalwa yantra

8) Guda

9) GUDA PAKA

10) HARITAKYADI GUTIKA

1) Haritaki
2) Haritaki churna
3) Nagar
4) Nagar churna
5) Musta
6) Musta churna
7) Khalwa Yantra
8) Guda
9) Guda Paka
10) Haritakyadi Gutika

RESULT

Table No 1: Showing the result of *Haritaki Churna* Preparation.

Batch	Initial weight of raw *Haritaki* (g) (before cleaning)	Initial weight of raw *Haritaki* (g) (after cleaning)	Weight of obtained *Haritaki* churna (g)	Weight loss(g)	Yield (%)
I	100	98	93	5	94.89
II	100	96.5	91	5.5	94.30
III	100	94	88	6	93.61
Average	100	96	91	5.5	94.26

Table No 2: Showing the result of *Nagar Churna* Preparation.

Batch	Initial weight of raw *Nagar* (g) (before cleaning)	Initial weight of raw *Nagar*(g) (after cleaning)	Weight of obtained *Nagar* churna (g)	Weight loss(g)	Yield (%)
I	100	96	90	6	93.75
II	100	94	88.5	5.5	94.14
III	100	97	92.5	4.5	95.36
Average	100	96	90	5	94.41

Table No 3: Showing the result of *Musta Churna* Preparation.

Batch	Initial weight of raw *Musta* (g) (before cleaning)	Initial weight of raw *Musta* (g) (after cleaning)	Weight of obtained *Musta* churna (g)	Weight loss(g)	Yield (%)
I	100	94	89	5	94.68
II	100	92	86	6	93.47
III	100	96	90.5	5.5	94.27
Average	100	94	89	5.5	94.14

Table No 4: Showing the result of *Gudapaka*Preparation.

Batch	Initial weight of raw *Guda* (g) (before cleaning)	Initial weight of raw *Guda* (g) (after cleaning)	Quantity of water (ml)	Weight of obtained *Guda Paka* (g)	Weight loss (g)	Yield (%)
I	300	294	05	292	2	99.31
II	300	296	05	293	3	98.98
III	300	295	05	293	2	99.32
Average	300	295	05	293	2	99.20

Table No 5: Showing the result of mixing of component drugs of *Haritakyadi Gutika.*

Batch	Initial weight of *Haritakyadi Gutika* before drying (g)	Final weight of *Haritakyadi Gutika* after drying (g)	Weight loss (g)	Total percentage of *Haritakyadi Gutika* obtained
I	564	549	15	91.5
II	558.5	540	18.5	90
III	564	545	19	91
Average	562	549	17.5	91

DISCUSSION

As per classical texts of *Chakradatta, Haritaki, Nagar, Musta* equal amount of fine powder mixed with equal quantity of *guda* (jaggery) & prepared *Gutika* used in *kasa* (chronic cough) and *shwasa* (asthma) diseases.[8]

Properties of *haritaki* are light to digest, *ruksha* qualities, Astringent dominance five rasa (except *lavana* rasa), sweet after digestion (*vipak*) with hot potency[9] and properties of *nagar* are light to digest, *snigdha* qualities, pungent in taste, sweet after digestion (*vipak*) with hot potency[10] while properties of *mustak* are light to digest, ruksha qualities, bitter, pungent, astringent in taste, pungent after digestion (*vipak*) with cold potency.[11] Old /stored jaggery is light to digest (*laghu*), forms wholesome diet, doesn't block the channels, enhances digestive capacity, pacifies *pitta and vata*, sweet taste (*rasa*), aphrodisiac and vitalizes *Rakta* (i.e. improves haemoglobin).[12]

The pharmaceutical procedures used in this study are *churna* preparation, *guda paka* preparation, *gutika* preparation. Dry *haritaki, nagar, musta* dravyas were made into very fine powder as per reference of *Sharangdhar Samhita*.

In stainless steel vessel, *Gudapaka* made by the references present in *Sharangdhar Samhita* and fine powder of *Haritaki, Nagar, Musta* were mixed to this *Guda Paka* and homogeneous mixture was formed. After that *Gutika* were prepared later dried in shade & stored in airtight container.

Initially after preparation of *Haritakyadi Gutika* weight were found as per batch 564 g, 558.5 g, 564 g, average 562 g; then this *gutika* dried in shade again and measured weight again as per batch were found that 549 g, 540 g, 545 g& average 549 g weight. In total 3 batches of *Haritakyadi Gutika*, Batch I prepared 91.5% *gutika* from total components of drugs while batch II prepared 90% *gutika* and batch III prepared 91% *gutika* from given component.

CONCLUSION

Averagely 91% *Haritakyadi Gutika* was obtained from total ingredients and average 9% loss was found due to removal of external impurities, sticking to the vessel and moisture.

Pharmaceutical Standardization being an initial step towards standardization of any drug. So, it should be done with extreme precision. This leads to re-genesis of drug and production of secure potent drugs. It will be help to scientific researcher in future.

Conflict of Interest: No conflict of interest.

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A CASE STUDY OF AYURVEDIC MANAGEMENT OF PSORIASIS/EK-KUSHTH

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ABSTRACT

Psoriasis is a chronic, multisystem inflammatory disease with predominantly skin and joint involvement. It is a long standing autoimmune disease characterized by patches of abnormal skin. It is non-infectious chronic inflammatory disease of skin characterized by well-defined erythmatous plaques with silvery scale. Psoraisis varies in severity from small localized patches to complete body coverage. The disease not only affects the patient physically but also disturbs the mental and social health of the patient. There is no satisfactory treatment available for Psoriasis. Ayurvedic treatment can give promosing results in such patients. In Ayurveda all skin diseases are described under the umbrella of *Kushtha* and in that Psoriasis is categorised under *Ek-Kushtha*. Repeated Shodhan Chikitsa followed by various Shaman Yogas and Rasayan Chikitsa for continued remission are emphasized in treatment of Kushtha in all ancient Ayurvedic texts. In this article a case of psoriasis is being presented which was treated successfully with Ayurvedic management.

KEYWORDS: Psoriasis, Ekakushtha, Virechana, Shodhan Chikitsa, Shamana Chikitsa, Rasayana chikitsa.

INTRODUCTION

Psoriasis is papulosquamous disease i.e. papules or plaques are covered with scales. Psoriasis is non-infectious chronic inflammatory disease of skin characterized by well-defined erythmatous plaques with silvery scale. Exact etiology is unknown, though the current thinking is that psoriasis is one of the commonest autoimmune diseases occurring in human. Familial occurrence suggests genetic predisposition. Mechanical, chemical or radiation

trauma can initiate or worsen psoriasis. Drugs like chloroquine, beta blockers & NSAIDs can worsen or induce psoriasis. Withdrawal of systemic corticosteroids in a patient with of psoriasis can precipitate an attack of erythrodermic or generalized pustular psoriasis. Summer improves psoriasis and winter worsens it. According to W.H.O. the world-wide prevalence of Psoriasis is 1-2%. It is spreading fast because of unsuitable life-style changes such as dietary pattern, busy schedule and stress. There is no satisfactory treatment available for Psoriasis. Pathology seen in psoriasis is that there is accelerated epidermal turnover and deficient keratinocyte maturation results in visible exfoliation of skin. Vascular changes lead to erythema whereas dense neutrophilic infiltrate may lead to formation of pustules. Initial lesion of psoriasis is a barely elevated erythematous papule topped by a whitish scale. Sometimes scales may not be evident unless the surface is stroked or scratched. Papules may enlarge or coalesce to form plaques covered with thick silvery scales. When the scales are removed, pinpoint bleeding is visible on the involved skin (Auspitz sign).Thus fully established psoriasis consists of well-defined rounded erythematous plaques covered with thick silvery scales. There may be variation in distribution such as scalp psoriaisis, palmoplantar psoriasis, nail psoriasis.[1]

In Ayurveda majority of all skin diseases are described under the chapter of Kushtha in Charak Samhita chikitsa sthaan. Vitiated doshas destroys the skin structure creating discolouration of skin. Kustha are divided into 2 types, (a) Mahakustha, (b) Kshudra Kustha. Mahakustha is again divided into 7 types and Kshudra Kustha is divided into 11 types.[2]

Commonly described etiological factors for development of Kustha are Viruddha Annapana, Drava Snigdha Guru Bhojan, Vegvidharana, eating during Ajeerna Avastha, Mitthyopacharin Panchakarma procedures etc.because of all these etiological factors all three doshas get vitiated and cause vitiation of twak (skin), Rakta (blood), mamsa dhatu (Muscular tissue) & Lasika (serum/lymph).[3] Symptoms of psoriasis can be correlated well with the symptoms of ekakustha and kitibh.[4]

Ekakushtha is described as Vata-Kapha predominant disease having signs and symptoms as - Aswedanam (absence of sweating), Mahavastu (big size lesions) and Matsyashakalopamam (scaling). Symptoms of Kitibha are skin discolouration (Shyava Varna - blackish discolouration), Khara Sparsha(keratinized skin).[5]

CASE REPORT

A 56-years male patient presented in Aarihant Ayurvedic Medical, Hospital, Panchkarma OPD with complaints of erythematous plaques over both legs. It was associated with scaling. Auspitz sign was positive. He was not having any past history of major medical and surgical illness. Patient was taking allopathic treatment for the psoriasis but, did not get much relief. So patient approached for Ayurved treatment.

MATERIALS AND METHODS

Assessment Criteria.

Aswedanam (Absence of Sweating)

Normal Sweating	0
Mild Sweating	1
Mild Sweating on exercise/exertion	2
No Sweating after exercise/exertion	3

Mahavastu (Big size lesion)

No lesion	0
Lesion on partial part of body (Hands and feet)	1
Lesion on most part of body (Abdomen and back area of body)	2
Lesion on almost whole part of body	3

Matsyashakalopamam (Scaling)

No scaling	0
Mild scaling from all lesions	1
Moderate scaling from all lesions	2
Severe scaling from all lesions	3

Skin Discouration (Shyav Varnata)

No discoloration	0
Discolouration on partial part of body.	1
Discolouration on most part of body.	2
Discolouration on whole part of body.	3

Treatment given

Dipana Pachana Chikitsa followed by Shodhana and then Shamana Chikitsa.

1.Deepana Chikitsa - Hingwasthak Churna 5gms 2 times a day before meal with ghrit anupan for 3 days.

2.Pachana Chikitsa- Musta (Cyperus rotundus) and Shunthi (Zingiber officinale) Kwatha (Decoction as mentioned in mentioned in Sharangdhar Samhita) given 20ml BID after meal for 3days.

Chitrakadi Vati 250mg 2 tabs 3 times a day with lukewarm water was given during Deepana Pachana Chikitsa.

3.Snehapan with Tiktaka Ghrita given in morning at 7:00 am for 7 days with increasing quantity of Ghrita every day, Anupana - Koshna Jala (Luke warm water).

a) 1st Day - 30ml Ghrita.
b) 2nd Day - 60ml Ghrita.
c) 3rd Day - 90ml Ghrita.
d) 4th Day - 120ml Ghrita.
e) 5th Day - 150ml Ghrita.
f) 6th Day - 180ml Ghrita.
g) 7th Day - 210ml Ghrita.

Sneha Siddhi Lakshan were continuosly monitored. Patient was asked to stop snehapaan after 7 days as Sneha Sansiddhi Lakshan were observed.

1. Then for 2 days Sarvang Snehan, Sarvang Swedana was given - Snehana with til oil, Swedana with Dashmool Bharad kwath.

2. On Third day after Snehapana - Virechana was given: Kalpa prepared for Virechan – Cows milk 60 ml plus Abhayadi Modak 4 tablets were given. This preparation was given orally to patient at 9:30 am in the morning after Snehana and Swedana. After one and half hour Virechana Vega (Loose Motion) was started. Ten Virechana Vega (Loose Motion passed) in 12 hours. Pulse Rate and Blood Pressure after Virechana were within normal limit. Sansarjana Krama (rules about diet after Shodhana Chikitsa) advised for 5 days.

3. Shamana Yoga was started 5 days after Virechana. Treatment given Kaishora Guggulu, Gandhaka Rasayana, Mahamanjishthadi Kwath[6] 30ml 2 times a day. Jatyadi taila was advised for local application.

BEFORE TREATMENT

AFTER TREATMENT

DISCUSSION

In above case study patient got satisfactory relief from symptoms of psoriasis. Ayurveda has Panchakarma Chikitsa as its unique specialty. In this case study Virechana Chikitsa showed good results along with Shamana Yoga. In Kustha Chikitsa according to Acharya repeated Shodhan Chikitsa should be given to Kustha patient. According to text Virechan should be given every month. Virechana Chikitsa is indicated for vitiated pitta and Kapha Dosha. In this case patient was having symptoms of Tridosha vitiation with predominance of Vata and Kapha Dosha. Virechan Chikitsa helps to remove vitiated Dosha from body. Shaman Yoga was given as a combination of Kaishor Guggul 500 mg bid, Gandhak Rasayan 250 mg bid and Mahamanjishthadi Kwatha 20 ml along with local application of Jatyadi taila.

Rasayana Chikitsa was also given with Tiktaka Ghrita10ml orally on empty stomach. Main content of Kaishora Guggulu is Guduchi, Triphala, Trikatu, Vidanga, Pippali, Chitraka, Dantimool and Nishothaalong with Guggulu. This Kalpais useful for vitiated Kapha Dosha & Rakta Dushti. Guduchi is *Agrya* medicine for vitiated Vata Kapha Rakta. And other content

like Vidang, Trikatu, Danti Pippali, Chitraka are very good medicine for Vata Kapha. They reduce excessively accumulated Kleda at the affected region. Gandhak Rasayana is drug of choice for the vitiated for Pitta Dosha, this combination of Kaishor Guggulu and Gandhak Rasayana found to very much useful in this case of psoriaisis. These 2 medicines were given with Anupana as Mahamanjishthadi kwath. Contents of Mahamanjishthadi kwath[6] are Ananthamoola, Daruharidra, Devdaru, Haritaki, Kantakari, Manjishtha, Vacha, Baheda, Chirata and Nimba. This Kwatha has Kledaghna, Kaphaghna and Rakta Shodhan property. Patient was adviced for local application of Jatyadi taila twice a day at affected part. This local application act by Shodhanaand Ropan Chikitsa. Rasayana Chikitsa was given with Tiktak Ghrita orally. It acts to pacify Vata and Kapha Dosha. It also provides internal oleation which is important part of the psoriasis treatment.

CONCLUSION

In this case study marked improvement was seen in patient of psoriasis. The treatment so planned was helpful in Aampachan, removal of vitiated Dosha from body and bringing Samyavastha (balanced condition) of Doshas. Also it improved Vyadhikshamatwa of patient and hence the treatment was effective to relieve the symptoms and induce remission.

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SCIENCE AND TRADITIONAL MEDICINE W.S.R. TO *TRISUTRA* AYURVEDA: REVIEW ARTICLE

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ABSTRACT

Introduction: The Science involves knowledge which follows some fundamental laws. There are many types of it among them physical science, the earth sciences, biological sciences etc. *Ayurveda* is life science which deals with body, mind and social wellbeing. **Aims and Objectives:** The aim of the present study is to understand and explore the significance of Science and Technology in Traditional Medicine with special reference to *Trisutra Ayurveda*. They are *Hetu, Linga and Aushadha*. **Materials and Methods:** This is a review article based on explanation and interpretation of references collected from the classic Ayurvedic texts, various research articles and websites. **Discussion:** Applying science in traditional medicine we can achieve the highest goal of the health care system by pinpoint diagnosis of many diseases, proper treatment protocols and therapies, use of advance instruments etc. for *Hetu (*causative factor) we can use microscopes, to understand *Linga* (sign and symptoms of a disease) *we* can take advantage of *Nadi Yantra*, Tongue Device and for *Aushadha (Ayurvedic Medicines)* we can make changes in the tablets form, shelf life, using science technology we can develop advanced panchakarma instruments ex. Automatic *shirodhara yantra*. **Conclusion:** Hence Science with traditional medicine w.s.r. to *Ayurveda* together play an important role to keep mankind not only disease free but it adds a heathy active lifestyle.

Key Words: Science, Traditional Medicine, *Ayurveda, Hetu, Linga, Aushadha*

INTRODUCTION: Science is such a double-edged sword that if used properly, it will create, but if it is used due to some misconception, then sure to be destroyed. In the present article, we will understand the usefulness of science and our traditional medicine. With the help of science, we can understand more about our traditional medicine and we will also know what science is hidden inside our traditional medicines, which is the definite need of the hour. Today, when the crisis situation that has arisen around the world, we try to overcome it to some extent through our traditional medicine.

AIM AND OBJECTIVE: The aim of the present study is to understand and explore the significance of *Science and Technology* in *Traditional Medicine* with special reference to *Trisutra Ayurveda*. By adapting scientific approach, we can find out causative agent for any disease accurately, we recognize pinpoint sign and symptoms of particular disease with the help of various medical gadgets, and accordingly we can prescribe the medicine to the patient with various forms like tablets, syrups, Capsule etc.

MATERIALS AND METHODS:

This is a review article based on explanation and interpretation of references collected from the classic *Ayurvedic* texts including *Charaka Samhita*, *Sushruta Samhita*, *Ashtang*

Hridaya and *Ashtang Sangraha and* other standard textbooks along with research articles and various websites on Science, Traditional Medicines, *Trisutra Ayurveda* that is *Hetu* (causes or etiology), *Linga* (Sign and symptoms), and *Aushadha* (Ayurvedic Medicine or therapies).

Review of Literature: Science and Traditional Medicine Science:

When we talk about science, first of all we will understand the definition of science by World Health Organization.

"Science is defined as any system of knowledge that is concerned with the physical world and its phenomena and that entails unbiased observations and systematic experimentation."[1]

Now we will discuss about some types of science here, it is divided in many types as,

1. The physical sciences study the inorganic world and comprise the fields of astronomy, physics, chemistry.
2. The Earth sciences.
3. The biological sciences such as biology and medicine study the organic world of life and its processes.
4. The social sciences like anthropology study the social and cultural aspects of human behaviour.

Traditional Medicine: The definition of traditional medicine by the 'World Health Organization' is defined as "the sum total of the knowledge, skills, Practices which is based on the theories, beliefs, and experiences[2] to cure of body as well as and mind."

India is well known for its six traditional medicinal systems that is *Ayurveda, Siddha, Unani, Yoga, Naturopathy, Homoeopathy*.[3] India is consecrated with an ancient heritage of traditional Indian medicine and *Ayurveda* is the most popular traditional systems among all.

Health: According to WHO health is defined as "Health is a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity."[4] *Ayurveda* consider health as equality of body, mind, and spirit. According to *Acharya Sushruta* health of the person is mentioned as, "The person is called as healthy *(swastha)*, if he has balanced or equilibrium condition of *dosha* (bio-energies), *dhatu* (body tissues), *mala* (waste products), *agni* (digestive fire) and happy and balanced state of soul, sense organs and mind.[5]

Illness: An unwell feeling of body and mind can be consider as Illness, according to *Ayurveda*, the root cause of any disease is always the imbalance of *Tridoshas* (body humours), which further manifests as imbalance in other body components inevitably leading to disease.[6]

The basic aim of any healthcare in the world is to restore those who are ill to health. Health and illness have always been a prime concern of human beings. In India, two parallel medical systems (i.e., Modern and Traditional) exist side by side. Modern medicine is evidence-based and traditional medicine which is present in our culture with evidence.

Ayurveda: The word *Ayurveda* is derived from two Sanskrit words, *'Ayu'* which means life and *'Veda'* which means science or knowledge. Hence the meaning of the word *Ayurveda* is the science of life.[7] *Ayurveda* takes into consideration physical, psychological, philosophical, ethical, and spiritual wellbeing of people.

Scientific Interpretation of *Trisutra*:

Ayurveda has three main components of treatment in order to treat various patients or diseases. The three parts of *Ayurveda* are collectively known as *Trisutra. Hetu* (causes or etiology), *Linga* (Sign and

symptoms), *Aushadh* (Ayurvedic Medicine or therapies). [8]

Now we will discuss in details about *Trisutras* which are present in *Samhitas,*

1. *Hetu* – Identification and Isolation of causative factors of a disease. Generally, *Hetu* can be categorized by two headings as a 1. *Bahya Hetu:* Various unwholesome diets, ill effects of seasons etc 2. *Abhyantara Hetu***:** Internal factors of the disease such as *Dosha Dushya* involved, Microorganism (*Sukshama krimi)* etc.

2. *Linga* – knowing a disease in its entirely by identifying its signs and symptoms (diagnosis). *Ayurveda* has eight ways to diagnose illness: *Nadi* (pulse), *Mootra* (urine), *Mala* (stool), *Jihva* (tongue), *Shabda* (speech), *Sparsha* (touch), *Druk* (vision), and *Aakruti* (appearance)[9].

3. *Aushadha* – treating disease comprehensively after properly diagnosing it i.e., giving *Ayurvedic* medicine or therapies. There are many treatment protocols mentioned in *Ayurvedic Samhitas*, we can choose or select particular treatment plan according to the *Prakriti* and *Dosha Lakshanas* present in the persons, some of the common treatment protocols is as below:

*Nidana Parivarjana (*Removal of Causes*)*[10], *Pathya Sevana* (Eating substances which help body and mind in curing of disease)[11], *Santarpana* (overnutrition), *or Apatarpana* (undernutrition)[12], *Shamana* (Palliative treatments) *or Shodhana* (Detoxifying / Purificatory procedures), *Daiva Vyapashraya* (Mystic & Spiritual healing), *Yukti Vyapashraya* (Intelligent use of drugs)[13,] *Rasayana* (rejuvenation) *and Vajikarana* (Sexual Rejuvenation Therapy)[14] *and Satvavajaya Chikitsa* (Ayurvedic psychotherapy)[15,] *Antah Parimarjana* (Internal cleanse or purify or heal), *Bahi Parimarjana* (outside cleanse or purify or heal*),*[16] *and Shashtra Pranidhana* (surgical treatments) etc.

Science in Ayurveda: After expression of the *Trisutra* of Ayurveda now we will throw some light on what are the scientific things present in *Ayurvedic* text which is the eyeopener of today's world. It is found that many of the *Ayurvedic* drugs, formulations, therapies have evidence-based results. When we talk about drug how can we forgot the importance of turmeric[17], its medicinal properties, and health benefits. *Amla* is such drug which is the best source of vitamin C and is useful in improve Immunity is proven. *Ayurvedic* therapies like *Shirodhara*[18] has significance outcome with Neurological benefits, Stress relieving effects, another most important example is *Jaluka*[19] - the leech therapy, useful in Varicose veins provide effective relief to patients, Preparation and use of *Kshara Sutra*[20]*:* Medicated thread tying technique for treatment of anal fistula has been accepted by surgeons.

DISCUSSION: Utilization of correct modern scientific techniques can give us better *Ayurvedic* drug preparation and form, using technology we can improve *Panchakarma* therapy instruments for beneficial of mankind. We can achieve our highest health goals with scientific approach in *Hetu, Linga and Aushadha.*

To know the *Hetu* of various diseases we can use the Microscope for Microbiology and Parasitology to identify different types of bacteria and parasites. For Unkind seasons which can affect heath on great extent we take consideration of weather forecasting and according to that make our lifestyle.

To understand exact sign and symptoms of a disease that is *Linga*, we

can use following instruments or procedures which are equipped with the help of science and technology for example for *Ayurvedic Pulse* diagnosis we can use *Nadi Yantra*[21], For Urine examinations we can do its Physical as well as chemical analysis, for *Jivha* examinations we can use tongue device which can give us exact color, texture and buds information and so many instruments and devices can be build up to do the diagnosis.

Aushadha which is the third pillar of *Trisutra Ayurveda* can be divided in to two basic types i.e.*Shamana* (Drug treatment) and *Shodhana (Panchakarma Treatment*). *Ayurvedic* medicines can be convert in advanced form so as it becomes more feasible to the patient. Using modern scientific approach *Vati* (Tablets) should be well coated, its shelf life can be increased with specific organic agents. Specific *Ayurvedic* therapies like *Panchakarma* we can use *Auto Electric Shirodhara Yantra*[22], *Calibrated Basti Yantra for Basti* (Medicated Enema), Various *Local Basti Yantras.*

CONCLUSION: The main aim of Science and Technology is to make things simple and easy to practice. In healthcare system symphony of Science and Traditional Medicine can progresses the overall standards and quality of life, as well as extension of life. To meet *Ayurveda's* goal of health, that is curative as well as preventive for illness can be achieved with scientific modification in *Trisutra Ayurveda*. It helps in pinpoint the diagnosis and treatment of diseases. Personalized treatment protocols can be introduced and assess with the help of technology. We can manage side effects of some modern medicines which are used for long time in chronic disease like Rheumatoid Arthritis, Chronic Skin Diseases, Cancer etc. It educates researchers, doctors, scientists, and even laypersons on how to live a healthy active life.

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PHARMACEUTICAL STANDARDIZATION OF HARITAKYADI GUTIKA

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ABSTRACT

Haritakyadi Gutika is an important ayurvedic polyherbal formulation. It should be used in kasa (chronic cough), and shwasa (asthma). **Aim:** The objective was to exploit the standard manufacturing procedure (SMP) and quality standards of Haritakyadi Gutika. **Materials and Methods:** In this present study, Haritakyadi Gutika was prepared in three batches to produce SMP. **Results:** Ingredients of Haritakyadi Gutika in which average percentage yield of Haritaki Churna was 94.26%, Nagar Churna was 94.41%, Musta Churna 94.14 % and Guda Paka was 99.20%; Averagely 91% *Haritakyadi Gutika* was obtained from total ingredients. **Conclusion:** Pharmaceutical Standardization made re-genesis of drug and production of secure potent drugs and useful in scientific area of research in future.

KEYWORDS: *Haritakyadi Gutika*, *Churna* preparation, Standardization.

INTRODUCTION

Haritakyadi Gutika is an important formulation in Ayurveda under the category of Polyherbal Medicine mentioned in *Kasa* (Cough) *Chikitsa Prakarana* of *Chakradatta* 11th *Adhyaya.*[1]

Triumph by Ayurvedic Medicine was totally dependent on the quality of medicine prescribed to patient. In *Chatushpad*, All treatise of Ayurveda given importance to *Vaidya.*[2] An ancient time, *vaidya* used traditional method of preparation of medicine according to diseases. The herbal medication of Ayurved retrieve the Siddhant of ***'Sarvam Dravyam Panchbhautikam Asmin Arthe'.***[3] These *Haritakyadi Gutika* medicine was prepared by the method given in *Sharangdhar Samhita.*[4] The ingredients present in the *Haritakyadi Gutika* are *Haritaki churna (Terminalia chebula), Nagarchurna (Zingiber officinale), Musta churna (Cyperus rotundus), Guda (Saccharum officinarum).* As this yoga was indicated in *Kasa* (Chronic cough) *Chikitsa, Purana* (Old) *Guda* (Jaggery) was preferably used for present study. This *Gutika* also used in the treatment of *Shwasa* (Chronic asthma). The specific pharmaceutical homogenous mixture of these contents can result in a more significant formulation. Therefore the present study has been planned to standardize the method of preparation of *Haritakyadi Gutika* according to method explained in classical texts. *Vatak, Gutika, Vati, Modaka, Vatika, Pindi, Guda* and *Varti* are the synonyms of *vati.*[5] All these terminologies are used as synonyms for *vati* in different part of classics. *Gutika* is a rounded shaped pill being purposefully used for internal administration.

MATERIAL AND METHODS

Collection of raw materials.

Sr. No.	Raw Material	Latin Name	Part Used
1	*Haritaki*	*Terminalia chebula*	Fruit
2	*Nagar*	*Zingiber officinale*	Rhizome
3	*Musta*	*Cyperus rotundus*	Root
4	*Guda(Jaggery)*	*Saccharum officinarum*	-

Haritaki, Nagar, Musta and *Guda*were obtained from the local market of yeola, Dist. Nashik. Preparation of *Haritakyadi Gutika* with the reference of *Sharangadhar Samhita*, was carried out in the Department of Rasashastra & Bhaishajyakalpana, Matoshri Asarabai Darade Ayurved College, Babhulgaon, Tal-Yeola, Dist.-Nashik, Maharashtra.

Equipment Used

Khalwa (Stone Khalwayantra, Length 12 inch), Stainless steel container 3 litre capacity, Stainless steel tray (length – 24 inch, width – 24 inch), Ladle stainless steel length: 15 cm, Cloth: clean cotton cloth of 1 × 1 feet, measuring machine: 2 kg capacity, and gas burner with LPG cylinder (14.5 kg capacity) were used in making process of Gutika.

Pharmaceutical Preparation of *Haritakyadi Gutika*

Study was carried out in three stages

1) **Stage I** -*Haritaki*, *Nagar*, *Musta Churna* preparation.
2) **Stage II** - Liquefaction of *Guda* (Jaggery) as per symptoms of *Guda paka.*
3) **Stage III** - Preparation of homogenous mixture of all ingredients and making of *Haritakyadi Gutika*

Stage I

***Haritaki Churna* Preparation**

Ingredients :- Dry *Haritaki* Fruit - 100 g

Procedure :-Dried *Haritaki* checked for any external impurities then it taken and triturated into clean *khalwa yantra* and filtered through clean white cotton cloth to obtain very fine powder.[6]

Observation :-Brownish coloured *Haritaki Churna* was obtained.

***Nagar Churna* Preparation**

Ingredients :-Dry *Nagar* (Ginger) Rhizome 100 g.

Procedure :-Dried *Nagar* checked for any external impurities then it taken and triturated into clean *khalwa yantra* and filtered through clean white cotton cloth to obtain very fine powder.

Observation :-White or Slightly Brownish coloured *nagar* churna was obtained.

***Musta Churna* Preparation**

Ingredients:- Dry *Musta* root 100 g.

Procedure:- Dried *Musta* root checked for any external impurities then it taken and triturated into clean *khalwa yantra* and filtered through clean white cotton cloth to obtain very fine powder.

Observation:- Brownish coloured *musta* churna was obtained.

Stage 2 - Preparation of *Guda Paka*

After removal of external impurities, clean raw *Guda* should be taken in equal quantity of *churna* (about 300 g) into clean wide mouthed stainless steel vessel of 3 liter sizes. It is added with required 5 ml quantity of water, placed over mild fire and heated with frequent stirring.

Stage 3 -Preparation of homogenous mixture of all ingredients and making of *Haritakyadi Gutika*.

Preparation of homogenous mixture of all ingredients

When *Gudapaka* of suitable consistency was obtained then removed from fire and the fine powder of *haritaki*, *nagar*, *musta* was added one by one into the vessel containing *Guda paka*. Homogeneous mixture of all ingredients was formed.

Making of *Haritakyadi Gutika*

After Homogeneous mixture of all ingredients it left for self-cooling. After cooling of mixture, *Gutika* (Pills) were made by hand with equal shape, size and weight. The prepared *Haritakyadi Gutika* were later dried in shade and stored in airtight container.[7]

Images showing the preparation of *Haritakyadi Gutika*

1) Haritaki

3) Nagar

5) Musta

2) Haritaki Churna

4) Nagar Churna

6) Musta Churna

7) Khalwa yantra

8) Guda

9) GUDA PAKA

10) HARITAKYADI GUTIKA

1) Haritaki
2) Haritaki churna
3) Nagar
4) Nagar churna
5) Musta
6) Musta churna
7) Khalwa Yantra
8) Guda
9) Guda Paka
10) Haritakyadi Gutika

RESULT

Table No 1: Showing the result of *Haritaki Churna* Preparation.

Batch	Initial weight of raw *Haritaki* (g) (before cleaning)	Initial weight of raw *Haritaki* (g) (after cleaning)	Weight of obtained *Haritaki* churna (g)	Weight loss(g)	Yield (%)
I	100	98	93	5	94.89
II	100	96.5	91	5.5	94.30
III	100	94	88	6	93.61
Average	100	96	91	5.5	94.26

Table No 2: Showing the result of *Nagar Churna* Preparation.

Batch	Initial weight of raw *Nagar* (g) (before cleaning)	Initial weight of raw *Nagar*(g) (after cleaning)	Weight of obtained *Nagar* churna (g)	Weight loss(g)	Yield (%)
I	100	96	90	6	93.75
II	100	94	88.5	5.5	94.14
III	100	97	92.5	4.5	95.36
Average	100	96	90	5	94.41

Table No 3: Showing the result of *Musta Churna* Preparation.

Batch	Initial weight of raw *Musta* (g) (before cleaning)	Initial weight of raw *Musta* (g) (after cleaning)	Weight of obtained *Musta* churna (g)	Weight loss(g)	Yield (%)
I	100	94	89	5	94.68
II	100	92	86	6	93.47
III	100	96	90.5	5.5	94.27
Average	100	94	89	5.5	94.14

Table No 4: Showing the result of *Gudapaka*Preparation.

Batch	Initial weight of raw *Guda* (g) (before cleaning)	Initial weight of raw *Guda* (g) (after cleaning)	Quantity of water (ml)	Weight of obtained *Guda Paka* (g)	Weight loss (g)	Yield (%)
I	300	294	05	292	2	99.31
II	300	296	05	293	3	98.98
III	300	295	05	293	2	99.32
Average	300	295	05	293	2	99.20

Table No 5: Showing the result of mixing of component drugs of *Haritakyadi Gutika.*

Batch	Initial weight of *Haritakyadi Gutika* before drying (g)	Final weight of *Haritakyadi Gutika* after drying (g)	Weight loss (g)	Total percentage of *Haritakyadi Gutika* obtained
I	564	549	15	91.5
II	558.5	540	18.5	90
III	564	545	19	91
Average	562	549	17.5	91

DISCUSSION

As per classical texts of *Chakradatta, Haritaki, Nagar, Musta* equal amount of fine powder mixed with equal quantity of *guda* (jaggery) & prepared *Gutika* used in *kasa* (chronic cough) and *shwasa* (asthma) diseases.[8]

Properties of *haritaki* are light to digest, *ruksha* qualities, Astringent dominance five rasa (except *lavana* rasa), sweet after digestion (*vipak*) with hot potency[9] and properties of *nagar* are light to digest, *snigdha* qualities, pungent in taste, sweet after digestion (*vipak*) with hot potency[10] while properties of *mustak* are light to digest, ruksha qualities, bitter, pungent, astringent in taste, pungent after digestion (*vipak*) with cold potency.[11] Old /stored jaggery is light to digest (*laghu*), forms wholesome diet, doesn't block the channels, enhances digestive capacity, pacifies *pitta and vata*, sweet taste (*rasa*), aphrodisiac and vitalizes *Rakta* (i.e. improves haemoglobin).[12]

The pharmaceutical procedures used in this study are *churna* preparation, *guda paka* preparation, *gutika* preparation. Dry *haritaki, nagar, musta* dravyas were made into very fine powder as per reference of *Sharangdhar Samhita*.

In stainless steel vessel, *Gudapaka* made by the references present in *Sharangdhar Samhita* and fine powder of *Haritaki, Nagar, Musta* were mixed to this *Guda Paka* and homogeneous mixture was formed. After that *Gutika* were prepared later dried in shade & stored in airtight container.

Initially after preparation of *Haritakyadi Gutika* weight were found as per batch 564 g, 558.5 g, 564 g, average 562 g; then this *gutika* dried in shade again and measured weight again as per batch were found that 549 g, 540 g, 545 g& average 549 g weight. In total 3 batches of *Haritakyadi Gutika*, Batch I prepared 91.5% *gutika* from total components of drugs while batch II prepared 90% *gutika* and batch III prepared 91% *gutika* from given component.

CONCLUSION

Averagely 91% *Haritakyadi Gutika* was obtained from total ingredients and average 9% loss was found due to removal of external impurities, sticking to the vessel and moisture.

Pharmaceutical Standardization being an initial step towards standardization of any drug. So, it should be done with extreme precision. This leads to re-genesis of drug and production of secure potent drugs. It will be help to scientific researcher in future.

Conflict of Interest: No conflict of interest.

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Elaboration of *Visha* in rasa classics with special reference to *Rasamanjiri*

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Abstract

Ayurveda is a science of antiquity, still in the practice of unbroken continuity. It represents the totality of life and gives complete knowledge required to maintain the holistic balance of the functioning of mind and body.

Rasamanjari was originally written in Sanskrit. 75 years back it was translated to Hindi by Sri Krishnanath of Mathura and published at Lakshmi Venkateshwara press Mumbai by its owner Sri Ganga Vishnu Srikrishnadas Ji Acharya. Later, as a part of the rewriting of rare books, Chaukhamba Orientalia took this book, and Acharya Siddhi Nandan Mishra compiled and published it in 1995.

Visha plays a great role in the treatment and is described as nectar in certain classical texts. Acharya Charaka has also mentioned that if poison is taken in appropriate quantity and form then it can act as medicine, if the medicine is taken inappropriately it acts as a poison. Hence there is a need to understand about poisons in detail from various classical texts.

Identification of poisons along with their special characteristics has been described in detail in this book which is not found elsewhere. The method of reduction of potency or *tikshnatwa* of poisons is mentioned in the book along with the *shodhana* method. *Visha* is described in detail in *Rasamanjari*. The author has dedicated the complete chapter for the description of *Visha*. This article attempts to highlight the peculiarities related to poisons that are not mentioned in other texts. It will also help future scholars and pharmaceutical companies to use methods described in this book while formulating drugs with *Visha* as an ingredient.

Keywords – *Rasamanjiri, Visha, Visha matra, Visha tikshnatwa, Visha* identification.

Introduction

Ayurveda is a science of antiquity, still in the practice of unbroken continuity. It represents the totality of life and gives complete knowledge required to maintain the holistic balance of the functioning of mind and body.

The richness of Ayurvedic therapy is with the drugs of natural resources, lack of side effects, wide compatibility, elimination of vitiating body humor, and maintenance of normal metabolic activities, in addition to curative and preventive aspects. *Rasa sastra* is one of the chief branches of *Ayurveda* with a wide range of potent formulations and rich literary treasures. *Rasamanjiri* is one among them, which was written sometime in the medieval Indian era.

The author of this book has given his brief introduction as the son of Sri Vidyanath. He has not given any information regarding his caste or the place to which he belongs. But, modern scholars of *Rasa sastra* consider his time period to be the 15th century.

Although we cannot find Shalinath's name among the names of 29 *Siddhas*, but he can be considered as one of the *Siddhas* from *Nath sampradaya*, because of his suffix Nath, which is a common tradition among the followers of the *Nath* cult. A *Nath sampradaya* is an initiatory *Guru Shishya* tradition. The primary aim of *Natha Siddhas* is to achieve liberation *(jeevanmukti*) during the current life span. The author of this book has also given priority to this method of learning. It is also an established practice in *Naths* to deal with tradition. Indian alchemy practices, extensively use cinnabar, mercury, crystal preparations, and other minerals for ritual, spiritual and medicinal usage. As a follower of *Nath sampradaya*, the author also described them in this book.

Rasamanjiri was originally written in Sanskrit. 75 years back it was translated to Hindi by Sri Krishnanath of Mathura and published at Lakshmi Venkateshwara press Mumbai by its owner Sri Ganga Vishnu Srikrishnadas Ji Acharya. Later, as a part of the rewriting of rare books, Chaukhamba Orientalia took this book, and Acharya Siddhi Nandan Mishra compiled and published it in 1995. This book was reprinted in 2010.

Visha plays a great role in the treatment and is described as nectar in certain classical texts. Acharya Charaka has also mentioned that if poison is taken in appropriate quantity and form then it can act as medicine, if the medicine is taken inappropriately it acts as a poison. (1) Hence there is a need to understand poisons in detail from various classical texts.

Rasa tarangini has described poison as *Sthavar* and *Jangam*. *Sthavar Visha* is again classified into *MahaVisha* and *UpaVisha*. But here no description of the appearance of each *Visha* is not provided which is provided in *Rasamanjiri*. *Rasamanjiri* has described in detail about poisons, their types, appearance, reducing their *tikshnatwa*, dose to be administered, *shodhana*, *ritu* for sevana of *Visha*, *mantra chikitsa*, *Visha*ghna yoga, and *pathya apathya* during intake of pure *Visha* is also described in detail.

Names of *Visha*s

The author has laid emphasis on *Visha* in this book and described them in detail. Eighteen types of kanda *Visha* are described in detail namely,

1. *Kalakuta Visha*, 2. *Mayurakhya Visha, 3. Binduka Visha, 4. Saktuka Visha,*

5. *Valuka Visha, 6. Vatsanabh Visha, 7. Shankhnabh Visha, 8. Sumangal Visha,*

9. Shringi Visha, 10. Markat Visha, 11. Musta Visha, 12. Kardam Visha,

13. Pushkar Visha, 14. Shikhi Visha, 15. Haridra Visha, 16. Harit Visha,

17. Chakra Visha, and 18. Halahal Visha.(2)

Appearance of *Visha*s (3)

Table no.1: Appearance of *Visha*s

Sr.No.	Names of poisons	Appearance
1.	k*alkuta Visha*	thick, dry, hard, and black like (*Anjana*) collyrium
2.	*MayurVisha*	looks like a peacock
3.	*Binduk Visha*	it looks like drop (*bindu)*
4.	*shaktuka*	looks like *shaktu and kamalkanda*
5.	*valuka Visha*	It has sand like grains in tuber *(kanda).*
6.	*Vatsanabh Visha*	*pandu varna* in appearance
7.	*Shankhnabh Visha*	looks like *shankha*
8.	*Sumangal Visha*	white in color
9.	*Shringi Visha*	is heavy, thick, black, and *shringa aakaar* in shape.
10.	*Markat Visha*	color of monkey.
11.	*KardamVisha*	white and yellow and like mud in color.
12.	*PushkarVisha*	the color of blue lotus.
13.	*ShikhiVisha*	color of a peacock's crown.
14.	*Haridra Visha*	yellow in color and has a tuber.
15.	*Harita Visha*	green in color.

16.	*Chakra Visha*	tuber has circular rings.
17.	*Halahal Visha*	blue in color

Types of *Visha(4)*

There are four types of *Visha* and each type of kanda *Visha* is classified into these four types. Namely,

a. *Brahman*
b. *Kshatriya*
c. *Vaishya*
d. *Shudra*

Brahman Visha is white in color. *Kshatriya Visha* is red in color, *Vaishya Visha* is yellow in color and *kshudra Visha* is black in color. *Kshudra Visha* is the least in qualities as compared to other *Visha*s.

Brahman Visha is used to cure diseases. If anyone has consumed poison then he must be given *kshatriya Visha*. *Vaishya Visha* can be given in all diseases. *Kshudra Visha* is to be used in snake bite poisoning.

Reduction in the potency of *Visha(5)*

The author has said in shloka that *Visha* becomes mrita after t*ritu*ration with an equal quantity of purified *tankan.* The potency of poisons can be reduced by this procedure. Poison mixed with *Tankan* should be used for all diseases. *Kanda Visha* mixed with *tankan* does not cause any ill effects on the body.

Purification of *kandaVisha* (poison)(6)

Poison (*kandaVisha*) should be cut into small pieces and kept in a pot filled with *gomutra*. The pot should then be kept in bright sunlight. On the second day, *gomutra* is changed and the pot is again kept in the Sun. On the third day again *gomutra* is changed and the pot is kept on fire and boiled for 2-3 hours. Then *kanda Visha* is then dried, powdered, and filled in the bottle for further use.

Dose of pure *Visha*(7)

Pure *Visha* should be taken in quantity of one *sarshapa* on the first day, two *sarshapa* on day two, three *sarshapa* on day three, four *sarshapa* on day four, five *sarshapa* on day five, six *sarshapa* on day six and seven *sarshapa* on day seven. Then the quantity is reduced from 8 to 14 days daily reducing 1-1 *sarshapa*. On day 14 the quantity of *Visha* must be one *sarshapa*. In the third week, poison should be administered in the quantity of one *yava* in increasing order increasing one *yava* each day. From the fourth week quantity of poison should be decreased by one *yava* each day up to the 28th day. On the 28th day the quantity of *Visha* is one *yava*. A healthy person can take one *yava* of poison daily. The person suffering from leprosy *(kushtha*) should consume one *ratti* of *Visha* every day.

Favorable season for the administration of *visha (Visha sevan kala*)(8)

Purified poison can be consumed in *Sharad ritu, Grishma ritu, Vasant ritu and Varsha ritu*. If pure poison is consumed for four months, it alleviates leprosy (*kushtha*) and *luta Visha (*spider poison*).*

Contra-indication for the administration of *visha (Visha prayoga nishedh*)(9)

A person less than 8 years of age and over 80 years of age should not consume pure poison. If any *Vaidya* uses poison in a person above 80 and less than 8 years then it produces dangerous side effects.

***Pathyas* during poison consumption (10)**

Pure *Visha* should be used in all diseases with the *anupana* of *goghrita* or *godugdha*. Its use produces rejuvenating effects on the body.

The person consuming pure *Visha* should follow celibacy. If he is not following it and taking poison with ill intentions it will not be beneficial for him.

***Visha vega* (11)**

If anyone consumes poison in excess quantity then he develops eight *vegas*. The following table shows the *visha vegas*,

Table no.2: *Visha vega and symptoms*

Sr.no.	Visha vega	Symptoms
1.	First *vega*	*Udvega*
2.	Second *vega*	*sharir kampa*
3.	Third *vega*	extreme *daah*
4.	Fourth *vega*	person falls on the ground
5.	Fifth *vega*	there is the development of froth from the mouth
6.	Sixth *vega*	person becomes anxious
7.	Seventh *vega*	person develops stiffness
8.	Eighth *vega*	the person dies.

Vishahara mantra (12)

Mantra chikitsa should be done after a proper examination of the patient. The *mantra* should be recited seven times and water potentiated with the *mantra* should be sprinkled afterward. Once the person regains consciousness, the conch shell should be blown near his ear. This reduces the toxic effect of poison. If the intoxicated person stays far then also if the *mantra* reciter goes to his house reciting the *mantra* the effect of the poison is nullified. The person gets cured on seeing the *mantra* reciter even if thousands of attempts have been made to kill him.

Vishaghna yoga(13)

Two *Vishaghna yogas* are described in the chapter

1. *Vandhyakarkotaki* should be mixed with cow's milk it nullifies the effect of three types viz. *sthavar, jamgam* and *audbhid* poisons. *Gojihva* should be mixed with *parad* and administered with *godugdha*. This nullifies the effect of all types of poisons.
2. *Tuttha* should be mixed in equal quantity with *tankan* and administered it reduces the poisonous effect of poisons. (14)

If anyone has consumed poison in excessive quantity then *tankan* mixed with *ghrita* should be given to alleviate the effect of poison.

Conclusion

Rasamanjiri has given a detailed description of *Visha* and highlighted the importance of *tankana*. It is clearly mentioned in the chapter that *Visha* along with *tankana* becomes harmless and can be used for all diseases. The dose of *Visha* to be taken in increasing and decreasing order has been mentioned very precisely by the author. *Visha sevan kala* is also mentioned in the chapter. The importance of the *Vishaghna mantra* is also told. *Vishaghna yogas* mentioned in the text are simple and easy to administer. This article attempts to highlight the peculiarities related to poisons that are not mentioned in other texts. It will also help future *Ayurveda* scholars and pharmaceutical companies to use methods described in this book while formulating drugs with *Visha* as an ingredient.

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ABSTRACT:

In ancient texts most of skin diseases are mentioned under the title of '*Kushtha Roga'*. *Vipadika* is kind of *Kushtha* which is included in the *Kshudra Kushtha*. Different Acharyas have given different signs and symptoms of *Vipadika*. As per *Acharya Vagbhata*, it is characterized by *Pani Pada Sphutana* (Cracking of the skin of palms & soles) &*Teevra Vedana* (Severe pain), *Manda Kandu* (mild itching) & *Saraga Pidika* (red patches of soles). It is chronic and recurring condition. It is predominantly *Vata* and *Kapha Doshaja Vyadhi*. Based on the clinical features it can be resemble with palmo-plantar psoriasis. In present case report, A 49-year-old female patient with complaint of excessive dryness, pain and fissures in palms and soles since 3 & ½ years (on & off). She was clinically diagnosed as a case of *Vipadika* (Palmo-plantar psoriasis). The patient was treated with classical Ayurvedic management of *Kshudra Kushtha*. After 1 month of follow up patient had significant relief in symptoms end of three months of treatment.

Keywords: -*Vipadika, Kushtha Roga, Ayurvedic* management

INTRODUCTION

In ancient classical text, *Kushtha* is the broad term use for all the skin diseases.18 types of *Kushtha Roga* mentioned in *Charaka Samhita*.[1] Which is divided into 7 *Maha Kushtha* and 11 *Kshudra Kushtha*. *Vipadika* is one of the type of *Kshudra Kushtha.* As per *AcharyaVagbhata*, it is characterized by *Pani Pada Sphutana* (Cracking of the skin of palms & soles), *TeevraVedana* (Severe pain), *Manda Kandu* (mild itching) & *Saraga Pidika* (red patches over soles).[2]

In modern science it can be correlate with Psoriasis. It is an autoimmune disease and chronic inflammatory condition. It may be localised to the palms and soles which is known as palmo-plantar psoriasis. It is characterised by red, dry and generalized thickening and scaling of the entire surface of palms and soles with deep and painful fissures which produces significant functional disability. As such, they are associated with substantial impairment in quality of life. Exact cause of Palmo-plantar psoriasis is unknown. However, it is caused by a combination of genetic & environmental factors.[3] Specific gene involvement, smoking, irritants, repetitive trauma are the causes of it. Patients may experience exacerbation carried on by seasonal changes, household work & detergents. It is not easily treated so we have to focus issues like palmo-plantar psoriasis.

Case study

A 49-year-old female patient consulted in Outpatient Department of Kayachikitsa Aarihant Ayurved Hospital, Gandhinagar in November,2022. She was complaints of the cracks on both soles and palms, scaling with severe pain followed by itching with difficulty in walking since last 3 & 1/2 years.

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Patient comes with complaints of cracks on both soles and palms, scaling with severe pain followed by itching & difficulty in walking since last 3 & 1/2 years. She took allopathic medicines at nearer hospital. She got temporary relief in symptoms. But again, she was suffering from above symptoms (on & off). So, she took allopathic medicines for 1 year continuously but she didn't get complete relief. So, patient comes at Kayachikitsa OPD of Aarihant ayurveda Hospital, Gandhinagar with the hope of permanent cure.

Past History

No H/o DM, HTN, any Allergy.

Treatment history

Patient was locally applied clobetasol ointment.

Family history

Not significant.

Menstrual and Obstetric History

Married, $G_2 P_2 A_0 L_2 D_0$

Menarche started at the age of 12 years.

Menstrual cycle was Regular (4-5 days/28 days)

Menopause before 4 years.

Personal History

Patient was vegetarian, appetite was good. Patient had sound sleep. Bowel habit was constipated (once in 3-4 days since 5 years), Micturition was normal with frequency of 4 to 5 times in day & 1-2 times at night.

On examination

Patient had the multiple cracks over both soles and few cracks on both palms with itching, dryness, severe pain on walking was observed. And blackish discolouration on both soles. surface was rough, dry and margin was irregular.

Patient was found to be irritable, depressed due to functional disability, had a *Madhayama Kostha.* Patient had *Vata Kaphja prakriti* with *Madhyama Sara*, *Madhyama Samhanana* (Moderate built). *Pramana* was having *Madhyama*, patient having no allergy to any food & drug (*Madhyama Satmya*),*Madhyama Vyayama Shakti, Aahara Shakti* was *Madhyama.*

Rogi Pareeksha

Nadi: 84 /min, Regular, *Hamsa Gati Nadi*

Mala: *Kathina Mala Pravritti* (once in 3 days)

Mutra: 4-5 times in day & 1-2 times in night

Jihva: Coated

Drika:Prakrita

Sabda: *Prakrita*

Sparsh: *Ruksha*

Aakruti: *Madhyama*

Reviewing her condition following *Samprapti Ghatak* were observed

Dosha: *Vata-Kapha* dominant

Dushya: Rasa (Twaka), Rakta, Mamsa, Lasika

Adhisthan: Twaka

Srotas: Rasavaha, Raktavaha, Mamsavaha

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Management

Internal medications

Table no. 1 : Intervention

Sr.No.	***Aushadha***	***Aushadhamatra* with *anupana***
1.	*Panchatikta ghrita*	10 ml BD on empty stomach with lukewarm water
2.	*Gandhaka Rasayan vati*	500 mg TDS with lukewarm water (After food)

External application

Soak palms & soles in the boiled water with *Tankan*(alum)*Bhasma* for 20 minutes then completely dry it with cotton cloth then apply *Jatyadi Ghrita* on palms & soles.

Mode of action of *Panchatikta Ghrita*:

Panchatikta Ghrita contains *Panchatikta ghana Dravya, Ghrita* & water. All contents are having *Tikta* (Bitter), *Katu* (pungent) *Rasa*, along with *Sheetavirya*(Potency) which helps to pacify the *Tridosha*.[4]

In this case *Rukshta* (Dryness), *Pani-pada Sphutana*(fissures of soles & palms) *Twaka dalana* (Dry Scaling), *Shyava Varna* (Blackish discoloration) etc symptoms are due to *Vata Dosha*. Here,*Vata dosha* get subside by above said properties. also, *Laghu*(light), *Ruksha*(dry), *Sheeta* (cold), *Snigdha* (oily) properties acts combined & helps to subside *Kandu* (Itching) due to *Kaphadosha* & also *Daha* (burning sensation) due to *pitta dosha*. It also has anti- microbial effect (*Rakshoghna*), *Deepan*, *Vaya Sthapaka, Rasayana(*Rejuvenating property), *Balya,* anti-inflammatory properties, hydration effect.

Mode of action of boiled water with *Tankan bhasma*:

Tankan is a *Kshara*. *Kshara* has property of *Ksharan*(cutting). It is *Katu* in *rasa*, *Katu rasa* acts as *Kleda-nashaka*(destroy the excess moisture), *Kandu-Nashaka*(subside the itching), *Mamsa-Vilekhana*(scrapping the dead tissues), *Vrana Avasadaaka*(helps in the removal of excesively projected tissues in wound). Here, in this case it is used with boiled water for the *Vrana-Ropana*(wound healing) action and softening the skin of soles & palms. That helps to improve the skin texture of palms & soles & leading to healing of cracks.[5]

Mode of action of *Jatyadighrita*:

Jatyadi ghrita contains *Jati, Kushtha, Padmaka, Daruharidra, Lodhra* like *Dravyas*. The majority of the *Dravyas* of *Jatyadi ghrit* contain *Tikta, Kashaya Rasa Laghu, Ruksha* & S*nigdha gunas*. It has *Vrana-shodhana*(Cleaning the wound), *Ropana*(healing property), *Pooti-hara* action.

It also has anti-microbial activity, anti-oxidant, anti-inflammatory action and it promotes the shedding of dead tissues and necrotic tissues and promotes healing of cracks, antifungal properties, analgesic, soothing and healing action on skin lesion, anti-septic properties. Overall, the healing effect is getting by the application of *Jatyadi ghrita* over cracks.[6]

Mode of action of *Gandhaka Rasayan Vati*

It contains *Suddha gandhaka*(pure sulpher), *Chaturjata*, *Triphala*, *Suntha*, *Guduchi* etc. It acts as *Kushtaghna*, *Kandughna*, antimicrobial action, blood purification, anti-toxin action, which helps in curing the *Vipadika*.[7]

The above treatment was continued for 3 months. In first 1 month of treatment patient got significant relief in symptoms of fissures of palms & soles, itching, burning& in pain. Gradually healings of fissures were seen. And after those 3 months of treatment patient got significant relief in symptoms.

Result

Table No 02 Effect of therapy on signs and symptoms

Signs & symptoms	15 days	1 month	1& ½ months	2 months	2& ½ months	3 months
Fissures of soles	+++	+++	++	++	+	+
Fissures of palms	++	+	+	+	+	+
Pain	++++	+++	++	+	-	-
Itching	++	+	+	+	-	-
Scaling of skin	+++	++	++	+	+	-
Dryness	++++	++	++	++	+	+
Burning of soles & palms	+++	++	+	-	-	-

Figure 01 Before Treatment

Figure 04 Before Treatment

Figure 02 During Treatment

Figure 05 During Treatment

Figure 03 After Treatment

Figure 06 After Treatment

DISCUSSION

As above mentioned case, patient was diagnosed as a case of *Vipadika*. Treatment was planned as per classical principles of *Kushtha Chikitsa.*

Vipadika is mentioned under the *Kshudra Kushtha*. It is *Vata* and *Kapha Dosha* dominant disease. Based on clinical features of *Vipadika*, it can be correlated with Palmo- Plantar psoriasis. In this case patient had difficulty in walking due to pain, excessive dryness of soles and palms and also sometimes bleeding occurs from cracks of soles. She took allopathic treatment but she didn't get proper relief so, she came to Kayachikitsa Outpatient department of Aarihant Ayurved Hospital for Ayurved treatment. Patient was treated with *Panchatikta ghrita Snehapana* internally and palms & soles soaked in boiled water with *Tankan bhasma* followed by local application of *Jatyadi Ghrita*.

Medicines used for skin diseases have qualities of *Shodhan* and *Shaman*. *Panchatikta ghrita* has *Dipana*, *Snigdha*, *Tridoshahara* action, *Kantikaraka*, anti- microbial effect (*Rakshoghna*)effect, *Vaya Sthapaka*, *Rasayan*

anti-inflammatory properties, hydration effect. Boiled water with *Tankan Bhasma* helps to improve the skin texture of palms & soles by softening of skin & leading to healing of cracks. *Jatyadi ghrit* has *Tikta*, *Kashaya Rasa Laghu, Ruksha* & *Snigdha Gunas.* It has *Vrana shodhana, Ropana, Pooti-hara karma*, anti-microbial activity, anti-oxidant, anti-inflammatory action and it promotes the shedding of dead tissue, necrotic tissues and promotes healing of cracks, antifungal properties, analgesic, soothing and healing action on skin lesion, anti-septic properties.*Gandhaka Rasayan vati* acts as *Kushtaghna* and *Kandughna* which helps in curing the *Vipadika*.

CONCLUSION

In above case study *Ayurveda* management provides the significant relief in three months of treatment. It can be concluded that with applying classical *Ayurvedic* principles & following properly *Pathya-apathya* by patient, the case of *Vipadika* shows excellent improvement and no any side effects were seen.

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Soak palms & soles in the boiled water with *Tankan*(alum)*Bhasma* for 20 minutes then completely dry it with cotton cloth then apply *Jatyadi Ghrita* on palms & soles.

Mode of action of *Panchatikta Ghrita*:

Panchatikta Ghrita contains *Panchatikta ghana Dravya, Ghrita* & water. All contents are having *Tikta* (Bitter), *Katu* (pungent) *Rasa*, along with *Sheetavirya*(Potency) which helps to pacify the *Tridosha*.[4]

In this case *Rukshta* (Dryness), *Pani-pada Sphutana*(fissures of soles & palms) *Twaka dalana* (Dry Scaling), *Shyava Varna* (Blackish discoloration) etc symptoms are due to *Vata Dosha*. Here,*Vata dosha* get subside by above said properties. also, *Laghu*(light), *Ruksha*(dry), *Sheeta* (cold), *Snigdha* (oily) properties acts combined & helps to subside *Kandu* (Itching) due to *Kaphadosha* & also *Daha* (burning sensation) due to *pitta dosha*. It also has anti- microbial effect (*Rakshoghna*), *Deepan*, *Vaya Sthapaka, Rasayana(*Rejuvenating property), *Balya,* anti-inflammatory properties, hydration effect.

Mode of action of boiled water with *Tankan bhasma*:

Tankan is a *Kshara*. *Kshara* has property of *Ksharan*(cutting). It is *Katu* in *rasa*, *Katu rasa* acts as *Kleda-nashaka*(destroy the excess moisture), *Kandu-Nashaka*(subside the itching), *Mamsa-Vilekhana*(scrapping the dead tissues), *Vrana Avasadaaka*(helps in the removal of excesively projected tissues in wound). Here, in this case it is used with boiled water for the *Vrana-Ropana*(wound healing) action and softening the skin of soles & palms. That helps to improve the skin texture of palms & soles & leading to healing of cracks.[5]

Mode of action of *Jatyadighrita*:

Jatyadi ghrita contains *Jati, Kushtha, Padmaka, Daruharidra, Lodhra* like *Dravyas*. The majority of the *Dravyas* of *Jatyadi ghrit* contain *Tikta, Kashaya Rasa Laghu, Ruksha* & S*nigdha gunas*. It has *Vrana-shodhana*(Cleaning the wound), *Ropana*(healing property), *Pooti-hara* action.

It also has anti-microbial activity, anti-oxidant, anti-inflammatory action and it promotes the shedding of dead tissues and necrotic tissues and promotes healing of cracks, antifungal properties, analgesic, soothing and healing action on skin lesion, anti-septic properties. Overall, the healing effect is getting by the application of *Jatyadi ghrita* over cracks.[6]

Mode of action of *Gandhaka Rasayan Vati*

It contains *Suddha gandhaka*(pure sulpher), *Chaturjata*, *Triphala*, *Suntha*, *Guduchi* etc. It acts as *Kushtaghna*, *Kandughna*, antimicrobial action, blood purification, anti-toxin action, which helps in curing the *Vipadika*.[7]

The above treatment was continued for 3 months. In first 1 month of treatment patient got significant relief in symptoms of fissures of palms & soles, itching, burning& in pain. Gradually healings of fissures were seen. And after those 3 months of treatment patient got significant relief in symptoms.

Result

Table No 02 Effect of therapy on signs and symptoms

Signs & symptoms	15 days	1 month	1& ½ months	2 months	2& ½ months	3 months
Fissures of soles	+++	+++	++	++	+	+
Fissures of palms	++	+	+	+	+	+
Pain	++++	+++	++	+	-	-
Itching	++	+	+	+	-	-
Scaling of skin	+++	++	++	+	+	-
Dryness	++++	++	++	++	+	+
Burning of soles & palms	+++	++	+	-	-	-

Figure 01 Before Treatment

Figure 04 Before Treatment

Figure 02 During Treatment

Figure 05 During Treatment

Figure 03 After Treatment

Figure 06 After Treatment

DISCUSSION

As above mentioned case, patient was diagnosed as a case of *Vipadika*. Treatment was planned as per classical principles of *Kushtha Chikitsa.*

Vipadika is mentioned under the *Kshudra Kushtha*. It is *Vata* and *Kapha Dosha* dominant disease. Based on clinical features of *Vipadika*, it can be correlated with Palmo- Plantar psoriasis. In this case patient had difficulty in walking due to pain, excessive dryness of soles and palms and also sometimes bleeding occurs from cracks of soles. She took allopathic treatment but she didn't get proper relief so, she came to Kayachikitsa Outpatient department of Aarihant Ayurved Hospital for Ayurved treatment. Patient was treated with *Panchatikta ghrita Snehapana* internally and palms & soles soaked in boiled water with *Tankan bhasma* followed by local application of *Jatyadi Ghrita*.

Medicines used for skin diseases have qualities of *Shodhan* and *Shaman*. *Panchatikta ghrita* has *Dipana*, *Snigdha*, *Tridoshahara* action, *Kantikaraka*, anti- microbial effect (*Rakshoghna*)effect, *Vaya Sthapaka*, *Rasayan*

anti-inflammatory properties, hydration effect. Boiled water with *Tankan Bhasma* helps to improve the skin texture of palms & soles by softening of skin & leading to healing of cracks. *Jatyadi ghrit* has *Tikta*, *Kashaya Rasa Laghu, Ruksha* & *Snigdha Gunas.* It has *Vrana shodhana, Ropana, Pooti-hara karma*, anti-microbial activity, anti-oxidant, anti-inflammatory action and it promotes the shedding of dead tissue, necrotic tissues and promotes healing of cracks, antifungal properties, analgesic, soothing and healing action on skin lesion, anti-septic properties.*Gandhaka Rasayan vati* acts as *Kushtaghna* and *Kandughna* which helps in curing the *Vipadika*.

CONCLUSION

In above case study *Ayurveda* management provides the significant relief in three months of treatment. It can be concluded that with applying classical *Ayurvedic* principles & following properly *Pathya-apathya* by patient, the case of *Vipadika* shows excellent improvement and no any side effects were seen.

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IMPACT OF INDIVIDUAL FACTORS, SOCIAL FACTORS AND ORGANIZATIONAL FACTORS ON EMPLOYEES' RESILIENCE

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Abstract

Resilience is a crucial aspect in today's workplace as it is linked to employee performance, loyalty, and job satisfaction. It's therefore important for organizations and individuals to study resilience. This study aimed to identify the individual, social, and organizational factors that influence resilience among employees. Resilience is crucial for organizations to cope with adversity and hardship, and individuals who lack resilience are more likely to feel overwhelmed and use harmful coping mechanisms. The study examined the impact of individual and social factors, as well as organizational culture and commitment, on employee resilience. The participants in this survey were working individuals from various sectors/ industries and data was collected from a sample of 150 people comprising 79 females and 71 males. The data also contains responses from generations X, Y and generation Z. The research suggests that there is a moderate to a high degree of positive correlation between resilience and individual factors, social factors, organizational culture, and organizational commitment. Specifically, individual factors such as self-assurance, personal vision, flexibility, organization, problem-solving skills, and proactivity are positively correlated with resilience. Social factors such as interpersonal competence and social connectedness are also positively correlated with resilience. Additionally, organizational culture factors such as achievement and affiliation are positively correlated with resilience, while continuance commitment does not correlate with resilience. Employers and organizations can benefit from this knowledge by investing in programs and policies that promote the development of these factors in their employees, which can lead to increased resilience and better job performance. Additionally, identifying and addressing factors that may be hindering the development of these factors in employees can help create a more supportive and resilient work environment**.**

Keywords: Resilience, individual, social, organizational commitment, organizational culture

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1. Introduction

The positive psychological power to rebound, and bounce back from adversity, uncertainty, conflict, failure, or even good change, progress and increasing responsibility have been termed organizational resilience. Personal resilience can therefore be described as an individual's ability to cope with adversity either by himself or with the help of society, even in the worst of circumstances.

Given that employees spend roughly one-third of their day at work, the importance of workplace resilience cannot be emphasized. Resilience is becoming a more important aspect in today's workplace because it is linked to an employee's dedication to the firm and its goals. A resilient workforce can increase employee performance and loyalty which in turn contributes to employee job satisfaction. It's therefore important for organizations and individuals to study resilience as it has an impact on the lives of employees while also ensuring that the organization has a positive outlook on the future to set clear goals and a strong desire to achieve them.

1.1 Problem Statement

Organizations function because of their workforce. Individuals are required to be resilient to be able to deal with changes and adversity. Various factors tend to affect resilience. Hence this study helps us understand the impact of those factors on employees. If employees as well as organizations can withstand the threats and challenges of the surrounding, they will successfully be able to survive the turbulence.

1.2 The objective of the Study

1. To understand the significance of resilient employees in an organization.
2. To understand the impact of individual factors on the resilience of employees.
3. To understand the impact of social factors on the resilience of employees.
4. To understand the impact of organizational culture on the resilience of employees.
5. To understand the impact of organizational commitment on the resilience of employees.

1.3 Purpose

The purpose of this study was to throw light on the various individual, social and organizational factors that impact resilience amongst employees at workplace positively or negatively.

Literature Review

Resilience

(Linda and Jeffrey Russell, 2006) state that resilience is "an attitude and more like a way of thinking." It is a dynamic quality that can be altered in response to the surrounding environment. A person's resilience may be evident at times and absent at others. This is due to the variable quality of an individual's inherent resilient capacities, as well as the intensity and degree of stress or change to which that individual is exposed. Because resilience is more of an attitude than a hereditary trait, it can be reinforced and cultivated.

According to Susan Kobasa, a famous psychologist, three factors are necessary for resilience:

Challenge: Adversity is viewed as a challenge by resilient organizations and individuals. They see their shortcomings and mistakes as opportunities for growth.

Commitment: Resilient employees in the organization dedicate their lives to the company, thus making the organization resilient as a whole.

Control: Even when an organization is facing tremendous pressure and employees are put on the spot, resilient organizations devote their time and energy to situations

they have some influence on. Resiliency has therefore been defined as the ability to successfully cope with adversity in the realm of human development (Werner; Smith, 2001) and can evolve throughout time as a result of one's growth and interactions with the environment (Kim-Cohen; Turkewitz, 2012).

Individual factors and Resilience

Individual (also known as personal) resilience refers to "a person's ability to cope with stress and adversity while continuing to function effectively in the face of setbacks, failures, and losses". This necessitates the development of appropriate coping mechanisms. People who can persevere and perform at a high level in the face of adversity have a strong belief in their potential to succeed and are optimistic. Resilient Individuals can look after themselves and are always optimistic and confident in their ability to overcome current and future challenges.

Resilient individuals possess the following key characteristics:

1. Self-Assurance: They have a strong belief in themselves and their abilities to handle challenges with real hope and optimism.
2. Personal Vision: They have a clear sense of their life purpose and mission, based on their abilities, interests, personality, values, objectives, skills, family, and life experiences.
3. Flexible and Adaptable: They are open to new experiences and can adjust to changing situations while staying true to their life purpose/vision.
4. Organized: They create structure and order to provide concentration and stability in the face of difficult times.
5. Problem Solver: They can identify the root cause of problems and come up with lasting solutions.
6. Proactive: They take control of their fate by actively participating in change and striving to increase their influence over a situation.
7. Determined: They have a strong willpower and firmness of purpose to persevere and succeed despite challenges or obstacles.
8. Enduring: They have the ability to withstand physical discomfort and mental stress to achieve their goals.
9. Recuperative: They have resilience and can bounce back from setbacks or injuries to return to normal functioning.
10. Self-Aware: They understand their thoughts, feelings, and behaviors, and their impact on others.
11. Self-Motivated: They are internally motivated and passionate about achieving their goals, persisting in the face of challenges and setbacks.

Social factors and Resilience

The term "social resilience" refers to "the ability of members of a group to maintain their well-being in the face of adversity" (Hall & Lamont, 2013b, p. 13). Some studies describe social resilience as "people's, social units', and social systems' ability to cope with, tolerate, and/or recover from calamities" (Khalili et al. 2015), describes social resilience as, "a community's ability to endure external social shock with the goal of improving social capacity to bear disaster losses during disasters and regenerate after disasters." Socially Resilient Individuals possess the following characteristics: Interpersonal competence, and Socially Connected.

- **Interpersonal competence** is a term that is sometimes used similarly to "social skills" and "social competence." There is no universally acknowledged meaning of this phrase due to its pervasiveness. Because so much of professional life revolves around human relationships, Fontana (1990) defines

social skills as "the ability to handle professional relationships effectively".

- **Socially Connected** refers to the strength and quality of a person's personal and professional relationships. Resilient individuals have a strong network of relationships that they can rely on for support, problem-solving, and encouragement during difficult times. Social connections and networks are essential for survival, as they provide a sense of belonging and understanding. The concept of connection is defined by experts such as Edward Hallowell, MD, and Jane E. Dutton, Ph.D., as feeling a part of something larger than oneself and having mutual knowledge and social interaction with others. Social support models include both a structural dimension, which includes network size and frequency of social interactions and a functional dimension, which includes emotional and instrumental components. While both dimensions are important, research suggests that the quality of relationships is a stronger predictor of good health than the number of interactions.

Organizational Culture

According to Poskiene (2006: 47), organizational culture "refers to the complex set of ideologies, traditions, commitments, and values that are shared throughout the organization and that influence how the organization conducts its whole performance becoming a potential source of innovation, advance and advantage". Organizational culture is the sum of values and rituals which serve as 'glue' to integrate the members of the organization. In this view, culture is about "the story" in which people in the organization are embedded. Organizational culture, according to Hofstede (1980**)**, is "the collective programming of the mind that distinguishes members of one organization from those of another." This comprises shared ideas, beliefs, and practices that set one organization apart from another.

Adaptability, according to Schein (2010), is an organization's ability to recognize and respond to external stimuli. To solve external adaptation difficulties, a strong organizational culture necessitates a set of basic assumptions that are planned, disclosed, and developed by organizational members (Cian & Cervai, 2014).

David McClelland's motivation theory suggests that humans have three basic categories of emotional needs that they acquire throughout their lives. These needs can influence behavior and performance in the workplace. Different individuals may have different levels of these needs, and organizations may have a dominant culture that reflects the prevalent need. By understanding our own needs and those of others, we can improve our self-awareness, self-management, decision-making, and overall ability to work effectively with others.

McClelland's motivation theory suggests that individuals have three basic needs:

- **Achievement:** The need for achievement is defined as, "the desire to achieve greatness in one's accomplishments by one's own efforts" (McClelland et al. 1953). Individuals with a high need for achievement have a strong drive to perform better than their peers. People with a high need for achievement are also found to be more effective leaders and to be happier in occupations that are hard and need a high level of competence. When it comes to issue-solving, such people are known to be quite persistent.

- **Affiliation:** It is defined as a person's desire to engage in cooperative and participatory activities (McClelland, 1976). Those who score well on this dimension are likely to spend a lot of time

looking for opportunities to interact with others (McClelland & Koestner, 1992). The desire for connection manifests as an emotional yearning to be liked and accepted. Individuals with a high demand for connection seek out amicable and collaborative workplace relationships as well as a pleasant social environment.

- **Power:** The desire for power, according to McClelland, signifies an "individual's desire to be influential" and involves attempting to persuade others to behave in a way that one desire or that they would not otherwise. As per (Veroff, 1992) those with strong power requirements want to remain in status-driven and competitive environments, attempting to collect status symbols. Individuals who have a strong desire for power want to be respected and have authority over others. Those who score high on this dimension enjoy competitive and status-oriented circumstances. Understanding these three basic needs can help individuals better manage themselves and others in the workplace.

Organization commitment

The term commitment means "engagement or involvement that restricts freedom of action" (Oxford Dictionary). Initially, for an employee, commitment depends on his or her perspective or expectations. Later it depends on various other factors such as job satisfaction, salary, relation with co-workers, etc. As time passes by, organizational commitment tends to become stronger because individuals develop deeper bonds with the organization and their co-workers as they spend more time with them; seniority is often helpful and tends to bring more positive attitudes; and also opportunities in the job market may decrease with age, causing workers to become more strongly attached to their current job (Hellriegel, 2001). The three-component model developed by (Meyer and Allen, 1997) arguably dominates organizational commitment research. The research on organizational commitment explains the behaviour of people concerning their commitment level to the organization Meyer et al, (2002). Some people do their job because they love them, and some do it because their goals are aligned with those of the organization. Some people stay because they fear what they might lose if they quit and some others stay because they feel there is a sense of obligation that they have to follow towards the organization. The research helps us identify 3 different types of commitment levels and those are:-

- **Affective commitment** refers to "the employee's emotional behavior, identification, attachment and involvement with their organization." (Meyer, J. P., & Allen, N. J., 1991). Employees that are emotionally dedicated to staying with the organization are doing so because of their working relationship, which is in line with the organization's values and principles (Beck, N. & Wilson, J., 2000). In general, affective organizational commitment is a one-of-a-kind system that determines the degree to which an organization is linked to a specific person (Allen N J and Meyer J P, 1990).

- **Continuance commitment** refers to "the employee's commitment based on the value associated with their organization." This is in contrast to affective commitment, in which people stay with a company because they want to and because they are familiar with the company's values. Continuance commitment can be viewed as an attack on the organization, in which a person's affiliation with the organization is solely dependent on an appraisal of the financial benefits acquired. (Beck, N. & Wilson, J., 2000). Individuals stay with the organization because of additional investments such as pension plans, and retirement, plans (Allen N J and Meyer J

P, 1990). However, a few research concluded that Continuance Commitment did not appear to be related to employee retention and resilience in the organization.

- **Normative Commitment** refers to "the employee's responsibility for the job and thus makes them stay with the same organization." This can be described as a sense of obligation to continue working with a particular organization (Meyer J P and Allen N, 1997). People who consider the moral commitment to continue inside a given organization, regardless of how much improvement in the state of fulfillment the organization affords the individual through time, are considered as the normative element (March, R. & Mannari, H., 1997).

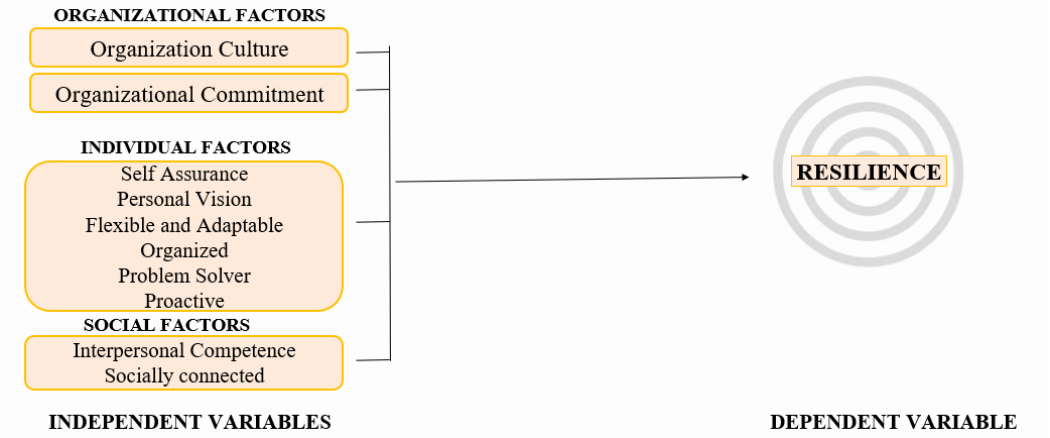
2. Research Methodology

Research Design

Primary research was conducted through an online survey questionnaire. The questionnaire was circulated to working individuals to gauge their resilience level and understand the impact of self-assurance, personal vision, organization, problem solver, flexibility & adaptability, and proactiveness on their working in the organization. The questionnaire was divided into 3 sections with 49 statements in total. The first section contained personal details like gender, age, and level of management. The second section comprised statements in regard to Brief Resilient Coping Scale (BRCS). The third section had statements on Individual factors.

Variables

In this research study, we aim to investigate the impact of various factors on the resilience of employees working in organizations. Specifically, we will examine the influence of individual, social, organizational culture, and organizational commitment factors on resilience. The independent variables in this study consist of individual factors such as self-assurance, personal vision, organization skills, problem-solving abilities, flexibility, adaptability, and proactiveness; social factors like interpersonal competence and social connections; organization culture factors such as achievement, affiliation, and power; and organizational commitment factors including affective commitment, continuance commitment, and normative commitment. These variables are expected to have a direct impact on the dependent variable, which is resilience.



It is important to note that the dependent variable, resilience, will vary depending on the level of influence exerted by the independent variables. Thus, our study

aims to understand the relationship between the independent variables and resilience and to explore how these variables collectively shape an employee's ability to cope with challenges and setbacks in the workplace.

Hypotheses

The null hypotheses of this study are as follows**:**

Ho1: There is no significant relationship between individual factors and resilience.

Ho2: There is no significant relationship between social factors and resilience.

Ho3: There is no significant relationship between organizational culture and resilience.

Ho4: There is no significant relationship between organizational commitment and resilience.

Data collection

Primary (quantitative) and secondary (qualitative) data sources were used to obtain the data for this research. The primary source comprises direct information collected through the questionnaire. Secondary data sources include research papers and related publications available online. To collect primary data, a quantitative approach was adopted through a survey questionnaire comprising 49 statements which were converted into a Google form and circulated online through social media applications/ email and responses were recorded digitally. The sample size of the study was 150. The data was recorded using a 5-point Likert scale (1 being strongly disagreed to 5 being strongly agreed)

Instrument

- Brief Resilience Coping Scale (Sinclair, V. G., & Wallston, K.A., 2004), was used to measure the degree of resilience in individuals. It comprised 4 items. Responses were scored on a 5-point scale. Higher scores indicated a greater resilience coping in the respondents.
- The resilience quotient (RQ) assessment tool (Designed by Jeffrey and Linda Russell 2006), was used to measure resilience with individual personality traits like self-assurance, personal vision, organization, flexibility, and adaptable, problem solver, proactive and social skills like interpersonal competence and socially connected. It comprised 24 items: 18 items for individual factors and 6 items for social factors. Responses were scored on a 5-point scale. Higher scores indicated a greater resilience coping in the respondents.
- Organizational culture (Designed by McClelland's theory, 1961) was used to measure organizational practices and values that impact the resilience of employees. It comprised 12 items, capturing 3 dimensions of Achievement, Affiliation, and Power. Responses were scored on a 5-point scale. Higher scores indicated a greater resilience coping in the respondents.
- Organizational commitment (Designed by Allen and Meyer, 1990) was used to measure 3 dimensions of Affective, Normative, and Continuance with the impact on the resilience of employees. It comprised 9 items. Responses were scored on a 5-point scale. Higher scores indicated a greater resilience coping in the respondents.

Sample/ Participants

The participants in this survey were working individuals from various sectors/ industries and data was collected from a sample of 150 people comprising 79 females and 71 males. The data also contains responses from generation X, Y, and generation Z which included employees of junior and middle-level management.

Sr. no	Demographic factor	Categories	Frequency	Percent
1	Gender	Male	71	47%
		Female	79	53%
2	Age	18-24	59	39%
		25-40	51	34%
		41-56	40	27%
3	Level of management	Junior level management	76	51%
		Middle level management	74	49%

3. Results and discussion/ Interpretations

Data analysis

The data was analyzed using Statistical Package for Social Sciences (SPSS). To ensure that the data was reliable, a reliability test was conducted. Cronbach's Alpha reliability index was used to evaluate the consistency of each construct. Statistical tests such as correlation analysis were conducted on this data.

Reliability analysis

The degree to which a scale produces consistent findings after multiple measurements are referred to as reliability. Reliability test analysis is used to check how reliable the data collected is. As a result, if the reliability analysis correlation is high, the scale delivers consistent results and is thus reliable. The reliability or internal consistency of the data was ensured using Cronbach's Alpha. As per the result shown in Table 01, the Cronbach's Alpha value obtained is 0.896 which indicates that the internal consistency is good and the data is highly reliable**.**

Correlation Analysis

Ho1: There is no significant relationship between individual factors and resilience

Data analysis gives a positive correlation between the independent variable individual factors and dependent variable resilience of 0.723. To deduce the relationship between the two variables, individual factors and resilience, Karl Pearson's coefficient of correlation was calculated. The significance value is 0.000 which is lesser than 0.01, hence the null hypothesis is rejected. (Refer to Table 02)

The null hypothesis

Ho1 is therefore **rejected in favour of the alternate hypothesis: There is a significant relationship between individual factors and resilience.**

An analysis between self-assurance and resilience gives a positive correlation with an r-value of 0.613. An analysis between personal vision and resilience gives a positive correlation with an r-value of 0.553. An analysis between flexibility and adaptability and resilience gives a positive correlation with an r-value of 0.573. An analysis between organized and resilience gives a positive correlation with an r-value of 0.569. An analysis between a problem solver and resilience gives a positive correlation with an r-value of 0.515. An analysis between proactive and resilience gives a positive correlation with an r-value of 0.455. (Refer to Table 02)

Ho2: There is no significant relationship between social factors and resilience

Data analysis gives a positive correlation between the independent variable social factors and the dependent variable resilience of 0.412. To deduce the

relationship between the two variables, social factors and resilience, Karl Pearson's coefficient of correlation was calculated. The significance value is 0.000 which is lesser than 0.01, hence the null hypothesis is rejected. (Refer to Table 03)
The null hypothesis
Ho2 is therefore **rejected in favour of the alternate hypothesis: There is a significant relationship between social factors and resilience.**
An analysis between achievement and resilience gives a positive correlation with an r-value of 0.404. An analysis between affiliation and resilience gives a positive correlation with an r-value of 0.230. An analysis between power and resilience gives a positive correlation with an r-value of 0.196. (Refer to Table 03)

Ho3: There is no significant relationship between organizational culture and resilience
Data analysis gives a positive correlation between the independent variable organization culture and dependent variable resilience of 0.372. To deduce the relationship between the two variables, organization culture and resilience, Karl Pearson's coefficient of correlation was calculated. The significance value is 0.000 which is lesser than 0.01, hence the null hypothesis is rejected. (Refer to Table 04)
The null hypothesis
Ho3 is therefore **rejected in favour of the alternate hypothesis: There is a significant relationship between organizational culture and resilience.**
An analysis between achievement and resilience gives a positive correlation with an r-value of 0.404. An analysis between affiliation and resilience gives a positive correlation with an r-value of 0.230. An analysis between power and resilience gives a positive correlation with an r-value of 0.196. (Refer to Table 04)

Ho4: There is no significant relationship between organizational commitment and resilience
Data analysis gives a positive correlation between the independent variable organizational commitment and dependent variable resilience of 0.254. To deduce the relationship between the two variables, organizational commitment and resilience, Karl Pearson's coefficient of correlation was calculated. The significance value is 0.002 which is lesser than 0.01, hence the null hypothesis is rejected. (Refer to Table 05)
The null hypothesis
Ho4 is therefore **rejected in favour of the alternate hypothesis: There is a significant relationship between organizational commitment and resilience.**
An analysis between affective commitment and resilience gives a positive correlation with an r-value of 0.285. An analysis between normative commitment and resilience gives a positive correlation with an r-value of 0.368. An analysis between continuance commitment and resilience gives no correlation with an r-value of -0.004. (Refer to Table 05)

Limitations
The sample size for the study is only 150, hence the statistical tests may not have been able to identify the accurate significant relationships between the different variables which further reduces the scope of the study. A larger sample size would provide a more accurate data analysis. This research paper focuses on a few individuals, social, organizational culture, and organizational commitment factors that influence the resilience of employees. However, several factors have not been taken into consideration but have an impact on the resilience of employees in an organization. In terms of demographics, the study focuses solely on management level, age, and gender; and could have further explored additional

demographic characteristics such as work experience and growing environment, both of which play a key role resilience of employees. Due to limited responses from top-level management and individuals in the age group 57 and above, the data was omitted in this study to ensure that the currently collected data gives accurate data analysis.

4. Recommendations and Conclusion

The study recommends conducting more extensive research that includes a larger sample size of professionals from various sectors and years of experience to determine if specific sectors or employee experience levels have a stronger correlation to resilience. Employers should be aware of the factors that promote employee resilience and use that knowledge to retain highly resilient employees. In conclusion, the study suggests that to be resilient, employees need to have confidence in their abilities, organize their behavior to achieve their goals and approach problems positively. Organizations should recognize the importance of employee resilience in achieving organizational outcomes and invest in programs and policies that develop individual and social resilience, organizational culture, and organizational commitment. Identifying and addressing factors that hinder the development of these factors in employees can help create a more supportive and resilient work environment.

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Annexure

Appendix 1: Questionnaire

Instructions: Read each of the following statements and, using the 5-point scale, indicate the extent to which you agree or disagree that each statement accurately describes how you perceive yourself and your organization.

1	2	3	4	5
Strongly Disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Disagree**

Factor- Wise Bifurcation

BRCS	
1	I look for creative ways to alter difficult situations.
2	Regardless of what happens to me, I believe I can control my reaction to it.
3	I believe I can grow in positive ways by dealing with difficult situations.

4	I actively look for ways to replace the losses I encounter in life.
Individual Factors	
5	I believe that I have the knowledge, skills, and abilities to deal with almost anything that happens to me.
6	I think and speak positively about myself and my abilities when facing a challenge or stress.
7	When I face great challenges, I look within myself for the answers about what to do and how to respond to the challenge.
8	I know what's important to me in my life.
9	When I look back on my life, I see a clear pattern in the choices and decisions that I have made.
10	I know what I need to do to achieve my personal and professional goals.
11	I approach new situations with an open mind as to what needs to be done.
12	I am willing and able to make adjustments to my goals and plans when situations and expectations of me change.
13	I find that most of the time, I am able to find a way to meet both my needs and the needs of others in a changing environment or during a conflict.
14	When faced with a major change, I usually find a way to create systems or structures that give me a degree of control that I find useful and helpful.
15	I start each work day by thinking about what I need to accomplish during that day and I end each day reviewing what I need to accomplish the next day.
16	I usually maintain some sort of a "to-do" list to help me focus on what I need to work on.
17	When I have a problem to solve or a decision to make, I usually spend time defining the problem or decision.
18	I see the problems that I face in life and at work as challenges that I can solve.
19	When I solve problems or make decisions, I try to identify the relationships between the problem I am solving or the decision I am making with other issues, problems, and challenges.
20	I view change - even difficult and challenging change - as an opportunity for me to learn and grow.
21	When an unwelcome change is forced upon me, I can usually find a way to either influence the course of the change or find a way to make the change work for me on my terms.
22	Rather than focusing on what others are doing to me, I tend to focus my energy on how I can make the best of a situation.
Social Factors	

23	In social interactions at work and in my personal life, I am usually able to laugh at myself when appropriate.
24	In stressful or conflict situations I am usually able to maintain effective relationships with others.
25	I value the diverse beliefs, approaches, and methods that people bring to their work and their daily interactions with me.
26	I have a diverse group of people whom I consider good friends.
27	I find it easy to form lasting friendships.
28	I regularly participate in one or more non-work-related group activities with friends (e.g., church, sports, cultural, etc.) where I can let off steam, learn, grow, and have fun.
Organization Culture	
29	People in my organization are concerned about achieving goals and meeting standards of excellence in performance.
30	People in my organization interact with each other to improve their performance and achieve goals.
31	People in my organization challenge others' ideas or work to improve performance.
32	Good performance is recognized and encouraged in my organization.
33	There is warmth and friendliness in relationships between most people in my organization.
34	There is frequently informal and friendly interaction among people in my organization.
35	There is a lot of cooperation and helpfulness among people in my organization.
36	People in my organization are helpful to each other in times of difficulty.
37	People in my organization are very concerned about status, position and power.
38	There is a tendency for people in my organization to engage in one-upmanship with each other.
39	There is a tendency for people in my organization to get into competition and rivalry with others.
40	Informal cliques tend to develop to promote or protect the interests of a few in my organization.
Organization Commitment	
41	I am quite proud to be able to tell people who it is I work for.
42	I sometimes feel like leaving this employment for good (R).
43	I am not willing to put myself out just to help the organization (R).
44	Even if the firm were not doing too well financially, I would be reluctant to change to another employer.

45	I feel myself to be part of the organization.
46	In my work, I like to feel I am making some effort, not just for myself but for the organization as well.
47	The offer of a bit more money with another employer would not seriously make me think of changing my job.
48	I would not recommend a close friend to join our staff (R).
49	To know that my own work had made a contribution to the good of the organization would please me.

Table 01 Reliability Analysis - Cronbach Alpha

Reliability Statistics

Cronbach's Alpha	N of Items
.896	49

Table 02: Co-relation Analysis Individual Factors

Correlations

		BRCS	Individual factors Resilience Quotient
BRCS	Pearson Correlation	1	.723**
	Sig. (2-tailed)		.000
	N	150	150

Correlations

		BRCS	Self Assurance	Personal Vision	Flexible and Adaptable	Organized	Problem Solver	Proactive
BRCS	Pearson Correlation	1	.613**	.553**	.573**	.569**	.515**	.455**
	Sig. (2-tailed)		.000	.000	.000	.000	.000	.000
	N	150	150	150	150	150	150	150
Self Assurance	Pearson Correlation	.613**	1	.676**	.555**	.540**	.555**	.467**
	Sig. (2-tailed)	.000		.000	.000	.000	.000	.000
	N	150	150	150	150	150	150	150
Personal Vision	Pearson Correlation	.553**	.676**	1	.406**	.603**	.540**	.322**
	Sig. (2-tailed)	.000	.000		.000	.000	.000	.000
	N	150	150	150	150	150	150	150
Flexible and Adaptable	Pearson Correlation	.573**	.555**	.406**	1	.469**	.445**	.423**
	Sig. (2-tailed)	.000	.000	.000		.000	.000	.000
	N	150	150	150	150	150	150	150
Organized	Pearson Correlation	.569**	.540**	.603**	.469**	1	.450**	.378**
	Sig. (2-tailed)	.000	.000	.000	.000		.000	.000
	N	150	150	150	150	150	150	150
Problem Solver	Pearson Correlation	.515**	.555**	.540**	.445**	.450**	1	.467**
	Sig. (2-tailed)	.000	.000	.000	.000	.000		.000
	N	150	150	150	150	150	150	150
Proactive	Pearson Correlation	.455**	.467**	.322**	.423**	.378**	.467**	1
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	
	N	150	150	150	150	150	150	150

Table 03 Co-relation Analysis - Social factors

Correlations

		BRCS	Social factors Resilience Quotient
BRCS	Pearson Correlation	1	.412**
	Sig. (2-tailed)		.000
	N	150	150

Correlations

		BRCS	Interpersonal Competence	Socially Connected
BRCS	Pearson Correlation	1	.286**	.369**
	Sig. (2-tailed)		.000	.000
	N	150	150	150
Interpersonal Competence	Pearson Correlation	.286**	1	.267**
	Sig. (2-tailed)	.000		.001
	N	150	150	150
Socially Connected	Pearson Correlation	.369**	.267**	1
	Sig. (2-tailed)	.000	.001	
	N	150	150	150

Table 04 Co-relation Analysis - Organization Culture

Correlations

		BRCS	Organization culture code
BRCS	Pearson Correlation	1	.372**
	Sig. (2-tailed)		.000
	N	150	150

Correlations

		BRCS	Achievement	Affliation	Power
BRCS	Pearson Correlation	1	.404**	.230**	.196*
	Sig. (2-tailed)		.000	.005	.016
	N	150	150	150	150
Achievement	Pearson Correlation	.404**	1	.636**	.186*
	Sig. (2-tailed)	.000		.000	.022
	N	150	150	150	150
Affliation	Pearson Correlation	.230**	.636**	1	.109
	Sig. (2-tailed)	.005	.000		.185
	N	150	150	150	150
Power	Pearson Correlation	.196*	.186*	.109	1
	Sig. (2-tailed)	.016	.022	.185	
	N	150	150	150	150

Table 05 Co-relation Analysis - Organizational commitment

Correlations

		BRCS	Organisational Comittment Code
BRCS	Pearson Correlation	1	.254**
	Sig. (2-tailed)		.002
	N	150	150
Organisational Comitment Code	Pearson Correlation	.254**	1
	Sig. (2-tailed)	.002	
	N	150	150

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Correlations

		BRCS	Continuance	Affective	Normative
BRCS	Pearson Correlation	1	-.004	.285**	.368**
	Sig. (2-tailed)		.963	.000	.000
	N	150	150	150	150
Continuance	Pearson Correlation	-.004	1	.313**	.403**
	Sig. (2-tailed)	.963		.000	.000
	N	150	150	150	150
Affective	Pearson Correlation	.285**	.313**	1	.369**
	Sig. (2-tailed)	.000	.000		.000
	N	150	150	150	150
Normative	Pearson Correlation	.368**	.403**	.369**	1
	Sig. (2-tailed)	.000	.000	.000	
	N	150	150	150	150

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

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AN EMPIRICAL ASSESSMENT OF MICROFINANCE AND ITS ASSOCIATED SOCIO-ECONOMIC DEVELOPMENT

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Abstract: Microfinance institutions (MFIs) provide support for the sustainability of livelihood and financial inclusion through social development. Micro-enterprises helps in empowering the communities especially marginalized section worldwide. The MFIs attempt to transform the lives of poor people, through different interventions. It revolved around the social development of marginalized people. In recent decades, microfinance played a vital role in alleviating poverty and involved empowering low-income earners socially and economically. The present study intended to highlight the role of MFIs located in Jabalpur (Madhya Pradesh) in enhancing the social and economic status of beneficiaries. This study also acknowledges the significance of MFIs in eradicating poverty, through financial services. In this research, questionnaire responses were gathered and analyzed from 150 beneficiaries of three MFIs (Credit Access Grameen, ESAF, and Fusion Micro-finance) in Jabalpur. The exploratory data analysis reveals diverse findings, regarding the impact of microfinance on the socio-economic conditions of beneficiaries through improving their savings, supporting the employment generation, and as a whole improving life standards as well as eradicating poverty. Alternatively, MFI programs also assist beneficiaries in employment generation, to a certain extent. The conclusion of the research prioritizes that MFI programs ought to be accelerated more by the Government through different schemes and can be easily accessed to even remote areas for economic expansion and social development of low-privileged people.

Keywords: MFI-Microfinance institutions, Jabalpur, social development, economic condition financial services.

JEL Codes: D00, D12.

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1. Introduction

Microfinance is defined as the provision of a broad range of different financial services including insurance, savings, payment services, and credit to low-income and poor people (Kumar, Chauhan, & Kumar, 2015). The poor people are deprived of reaching out to formal financial institutes since they fail to provide collateral. Microfinance was identified as a beneficial tool in combatting poverty and fulfilling the basic requirements of the poor consistently and independently. This provides small-interest credit services to poor people and can exploit employment opportunities and expand the present business activities.

The non-government and government microfinance institutes were performing in African and Asian countries to serve the clients. In 1990, the decade is referred to as the decade of Microfinance, and a new Micro-credit Summit was launched to develop small businesses in 1997 for poor people empowerment. Nearly one hundred and seventy-five million poor households and women population within families had focussed on reaching the micro-credit Summit (Rehman, Moazzam, & Ansari, 2020). Similarly, in 2005, the United Nations announced this year to be the International Year of Micro-finance, because of MFI's contribution to minimizing the poverty vulnerability globally. (ADB) Asian Development Bank, comprises two different primary sources such as offering microfinance to needy people, informal institutes, and semi-formal and formal institutes. The Co-operatives and rural banks were playing a predominant role in developing nations as formal Microfinance streams. The primary part of MFI narrated its key objective to be fascinating micro-credit to the low-income people, who were not able to provide the collaterals to those MFI (Farghly, Saleh, Youssef, & Bary, 2018). The activities of MFI encompasses offering small loan amount since the MFI client consists of daily wage people or low-income earners. These people may generally have constrained access to different financial services such as remittances, insurance, savings, and loans. The MFI paves a road path to explore the small business of these low-income earners. The loans were offered for various benefits like the development of micro-enterprise and their establishment.

The major goal of this MFI is to provide consistent financial services like savings and credit to relieve the low-income bearers (poor) from financial constraints. The MFI aids in eradicating poverty in society concern. Irrespective of whether it is profit-oriented or not like so, every MFI attempts to increase the performance of repayment. Both borrowers and MFI were greatly related to higher rates of repayment. The higher rates of interest enable MFI to minimize loans' financial costs and to permit more count of borrowers in their accessibility by eliminating charged interest rates to those borrowers. For example, usually, there are three categories of institutions such as commercial and specialized banks, (NGO) non-Governmental organizations, and been operated using BARDM BRDB, RDA, ministry of

government, or other departments. But also this micro-finance plays a vital role in developing the social status of low-wage people or in the empowerment of people through business or loans (Zahir, Al Mamun, & Shrestha, 2020).

Many recognitions and achievements are claimed about micro-finance activities effects and foreign-observer could not however wonder at the broad level of amenities bought down by MFI. For different socio-economic reasons, Bangladesh is one of the poorer countries, wherein half of the entire population lives below the line of poverty at this time. Hence, the reduction in poverty and generating rural employment for those people stand as the topmost priorities, for the government of Bangladesh (AHAMAD, BHUIYAN, SOLAIMAN, & JOARDER, 2021). Hence the government initiates a wide approach for alleviating poverty, to improve the economic status of the public and nation through emphasizing economic independence, support for MFI, empowerment, and macro-economic stability. In this approach, MFI turned out widespread throughout the nation and aided in expanding the economy and alleviating poverty tremendously. In Bangladesh, some of the examples of leading MFI were ASA, BRAC, and Grameena Bank (Chouksey & Karmarkar, 2019).

Across the World, MFIs try to construct a unique kind of tripod in financial inclusion, and sustainability of livelihood through social development and micro-enterprises to empower communities of marginalized sections. The research spoke about the involvement of MFIs in preventive healthcare, financial literacy, livelihood promotion, capacity building, training and education, sanitization and water, etc. beyond the core financial activities like micro-credits to the poor. Out of 23 MFIs operate 20 backward districts in Madhya Pradesh. MFIs shifted the focus to states like Uttar Pradesh, Madhya Pradesh, Bihar, and Rajasthan; the states from south India like Tamil Nadu, Kerala, and Karnataka indicate greater penetration of MFI, in the backward districts and commensurate with overall greater penetration across these India states. However, it has been a contradiction that the work of MFIs done only in backward districts and backward states. MFIs operate currently in 568 districts, 28 states, and 5 union territories in India (Jamal & Mazhar, 2019).

Indian MFIs extended their environmental outreach and also associated their footsteps in the arena of social development in a wide way. Particular thrust area with social development where the Indian MFIs are active includes financial literacy, preventive health care, capacity building, livelihood promotion, training and education, sanitation and water, etc. (Lindahl & Mokvist, 2020). In the existing study particular important interventions by many MFIs have been revised to cause more actions on borders also with particular discourse and academic research on the subject. According to the Bharat Microfinance report, several MFIs have been involved in socio-developmental initiatives such as preventive healthcare (45), water

and sanitation (35), financial literacy (51), training (56), capacity building (35), education (31) and livelihood promotion (56) (Mohd, 2018).

There lies a powerful argument for central bank authorities and regulators, to expand the efforts rapidly at stabilization of the financial sector to indulge all Microfinance norms. The industry of Microfinance was connected closely with the rural economy by offering micro-credit to non-financial services and smaller businesses to poor households. With the rapid progress of micro-finance activities, several studies in identified MFI programs' effects on poverty reduction, and some researchers also emphasized assessing the impacts of micro-credit and savings services on the living standards of the people. The parameters such as social and economic progress are lacking in the existing studies with detailed quantitative analysis as well as empirical evidence.

Today Microfinance movement seems thriving and large, evidenced by the existence of 916 MFI. Having an approximate aggregate loan portfolio, constituting 124 billion dollars. MFI had nearly 140 million active borrowers, globally in the year 2018, of which 80 percent of them were women and 65 percent of the population are people residing in rural regions. To incorporate more services, both non-financial and financial, microfinance orientation diverges from lending to low-income people to pursue double bottom-line goals of financial sustainability and outreach (Zamore, Beisland, & Marsland, 2019). In today's era, MFI Serves hundreds of millions of borrowers hence playing a key role in uplifting societal and economic status and alleviation poverty in developing nations, specifically in Pacific and Asian countries. MFI were the invincible knights to shine armor on a mission to eradicate salvage and poverty. The financial stability of the population is yet a concern for MFI, and it should essentially behave like other firms, focused on being profitable (Zamore et al., 2019). Even though like another financial sectors like commercial banks, MFI were evaluated commonly with regards not alone to profits but to other social impacts.

The role of micro-finance whether local or global is to provide financial services and substantial financial flow to economically marginalized populations, who are often ignored by the formal financial stream. With the evolution of microfinance, in developing economies, the people excluded from the traditional financial system, possess access to alternatives in saving and borrowing, instead of having dependency on friends and family. MFI possesses considerable changes in socio-economic conditions, and ought to be assessed, prior to rectifying the gaps. Microfinance can maximize self-employment and evolve in creating microenterprises (Nogueira, Duarte, & Gama, 2020). With the support of micro-finance, in many developing nations, the household was capable of expanding opportunities for income accumulation, hence permitting people to offer to their respective families. By

having accessibility to credit, could aid in recovering from poverty, in immediate terms, in disruption of the poverty cycle, hence facilitating business opportunities.
Through the assistance of micro-finance, entrepreneurs in developing nations, and impoverished communities, might operate, survive, and even thrive by generating more employment opportunities. Participation in microfinance programs, related to high consumption levels, better nutrition commonly uplifted living standards, and progressing economies (Nogueira et al., 2020). In spite of the inherent purpose, of acquiring good benefits, it seems crucial to acknowledge MFI is not without any faults, a few of them include, driving client over-indebtedness, exorbitant interest rates, questionable record upon female empowerment (Garikipati, Johnson, Guérin, & Szafarz, 2017), overemphasis upon credit instead of other related financial services, lacking in explaining the impacts on reduction of poverty.
The need to reconsider MFI claims, both about the economic and societal impacts upon households. The profitability of microfinance as a business enterprise, which serves low-income households. The claims about profits and large were exaggerated, however, it should have claimed about its failures. There is significant, heterogeneity, in profit and impacts, and micro-finance holds real appeal in certain contexts, specifically if communities are fundamentally under-served. The expectations for effects are set higher through microfinance pioneers. Hence the impact of MFI to overcome, financial constraints, economic status, and societal parameters from the perspectives of the public is always a necessity gap to fill in, and thus it could radically expand the public opportunities to earn, in pre and post-accessibility to MFI benefits.

1.1 Problem Identification

It had been recently determined that instead of reducing poverty, the Microfinance program maximized income generation and consumption, however microfinance scenario, fails in supporting sustainable business-enterprise, for certain reasons. The micro-finance institution ensures the empowerment of the economy to a higher degree of extent. There lies a huge necessity to arrange the credit-plus programs through MFI, to attain more and more empowerment of its beneficiaries. Few researchers had disclosed that these MFI programs would not contribute properly towards the socio-economic development of the nation and in alleviating poverty as per expectation. The significance of the MFI and its schemes, with evidence outcomes, ought to be emphasized to circulate awareness to the public and to attain the benefits. The existing research has explicated that the impacts of Microfinance on assets and income are not important for all the regions of Bangladesh, however, its micro-credit possesses significant effects on expenditure or consumption (Ray & Mahapatra, 2019).

The micro-finance loan will be utilized for consumption expenditure sources. The credit holder spends the money on non-economic activities (Vassallo, Prabhu, Banerjee, & Voola, 2019). Hence at the instalment of repayment, poor credit ought to borrow the amount from various sources and hence the situation became highly complicated for the populace. Therefore, the study focuses on the performance of micro-finance programs and their impact on social development.

The present study analyses the various factors such as economic conditions, generation of income, savings, employment, health expenses and living standards before and after getting financial aid such as loans. The results of the study highlight the impact of MFIs in improving the socio-economic conditions of the beneficiaries of the MFIs. Thus, this study brings deserving attention to the MFIs in order to improve the livelihood of the poor.

1.2 Paper organization

Section 1 states the introductory concepts of research. Section 2 enumerates the review of literature studies and its gaps, Section 3 describes the research method, Section 4 illustrates the results of statistical analysis, Section 5 presents the discussion and Section 6 defines the conclusive statement of the study.

2. Review of Literature

The below section enumerates the review of different existing studies, stating the role of microfinance in different aspects to improve society and services.

The literature on microfinance, highlights the different multitude of actors, having various categories of institutional logic that provide financial services to needy and poor people. However, it has not been defined, how the logic classification is applied. The perspective of institutional logic, MFI, enunciated how the organizational actions were shaped through shared belief, delivered towards poor people and the poorest group of societies. Hence this institutional logic, being adopted by MFI generates expectations of MFI in a similar context (Atiase, Mahmood, & Wang, 2019). Conversely, in the research of Semambo Hussein Kekambo, he stated that Islamic microfinance was noted to be a panacea towards financial inaccessibility challenges between (SME) Small and medium-sized enterprises particularly in developing countries. The objective of this research relies on examining how Islamic microfinance adoption could play a vital role in enhancing MFI sustainability whilst meeting the SME financial challenges in Uganda's regions. In the Practical model, the study would serve to be a guide to those practitioners and policymakers in the microfinance field by adding flair. This would enable bridging challenges related to inadequate SME financing in the Uganda region (Kakembo, Abduh, Hj, & Salleh, 2021).

Owing to these challenges, Sunil Sangwana, reported the research about the assessment of loan re-payment behavior, among those Clients of MFI residing in two Eastern Indian states. The contribution of demographic characteristics, loan characteristics, economic characteristics, regional attributes, and moral hazard features of client households are examined by the researcher. The inferences in this literature reveal comprehending repayment risk under uncollateralized credit and asymmetric conditions. Tracking the loan characteristics and household attributes aids the MFI in generating certain credit risk parameters and in the formulation of credit scores (Sangwan, Nayak, & Samanta, 2020).

Similarly, Jarrod P. Vassallo explored research on hybrid organizations and determined Microfinance organizations to be an ideal hybrid representation and as quintessential social innovation. The MFI is generally administered using group-lending schemes whereas conventional bank loans were not. In coping with this, the credit provision for product purchases like solar energy systems for a house depends highly on trustworthiness supervision in comparison to formal collateral (Vassallo et al., 2019). Research by Amit demonstrates that the Indian Government reinforced the microfinance program in the SGSY system to decrease rural households' poverty. Some extension of the National Rural Employment Guarantee scheme plays the aid's role. It has been evidenced that by using Natural experiments, microfinance programs can diminish the susceptibility of rural household participation. It has been completed by constructing a susceptibility index. Social parameters (Jha, 2019) include enrichment of empowerment of the contributing independent group participants who belong to categories of women under SGSY enterprise between the apprehensive time and microcredit's size that have been grabbed for profits generating schemes (Aggarwal, Kumar, & Garg, 2020). It plays a vital role in decreasing the susceptibility of the contributing rural households in the Microfinance program. The paper (Kundu, 2010) demonstrates that the microfinance program in the SGSY system can decrease the vulnerability of involvement of rural households. Microfinance programs contribute to financial services that help poor households to create renovation from day-to-day existence to plans. Few works like the river dam's construction that ranges in NREGS support the marginal agriculturalists to perform binary cropping which plays an important role in easing their susceptibility and the scarcity of household members. NREGS (National Rural Employment Guarantee Scheme- Implementations) has been playing a significant role in diminishing the vulnerability of the country's women.

Indra's research states (Widiarto & Emrouznejad, 2015) that it suggests two-stage examinations to measure the performance of IMFIs (Islamic Microfinance Institutions) by associating with the predictable MFI's efficacy in its twofold objectives regarding financial and social efficacy. During the second phase,

nonparametric tests have been used to associate the performance and pinpoint elements that contribute to the efficacy of MIFs and IMFIs.

The microfinance sector has been focused largely, on providing loans to underprivileged people without the necessities such as collateral security. The majority of microfinance firms, within India, employ Self-help groups (SHG) or any (JLG) Joint liability group models of people group lending towards issue loan facilities since the pressure acts as one of the social collateral in those models. Offering micro-loans to micro-enterprises was acknowledged as a critical strategy for socio-economic progress by enhancing the livelihood of micro-finance beneficiaries and their households. The literature review aids in determining the research gaps which might be stated succinctly. At first, the investigated literature depicts that there are various researchers on micro-finance and its impacts on socio-economic progress from different global regions, based on diverse theories. However, there were no present studies, investigating the impacts of MFI in association with metropolitan regions (Bothra & Sapra). The researchers on the impacts of MFI, in Delhi areas, were more specifically scarce. In the second stage, the majority of researchers analyzed the MFI impacts commonly, wherein some of MFI had sought to determine if there prevailed any differences according to group type of beneficiary if SHG Microfinance beneficiaries or any other JLG beneficiaries. The existing study of Sapra and Bothra attempted to fill the research gaps, by investigating the micro-finance effects on socio-economic progress. The research was capable of perceiving the micro-finance impacts by particularly assessing the effects of MFI loan experience on population, micro-finance loan accessibility, and MFI group type upon the development of socio-economic status. The Microloan accessibility was proven to improve significantly the entire socioeconomic growth of beneficiaries.

Microfinance is another efficient technique that impacts the socio-economic respondent's conditions and family members, specifically for personal purposes (loan). The stability enables families to achieve livelihood, purchase nutritious food supplements, construct house purchases, land purchases, accessibility towards contemporary health care, start up new businesses, multiple cultivations, and send their children or siblings abroad for higher studies. The existing research of Mamun and Al-Amin explored the reasons for receiving micro-credit and the effects of Micro-finance upon socio-economic enrichment, based on secondary and primary data. This analysis was accomplished through in-depth interviews, and personal interviews utilizing open-ended questionnaires, arranged with micro-credit receivers from ASA, Grameen Bank, and BRAC, and field staff, at Cumilla (Bangladesh) in the year 2021. Both snowball and random sampling approaches were adopted to choose respondents (Al-Amin & Mamun, 2022). The research highlighted that MFI generates positive differences in income response, changes in family status, and

entire socio-economic condition, yet in certain places, few borrowers, are not able to mobilize credit appropriately, which leads to the rise of bad loans. Therefore, a few recommendations were provided to reduce loan misuse and as self-reliant.

Ozdemir, Savasan, and Ulev aimed to assess the impact of Islamic microfinance on poor households through the IKSAR Qard al-Hasan Program prevailing in Turkey (Ülev, Savaşan, & Özdemir, 2023). To attain the objectives, it investigates the differences in socio-economic beneficiaries' status before availing of MFI services and after MFI services. It also utilizes longitudinal data whilst investigating the effect of Islamic microfinance on poor population welfare.

Hence the contribution of micro-finance is prominent, wherein Tunio, Talpur, and Baghal claimed to deliberate the effect of MFI upon the socio-economic empowerment of the female population in Nepal. Financial independence, decision-making competence, and self-confidence were the dependent variables. The chosen independent variables, were entrepreneurial skills, self-efficacy, insurance services, resource accessibility, and leadership skills. The primary data source was utilized to analyze the respondent's opinions regarding micro-finance programs on socio-economic women empowerment in Nepal (Baghal, Talpur, & Tunio, 2023). The research analyses twenty-three MFI with nearly 154 respondents. To attain the study objectives, a structured questionnaire was utilized. The regression model and correlation coefficients are predicted to verify the significant impact of microfinance programs on the socio-economic empowerment of women in Nepal. The outcomes of the research evidenced that leadership skills possess positive effects on decision-making ability, financial independence, and self-confidence.

The expectations for effects have been constructed by the microfinance developers. The research helps the SSE (small-scale entrepreneurs) to overcome economic constraints and radically improve their earning opportunities. The researcher of the study claimed at minimum range, that microfinance might provide money at a low-cost interest amount compared with private financiers and reduce the level of dependency on experienced trade-lenders in surpluses extraction [House of Representatives U.S., 1986]. Therefore microfinance has optimistically assured to increase income; and improve health, education, and empowerment for women with brand-new resources. The considered study perceived finance as a tool for personal renovation, and it captures the imaginary minds of those people, who seek new kinds of economic and social change. Besides establishing the probability of new modes of economic institutions, microfinance has motivated innovations accepted in various fields like education, energy, and health. Prior efforts in fostering social investment and constructing social businesses owe their motivation to the microfinance pioneers (Cull & Morduch, 2018).

The major part of the population belongs to rural Nigeria, for the financial development of women and the growth of Nigeria with the involvement of country

women in financial activities at every level seems highly crucial. The microfinance banks should improve their financial role by stakeholders due to the impact on rural women and any financial policy in the future. The policies that should be adjusted respect the effect on employment, empowerment, and financial advancement of rural women. Incentives should be given to rural women to start financial activities that develop the socioeconomic circumstance, thus ensuring the improvisation in the micro-finance sector (Maureen, Pius, Maikeffi, Samuel, & Bara'atu).

Research Gaps

MFI schemes provide opportunities for women in finance, public works, and agriculture with much-required credit, and beneficiaries' participation in those activities could accelerate the growth of the economy. It also mitigates the consequences of future and present financial crises. The role of micro-finance must be strongly stated in the nooks and corners of the nation and their benefits to rural and urban livelihood. Since the inequalities in gender hinder sustainable development and economic progress, micro-finance participation and assistance to empower society are highly crucial. Typically, the MFI was found to possess positive effects on education as well as their contribution towards the emancipation of women and gender equality. The loan arrangements by MFI, then their supportive male members, confirm the socially beneficial implication of offering easeful financial services to the public specifically the female population. Certain Myriad empirical assessments concluded that those MFI programs support people's empowerment both economically and socially. These conditions can be evidenced by, bringing out the positive counterparts of Microfinance (Hassan & Saleem, 2017).

Alternatively, The MFI policy ambiguity might have crucial implications for the future credibility and client behavior of MFI. For instance, one such MFI explored that in various districts in Pakistan, the staff heard some rumors from current clients their false rumors wherein the Pakistan Government had decreed loans of Microfinance were forgiven now to be a matter of national policy. Hence there is lacking to measure out and identify this ambiguity (A. A. Khan et al., 2021).

Several other researchers exposed that MFI programs of government acquire political interference, and it stresses out the inefficiencies related to MFI intended services distribution by political interference for instance Samurdhi Micro-finance program. Other research has determined that the Janasaviya Program was always hindered by resource misallocation and political patronage (Sangjeli & Mustafa, 2019). Those phenomena ought to be addressed in any study, to spread its awareness. The recapitalization and emergency liquidity facilities should be assumed to permit MFU to forbear present loans and stand in position for expanding liquidity management products while in control of the pandemic (Czura, Englmaier, Ho, & Spantig, 2022).

3. Research Methodology

The present study is a quantitative approach research with empirical analysis, fed with quantitative data, about the microfinance effects in the city of Jabalpur in Madhya Pradesh. The major sampling units are the Microfinance institutions in the city and the sampling units collected as secondary units are beneficiaries of chosen MFI in this Jabalpur district. The items of samples represent the local branches of ESAF, Fusion MFI, and Credit Access Grameen. Random sampling methods have been utilized to select out MFI significant branches specifically and corresponding beneficiaries of MFI micro-credit loans. The sample size of those beneficiaries is 150 obtained from Credit Access Grameen Limited, ESAF Microfinance & investment, and Fusion Micro Finance local branches. The self-administered and semi-structured questionnaires have been utilized in secondary data collection from other sources.

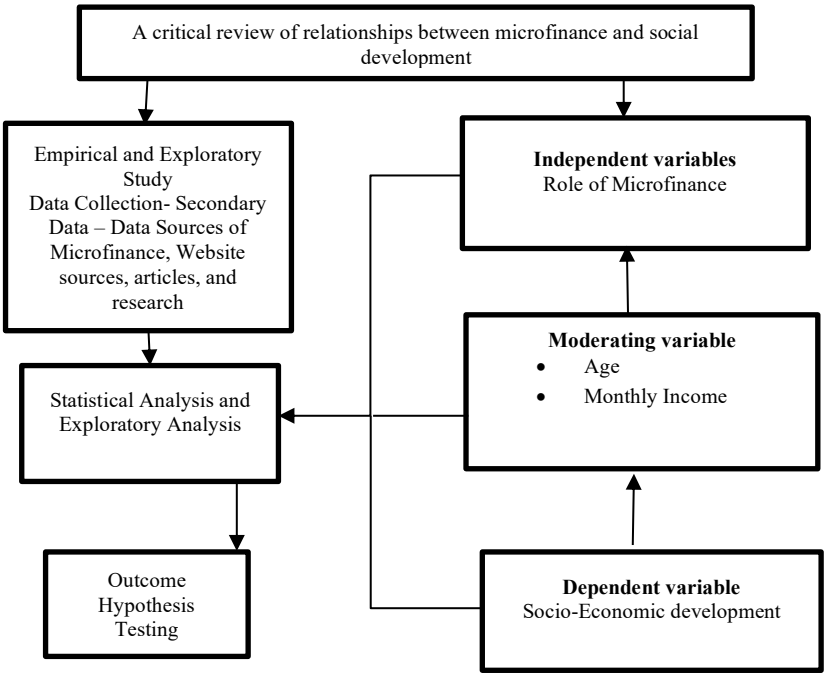

Figure 1. The research framework of the study
Source: Own processing

The Research framework as shown in Figure 1 was developed based on various independent, dependent, and moderating parameters. The empirical research propounded to elucidate the prominent role of Microfinance institutions in the socio-

economic status of Jabalpur city in Madhya Pradesh. The secondary data analysis is put forth to test the hypothesis of the study. Other moderating parameters that reveal the role of micro financial services. Statistical data are analyzed to test the hypothesis. The socioeconomic impacts are assessed through simple regression analysis. This study is a descriptive and empirical research study. The data has been collected randomly from secondary data sources such as articles, researchers, and website sources. The collected secondary data were utilized for statistical analysis through the IBM SPSS software package. The hypothesis has been tested based on the objectives of the study.
The following are the research hypotheses framed for the study.

H1: There is a significant impact of microfinance services on the savings, income generation, living standard, and employment generation of the beneficiaries.
H2: There is a significant association between monthly income and age characteristics of beneficiaries in MFI with economic and social development.

The common goal of the research is to analyze the effects of micro-finance programs on beneficiaries of Jabalpur (Madhya Pradesh). The peculiar objectives are stated below

- To explicate the demographic characteristics of Microfinance program beneficiaries.
- To assess the significance and impacts of MFI programs on beneficiaries' social and economic conditions in terms of employment generation, savings, and income.
- To analyze the significance and impact of MFI programs on the social status of beneficiaries through decision-making, living standards, and expenditure.

The study relies on Secondary data. The sample comprises around 150 beneficiaries of the chosen MFI, selected from the local branches in Madhya Pradesh from the period of 1st February 2022 to October 30. Data collection is the tool used to gather information from the respondents based on a specific subject that is taken for research.
Data were collected from 2022 February to October 2022 in the local MFI branches of Credit Access Grameen Limited, ESAF Microfinance & investment, and Fusion Micro Finance. Undisguised, standardized research instruments were framed on secondary data based on five points on a Likert scale having a rating scale such as 1, 2, 3, 4, and 5 denoting strongly disagree, disagree, neutral, agree, and strongly agree, respectively. This scale is utilized for measuring the socio-economic status of the beneficiaries in the MFI local branches. The respondents of the study are the general beneficiaries, taken for survey assessment. The Microfinancial services information

gained by beneficiaries is collected as the secondary data in the study. Other statistical outcomes are collected from the other MFI websites as well. The statistical assessment employed on secondary data draws out conclusions and inferences by using (the SPSS) statistical package for social sciences. The respondents were assessed twice by the research objectives, the prior period before they took up the facilities of Microfinance and the post period after they availed the services of Microfinance, such as loan facilities, credit expenses, finance availability for business start-up of the privileged people or the population availing for their financial stability for their societal and economic status.

By adopting a random sampling strategy, the total data gathered from the selected participants is 150. After collecting the data, it is fed as different variables and assessed through the tool called SPSS to accomplish the aim of the research. Thus, the valuable respondents for the survey were 150 which were filtered using random sampling methods for their perceptions, regarding the benefits availed by the participants, and challenges faced by the population during the accessibility of micro-finance services. Similarly the socio-economic factors before availing of the MFI services as well as after the MFI services were analysed using a semi-structured questionnaire.

The samples of the research constitute the general public who require as well as attain MFI services. The technique used to fetch out the responses is the random sampling technique. The random sampling technique is defined as a sampling process that allows for randomization in the selection of samples. Every sample possesses the same probability as other research samples to be chosen serving as a representation of the whole population. For assessing data from participants, who have not acquired MFI services, a random sampling technique is proceeded.

The research instrument has been denoted as a tool that has been utilized to measure, analyze, and collect data based on the proposed research interests. These tools have been frequently utilized in the education, social sciences, and health sciences sectors to examine the students, clients, and patients. The proposed research has used a semi-structured questionnaire retrieved from primary data sources. This tool of semi-structured questionnaires with closed-ended questions has a fixed level of responses to every question.

The secondary data sources employ a standard structured questionnaire as the research instrument for the study. The research assesses the demographic profile of beneficiaries and the impact of MFI programs on beneficiaries' economic conditions and social status. The statistical assessment employed on secondary data draws out conclusions and inferences by using (the SPSS) statistical package for social sciences.

Quantitative research analysis (Jung, 2019) is determined as a systematic phenomenon by collecting data and executing mathematical, statistical, and

computational methods. The quantitative method fetches data from conventional and prospective customers utilizing sampling techniques and providing online research, polls, and surveys, the results are determined in numerical terms. After careful interpretation, these numerals are used to predict or evaluate the future of the research and make the necessary changes.

With the support of a framed questionnaire, the data are collected from the particular sample respondents, and quantitative methodology is utilized for the data analysis. The data will be recorded using an Excel sheet to reveal the variables. The software tool SPSS is used for the subsequent estimation stage to analyze the variables entered in Microsoft Excel. The outcomes are estimated using five evaluation approaches. The statistical assessment is explicated through exploratory data analysis, regression test, and ANOVA test. ANOVA is a statistical tool and it is used to find the difference between the means of two independent collections by the analysts. Frequency distributions are defined as the visual displays that form frequency counts and this helps the information be concluded simply.

The implications are performed based on the results of the study and further enhancement is suggested for the implementation of the research in the future. The usage of SPSS software in this research makes the results to be effective and consistent in counting the values. The collected data was enumerated with the usage of Excel and SPSS software. Regression and ANOVA are accomplished to evaluate the organized hypothesis. The data estimation comprises 3 levels namely,

- Microsoft Excel is used to incline the demographic variables, and the design of frequency distribution is done.
- To list the data that are analyzed by statistics to predict the median range, and the mean standard deviation of several variables in this research is a significant step. Hence SPSS software is employed in this research.
- Regression, ANOVA, and Correlation evaluation are employed to evaluate the research hypothesis.

Certain ethics will be followed while conducting the research analysis. As the study is based on the individual perceptions of women regarding online flaming behavior, causes, prevention, mitigation ways, the role of online platforms, and their psychological effects it poses, the research deals with highly confidentiality-based responses. The following ethics are followed:

- Before the researcher's survey assessment, information is passed to the respondents in the prior stage.
- The respondents are not forced by any means to give their responses. Only willing respondents are selected for the survey analysis.
- Only the responses to the questionnaire are asked of the respondents, their private reports or data are not forced to be exposed by them.

- Since the research study uses only original data for data analysis, it doesn't contain any false data.
- All the data organized and gathered would be kept highly confidential.

These are the ethical considerations used by the researcher for the research analysis, which are accurate to their knowledge based upon this research study.

4. Results and Discussion

This section presents the results and the related discussions of the collected secondary data. The demographic details and impact of MFI on the economic and social conditions of the beneficiaries are presented below.

4.1 Beneficiaries' Demographic Details

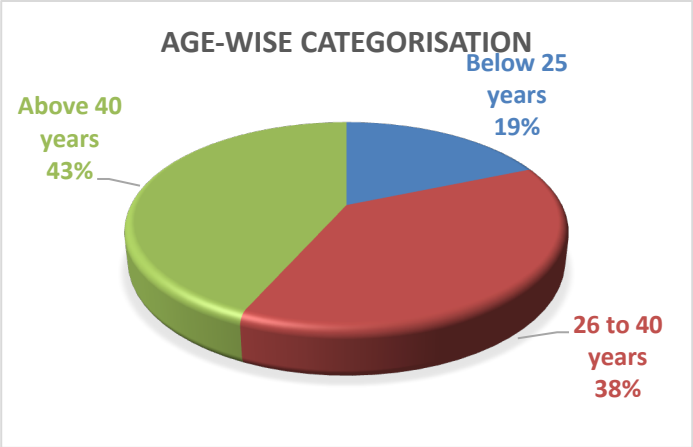

Figure 2. Age Distribution
Source: Own processing

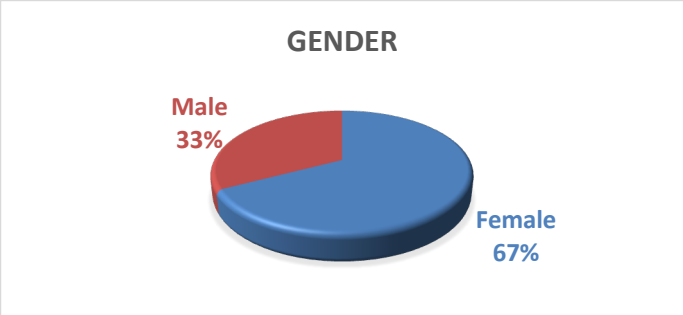

Figure 3. Gender Distribution
Source: Own processing

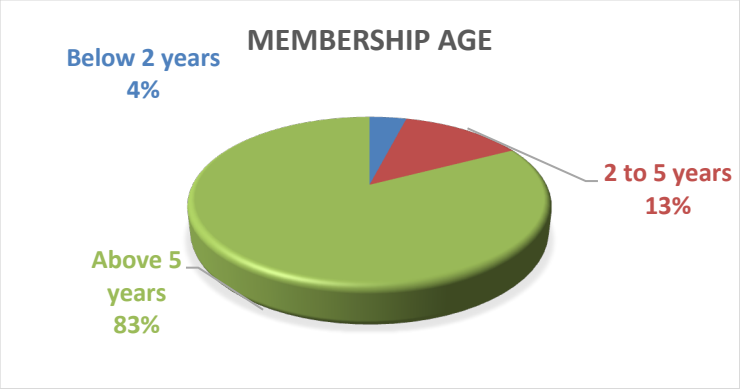

Figure 4. Membership Age
Source: Own processing

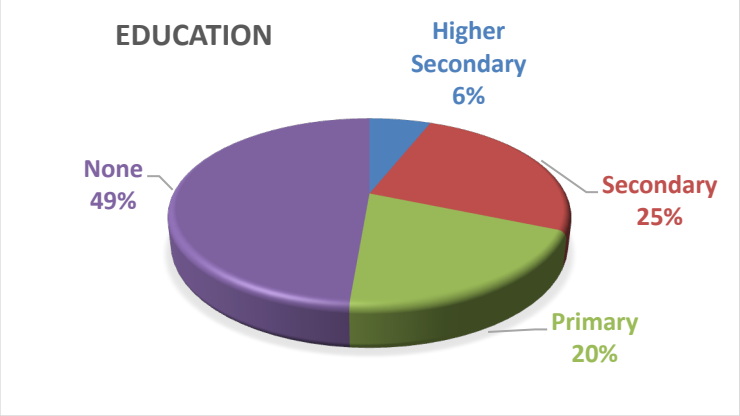

Figure 5. Educational Details
Source: Own processing

The above figures 2, 3, 4, and 5 show that 43% of the beneficiaries are above 40 years of age and 67% of the beneficiaries are female while it can be seen that 38% of the beneficiaries are around 26 to 40 years of age. It is also evident that 25% of the beneficiaries possess an educational qualification of below secondary education with more population having no education background, are in a situation of availing MFI services. Also, only a meager proportion of 6% of the beneficiaries have completed higher secondary education. While the membership age details show that 83% of the beneficiaries have a membership of 5 years and above with the MFIs. These inferences imply that the female population possesses more interest in MFI,

to avail the benefits for livelihood uplift. The population who are more than 40 years of age, with more experience and demands and commitment in life pose their opinion to opt towards MFI services, implied by 43% of respondents' target population.

4.2 Impacts of the Microfinance Programs on the Beneficiaries' Economic Conditions

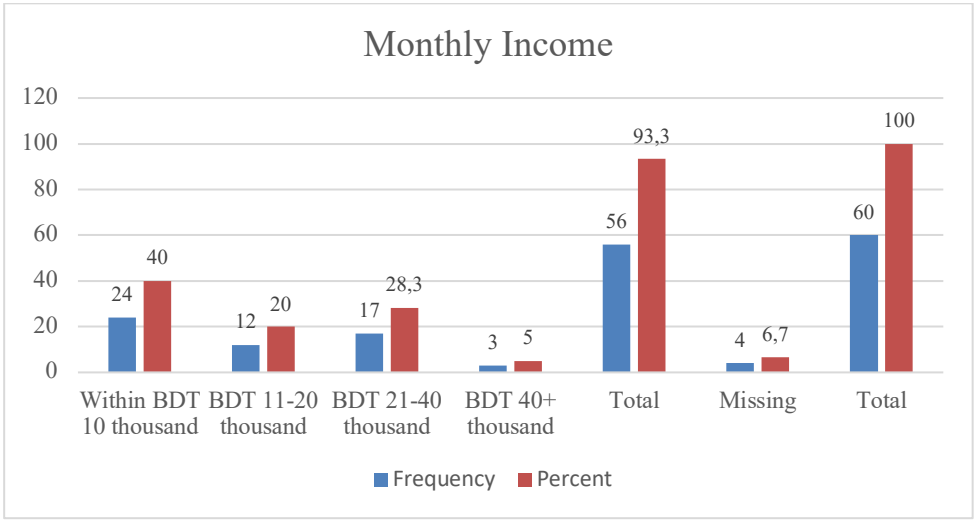

Figure 6. Monthly Income of the Beneficiaries
Source: Own processing

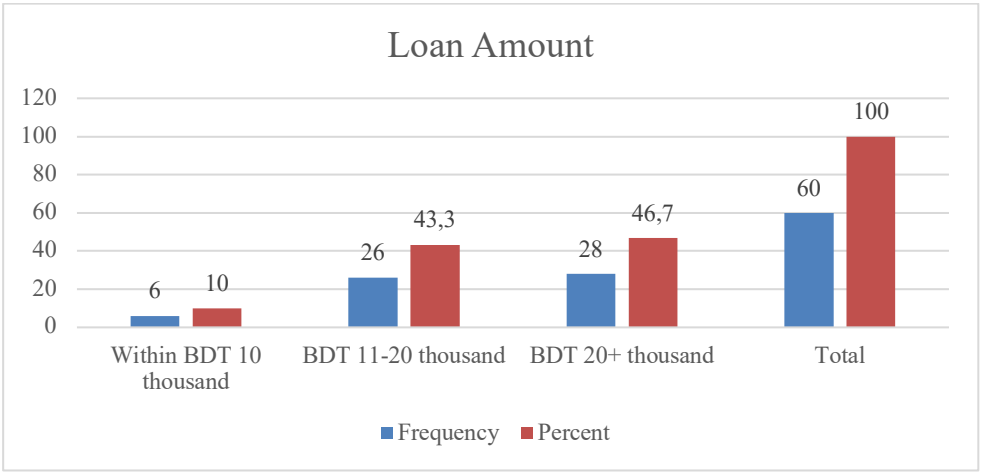

Figure 7. Amount of Loan Received by the Beneficiaries
Source: Own processing

From the above figure 6, it can be seen that the majority of the beneficiaries have a monthly income of less than BDT 10,000. Figure 7 depicts the loan amounts granted to the beneficiaries by the MFIs. It can be observed that more than 90% of the beneficiaries received an amount greater than BDT 10,000. The economic conditions and societal impacts of the population by the services of MFI were calculated for 100 respondents, by the excluded population of the control group, who have not yet availed of the MFI services.

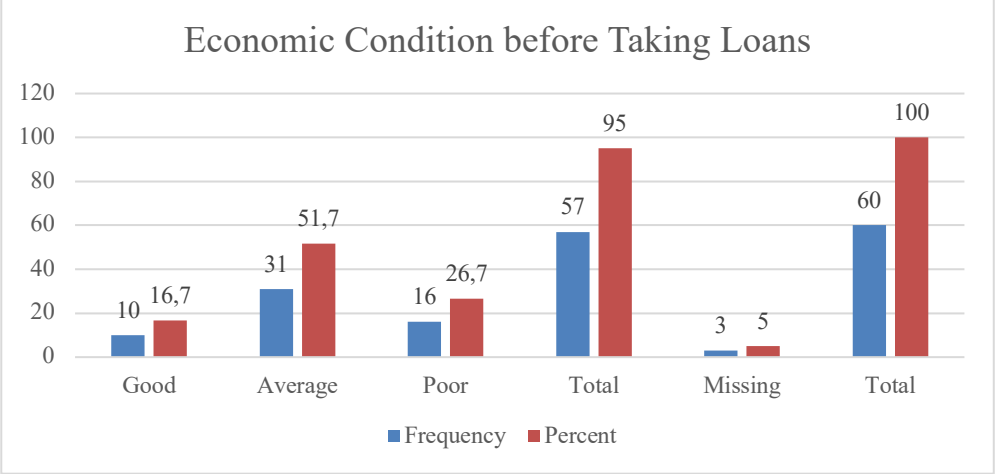

Figure 8. Economic Conditions before availing loans
Source: Own processing

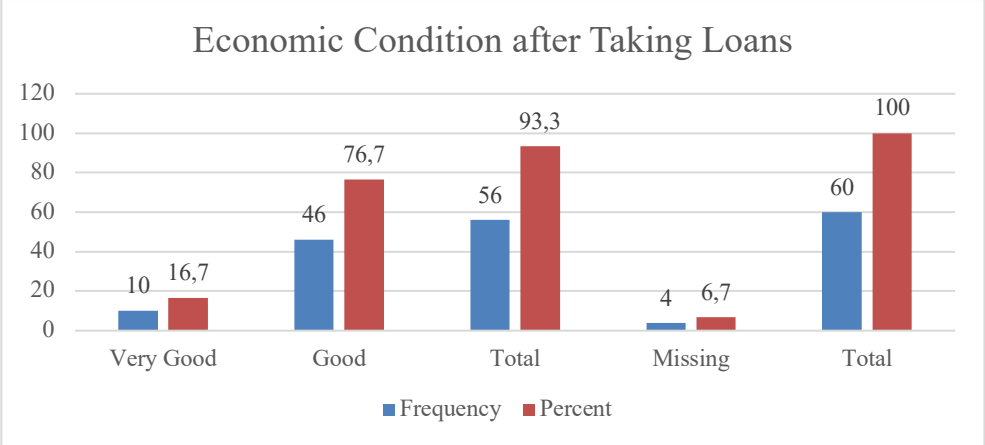

Figure 9. Economic Conditions after availing loans
Source: Own processing

Figures 8 and 9 show the beneficiaries' economic conditions before availing of loans and after receiving them. It can be noticed that the count of beneficiaries in good economic condition increased and 10 of them have moved from good economic condition to very good condition. Hence this shows that Microfinance programs have a constructive impact on economic conditions.

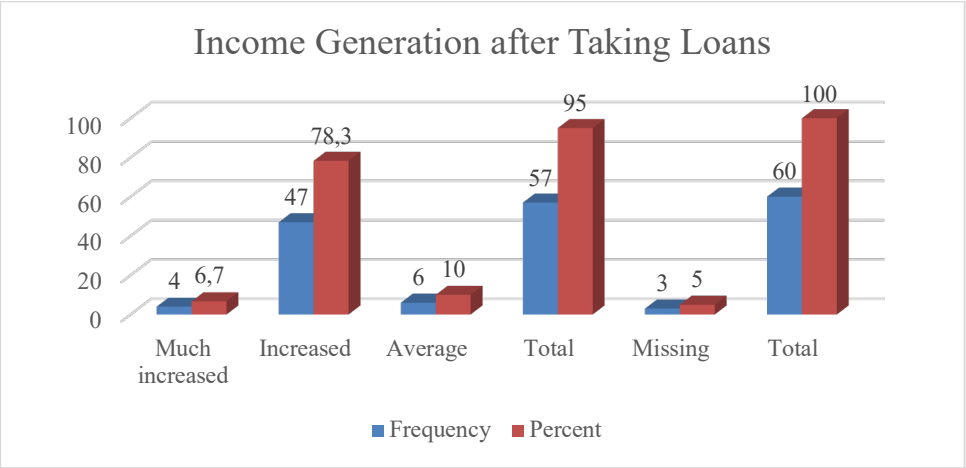

Figure 10. Generation of income after loan
Source: Own processing

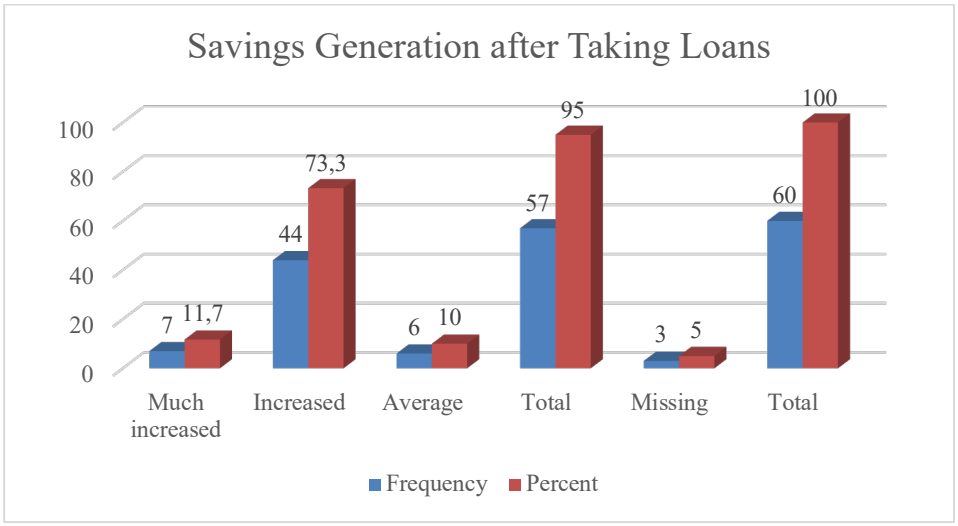

Figure 11. Generation of savings after loan
Source: Own processing

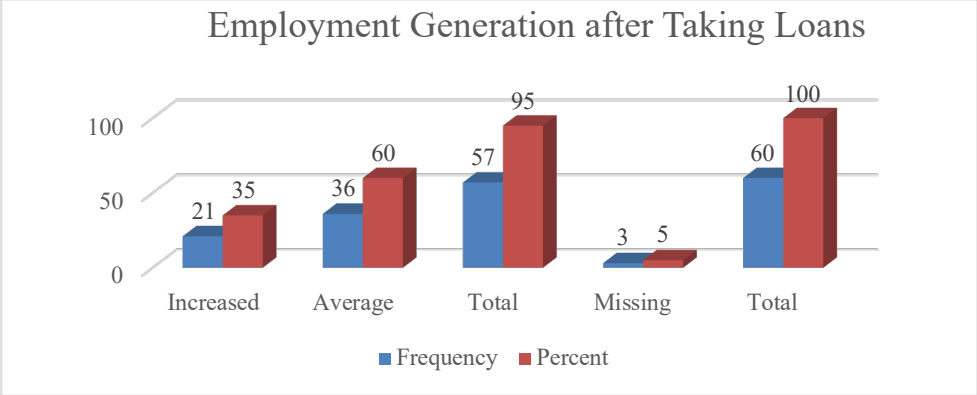

Figure 12. Generation of Employment after Loan
Source: Own processing

The above figures 8, 9, 10, 11, and 12 depict that the level of income and savings significantly increased with the microfinance programs. The savings and income have been found to increase to 85.6% and 89.5% respectively. While figure 8 shows that almost 35% of the beneficiaries' employment chances have surged.

4.3 Impacts of the Microfinance programs on the Beneficiaries' Social condition

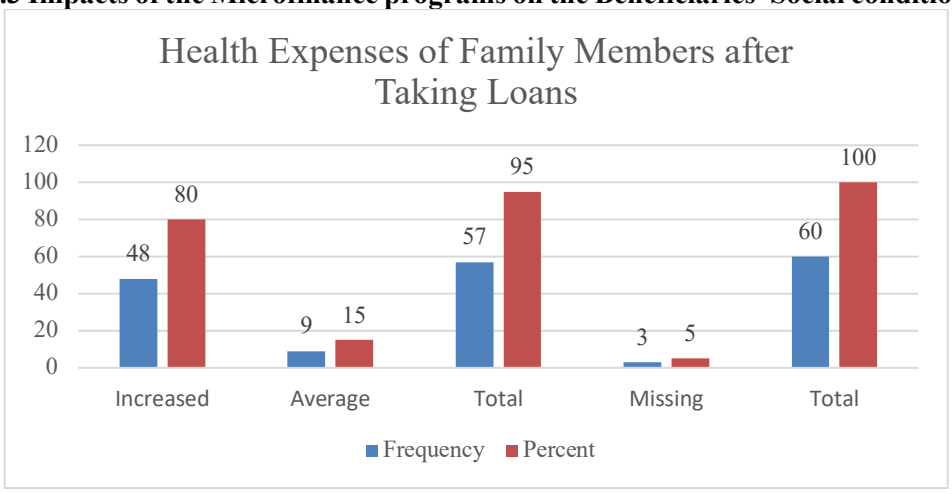

Figure 13. Health Expenses after Loan
Source: Own processing

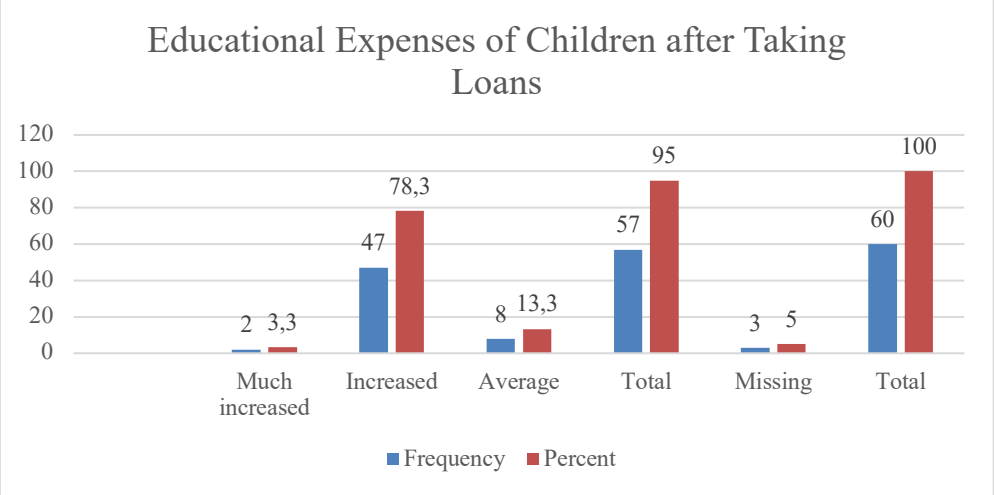

Figure 14. Educational Expenses after Loan
Source: Own processing

The above figures 13 and 14 show that health, as well as educational expenses, increased, which means that the solvency has grown and an upsurge in the expenditure paves the way to better living standards.

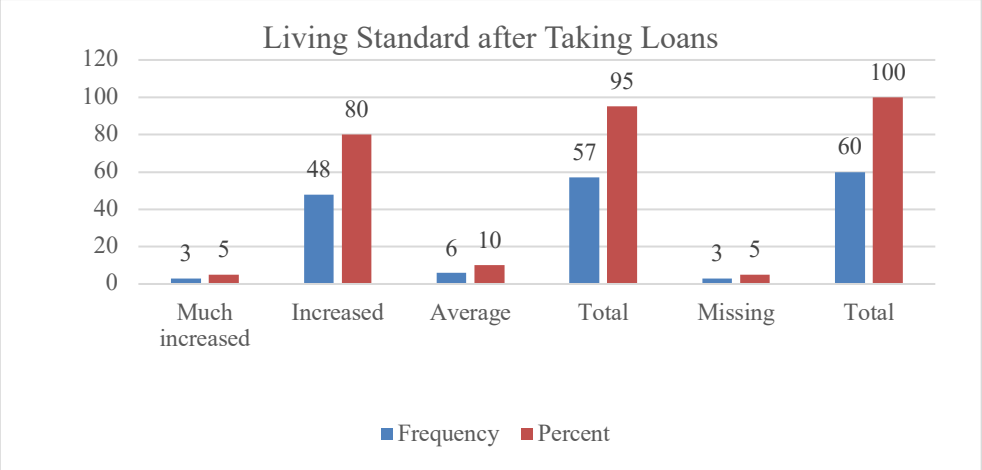

Figure 15. Living Standards after Loan
Source: Own processing

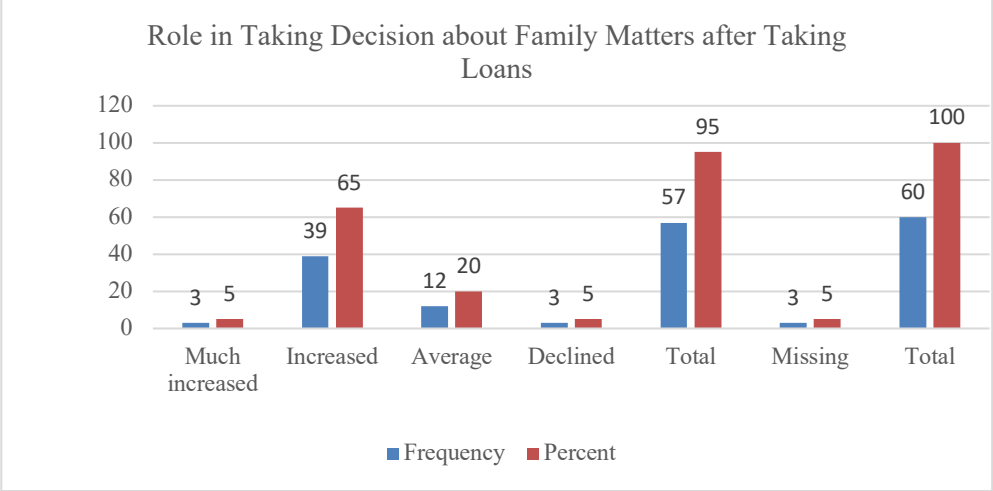

Figure 16. Decision taking after loan
Source: Own processing

The above figures 13-16 show that almost 89.5% of the beneficiaries' living standards have been increased with the microfinance programs and figure 16 shows that the beneficiaries' role in decision-making has momentously increased to 73.7%. It resulted in the elevation of saving and expenditure as the microfinance programs have the ability to generate income. The microfinance service holders get the opportunity to spend more for their children than before. In addition to this, the expenses for health are also found to be increased but the decision-making has marginally increased.

4.4 Analysing Socio-Economic Impact by Simple Linear Regression Analysis

The models that are utilized to analyze the socio-economic microfinance impacts are stated below.

$$IGV = \alpha + \beta.MA \quad \text{-- (1)}$$
$$SGV = \alpha + \beta.MA \quad \text{-- (2)}$$
$$ECV = \alpha + \beta.MA \quad \text{-- (3)}$$
$$SGV = \alpha + \beta.IG \quad \text{-- (4)}$$
$$CEV = \alpha + \beta.IG \quad \text{-- (5)}$$
$$LSV = \alpha + \beta.IG \quad \text{-- (6)}$$
$$LS = \alpha + \beta.MI \quad \text{-- (7)}$$

Wherein α represents the constant, β denotes the independent variables co-efficient, the Income generation variable is denoted by IGV, the Economic-condition variable

is represented by ECV, MI implies Monthly-income, age of membership pointed by MA, CEV represents the employment creation variable, living standard variable denoted by LSV and savings generation represented by SVG.

IGV – Income generation variable - There is an increment of profit in income after the intervention of Microfinance, by organizing your own business.

CEV - Creation of employment – The loan facility available through MFI allows you to commence new business in your locality providing better employment.

Monthly Income- MI – Does it result in an increment of the monthly income, in comparison to the previous period before 2 to 3 months?

MA – Membership age – There is a consideration in the membership age have you come forward to invest in Microfinance Investment or loan availability for your business?

LSV- Living standard variable - The living standards of the people in terms of income generation in the business, daily wage profit, and societal perception of you and your family have been improvised.

SGV- Savings generation variable – The family savings for your personal needs and the family expenses are improvised after the financial stability through microfinance facilities.

Table 1. Co-efficient Table

Models		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.326	.263		5.016	.000
	MA	.260	.094	.345	2.733	.007
	(DV)Dependent-Variable: IGV					
2	(Constant)	.472	.245		1.921	.050
	MA	.554	.088	.644	6.253	.000
	Dependent Variable: SGV					
3	(Constant)	.706	.205		3.438	.001
	MA	.410	.073	.598	5.542	.001
	Dependent Variable: EC					
4	(Constant)	.540	.250		2.151	.034
	IGV	.707	.120	.621	5.853	.000
	Dependent Variable: SGV					
5	(Constant)	1.660	.294		5.631	.001
	IG	.476	.141	.412	3.360	.001
	Dependent Variable: CEV					
6	(Constant)	1.458	.250		5.804	.000
	IG	.291	.120	.308	2.408	.016
	Dependent Variable: LSV					

7	(Constant)	1.814	.120		14.952	.002
	MI	.124	.055	.296	2.222	.030
	Dependent Variable: LS					

Source: Own processing

Tables 1, 2, and 3 describe the coefficients of the study's independent variables, the Model summaries table, and the analysis of variances table, which are found significant. In the first, second, and third models, it has been depicted that more membership age in MFI, in parallel there occurs more probability for income generation, better economic, and more savings generation. The fourth, fifth, and sixth models, revealed that the MFI income generation variable resulted in high employment creation, more savings, and better standards of beneficiaries living. The seventh model enumerated that if there is a high monthly income, there will be a better living standard.

In an elaborative manner, the models defined that if the beneficiary's age from MFI is increased by 1 percent, then there will be an increase of income generation by 26 percent, a 56% increase observed in savings. Similarly, there will be better economic conditions as well, with an increase of 41 percent. Likewise, if there is a maximization of income generation by 1%, there will be a simultaneous increase in employment creation (48%), an increase in savings generation (71%), and paves to better living standards to a 29% increase than the previous one. If the parameter monthly income increases by 1%, then the living standards of the beneficiary would be better by comparing to the prior stage by 13 percentage.

Table 2. Model-Summary

Models	R	R Square	AdjustedR square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.345	.121	.103	.398	.121	7.476	1	55	.007
	Predictors: (Constant), MA, Dependent Variable: IG								
2	.644	.415	.404	.370	.415	39.110	1	55	.000
	Predictors: (Constant), MA, Dependent Variable: SG								
3	.598	.357	.346	.311	.357	30.721	1	55	.002
	Predictors: (Constant), MA, Dependent Variable: EC								
4	.621	.383	.372	.380	.384	34.273	1	55	.001
	Predictors: (Constant), IG, Dependent Variable: SG								
5	.412	.171	.154	.446	.171	11.293	1	55	.001
	Predictors: (Constant), IG, Dependent Variable: CE								
6	.308	.094	.078	.380	.094	5.802	1	55	.018
	Predictors: (Constant), IG, Dependent Variable: LS								

7	.296	.087	.071	.396	.087	4.941	1	51	.032
	tors: (Constant), MI, Dependent Variable: LS								

Source: Own processing

From inference of the above table, it could be depicted that the p-value of t-statistics, for all the independent-variable, co-efficient was less than 0.05, which implies that all independent variables of the study possess a significant effect on the dependent variables, of corresponding respective models.

Table 3. ANOVA Table

Models		Sum of Squares	df	Mean-Square	F-Value	Sig.
1	Regression	1.187	1	1.187	7.476	.007
	Residual	8.742	55	.158		
	Total	9.931	56			
	(DV)Dependent Variable: IG, Predictors: (Constant), MA					
2	Regression	5.394	1	5.394	39.110	.000
	Residual	7.586	55	.137		
	Total	12.981	56			
	DV: SG, Predictors: (Constant), MA					
3	Regression	2.954	1	2.954	30.721	.000
	Residual	5.290	55	.095		
	Total	8.245	56			
	DV: EC, Predictors: (Constant), MA					
4	Regression	4.983	1	4.983	34.273	.000
	Residual	7.997	55	.144		
	Total	12.981	56			
	DVe: SG, Predictors: (Constant), IG					
5	Regression	2.261	1	2.261	11.293	.001
	Residual	11.003	55	.201		
	Total	13.262	56			
	DV: CE, Predictors: (Constant), IG					
6	Regression	.843	1	.843	5.802	.014
	Residual	7.997	55	.144		
	Total	8.841	56			
	DV: LS, Predictors: (Constant), IG					
7	Regression	.781	1	.781	4.941	.033
	Residual	8.051	51	.157		
	Total	8.831	52			
	DV: LS, Predictors: (Constant), MI					

Source: Own processing

Tables 2 and 3 define the model's fitness test. It is implied from the ANOVA table in Table 3, that the F-statistics p-value for all the models is less than 0.05. This low significance value indicates that all the models were significant at a 5 percent significance level.

From the outcomes of the models, it is seen that the programs of MFI were playing a significant role in savings generation and income that are statistically significant. Hence, it reveals the social impact of MFI on the beneficiaries. The results, clearly show that holders of Microfinance services could see a gradual increase in their living standards day by day. The MFI programs, aid in generating more and more employment opportunities, and hence the expansion of better economic conditions emerges significantly. These MFI were offering training programs for those service-holders as well as various other financial services except lending activities such as financing, to open DPS accounts for micro-enterprise development it offers educational loans, life-insurance programs, scholarships, and better medical and health facilities.

The results of this study are comparable with the previous studies (Shafique & Khan, 2020), (Roy & Mohanty, 2020), (Al-Amin & Mamun, 2022) and (T. A. Khan, Khan, Violinda, Aasir, & Jian, 2020). The study (Shafique & Khan, 2020) proves that the micro-credit providing schemes have improved the socio-economic conditions of small agriculturists in Pakistan. The study (Roy & Mohanty, 2020) proves that MFIs can improve the educational attainment, life expectancy, and ability of income generation in India. The study (Al-Amin & Mamun, 2022) has proved the impact of MFIs in improving the living status of the beneficiaries in Balunnaghar, Bangladesh. The study (T. A. Khan et al., 2020) reveals the potential of MFIs for transforming women entrepreneurs to be financially stable in society.

5. Conclusions

With the popularity of Microfinance, it had traversed an empirical study with a quantitative approach and exposed it as one of the prominent instruments in enhancing the socio-economic development of the people. Analysis of quantitative information from the MFI of Jabalpur led to a significant conclusion for comprehending the social and economic development of beneficiaries through their MFI services. As per the statistical outcomes, microfinance programs have significant and prominent impacts among the beneficiaries of MFI services, to alleviate poverty and in the generation of savings and income. MFI programs support promoting employment to a certain extent, in Jabalpur district in Madhya Pradesh, yet it is not still a satisfactory approach. The consumptions and savings of MFI service-holders who are all the beneficiaries of Fusion MFI, Credit Access Grameen, and ESAF MFI, tend to increase and they attain better living standards. Hence, the Microfinance programs, ought to be accelerated more, to attain social development

outcomes, and to uplift the economic status of the service-holders. Above all, with the esteemed role of Microfinance services to unprivileged people, poverty eradication could be accomplished in developing countries, promoting their social standards. The study implication states that Microfinance programs play a vital contribution to enhancing the socio-economic condition of the beneficiaries. The results insist that the government should frame necessary policies, and encourage poor people to utilize micro-finance services. There prevails a distinctive opportunity to organize large-scale research in this field with appropriate resources and time, wherein determines a pathway to explore more financial backing schemes by Micro-finance institutions and the Government as well.

Though this study provides valuable insights into the impact of MFIs in improving the socioeconomic status of the beneficiaries, this study has certain limitations. This study has considered less number of respondents. This may reduce the dependability of the results. This study results are associated with the specific location of Jabalpur (Madhya Pradesh). This renders the generalized comparability of the results with other geographic locations. Future studies should be conducted with a larger study population and broader geographical location to overcome the limitations of this study.

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Appendix

Questionnaire

1. Name of the respondent (Optional):

2. Please mention your Locality: Rural ☐ urban ☐ Semi Urban ☐

3. Age in years:

☐ Below 25 Years

☐ 26 to 40 years

☐ Above 40 years

4. Gender Male☐ Female☐

5. Marital status: Married☐ Single☐

6. Education: ☐ Higher Secondary ☐ Secondary ☐ Primary ☐ None

7. Membership age: ☐ Below 2 years ☐ 2 to 5 years ☐ More than 5 years

I. Rate the below factors as per your personal opinion

8. There is an increment of profit in income after the intervention of Microfinance, by organising your own business?	☐Strongly Agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly disagree
9. The loan facility available through MFI allows you to commence new business in your locality providing Better employment.	☐Strongly Agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly disagree
10. Does there arise an increment in the monthly income, in comparison to the previous period before 2 to 3 months?	☐Strongly Agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly disagree
11. There is a consideration in the membership age if you come forward to invest in Microfinance Investment or loan availability for your business.	☐Strongly Agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly disagree

12. The living standards of the people in terms of income generation in business, daily wage profit and societal perception of you and family have been improvised.	☐Strongly Agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly disagree
13. The family savings for your personal needs and the family expenses, are improvised after the financial stability through microfinance facilities.	☐Strongly Agree ☐ Agree ☐ Neutral ☐ Disagree ☐ Strongly disagree

IMPACT OF MICROFINANCE SERVICES

a) Before Membership

Year	Purpose (Specify IGA/ Consumption Purpose)	Amount of Loan taken	Sources of taking a loan (i.e. Bank, SHG, Moneylender, relatives	Interest paid (%)	Duration / Period	Status of Repayment	Remarks (problems faced)

b) After Membership

Year	Purpose of Loan	Amount of Loan taken	Sources of taking Loan (i.e. Bank, SHG, Moneylen	Interest paid (%)	Duration / Period	Status of Repayment	Assistance in the form of subsidy / Grand received under	Did you get training for starti

			der, relatives				the program me	ng the IGA?

15. BENEFITS DERIVED BY YOU THROUGH MICROFINANCE PROJECT INTERVENTION

S.NO	Attribute of Assessment	Answers (Yes, No)
1	Increase in Knowledge & Social Awareness	
2	Increase in Self–confidence	
3	Development of IGA Skills	
4	Improvement of Communication Skills	
5	Improvement in decision-making Capacity	
6	Increased awareness of health	
7	Increase in the ability to face problems	
8	Increased awareness about Microfinance	

[Indicate level by indicating 1 – No change, 2-Better, 3-Significantly better.]

INCOME OF HOUSEHOLD

Sources of Income	Net Income in rupees (Annual / Monthly)		Specify new IGA started after project intervention
	Before Membership	After Membership	
Farm (Agri. & Agri.- Allied activities)			
Non-farm (Other business)			
Labor work			
Other income			
Total			

SAVINGS

S.No.	**Mode of Savings (Banks/PO/SHG/ Chit Fund etc.)**	**Amount**	
		Before Membership	**After Membership**

16. Problems and Suggestions Problems: (Tick the Answers)

Organizational problems

1. Lack of encouragement to IGAs
2. Politicization of the programme
3. Drop-out of members
4. Lack of cooperation and unity among members
5. Poor monitoring and follow-up action
6. Any other

Financial problems

1. Insufficient financial help and subsidy
2. Inadequate loan
3. High interest rate on loan
4. Loan not received in time
5. Low-income generation from IGA
6. Overdue of debts

Production problems

1. Inadequate production
2. Difficulty in getting raw materials
3. Lack of training
4. High cost of production

Marketing problems

1. Lack of market information
2. Inadequate transportation facilities
3. Competition-3, Involvement of middlemen
4. Lack of demand for the product manufactured

Other Problems _____

Suggestions: _____

Place:

Date: *Thanks for your cooperation...*

A STUDY OF PREFERENCE OF YOUTH TOWARDS ATTRIBUTES OF CLOTHING IN SAURASHTRA REGION

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Abstract
The Research study is done with the objective of systematically knowing the preference of youth towards attributes of clothing in Saurashtra Region, Gujarat. For the sake of collecting responses the method of sampling is used in this research paper is random sampling technique. The collected data has been analyzed with the help of SPSS statistical tool. The result found in this research is descriptive in nature and were presented using percentage distribution method and with the pie charts, graphical presentation. As per data collected for the purpose of research, the respondent's age range is from 17 to 40 years and out of that 53% were male and 47% female from different race and religion whose average monthly income were Rs. 25000 to 30000. The research survey shows that 75% were unmarried and 25% were marriedand about 26% respondents making choice by their own and rest 34% were influenced by their Family and 40% were influenced by their friend circle. Respondent's preference towards Styles of clothing that were unique at Saurashtra region which includedjeans trousers, hipsters, denim jeans, skirts and jackets,tiered skirts, hot pants and skirts etc.
The literature review of earlier research concludes that majority people were not well aware about attributes of clothing and textile industry. Hence,thetrendat Saurashtra region seemedtosuggestthatmanyofthemdidnotknowhowto select appropriate clothing which is suiting their figure types and for the variety of occasion.This research study therefore made to find out attributed thatinfluencedtheclothingselectionoftherespondents of Saurashtra Region.Factors towards attribute of selection of clothing that influenced the respondents are fitting, Quality, Uniqueness, Colors, Availability, Style and Current fashion, Durability, Variety, Price and Status symbol.Therespondentssuggestedthatthepeople should be well are about basic knowledge for right choice of clothing to enable them to make informed clothingdecisionsinlife.
Keywords:Clothing,Fashion,Apparels,Style, Trend.

1.Introduction

Various theories have persuaded to explain the basic motivations behind clothing for human beings to cover the body. Majorly Modesty, Protectionandadornmentarethe threekey theories which explain logicsbehindthewearingofclothes.However there are some point of disagreement among various theorists.A research study ofmotivations towards clothingcould assist one to understand the dressing behavior of people.
The first theory found about clothing was the biblical one of modesty, that explain that clothes were worn to cover nakedness andbecause of sort of shame. Howeverthis theory was disputed by researchers on the grounds thatmodesty is not the same indifferent cultures. It has been updated like apart of the body covered by those in one specific culture may be left exposed or opened without any shame bythose

in a different culture. The secondtheory explains about the origin of clothes is the opposite of the first theory. According to the second theory, clothing werefirst worn to call attention to the parts of the body covered. A third theory states that man first wore clothes as toprotection against the elements of insects, beasts and enemies or against harm or supernatural forces. The fourthand final theory of the origin of clothing is that it was one means of aesthetic expression. This theory has beencalled thedecorationorornamentationtheory.

2. Literature Review

According to theory and research of Ryan(1966) and Dearborn (1980) as having stated like clothing protectsus from varioustypesoffear,theestimationof poverty,theestimation of inefficiency, bodily internal discomfort, anxiety, estimation of lack of self-respect, estimation of lack of good taste towards clothing etc.

Accordingto the research study of Frings(1991)buyingmotives is not same for all consumers, itvaryfromconsumertoconsumerandfromdaytoday.Every human being do have some desire to be fashionable, attractive, impress others, be accepted by friends, peer groups orcolleagues and fulfill an emotional need- new clothes often give a feeling of security and confidence.
In his view,criteria used by consumers for Selection of fashion clothing include: color which is usually the first aspect of a garment and other attributes like fitting, Quality, Uniqueness, Availability, Style and Current fashion, Durability, Variety, Price and Status symbol etc. are playing very important role in buying behavior.

Practical considerations with reference to attributes of clothing include: Price- Means theconsumerevaluates the totalworthof Clothing. Fitting- the try-on is a crucial step in consumer selection of agarment. Comfort- to keep the wearer at ease, warm or cool. Appropriateness – suitability or acceptability for aspecific occasion or need, fabric performance, care and workmanship - quality of construction, stitching, orfinishing.

As there will be always a research gap about selection of clothing and Attributes of clothing as the fashion change process consists of several stages including change in clothing and appearance ofstyles, introduction new ways of wearing and style, acceptance and decline.

3.0 ResearchMethodology

3.1 ResearchDesign

In this research study basically two technique of research designs were used; First one is quantitative technique which usednumbers in describing observation of materials or characteristics rather than words and the qualitative techniquewhichusedwordsandpicturesmorethannumbers

3.2 PopulationoftheStudy

A population is a particular Saurashtra region, Were 12 districts are there and a sample size is a smallergroup selected from a larger group or population. Out of the total population of youth asample size of 394 was used to undertake the study. The population of this study was all youth belong to various districts of Saurashtra Region.

The proportionate random sampling technique was used to select the respondents from the 12 districts of Saurashtra Region.Thistechniquemadeit possibleto selectarepresentativenumber ofrespondents for thestudy.

3.3 DataCollectionTechnique

A well-structured questionnaire is used with a series of written questions on a attributes of clothing about which a respondent's opinion issought and it could be open or close ended and many questions was with check box. In this research study, for the sake of data collection from respondent both the type of questions were used that is open-ended and close-ended. It has been found that all the respondents were literate, the questionnaire was self-administered by respondents to savetime, Energy and tomakeanalysiseasier.

4. FindingsandDiscussion

Table 1:GenderofRespondents

Gender	Numbers	% (Percentage)
Male	211	54
Female	183	46
Other	0	0
Total	394	100

Table-1 Shows that the respondents were made up of 53% (211) males and 47% (183) females. New trend of Fashion changesamong females was more rapid at Saurashtra Region than that of their male counterparts. As the data says there will more chances of changing preference towards attributes of clothing are more in females as compare to males, It is found that males usually does not change preference towards attributes of clothing.

Table2:AgeDistributionofRespondents

Age in years	Numbers	% (Percentage)
17-22	191	48
22-27	120	30
27-32	60	15
32-37	13	4
37-42	10	3
Total	394	100

Table-2 Depicts the age distribution of the respondents. The age distribution of the respondents was from the agerange of 1-22 years. There were 191 respondents in that age range making 48% of the sample. In the agerange of 22-27 years there were 120 respondents in that age range making 30% of the sample. In the agerange of 27-32 years there were 60 respondents in that age range making 15% of the sample. In the agerange of 32-37 years there were 13 respondents in that age range making 4% of the sample. In the agerange of 37-42 years there were 10 respondents in that age range making 3% of the

sample. This wasbecause the age range expected of majority of youth was in that range. It is very clear from the above mentioned data that major age group with reference to selection of clothing are belong to age group of 17-22.

Table3: Reference group affecting in selection of Clothing

Reference group	Numbers	% (Percentage)
Family Members	136	34
Friends	140	36
Colleagues	17	4
Neighbor	4	1
None (Alone/Self)	97	25
Total	394	100

Table-3 As per the collected data it has been found that 136 (34%) of the respondents made buying decision with the Influence of their family members, 140 (36%) of the respondents with the influence of their friend circle, 97 (25%) of the respondents make buying decision by their own clothing choices, 17 (4%) of the respondents made buying decision with the Influence of their Colleagues and 4 (1%) of the respondents made buying decision with the Influence of their Neighbor. It has been found that as far as the influence of selection of clothing is concerned, Friend circle do have maximum influence and then after Family members.

Table 4: Preference toward Fitting Attribute

Fitting Attribute	Numbers	% (Percentage)
Tight	23	6
Loose	19	5
Comfortable	352	89
Total	394	100

Table-4 With reference to Preference of fitting attribute in selection of clothing, As per the response of respondent it has been found that out of total sample size 23 (6%) do prefer clothing with Tight fitting, 19 (5%) do prefer clothing with loose fitting and Majority i.e 352 (89%) respondent do like clothing with confirmable fitting. From the above statistics it has been very clear that majority of sample size will be preference towards attributes if clothing which give a feel of comfort and then may be of tight fitting.

Table 5: Preference toward Quality Attribute

Quality Attribute	Numbers	% (Percentage)
Very High	131	34
Moderately high	153	39
Good	107	27
Total	394	100

Table-5 shows the percentage of respondent with reference to Preference toward Quality Attribute, According to data collected it has been found that out of total population selected 131 (34) people do

prefer clothing with very high quality of material, 153 (39%) people do prefer clothing with moderately high quality of material and 107 (27%) respondent do prefer clothing with good quality only. It has been proven from the above data that 39% who is majority do prefer clothing with moderately high quality.

Table 6: Preference toward Uniqueness Attribute

Uniqueness Attribute	Numbers	% (Percentage)
Always Required	148	38
Generally Required	191	48
Not Necessary	55	14
Total	394	100

Table-6 Explain about preference towards Uniqueness attribute in buying of clothing, On the ground of data collected it reveal interpretation like 148 (37%) respondent do required uniqueness in clothing always, 191 (48%) which is major part of respondent do expect uniqueness not always but Generally is expected, 55 (14%) Respondent said it not required to have uniqueness in clothing. As per data we can conclude that majority of people do observe uniqueness in clothing.

Table 7: Preference toward Color Attribute

Uniqueness Attribute	Numbers	% (Percentage)
Same Color	30	8
Contrast	182	46
Mix & Match	182	46
Total	394	100

Table-7 Shows preference of people towards color attribute in selection of clothing, As per the review of respondent it is found that as far as the color attributes is concerned 30 (8%) do prefer clothing with same color whereas 182 (46%) respondent do prefer clothing with the attribute of contras, Equally 182 (46%) respondent has given their opinion like they do prefer clothing with Mix & Match attribute.

Table 8: Preference toward Availability Attribute

Availability Attribute	Numbers	% (Percentage)
Everywhere	188	48
At Selected Places only	206	52
Total	394	100

Table-8 Flashing light on what is the preference of youth of Saurashtra Region about Availability attribute, from the data collected, It has been found that 188 (48%) people do find clothing as per their need and requirement at every apparel store and on the other hand it is like 206 (52%) population said like they do not get availability of preferred clothing at all the apparel shops but at Selected places only. The above shows that it will be difficult to find apparel as per preference at every apparel shop and Respondent will be in need to visit selected and specific apparel store only.

Table 9: Preference toward Style and Current fashion Attribute

Style and Current fashion Attribute	Numbers	% (Percentage)
Highly Fashionable	217	55
Classical	115	29
Comfortable	62	16
Total	394	100

Table-9 Explain about Preference toward Style and Current fashion Attribute in decision making process of clothing. As the data say that 217 (55%) respondent do expect and give preference toward selection of clothing as on the basis of highly Fashionable Clothing, On the other hand is has been found that out of total samples size 115 (29%) people do prefer clothing with classical look (Style) which is not changing rapidly, 62 (16%) respondent share their views like they prefer clothing which provides Comfort to them.

Table10: Preference toward DurabilityAttribute

DurabilityAttribute	Numbers	% (Percentage)
Less than 1 Year	60	16
1-4 Years	309	78
5-8 Years	19	5
More than 8 Years	6	1
Total	394	100

Table-10 is all about preference of people toward the durability attributes in the buying process of clothing. Collected data is very clearly defining that 60 (16%) respondent from Saurashtra Region do give preference towards clothing which durable for less than 1 years, Majority i.e. 309 (78%) respondent given their consent like they give preference in selection of clothing which is providing durability of 1 to 4 years. Rest 19 (5%) and 6 (1%) respondent shared their response like they prefer clothing with durability of 5 to 8 years and More than 8 years respectively. Means majority of population do prefer clothing with durability of 1 to 4 years.

Table 11: Preference toward Variety Attribute

Variety Attribute	Numbers	% (Percentage)
Wide	164	42
Moderate	191	48
Limited	39	10
Total	394	100

Table-11 Explain about preference of youth towards variety attribute in selection of clothing. With the help of data generated on the primary bases, we can say that 164 (42%) respondent do prefer clothing with wide range of variety, on the other side 191 (48%) which is majority of population says that they

do prefer clothing were moderate varieties are available and 39 (10%) respondent shared their opinion like they prefer clothing with limited variety and Edition.

Table 12: Preference toward Price Attribute

Price Attribute	Numbers	% (Percentage)
Designer (More the Rs.2000)	121	31
Better (Rs.1000)	231	59
Moderate (Rs.500)	36	9
Budget (Rs.300)	6	1
Total	394	100

Table-12 Shows responses of population about preference towards price attribute, It has been found from the collected data that 121 (31%) of respondent do prefer designer clothing which is costing 2000 and more, 231 (59%) respondent says like they do prefer better clothing with cost of 1000, 36 (9%) people says that they do prefer clothing with moderate price i.e. Rs.500 and 6 (1%) shared their view like they prefer budget clothing which is costing them Rs.300 and below. It has been proven from the data above that, Majority of people do prefer clothing which is costing them around 1000 Rs.

Table 13: Preference toward Status SymbolAttribute

Status SymbolAttribute	Numbers	% (Percentage)
Sophisticated	121	31
Normal	231	59
Total	394	100

Table-13 At the last gives brief about people's opinion with reference to Status symbol attribute of clothing. From the data it can be interpreted like 121 (31%) respondent do prefer clothing which provides sophistication in look, on the other rest majority i.e. 231 (59%) people do prefer clothing with normal status symbol look.

5.0 Summary and Conclusion

5.1 Summary

The main objective of the research study was to know about preference towards attributes of clothing of youth of Saurashtra region. The proportionate random sampling method was used to select three hundred ninety four respondent from different district of Saurashtra Region, Well-structured questionnaire with both open question and close-ended questions was used in collecting primary data from population of Saurashtra Region. All questionnaire were retrieved and analyzed. The respondents comprised 211(54%) male and 183 (46%) femaleyouth.Theywereagedbetween17and42withmajoritywithin17to22.It has been found that as far as the influence of selection of clothing is concerned, Friend circle do have maximum influence and then after Family members.Majority of sample size has given preference towards attributes if clothing which

gives a feel of comfort and then may be of tight fitting.It has been proven from the data collected that 39% which is majority of respondent do prefer clothing with moderately high quality. As per data collection we can conclude that majority of people do observe uniqueness in clothing. Out of 394 respondent182 (46%) respondent has given their opinion like they do prefer clothing with Mix & Match attribute. As the opinion of respondent it will be difficult to find apparel as per preference at every apparel shop and Respondent will be in need to visit selected and specific apparel store only. From total respondent 217 (55%) respondent do expect and give preference toward selection of clothing as on the basis of highly Fashionable Clothing. Majority of population do prefer clothing with durability of 1 to 4 years. On the other side 191 (48%) which is majority of population says that they do prefer clothing were moderate varieties are available. 231 (59%) respondent says like they do prefer better clothing with cost of 1000Rs. On the other rest majority i.e. 231 (59%) people do prefer clothing with normal status symbol look.

5.2 Conclusions

Majorityofthestudentsworesecond-handclothessincetheywereaffordableandthesecameinstylesthatexposedtheirvitalbodyparts.Therewastherefortheneedtoresearchintotheperceptionsofstudentstowardcampusfashion.Colour,durability,cost,religionandfashionwereimportantfactorsthatinfluencedrespondents'clothingselection.

6.0 Acknowledgement

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SOCIAL ENTREPRENEURSHIP EDUCATION: INSIGHTS FROM THE INDIAN HIGHER EDUCATIONAL COURSES

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ABSTRACT

The major focus of the research conducted is to evaluate the trends of developing a postgraduate program for social entrepreneurship in India's Higher Educational Institutions (HEIs). The researcher has performed an extensive search on the syllabi of social entrepreneurship from websites of HEIs in India focusing on the keywords on entrepreneurship, social entrepreneurship and social innovation. The studies identified that the curricular differences exist among various institutions were considered significant. To get better and deeper insights, the researcher has performed an analysis of the schools where these courses are being taught. Moreover, evaluation of course objectives, its contents, teaching pedagogies and strategies is conducted on entrepreneurship. Discussion on these offered insights has ignited an argument for the requirement of inter-disciplinary collaboration among social entrepreneurship educators.

Keywords: Higher Education; Social Entrepreneurship; Higher Educational Institutions; India

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INTRODUCTION

In today's contemporary society, there is an emergence of social enterprise which has been considered as responses to inabilities of the commercial and public sector in solving the social problem faced by the society which includes problems like unemployment, poverty and inadequate social services (Tam, 2017). Because Social Entrepreneurship (SE) is considered as an approach to resolve the social and societal problems through innovative solutions that ensure the sustainability of social value (Mort et.al, 2003). Further, this concept of SE is well-established in business vocabulary (Peredo & Mclean, 2006). The importance of SE is expanded to the level that it has made a place in the educational aspects of leading business schools with an essential matter of discussion at several academic and professional forums. But when it comes to the Indian context, SE has still not made appealing development and numerous reasons are supporting it. Considering the similarity between India and other developed nations based on their respective political background, India is just second largest democracy after the United States where the economic developed is backed up with such democratic setup (Khanna, 2007). The other essential feature is the fact where in the oldest market-based economies had no restrictions on private property rights. Presently, India is incredibly diverse having several religions, ethnic groups, cultures and languages spoken, English is still considered to be the business language. As per the statistics provided by Nasscom in 2015, India is just second to China in terms of the largest emerging economy and ranks third in global start up ecosystems. Also, India is second to China in terms of total population wherein India has more than 1.2 billion people (Census of India, 2011). With this high and increasing growth rate of population, there is an extreme demand for fulfilling social and environmental needs with restricted resources. Further aggravating the scenario, other social problems are emerging in India such as poverty, healthcare systems, education, lack of employment opportunities, hygiene and sanitation, water, and environmental issues. Considering the spread of poverty which is having a wider reach but not uniform distribution (Gore, 2003) there are a large number of social entrepreneurs emerged at a varied level to resolve the issue. They have come to function in a situation where all-state, market and third sector-have failed to overcome the social issues. The social entrepreneurs have utilized the existing resources and moulded into an innovative alternative to come up with sustainable and scalable solutions to the social problems thereby creating value to the beneficiaries.

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Social entrepreneurs use both social mission and entrepreneurial skills to solve social problems. In India, there is no existing special legal framework for Social Enterprise (Singh, 2016). Indian social entrepreneurial ventures are considered as a means to deliver basic services and opportunities to the underdeveloped sectors like education, sanitation and healthcare facility to the weaker sector or underprivileged people of the society. There are some social enterprises are applying an innovative, cost-efficient and technology-driven business model to serve a vulnerable group of people and others are creating a supporting infrastructure to remove barriers that create a hurdle for social enterprise (Intellcap, 2012). The benefit from social enterprises in India is enormous owing to diversity and uncertainty of cultural aspects (Bornstein, 2007). According to the Asian Development Bank, 2018, in India, 21.9% of the population falls below the poverty line. To solve above problems, socially inclined citizens are required to collaborate for the formation of civil society (Lan et al., 2014) or individually, create a social enterprise to address the social problem in the affordable way (Mair & Noboa, 2006). For this purpose, social entrepreneurial education and training are required in a professional manner to create trained social entrepreneurs.

The entire paper is divided into seven major sections. The first section introduces the readers to the topic of social entrepreneurship, summarizes or discusses the relevant prior research and gives a brief understanding of the aspects to be covered in the coming section. The second section focuses on providing an overview of social entrepreneurship education in the Indian context. The third section discusses the data collection and analysis approach in analysing social entrepreneurship. Fourth and fifth sections cover the essence of the paper. It describes the curriculum and pedagogy of social entrepreneurship education in major Indian universities along with challenges faced in doing so. The sixth section describes the appropriate model of a curriculum for imparting social entrepreneurship in HEIs. And the final section provides the concluding remarks along with the future scope of research in this area.

Social Entrepreneurship

Bill Drayton was the first person to coin the term social entrepreneurship in 1980. At present, social entrepreneurship is gaining significant importance in the field of education that shows societal problem can be solved through innovation, value creation, sustainability and

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outcomes associated with entrepreneurial efforts has emerged as a critical area (Austin, Stevenson & Wei-skillern, 2006). There are several studies conducted on social entrepreneurship, gave several definitions, concepts, theories and arguments (Seelos & Mair, 2004). Few researchers described social entrepreneurship as an established concept (Peredo & McLean, 2006) followed by others who believed in different schools of thought possessing reverse consent & belief for social entrepreneurship. Hence, the notion of social entrepreneurship has been debatable since the beginning of the last decade (Choi & Mazumdar 2014). On contrary, the third group noticed a lack in the process of social entrepreneurship. Being, a critical issue for researchers, social entrepreneurship has to be dealt with concrete knowledge and use of appropriate methodologies prevailing to the existing scenario. It is therefore useful for researchers to reach a consensus to describe the social entrepreneurship empirically. Viewpoint to social entrepreneurship varies concerning geography, culture & eco-system of the prevailing nation. Seelos & Mair defined social entrepreneurship that created social values through the innovative business model in the society followed by researchers who argued that social entrepreneurship must be included in creating economic and social values (Zahra et al., 2009). However, these researchers were unable to make a concrete and reasonable association of social entrepreneurship with economic and social outcomes. Also, a study by Choi and Majumdar argued that there is no scientific definition of social entrepreneurship in existing literature hence, emphasized developing more viable definitions on social entrepreneurship. In this regard, another group of researcher urged that scientific and social research community needed to be focused on areas to draw the attention of policymakers, development thinkers, and new entrepreneur to take initiation to develop a social venture in a region. However, social entrepreneurship can be regarded as a social activity that is performed by a social entrepreneur who has a particular social mission to identify and resolve a social problem. In the process of doing so, she utilizes an innovative strategy and sustains the business by bringing about social impact thereby ensuring sustainability and scalability (Hadad & Gauca, 2014). Definitions of social enterprise has been changing within the regions according to use, context and policy for social enterprise (Kerlin, 2006) in the US, social enterprise is termed to be non-profit and market economy is driven but in contrast to Europe, It has an association/ co-operative and social economy driven (Kerlin, 2006). Due to the growth of social entrepreneurs in large

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numbers and looking at their level of knowledge and skills, it is said that they can be groomed/ trained through a well-designed curriculum.

The evidence found when Harvard Business School (HBS) launched the course titled "Social Entrepreneurship" in the mid-nineties. Soon it spreads across the globe with leading business schools started offering social entrepreneurship education. It gathered attention and became a hot topic for discussion in various academic and professional forums (Peredo & McLean, 2006).

Social Entrepreneurship Education in India

In India, there are more than 700 universities, 37000 colleges and 11000 stand-alone institutions as per the latest statistics from the UGC website. The higher education sector in India has become an important source of promoting and supporting social enterprise sector in the form of developing start-up enterprises. According to a report published by Yes bank, there are more than 100 incubators in India and their focused areas are manufacturing, technology, innovation, health care and entrepreneurship. Although the focus area of these incubators are not exclusively on social enterprise or using business concept and tools to solve social problems, there are many pieces of evidence that major portion of incubates are using innovative approaches to give social impact (British Council, 2016).

There are a growing number of academic institutions those started academic courses on social entrepreneurship either as full-fledged postgraduate or diploma program. Social entrepreneurship education is progressing in India as many higher education institutions involved in social enterprises are found nowadays. The Tata Institute of Social Sciences (TISS) was one of the first academic institutions to introduce an academic curriculum on social entrepreneurship as two years full-time Postgraduate course *i.e.* M.A. in Social Innovation and Entrepreneurship in 2007. The course is designed for those who believe that social innovation and enterprise can work as a tool for social change. At present, there are other universities and AICTE approved institutions like Ambedkar University, New Delhi, Azim Premji University, Bangalore, SVKM's Narese Monjee Institute of Management, Mumbai, Institute of Rural Management, Anand and Entrepreneurship Development Institute of India, Gandhinagar are prominent academic institutions that offer a course either as a one-

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year diploma or two years post-graduate degree on social entrepreneurship. Apart from this, various higher institutions are utilizing their expertise by researching social entrepreneurship.

Methods of Data Collection and Analysis

The main aim of this paper is to give a broader picture of social entrepreneurship education in India. This is done by reviewing the existing literature on social entrepreneurship across the world. It is important to note that the most prominent contributions are reflected in this paper. The major databases referred to in this case are Google Scholar, Scopus, and Thomson Reuters to identify and review the papers. Further, the methodology adopted by the researcher includes identifying the HEIs offering postgraduate courses in social entrepreneurship either in the mode of full time or part-time or distance learning. This was achieved through secondary research and desk analysis. The narrative is built using the relevant documents available on the websites of HEIs. The content analysis approach is done for these documents thereby creating a constructive comparison among them. Thus, a broader picture obtained from the websites of five prestigious institutions whose program curricula and syllabi were accessed is utilised for further analysis.

Social entrepreneurship Education and Pedagogy in India

While pedagogy remains a central focus in education, designing an appropriate pedagogy for social entrepreneurship education creates multiple challenges. The existing SE curriculum is designed and developed to give facilitators a series of teaching methods to select from available options. These options are a combination of traditional lectures and discussion in class, case-based and field projects that include interviewing/shadowing the entrepreneurs, building a business plan for a social enterprise that is fictitious.

So far it is observed that the most common pedagogy used by academic institutions in India to run postgraduate course in social entrepreneurship is lecture, activities and simulations on a topic related to a social issue and critical discussion of cases on successful social entrepreneurs in India and abroad, immersion (field visit and rural visit), workshop components, and guest speakers. It is also evident that social entrepreneurship curriculum is greatly influenced by the foreign syllabus and pedagogy mostly from Europe and the USA and there is a lack of Indian literature on social entrepreneurship. Therefore, there is an

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urgency to develop Indian case studies and syllabus based on social enterprise and has to be incorporated accordingly (Thomas & Reddy).

Table 1
LIST OF INSTITUTIONS/UNIVERSITIES OFFERING SOCIAL ENTREPRENEURSHIP PROGRAM

University/ Institution	Course title of post graduate course	Course objective and pedagogy
Tata Institute of social sciences, Mumbai	M.A. in Social Innovation and Enterpreneurship	The objective of two years program in social entrepreneurship is to help students to get the skills, knowledge, and mindset important to lunch social enterprise or act as an important role in existing one in a rural context. This program is interdisciplinary and combination of theory and cases, experience and student enquiry.
Despande Education Trust and Karnataka University, Dharward	Master of Social Entrepreneurship Program	The program imparts students important skill sets in social innovation, entrepreneurship development and business practice.
Ambedkar University	MA in Social Entrepreneurship	The purpose of this program is to make participant familiar with the emerging area of social entrepreneurship and the impact. It imparts specialized skills to start a social business venture that creates social impact. The teaching pedagogy used is reading activities, simulation on topics related to social issues and critical discussion of cases on live social entrepreneurs and enterprise.
SVKM's NareseMonjee Institute of Management, Mumbai	Part-time MBA in Social Entrepreneurship & Sustainability Management	MBA in Social Entrepreneurship aims to develop strategic Orientation and motivation of students towards creating a successful social enterprise that solves societal problems in an innovative way. The pedagogy used to teach the courses are lectures, case studies, academic analysis and framing the issue.
Indira Gandhi Open University and Centre for Entrepreneurship Development	MBA (Social Entrepreneurship)	The program is innovative and aims to equip professional in the social sector with knowledge and skills to address specific managerial problems and challenges in the social sector. The course is delivered through distance learning mode, lectures, and study materials.

As mentioned in Table 1, the institutions were using a variety of learning and teaching strategies to teach social entrepreneurship course. These strategies were started from traditional learning, e-learning, case studies, and hands-on projects, visits to social ventures, and the importance given to social innovation. The institutions were adopting different pedagogies to teach social entrepreneurship in a simplified manner. After evaluating the

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curricula and contents of the above five institutions, it can be inferred that for an individual to be a successful social entrepreneur, she should be aware of both business and social aspects. However, the hurdle lies in the type of education being imparted to social entrepreneurs in terms of its sufficiency to cater to the need of both business and social models which is still an on-going debate.

Challenges in Social Entrepreneurship Education: Mono- disciplinary or Multi-disciplinary programs

The different issues discussed in social entrepreneurship in the previous section indicates that social entrepreneurship education should able to handle financial and marketing needs on one hand and societal problems on others.

Tracey and Philips had given importance to the business education for the entrepreneurs but one must keep in his mind that a social entrepreneur has to accomplish social objectives. It means that social entrepreneurs need to be trained in a different discipline to help them to face the challenges.

Dees has emphasized that students should develop a capability to resolve a social problem innovatively with the help of cross-disciplinary learning.

The social entrepreneurship education imparted in the US for the postgraduate students focuses majorly on inculcating the marketing skills. On contrary to the courses that are offered at the public administration schools targets predominantly philanthropic and political skills. This is due to the reason that the social entrepreneurship educators should ensure that there is mutual learning supporting in equipping the students with all the skills (Mirabella & Young, 2012).

DISCUSSION AND FINDINGS

Social entrepreneurship in India is mostly developed based on the understandings of the faculty members of universities and limited international exposures. However, for an emerging economy like India, it needs further concentrated investigation due to the vividness of problems to be catered via social business models. But the research in this area is limited and confined to the definition of social entrepreneurship. It doesn't cover the pivotal aspects such as nature and dimensions of social business model, contemporary issues that could be

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solved via social entrepreneurship, and both formal & informal modes of delivery of such an education (Arasti & Salamzadeh 2018). There are instances wherein the social entrepreneurship is compared with corporate entrepreneurship, intrapreneurship, sustainability, so on and so forth (Nigam et. al., 2014). However, social entrepreneurship as defined in the aforementioned sections has a clear distinction that it aims to solve a social issue utilizing the business concepts. This understanding should be focused on while formulating the curriculum in Indian Universities. But content analyzing as presented in Table 1 reflect a different picture. The course objectives column reflects a common theme wherein aspirants are trained in knowledge, skills and approach of setting a social enterprise. These aspects are important and experiential, but having a conceptual clarity along with the philosophy behind social entrepreneurship is vital to enable individuals to apply the right tool in resolving social problems (Salamzadeh et. al., 2013).

The problems of developing countries are different from the ones belonging to developed economies. Also, there is a great extent of variation in issues among developing countries as well. Thus, management of social enterprise requires a local understanding of the country and its problems because the social problems are extremely contextual. Along with this, there are certain characteristics of a social entrepreneur overlapping with conventional entrepreneurs such as leadership style, organisational culture, networking abilities, etc. boosting the success of social enterprise (Prasetyo, 2016). However, this local context is not fully incorporated in HEIs in India while imparting social entrepreneurship education. Much of the content is taken from international best practices that don't capture the essence of local social issues.

India is already suffering from the issue of low female participation in all socio-economic activities. This is contradicting the demographic dividend argument of India. It is extremely important to give due recognition to gender balance in creating social entrepreneurs in society. Without gender balance, several social enterprises would fail to provide gender-neutral solutions (Salamzadeh, Arasti & Elyasi 2017). None of the contents analyzed of the five universities in this research catered to the gender-sensitive approach of social entrepreneurship. Also, having a huge opportunity cost involved in pursuing social entrepreneurship refrain the female participation in such education in India.

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Finally, the theoretical and practical contribution of this paper to the body of literature would include suggesting a comprehensive model of social entrepreneurship education in India (Salamzadeh, Salamzadeh & Nejati 2011). The current model of social entrepreneurship is operating in isolation from a prior understanding of the relationship with humans. It is infeasible to operate as a social entrepreneur without having basic knowledge in the stream of humanities. Current HEIs in India are operating on the earlier model wherein they are producing entrepreneurs rather than social entrepreneurs. Thus, the refined model should include a strong subset of the following disciplines to inculcate a strong behavior of social entrepreneurship that is successful and sustainable in long run.

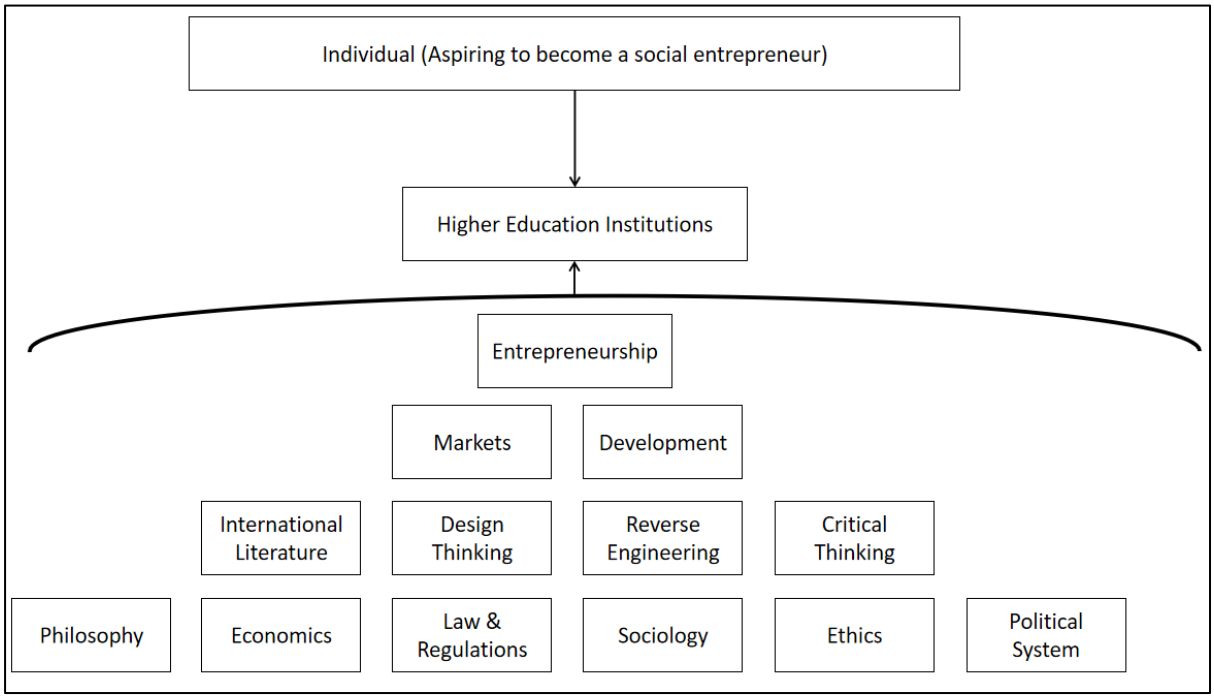

FIGURE 1

PROPOSED SOCIAL ENTREPRENEURSHIP MODEL

This model should attempt to stimulate the zest among the individual to pursue social entrepreneurship in HEIs (Sousa et. al., 2016). As a result of this, more and more employment opportunities will be created along with a private resolution to social problems. The role of government would be reduced in resolving social issues thereby providing higher bandwidth to them in catering to their major functions of providing public goods, national security, criminal justice, the judicial system and tax collection.

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CONCLUSION

India's post-graduation level program on social entrepreneurship is still in its initial stage and slowly getting accepted across universities and institutions. The paper has given light on the social entrepreneurship education at post-graduation level in India. The data collected by the researcher on the five institutions from India indicate that when there was no significant difference exists in the design of the courses, the pedagogical input varies. Still, in infancy, the social entrepreneurship program is offered by selected institutions. Hence, the sample size in this study has been limited to five institutions. Nevertheless, the research serves as the beginning of a discussion for further increasing the spectrum of research in social entrepreneurship education at the postgraduate level in India.

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A homoeopathic approach in the treatment of gastritis

Dr. Jyoti Patel, Dr. Vidhi Khamar, Dr. Nisha Manani and Dr. Megha Parmar

Abstract
Homeopathic medicines are prescribed on the basis of presenting complaints while taking into account the physical, emotional and genetic make-up that individualizes a person. This constitutional approach encompassing mind and body works at root-level. Homeopathy is very effective in managing all the acute as well as chronic expressions of gastritis; it also plays an important role in prevention of relapse of the condition. Here we are discussing detail about gastritis and its homoeopathic treatment.

Keywords: Homoeopathy, gastritis, homoeopathic medicines, constitutional, characteristics, rubrics, therapeutics

Introduction
Homeopathy is considered to be the most ideal method for treating Gastritis. In homeopathy the treatment for the gastritis is done only after detailed examination of the individual's sign and symptoms and constitution. Hurry and Worry that are at the base of the disease now a day and are related to one's nature and tendency, which can be tackled by a constitutional or individualized homeopathic treatment. The homoeopathic remedies are not just control the symptoms but they work deep inside and also prevent recurrence of the disease by treating the root causes successfully. For gastritis homeopathy is strongly recommended as it is safe and does not lead to any side effects. Due to holistic approach of the treatment in homoeopathy we can get rid of disease from physical as well as mental aspect also.

General View about Gastritis
Definition: Gastritis is an inflammation, irritation or erosion of the stomach mucosa.
Gastritis is not one disease but a group of conditions, which are characterized by inflammation of the lining of the stomach. Gastritis can broadly be divided into acute gastritis and chronic gastritis.
Types of Gastritis:
Gastritis can broadly be divided into:
1. Acute gastritis and
2. Chronic gastritis.

1. Acute gastritis: Acute gastritis is a sudden inflammation of the lining of the stomach. Acute gastritis is a term covering a broad Spectrum of entities which include inflammatory changes in the gastric mucosa. Inflammation of the whole stomach is called pangastritis and an inflammation of a part of stomach is called antral gastritis.
Acute gastritis can divided into:
Erosive and Non-erosive

Causes
Medications, alcohol, eating or drinking corrosive substances, extreme physiological stress, infections.
Acute gastritis is often associated with a severe, acute illness, or trauma.

Risk factors
Nonsteroidal anti-inflammatory drug use (NSAIDs), recent heavy alcohol use, and physiological stress such major surgery, head trauma, renal failure, liver failure or respiratory failure.

2. Chronic Gastritis

Chronic gastritis is an inflammation of the lining of the stomach that occurs gradually and persists for a prolonged time.

Causes

Prolonged irritation from the use of nonsteroidal anti-inflammatory drugs (NSAIDs), infection with the bacteria Helicobacter pylori, pernicious anemia (an autoimmune disorder), degeneration of the lining of the stomach from age, chronic bile reflux.

Sign and Symptoms

The signs and symptoms of gastritis include:

- A gnawing or burning ache or pain in the upper abdomen that may become either worse or better after eating.
- Loss of appetite.
- Bloating: A feeling of fullness in upper abdomen after eating
- Weight loss.
- Belching: Belching either does not relieve the pain or relieves it only briefly.
- Nausea and vomiting: The vomit may be clear, green or yellow, blood-streaked, or completely bloody, depending on the severity of the stomach inflammation.

In more severe gastritis, bleeding may occur inside the stomach. Any of the following symptoms can be seen as well as those already mentioned.

- Pallor, sweating, and rapid (or "racing") heart beat.
- Feeling faint or short of breath
- Chest pain or severe stomach pain
- Vomiting large amounts of blood
- Bloody bowel movements or dark, sticky, very foul-smelling bowel movements

Homeopathic Treatment of Gastritis

Homeopathy is one of the most popular holistic systems of medicine. The selection of homeopathic medicine for gastritis is based upon the theory of individualization and symptoms similarity by using holistic approach. This is the only way through which a state of complete health can be regained by removing all the sign and symptoms from which the patient is suffering. The aim of homeopathic medicine for gastritis is not only to treat gastritis but to address its underlying cause and individual susceptibility. As far as therapeutic medication is concerned, several remedies are available to treat gastritis that can be selected on the basis of cause, sensations and modalities of the complaints.

Rubrics of Gastritis in Reportories

There are so many rubrics given in the repertories related to gastritis. Some of them are given here:

[Boenninghausen's] Stomach, Inflamed, Acute gastritis
[Boericke] Stomach, Inflammation
[Boericke] Stomach, Inflammation, Acute
[Boericke] Stomach, Inflammation, Chronic (catarrh of Stomach)
[Boger] Supplimentry references, Gastritis
[Complete] Stomach, Gastritis
[Kent] Stomach, Inflammation
[Knerr] Stomach, Burnining, Gastritis, in
[Murphy] Clinical, Gastritis, Infection
[Murphy] Clinical, Gastritis, Infection, Chronic
[Murphy] Stomach, Gastritis, Inflammation, Chronic
[Murphy] Stomach, Gastritis, Inflammation
[Synthesis] Stomach, Inflammation, acute

There are number of medicines has been given in the Materia medica which has great affinity to cure the different kind gastric derangements. Some of them are mentioned here:

- Nux Vomica
- Lycopodium
- Phosphorus
- Arsenic album
- Carbo vegetabilis
- Mercurious Solubilis
- Veratrum album
- Bryonia alba
- Belladonna
- Argenticum Nitricum
- China officinalis
- Sulphur

Homoeopathic Therapeutics for Gastritis

Nux Vomica

It has great affinity to gastric derangement. It is pre-eminent remedy for the disease conditions arise due modern life style. Nux vomica is mostly indicated in case of chronic gastritis which is caused by tobacco, alcoholic stimulants, aromatic or patent medicines, sedentary habits, highly spiced food. Heartburn with flatulence for gastritis has nausea and vomiting in the morning He feels "If I could only vomit I would be so much better". Alternating constipation and diarrhea. Eructations sour, bitter; nausea and vomiting every morning with depression of spirits, after eating. Drinking milk seems to cause acidity. Hunger, but if he eats ever so little, he is satisfied and feels quite full. Repeated, violent vomiting of sour mucus with headache or with blood. Contractive, squeezing stomachache.

Lycopodium

It has pain in the pit of stomach when the hypochondria are pressed and pain in hypochondria when the pit of stomach is pressed. Indicated for gastritis has fullness even after a light meal, with no intestinal irritation. A grand characteristic of Lycopodium is "The patient goes to meals with a vigorous appetite, but after eating a small quantity of food he feels so full and bloated that he has to force himself to swallow another mouthful; and he leaves the table with his hunger, only momentarily satisfied." Craves everything warm, intolerant to cold drinks. Incomplete burning eructation rise only to pharynx, then burns for hours. Eructation ameliorates gastric troubles. Bitter taste in mouth at night, sour vomiting.

Phosphorus

Irritation, Inflammation and degeneration of mucus membrane. Gastritis with chronic erosion. Burning, gnawing circumscribed pain. The all gone, weak feeling at 11 a.m. starting from stomach to bowel. Craves for cold food and cold drinks which give relief temporarily, but are vomited as soon as they become warm in stomach. Very useful remedy in the vomiting of chronic dyspepsia. Hunger soon after eating. Sour taste and sour eructations after every

meal. Belching large quantities of wind, after eating. Throws up ingesta by the mouthfuls. Pain in stomach; relieved by cold food, ices. Region of stomach painful to touch, or on walking. Inflammation of stomach, with burning extending to throat and bowels. Bad effects of eating too much salt.

Arsenic Album
Restlessness is one of the grand characteristics of Arsenic. Ailments from fear, fright and worry. Foul, bitter or sour taste. Cannot bear the sight or smell of food. Great thirst; drinks much, but little at a time. Burning pain in stomach like fire, as if hot coals were applied to part, better by hot application, hot drinks. Acrid and bitter eructation. Irritative dyspepsia and acute inflammation. Nausea, retching and vomiting of slimy mucus tingled with blood. Trembling and coldness of extremities with pain in stomach and oppressive anxiety. Dyspepsia from vinegar, acids, ice-cream, ice-water, tobacco. Terrible fear and dyspnea, with gastralgia; with great exhaustion

Carbo Vegitabilis
Best suitable for Patient seems to be too weak to hold out. Persons who have never fully recovered from the effects of some previous illness. Violent burning in the stomach, with paroxysmal cramps which force the patient to double up; with flatulence. Putrid variety of dyspepsia. Slow digestion; feels as if a weight in the stomach, which is not relieved by eating; but after a few mouthfuls there is a sense of fullnesss. Eructations are rancid, putrid or sour. Heaviness, fullness, and sleepiness; tense from flatulence, with pain; worse lying down. Eructations after eating and drinking. Contractive pain extending to chest, with distention of abdomen. Colic, with the sensation of a burning pressure; much flatulence and sensitiveness of the pit of the stomach. Pain in the hypochondria like that of a bruise.

Mercurious Solubilis
It has deathly faintness at the pit of stomach. Profuse saliva in the mouth with a putrid or bitter or sour and rancid taste. Mercurial smell and taste in mouth. Stool hot, scanty, bloody, slimy, and offensive, with terrible cutting, colicky pains. Useful in painful acute inflammation. Tenesmus, not relieved by stool. A never get done feeling in the rectum. Complains worse in both warm and cold atmosphere. Stomach is chronically disturbed, sour eructations, regurgitations, heartburns etc.

Veratrum Album
Hiccups after hot drinks. Forcible eructations, mostly of air. After eating, empty eructation of air. After frequent eructation, copious ejection of mucus. Constant sick eructation with very violent cough. Voracious hunger, great thirst. Vomiting is –Slimy acid liquids with food froth. Yellowish green or white mucus. With black bile and blood. Colicky pain with salivation, profuse cold perspiration.

Bryonia
It is best adapted to persons of gouty or rheumatic diathesis. Great thirst for large quantities at long intervals. Pressure as from stone at pit of the stomach, relieved by eructation. Stool large, hard, dark, and dry, as if burnt. Diarrhea during a spell of hot weather; bilious, acrid with soreness of anus; like dirty water; of undigested food; from cold drinks when overheated, from fruit or sour foods aggravated in morning, on moving, even a hand or foot and ameliorated by absolute rest. Aggravation from any motion, and corresponding relief from absolute rest, either mental or physical. Pains: stitching, tearing, worse at night.

Belladona
Abdominal pain in short attacks, causes redness of face and eyes. Abdomen tender, distended; aggravated by least jar. Loss of appetite with desire to drink without thirst. Eructation and vertigo. Nausea and inclination to vomit. Violent stomachache after a meal. Bilious vomiting.

Argentum Nitricum
Violent belching and great relief from it. Pain is gnawing, ulcerative, referred to the pit of stomach. Vomiting of glairy mucus, which can be drawn into strings. Longing for sugar which aggravates the complaints. Pain in spot radiates to every direction.

China Officinalis
Homeopathic medicine for gastritis best suited to weak patients having low vital power. Sensation of satiety after a few mouthfuls of food. Sour, bitter eructations; flatus is offensive. Slow digestion and patient faints easily. There is a sensation as if food had lodged in the oesophagus. In cases where the food does not digest, but lies a long time in the stomach, causing eructations and finally is vomited out undigested.

Sulphur
Burning in the stomach. Gastritis caused by chronic alcoholism. When carefully selected remedies fail to produce favorable effects, especially in acute diseases, it frequently serves to rouse the reactive powers of the system. Weak, empty, gone or faint feeling in the stomach about 11.a.m. and can not wait for lunch. Congestion of abdomen. Stool acrid excoriating. It follows Aconite well. Sour eructation all the day. Long heartburn. Belching up of a portion of the food that had been eaten. In the morning inclination to vomit. Morning nausea. Bulked eructation on going to sleep.

Some Diet & Lifestyle Tips for Gastritis

- Eating habits. If you experience frequent indigestion, eat smaller, more frequent meals to buffer stomach acid secretion. Avoid any spicy, acidic, fried or fatty food. Practice good eating habits.
- Avoid alcohol. It irritates and erodes the mucous lining of the stomach, causing inflammation and bleeding.
- Don't smoke. Smoking interferes with the protective lining of the stomach, making the stomach more susceptible to gastritis as well as ulcers. Smoking also increases stomach acid; delays stomach healing and are a leading risk factor for stomach cancer. Still, quitting isn't easy, especially if you've smoked for years. Talk to your doctor about methods that may help you stop smoking.
- Switch pain relievers. Some may cause stomach inflammation or make existing irritation worse.
- Follow doctor's advice. Your doctor may recommend that you take an over-the-counter antacid or acid blocker to help prevent recurring gastritis.
- Maintain a healthy weight. Heartburn, bloating and

constipation tend to be more common in obese people. Maintaining a healthy weight can often help prevent or reduce these symptoms.
- Exercise regularly. Aerobic exercise that increases your breathing and heart rate also stimulates the activities of intestinal muscles, helping to move food wastes through your intestines more quickly.
- Manage stress. Stress increases risk of heart attack and stroke, increases stomach acid production and slows digestion. For relaxation practice yoga. Make a habit of regular exercise, morning walk, eat healthy, nutritious food, it boosts your immune system & makes you calm.

Discussion and Conclusion

Gastritis is the very common condition prevailing into the society now a days. Due to some faulty food habits and stressful modern life style plays major role in developing this disease. Here we have discussed some of the important homoeopathic medicines which are frequently prescribed on the therapeutic basis as well as on the constitutional basis also. With the help of homoeopathic medicine we can cure the gastritis as well as can check the disease progress of the it. The medicines which are prescribed on the basis of the constitution of the person or by individualization can also prevent the recurrence of the gastritis. So from this work we can conclude that the homoeopathic medicine are very useful in the treatment of the gastritis as well as to prevent the recurrence of gastritis.

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AN EXTENSIVE STUDY ON ISODES – THE NEW SOURCE OF DRUG IN HOMEOPATHY

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ABSTRACT

Homoeopathy is a system of medicine that heals illness using substances capable of causing the same illness. From the proving's of Dr Samuel Hahnemann in 1790, there are over 2000 homoeopathic drugs that have been proved and are in used world over. homoeopathic medicines are prepared from a wide range of natural sources like plants, chemicals, minerals, animals, nosodes, sarcodes, imponderabilia, synthetic sources, allersodes, and isodes.

KEYWORDS: New sources, Preparation of medicine, Potency, Complementary Medicine.

INTRODUCTION

Homoeopathy is a system of medicine that heals illness using substance capable of causing the same illness, that is presenting the same symptoms & condition when administered to healthy people. After so many years homoeopathy had proven the science of holistic & scientific approach.

The Homoeopathic medicines are Prepared from wide range of natural sources & Homoeopathy had discovered two new sources i.e., Allersodes & Isodes.

Isodes are the Homoeopathic attenuation of botanical, zoological or chemical substances, including drug exciepients on binders; which have been ingested or absorbed by body & they believed to produce a disease which interferes with Hormesis.

MATERIALS AND METHODS

Theoretical Study

1. Homoeopathic journal,
2. Internet sites & database
3. Homoeopathic textbooks and Allopathic textbooks.

RESULTS AND DISCUSSION

Homoeopathic Medicines were in used traditionally for the treatment of various allergies, infections, toxicities, autoimmune diseases, chronic diseases and acute diseases.

The Homoeopathic medicines are prescribed on the basis of Homoeopathic cardinal principles "Similia similibus Curentur"

The practice of homeopathy has become contemporized to meet the challenges of today's industrialized, stressful society. Modern living has created chronic "diseases" that are unresponsive to conventional, symptom suppressing drugs. Alternative/ complementary practitioners have rediscovered the teachings of Hippocrates; "the cause is the cure" has been termed the isopathic or homeovitic approach. This contemporary approach is being used successfully to overcome chronic conditions often associated with toxicities.

CONCLUSION

Isodes is a new source of homoeopathic medicines is proved useful in treating toxicities and allergies. After meta- analysis of literature, the effect of medicines prepared from Isodes have good therapeutic effect in potencies (12C,30C, 200C).

Thus, based on study of isodes it can be concluded that isodes – Homoeopathic medicines (12 C, 30C, 200C)

Potencies in treatment of toxicities, allergies, autoimmune diseases, and infections.

Further analysis of different potencies of isodes can be studied in the in-vitro and in-vivo experiments.

Conflict of Interest
No any conflict of interest and no funding was provided.

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EFFECTS OF HOMOEOPATHIC MEDICINES IN THE CASES OF CREVICE IN ANO BY USING PEARSON'S LINEAR CORRELATION TEST SCORE & NUMERIC PAIN RATING SCALE

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ABSTRACT

Background and objectives- to study the efficacy of Homoeopathic remedies in the management of crevice in ano & providing relief in pain, constipation & bleeding to brief about the treatment facilities available for crevice in ano by giving treatment to 10 patients. Pearson's Linear Correlation Test Score for Constipation and Numeric Pain Rating Scale for Pain and its analysis.

Material and Methods- By using Pearson's Linear Correlation Test Score and Numeric Pain Rating Scale at Nirmala Holistic Healthcare & Research institute, patients who presented with diagnosed crevice in ano with the symptoms as frank bleeding, cracks, constipation, Pains were included.

Patients were given individual Homoeopathic medicines and placebo for a period of 70 days. Changes in crevice in ano symptoms were the main outcome measures.

Results- 10 patients were analysed. After 70 days in total with 4-7 follow up of each and every patient, a significant difference was found in constipation, bleeding and pain.

We get to know the efficacy of many Homoeopathic remedies like *Sepia, Arsenic Album, Nux Vomica, Lycopodium, Sulphur & Natrum Muriaticum* on patients on the basis of totality of symptoms. We wanted to see the reoccurrence of the diseases and it is absent when the patient came for follow up.

Keywords- Crevice in ano, Homoeopathy, Pearson's Linear Correlation Test Score , Numeric Pain Rating Scale.

INTRODUCTION

Crevice in ano is the most common condition in INDIA. According to the article published by WHO, there are approximately 17 – 20% of population in India suffered from crevice in ano. According to the recent study conducted on prevalence on crevice in ano in India by Indian proctology society in a defined population of some state. In London approximately 10% of population suffered from anal crevice in ano and among the anorectal disorders 4% of new patients are suffer from crevice in ano. This disease is seen in all age group but mostly seen in adults. The prevalence of crevice in ano in female is 58% and in male it is 42% & 12% of cases occurred in children.

Crevice in ano caused due to tendency of Chronic constipation, incorrect operation of haemorrhoids, Crohn's disease, anal sex, irritable bowel disease etc. Dietary habits such as non-veg, spicy food, low fibre diet are the risk factors for crevice in ano. It presents with pain & bleeding at anal region along with stool.

In Homoeopathy the duration of treatment varies from patient to patient, depending upon the duration and extent of the crevices. Most patients show significant improvement in about 4 to 7 weeks. Some patients may need longer course of medication.

MATERIALS AND METHODS

Trial design

Study Crevice in ano is done from various authentic books, of short practice of surgery by bailey & love's, A manual on clinical surgery by S. Das and also homoeopathic books. We also referred various research articles & journals.

10 cases of crevice in ano were selected after the screening which fitted in criteria of case definition inclusion detailed case taking, physical examinations and P/R Examinations. Pearson's Linear Correlation Test Score is used to assess constipation & Numeric Pain Rating Scale to assess pain was done while case taking & follow ups.

Patients and settings

10 cases of crevice in ano were selected after the screening which fitted in the criteria of case of, case definition. Detailed case taking, physical examination, P/R examination, Pearson's Linear Correlation Test Score& Numeric Pain Rating Scale.

Inclusion criteria of patients were above 20 years irrespective of any gender & socio-economic status. Presenting case with sign & symptom such as fissure/ulcers, constipation, bleeding through anus before, during and after stool, pains that are burning, pricking or cutting, itching on anal region, straining to pass stool are also eligible for the study.

Patients with following conditions were excluded: - patient below 20 years, pregnant woman, lactating mother, venereal diseases & HIV, patients who had not completed the 5 follow up, patients with psychiatric diseases and inability to comply with the study protocol.

Study was conducted at Nirmala Holistic Healthcare and Research Institute situated in Gorakhpur, UP. The study was carried out with detailed case study and their follow up in the health Centre.

Result

After completion of this study we had seen males are more prone to Crevice in ano than females. The patients who are 30 years or above are more prone to crevice in ano. In rural area People are more affected, aggravating factors & predisposing factors for crevice in ano are alcohol, tobacco, Chicken, spicy food, night watching, eating Non vegetarian& spicy food. The common symptoms observed study are pain after stool, bleeding during stool, & constipation. At the end of this study we come to know the effectiveness of homoeopathic medicines and also the effect of calendula mother tincture Sitz bath.

DISCUSSION –

1) We studied 21 cases of P/R Bleeding & pain at anal region .

2) We included 10 patients out of 21 patients who are fulfill our case definition & Inclusion criteria.

3) We excluded 11 patients-

- Prolapse of rectum – 1pt.
- 3rd grade perineal tear with recto-vaginal fistula – 1pt.
- Heart complaint but no Crevice – 1pt.
- Perianal abscess -1pt.
- Drop out – 7pt.

4) Age wise distribution –

- 1 = 20 – 30 yr. Age group.
- 3 = 31 – 40 yr. Age group.
- 3 = 41 – 50 yr. Age group.
- 3 = 51 yr. above Age group

5) Sex wise distribution –

- 7 = Male.
- 3 = Female.

6) Place wise distribution –

- 4 = Urban.
- 6 = Rural

7) By considering an occupation, out of 10 patient –

- 4 = Farmer.
- 1 = Housemaid.
- 1 = Security guard.
- 4 = Other occupation.

8) By considering risk factors –

- 2 = Alcohol.
- 2 = Tobacco.
- 5 = Chicken.
- 8 = Spicy food.
- 1 = Night watching.

9) Pain relief –

- 10 = relief.
- 0 = no relief.

10) Bleeding relief –

- Out of 10 patient, 7 patient are with bleeding.
- 7 = Bleeding nil.
- 0 = No relief.

11) Constipation relief –

- 8 = Relief.
- 2 = No relief.

12) Remedy used –

- 3 = Nux Vomica.
- 2 = Lycopodium.
- 2 = Arsenic Album.
- 1 = Sulphur.
- 1 = Natrum Muraticum.
- 1 = Sepia.

13) Fissure healed –

- 4 = fully healed.
- 4 = partial healed.
- 2 = no healed.

We can give relief to anal pain, bleeding & constipation in cases of Crevice in ano.

CONCLUSION

We studied 21 cases of P/R bleeding out of which 10 cases of crevice in ano were assessed in terms of constipation using Pearson's linear correlation test score, assessment of pain by NPRS and assessment of bleeding. By providing Homoeopathic management regular follow up was done and we observed cases of crevice in ano in which patients had relief from constipation, pain and bleeding by Homoeopathic treatment. And we come to know about the role of *Calendula* mother tincture in sitz bath for crevice in ano patient to relief pain.

In this study Homoeopathic interventions relieved crevice in ano symptoms and along with it there is no reoccurrence of any symptoms.

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Conflict of Interest

Not declared.

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Homoeopathic Drug Standardization through Biological Evaluation- Future Perspective

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ABSTRACT

There is a scarcity of chemico-analytical method of standardization of high dilution of homoeopathic drugs. Homoeopathic medicines include any drug which are prepared by the methods given in homoeopathic pharmacopoeias. Efficacy of homoeopathic medicines are obtained by clinical use, from homoeopathic authenticated literature and research.

KEYWORDS: *Homoeopathy; Drug standardization; In vitro trial; In vivo trial; Ultra-high dilution; Biological evaluation*

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INTRODUCTION

Homeopathic medicines include any drug which are prepared according to methods endorsed in homeopathic pharmacopoeias. Their therapeutic efficacy is established through clinical use, experience as recorded in authoritative homeopathic literature and to some extent by means of research. Homoeopathy is the most widespread form of complementary and alternative medicines[1,2]. Homeopathic medicines are prepared by vigorous agitating/shaking in a step wise manner known as potentization. The process of potentization is supposed to make the drug suitable to be given to an organism[3]. Homeopathic practice includes the use of potentized drugs routinely in high dilutions[4,5]. Various authorities have proposed certain pathways to explain the action of high dilutions[6-10]. Although some homoeopathic remedies contain molecules of the diluted compounds, a major and proactive claim of homoeopaths is that high dilution on the basis of Avogadro's number, are statistically very unlikely to contain molecule of diluted compound, do exhibit a biological and therapeutic effects. Various in vivo and in vitro model have been proposed to investigate this question[2]. The scientific investigation of ultra-high dilution has been triggered by recognition of therapeutic efficacy of homoeopathy. Homoeopathic medicines are often used in extremely high dilution-including ultra-high (or ultra molecular) dilution. It is extremely unlikely that any molecule of the starting substance persists[11].

Homoeopathy is a time tested two century old empirical system of healing. Homoeopathic medicines are prepared through a characteristic process known as potentization where serial dilutions are performed with succussion at each step of dilution[12]. Homoeopathic pharmacists prepare medicines from various biological active substances that belongs to two main groups: organic materials (plants, animals and nosodes) and inorganic substances (synthetic chemical, metals, alloys and natural & synthetic ceramic materials)[13]. To make homoeopathic medicines they are diluted hundreds, even thousands of times to reduce their toxicity and to ensure that they are biologically active and compatible with human physiology[9].

New evidence is emerging on the nature and properties of high dilution of homoeopathic medicines. These findings indicate that the science of homoeopathy is a form of nano medicine, with the medicines capable of initiating changes in the physiological and biochemical dynamics of the animal as a complex adaptive[14].

MATERIALS &METHODS

Theoretical Study: -

1. Homoeopathic journal,
2. Internet sites & database
3. Homoeopathic textbooks and Allopathic textbooks.

RESULTS AND DISCUSSION

Homoeopathic drug standardization by ultra-high dilution have a reproducible biological activity on human and mice basophils. There is enormous amount of experiments conducted over a long period. After all the experiments that have undergone in the past, will give a glimpse about the bright future of acknowledging the standardization of Homoeopathic medicines in a broad aspect. For future references it will increase the legitimacy and genuineness of the Homoeopathic medicines. We should also try and doing this on humans for better understanding. By including the drug standardization, we can develop a new technology to the homoeopathic world or fraternity. We can also assure the quality of the drugs by initiating the process in Homoeopathic science. As the medicines work on DNA of human beings so it is important to inspect it on humans. Some part of the homoeopathic Materia Medica will also increase by doing this process and increasing the affinity of Homoeopathic medicines. It will also clear the misconception about the placebo effect of Homoeopathic dilutions.

CONCLUSION

After all, the meta-analysis it is clearly understood that biological evaluation for homoeopathic drug standardization is a key factor for turning out or changing the aspect towards the Homoeopathic science.

So, based on the studies of all the drugs standardization of homoeopathic medicines by evaluating biologically we can get more authenticity of the medicines. Also, by initiating it we can sort two agendas together that is the affinity of homoeopathic medicines and at the same time its originality.

These studies should at least be considered an encouragement for developing other protocols, organizing multi-center trials and gathering multi-disciplinary specialists leading to a new and synthetic approach to this phenomenon.

CONFLICT OF INTEREST

No any conflict of interest and no funding was provided.

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Kingdom Fungi 'A Compilation of Group Symptoms at a Glance'

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ABSTRACT

Homoeopathic medicines are made out of fungi. Fungi are very large group of thallophytes without chlorophyll. There are harmful as well as useful fungi. Fungi causes diseases in human being animals and plants. The reason why some fungi are so dangerous is that unlike any other living things, fungi are able to assimilate extremely complicated organic compounds which attack common organs. I have undertaken prospective type of study of fungi group of remedies group profile.

KEYWORDS : Fungi, Homoeopathic Medicines, Mycology, Fungi Group, Homoeopathy

AIMS & OBJECTIVES

To prepare group profile of fungi group and verification of theoretical group profile.

INTRODUCTION

Homeopathy is not that easy task, every patient and each and every medicine needs to be studied very precisely and deeply. It is an artistic science. It is very tough to study and memorise each and every medicine in its whole aspect.

Faced with the enormous number of living organisms on earth, scientists have long realized that we needed a way of classifying and naming individual species. The Greek philosopher Aristotle devised a primitive classification system over two thousand years ago. In modern biology, an organism is generally classified on the basis of its evolutionary relationship to other species, including anatomy, genetics and reproductive behaviour.

Kingdom Fungi, as represented in homoeopathy, is a relatively small group. Considering the diversity of fungi in nature, and the biological importance within the ecosystem it is surprising that the kingdom does not have a deeper understanding and a greater use in homoeopathic practice [1].

Kingdom Fungi contains the fungi, which are mostly multicellular eukaryotes of varied structure that share a common mode of nutrition. Fungi either live as parasites on other living plants or animals, or they live in decaying matter. In either way they derive their energy by breaking up highly complex substances (when these are broken down in another living organism, the organism suffers). Therefore, like animals, fungi are *heterotrophic* and consume performed organic matter[1]. Fungi, however, are heterotrophic by absorption; animals are heterotrophic by digestion[2]. Most fungi act as *saprotrophic* decomposers that aid the cycling of chemicals in ecosystems. They, along with bacteria, enrich the immediate environs with inorganic nutrients and thereby keep chemicals cycling in the ecosystem. Some fungi are *parasitic*, especially on plants, and others are *symbiotic* with plant roots and algae.

Fungi are characterized by non-motile bodies constructed of apically elongating walled filaments (hyphae), a life cycle with sexual and asexual reproduction, haploid resulting from zygotic meiosis, and heterotrophic nutrition. The characteristic cell wall components are chitin and glucans[3]. Exceptions to this characterization are well known. Fungi as a biological group have been classified into a kingdom on its own separating them from the plant kingdom. Robert Whittaker proposed that organisms should be broadly divided into kingdoms, based on certain characters like the structure of the cell, mode of nutrition, source of nutrition, interrelationship, body organization and reproduction[1]. According to this system, there are five main kingdoms[4].

They are

Kingdom monera

Kingdom Protista

Kingdom fungi

Kingdom animalia

Kingdom plantae

Kingdoms are divided into subgroups at various levels the following flowcharts show the hierarchy of classification.

Kingdom >phylum>class>order>family>genus>species

Fungi are a very large group of thallophytes without chlorophyll. They reproduce by means of spores. They may occur in soil, water or on other living organisms etc. There are harmful and useful fungi some like mushroom are edible. Fungi are widely used in certain industries; antibiotic penicillin is produced from the fungus penicillium[4].

Oxygen is required for cellular respiration and is used to break down nutrients, like sugar to generate ATP (energy) and carbon dioxide and water (waste) so, fungi do cellular respiration. STUDY OF FUNGI IS CALLED MYCOLOGY. Fungi grow usually best in environment that is slightly acidic. They can grow on substances with low moisture. Fungi live in the soil and on your body in your house and on plants and animals i.e., freshwater and seawater. A single teaspoon of topsoil contains about 120,000 fungi[4]. Fungi reproduces asexually by fragmentation budding or producing spores. Fragments of hyphae can grow new colonies. They have no leaves due to which their metabolism is catabolic[5]. Fungi play a major role in decomposing organic matter into inorganic. They can also cause disease in plants, animals and humans.

Fungi in Homoeopathy

The Homoeopathic medicines are prepared from vegetable (plant), animals, minerals, sarcodes, nosodes and imponderabilia. One more group is present on which very less light has been given and that is fungi group. Homoeopathic materia medica is a vast subject comprising of sign and symptoms of many medicines to study and specially to memorize all these medicines is a very difficult task**.**

SOME COMMON POISONS OF FUNGI:

- Amanitin – poison produced by mushroom. The mushroom is also known as death cup or the destroying angel. Upon ingesting the mushroom, symptoms are reported between 10-24 hours. Initial symptom includes; diarrhea and cramps. These symptoms usually go but after fourth or fifth day it is having severe effects in liver and kidney. Hence can damage the system.
- Orellanine- it is also a mushroom poison which can permanently damage the kidney.
- Gyromitrin- it is a poison which is similar to amantin.
- Muscarin- acts as a nerve poison and affects the heart and blood circulation.

CLASSIFICATION OF FUNGI KINGDOM:

The kingdom fungi contain five major phyla that were established according to their mode of sexual reproduction or using molecular data. The five true phyla of fungi are;

- Chytridiomycota (chytrids)
- Zygomycota (conjugated fungi)
- Ascomycota (sac fungi)
- Basidiomycota (club fungi)
- Glomeromycota

  "Mycota" is used to designate a phylum while "mycetes" formally denotes a class or is used informally to refer to all members of the phylum.

The different remedies of this group have been employed in various clinical conditions by different school of medicines since ancient time. Among them some are being well proved and some partially.

Homoeopathic remedies belonging to fungi kingdom

- AGARICUS EMETICUS
- AGARICUS MUSCARIUS
- AGARICUS PHALLOIDES
- BOLETUS LURIDUS
- BOLETUS LARICIS
- BOLETUS SATANAS
- BOVISTA
- PHALLUS IMPUDICUS
- POLYPORUS PINICOLA
- SACALE COR
- THALAPSI BURSA PASTORIS
- USTILAGO

Other rare homeopathic medicines prepared from fungi are:

- Agaricus campestris
- Agaricus citrinus
- Agaricus procerns
- Turula cerevisiae
- Psilocybe caecrulescens
- Solanum tuberosum aegrotans

Uses of fungi

- Decomposers of organic materials.
- Yeast is crucial for fermentation process that makes beer, wine and bread. Fermentation occurs in the absence of oxygen and allows the first step of cellular respiration, glycolysis to continue.
- Some fungi are used in the production of soy sauce and tempeh, a source of protein used in south Asia.
- Fungi can produce antibiotics, such as penicillin.
- Mushroom are fungi that are eaten by people all over the globe.
- They are major source of citric acid.
- They can be genetically engineered to produce insulin and other human hormones.

Properties of Fungi

- All of the fungi are eukaryotic. They possess membrane bound cell organelles including nucleus, mitochondria, Golgi apparatus, endoplasmic reticulum, vacuoles etc.
- They have glucans, mannoons and chitin in their cell wall and ergosterol in cell membrane
- They are non-motile because of rigid cell wall.
- They are chemoheterotrophs. They require organic compound for both carbon and energy resources.
- They are osmotrophic. Obtain their nutrition by absorption.
- All fungi are gram positive.
- Food storage is generally in the form of lipids and glycogen.

Formation of Group Symptom Profile

The group symptom profile is erected after study of remedies from the following books:

1. New manual of homoeopathic materia medica, William boericke.
2. A dictionary of practical materia medica, Clarke J. H.
3. Allen's keynotes, H. C. Allen
4. Concordant materia medica, Frans Vermeulen.
5. Materia medica of homoeopathic medicines, Dr. S. R. Phatak.
6. Regional reader, E. B. Nash.

After studying the medicines of fungi group from these books, the group symptoms profile will be formatted on the following bases:

- Symptoms which are present in two or more materia medica will be included in the group symptoms.
- Symptoms which are present in two or more remedies will be consider into group symptoms.
- Mental and physical general along with emotional presentation will be considered.
- Symptoms which are 3 marks & 2 marks are considered.
- The name mentioned in the bracket indicate the book in which this symptom must be present. (see abbreviations table)

CHARACTERISTIC FEATURES OF FUNGI GROUP

Constitution
Hydrogenoid constitution, General puffiness, bloated condition of body surface, in old people with indolent circulation, or drunkard, especially of their headaches.
At climaxis, old people.

Ailments from
Coitus, fright, mental application or excitement, over exertion, sexual excess, alcoholism, blood poisoning, subjective symptom arising after frost or sun, frostbite, all consequences of exposure to cold, use of cosmetics.

Miasm
All three miasms but predominantly Sycosis and tubercular background.

Temperament
Sanguine and irritable

Diathesis
Hemorrhagic

Thermal relation
Chilly

Sphere of action
It is noted that certain remedies have an affinity towards specific physiological systems, and the following sphere of action was noted in the case of kingdom fungi:
a) Central nervous system
b) Peripheral nervous system
c) circulation- haemorrhage tendencies

d) Female sexual organs
e) Skin
f) Male sexual organs

Patho-physiological action

- Central nervous system- they involve the cerebrospinal axis, producing irritation, inflammation, and degeneration.
- Produces spasm—ischemia—gangrene.
- Produces dilatation—relaxation—hemorrhage
- On skin- inflammation—exudation—eczema.
- Produces a state of intoxication and is used in many parts for making an intoxicating drink. [6,7,8,9,10,11]

Characteristic mental symptoms

- Anxiety [6,7,9]
- Confusion of mind[6,8,9,10]
- Delusions- enlarged, intoxicated, and poisoned, under superhuman control, low weight, visions. [6,7,9]
- Irritability. [6,7,9]
- Sensation as if boiling water running along the back. [6,8,9]
- Very depressed, weeps, desponding, feels null, great depression of spirit. [6,7,9,10]
- Prostration form sexual abuse and loss of semen. [6,8,9]
- Could not bear to see or talk with anyone, aversion to company. [6,9]
- Desire solitude to practice masturbation. [6,8,9]
- Awkward, inclined to drop things, from hands, objects fall from powerless hands. [6,8,9]
- Quarrelsome. [6,9,10]
- Great sensitiveness, irritable, takes everything amiss. [6,8,9]
- Weakness of memory, absence of mind. [6,9]
- Laughs and cries alternately. [6,9]

Characteristic physical symptoms

- Tendency to involuntary movements like twitching, jerking especially of the eyelids and tongue. [6,8,9]
- Twitching ceases during sleep. [6,8,9]
- Nystagmus and uncertain gait. [6,9]
- Clonic tetanic movements [6,9]
- Tendency to develop paraesthesia like tingling, numbness with or without pain or twitching. [6,8,9]
- Sensation as if pierced by cold or hot needles. [6,8,9]
- Shooting and burning along the spine. [6,8,9]
- Burning itching redness and swelling as if frozen.[6,8,9]
- Sensation of boiling water flowing along the back.[6,8,9,10]
- Tendency to hemorrhage. [6,8,9]
- Nose bleeds persistent in drunkards. [6,8,9]
- Bleeding dark, offensive and stingy.[6,8,9]
- Metrorrhagia- especially during climaxis. [6,8,9]
- Vicarious menstruation. [6,8,9,10]
- Congestive, passive or slow bleeding dark watery or in clots forming large black strings. [6,8,9]
- Tendency to increase sexual desire with masturbation.[6,8,9]
- Tendency to catch cold, feels very chilly yet aversion to covering.[6,8,9]
- Suited especially to females during climaxis.[6,8,9]
- Tendency to form new growth.[6,8,9]
- Complaints appear diagonally, upper left and lower right side.[8]
- Epilepsy from suppressed eruption.[8]
- Loss of hair and nails, complete alopecia.[8]

Particulars

HEAD

- Vertigo from sunlight, and on walking.[6,9]
- Lateral headache, as if from a nail.[6,9]
- Dull headache from prolonged desk work.[6,9]
- Icy coldness like icy needles or splinters. [6,8,9]
- Neuralgia with an icy cold head. Desire for warm covering.[6,9]
- Headache with epistaxis or a thick mucoid discharge.[6,9]
- Headache with epistaxis or a thick mucoid discharge.[6,9]
- Stammering.[6,8,9]
- Scalp itches, worse, warmth, sensitive, must scratch until sore.[6,9]
- Nervous headache from menstrual irregularities.[6,9]

EYES

- Lids agglutinated in morning. [8]
- Dim vision [6,8,10]

NOSE

- Nosebleeds in old people, with relaxed circulatory system. [6,8,10,11]

NECK AND BACK

- Aching along the spine and limbs, column sensitive to touch. [11]
- Painfulness along spinal cord when stooping every turning motion of the body causes pain. [8,11]
- Sensation of ant creeping along spine.[11]
- Itching coccyx. [6,8,9,10]

EXTREMETIES

- Twitching of gluteal muscles. [7,11]
- Itching, burning, and redness of hands, fingers, and toes, as if they had been frozen. [6,8,11]
- Chilblains that burn and itch intolerably. [7,8,11]
- Involuntary movements while awake, cease during sleep. [7,8,10]
- Chorea from simple motion jerks of single muscles to dancing of whole body, trembling of whole body.[8]

SKIN

- Burning, itching, redness and swelling as from frost bites. [7,8,10,11]
- Herpetic eruptions. [6,8]
- Pellagra, eczema, urticaria covering whole body [6,8,10]
- Itching aggravates at night. [6,9]
- Rubbing any part brought out the eruptions, skin hot. [6,9]
- Corns, warts shooting pains. [6,9]

FEMALE

- Menses flow only at night or only in the morning. [6,9]
- Passive Metrorrhagia of bright or dark blood, with many clots and pains in the ovaries. [6,11]
- Prolapsed, post- climacteric, hemorrhage, bearing down pain almost intolerable [6,10,11]
- Yellow and offensive leucorrhea. [6,10,11]

MALE

- Increased sexual desire, with flaccidity of the penis. [6,10,11]
- Scanty emission in coition. [6,7,10]

General modalities

WORSE
Climacteric, touch, motion, menses, cold.

BETTER
Bending double, hot food, eating

Clinical conditions
Gangrene, hyperpyrexia, itching, jaundice, lachrymal fistula, lichen, lumbago, Acne rosacea, blepharospasm, softening of brain, bunion, chilblains, chorea, coldness, cough, cramp, delirium tremens, dysmenorrhea, enteric fever, epilepsy, meningitis, myopia, neuralgia, numbness, nystagmus, phthisis, rheumatism, sebaceous tumor, sexual excess, tremor, typhoid fever, eczema, corns, gleet, urticaria, warts, whitlow, rheumatic affections, ovaries affection of, alopecia, climaxis, ovaries affection, tonsillitis,

Remedy relation
Antidotes- absin. Coff, Camph.
Compare- cimicifuga, cann. i, hyos, tarantula his, rhus t, Sep, cic, calc, Sabina. [6,7,8,9,10,11]

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Clinical Cases

A Difficult Wisdom Tooth Eruption

July 17, 2024 • 2 Comments • by Rajiv Peres

Dr. Rajiv Peres shares a case of difficult wisdom tooth eruption. A careful comparison of two similar remedies led to the simillimum.

On 12th June 2023, a 23-year-old boy presented with complaints of pain in left lower wisdom tooth for the last four days. He was unable to eat anything on the left side. Touch aggravated.

He felt better by holding cold water in his mouth. A lot of saliva accumulates in region of left lower jaw and when he tries to swallow it creates pain in left aspect of throat radiating downwards. Difficult to even swallow saliva.

Face swelling present on left side with a pinkish hue. When he moves the jaw, some crackling sound is produced at left angle of mandible. For last three days he was on pain killers as well as antibiotics without relief. Pain and uneasiness are usually during daytime.

time. No peculiar taste of the saliva observed.

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Patient is aggravated by slightest touch. Pains fling upwards to the ears is absent in this case, so Staphysagria can be ruled out. Patient is not going crazy with the pain so he can't be Nux vomica.

I look for what is most peculiar and then later match it with the materia medica. This is an acute case, sporadic type. I search for concomitant, ailments from, characteristics, modality, sensation, and lastly location. What are characteristic and common symptoms in terms of intensity.

Patient is active despite pain but it's not very intense, onset is sudden, progress is fast, redness++, gum swelling. There is no characteristic mental concomitant in this case but physical concomitant is present of excessive salivation. Is there anything in the pain that makes it peculiar? What is the peculiarity of sensitivity? Nothing!

See also
Carbuncle on the back of the neck

In this case I also have characteristic uncommon peculiar modality, amelioration holding cold water in mouth. Some would argue here that in an inflammatory state holding cold water in mouth is a common relief, but do all patients having toothache hold cold water in mouth and feel better by it?

This phenomena of holding cold water in mouth and feeling better is individualistic. If you refer to sensodyne toothpaste advertisement from television "Jab Thanda piti

No characteristic peculiar sensations are available. Here location is available of left side. According to Kent and Boericke materia medica, Merc-sol is predominantly right sided.

Enormous salivation is present along with modality of cold water ameliorates. This symptom stands out as per the intensity of relief that it offered to him and also restlessness.

I find Boger- Boenninghauosen repertory (BBCR) ameliorated by holding cold water in mouth. Hence Merc-cor 30 was selected as the simillimum. 30c potency was chosen as the susceptibility seems low as he was unable to describe the type of pains or sensations, no presence of any mental symptoms.

Modality of better by cold water is a syphilitic expression and to avoid any unwarrented aggravation in an already suffering patient, low potency seems wise. Mer-cor also has aggravation by swallowing and worse during daytime unlike its counterpart Merc-sol which aggravated at night and more right sided. Salivation increased you shall find in both. Salivation brought me to Merc group, BBCR guided me to Merc-cor and Materia medica helped me confirm it.

See also
Recurrent Cold and Cough in a Girl of 4

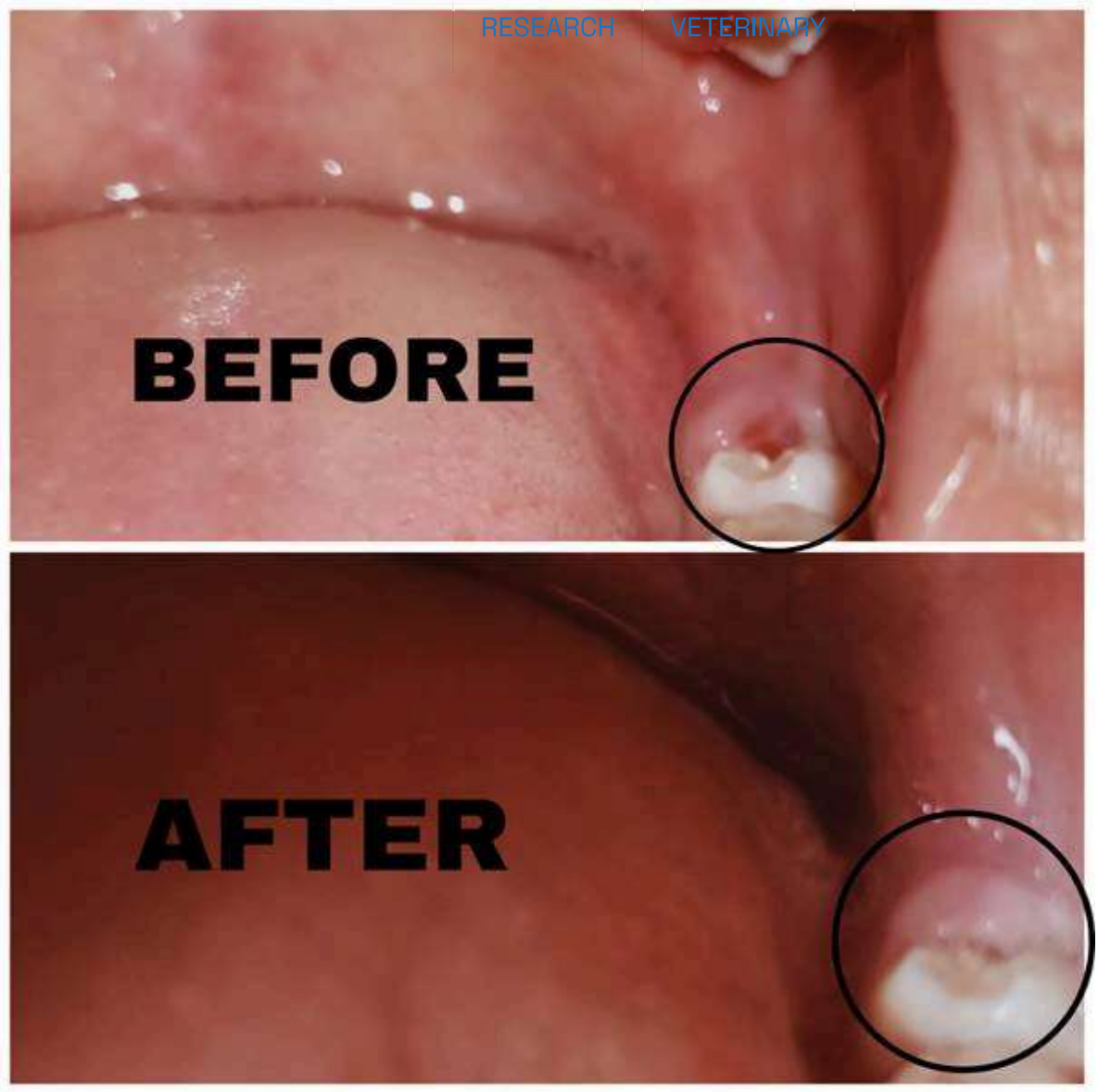
Follow up on same day after two doses of remedy on same day. First dose given was dry. Pain while swallowing eased within 8 minutes of first dose. Patient was insisting for another dose as he was in a hurry to feel better. Second dry dose was

Follow up on Next day 13th June 2023. After taking the remedy he could eat dinner the same night of 12th June. Overall 30% relieved. The remedy was repeated twice mixed in water.

Follow up on third day: Overall 60% relieved. Seemed happy and relaxed. No remedy given.

Follow up on fourth day: Overall 80% relieved. No trouble while eating nor while swallowing.

Photo’s below———



Follow up on Fifth Day 16th June 2023: 100% okay. No complaint.

The photo taken for follow up is on 22nd June 2023. Patient has not had the need any remedy till date.

14th November 2023: No recurrence of complaint nor any new complaint to this day.

Key words: Increased salivation – Better by Cold – Merc-Cor

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August 2, 2024 at 1:25 pm RESEARCH VETERINARY

Very nicely presented case – made for good learning – also you reinforced that the OLD is GOLD book of BBCR needs a look through once in a while surely.

Reply

Serdar Buyukozer

September 4, 2024 at 6:40 am

did the cavity in the biting surface really healed? or the tooth moved and further tilted and the clean picture we saw is actually not the biting area as in eariler picture but the side of the tooth. Meaning, it has to be pulled eventually in some not distant future, anyway… and this is just the acute relief?

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Clinical Cases

Hirschsprung Disease in a 3-Year-Old Boy

March 17, 2022 • 1 Comment • by Rajiv Peres

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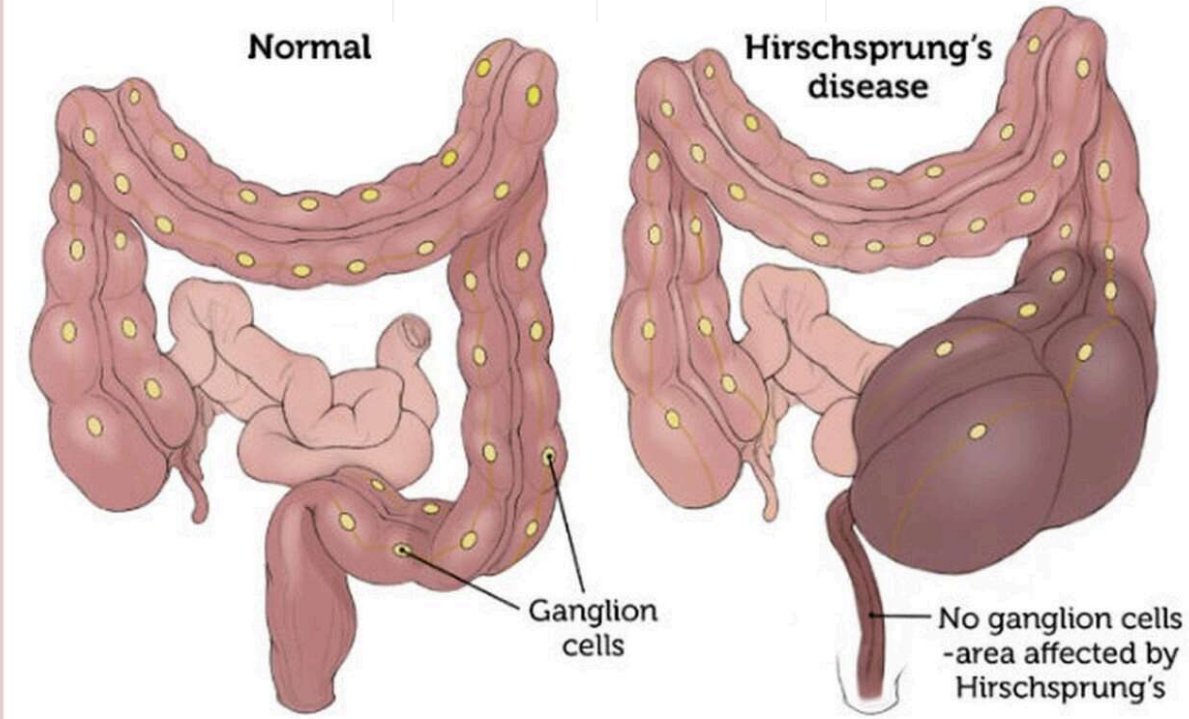

Dr. Rajiv Peres presents a case of Hirschsprung disease in boy of three. The diseases is congenital and is due to missing nerve cells in the muscles of the baby's colon. The child improved in spite of the congenital nature of the disease.

Hirschsprung disease is congenital and is due to missing nerve cells in the muscles of the baby's colon.

On 18th July 2021 a boy of 3 years was brought by his parents who were both consultants (father psychiatrist and mother ophthalmologist). They asked me if I could offer something for Hirschprung disease. This child had chronic constipation since more than one year. He would pass stool once in 7 days with lots of straining.

Stool was dry and in between hard stools was liquid form (soiling) with mucus. He

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From 3rd month to the first year he appeared to be a healthy chubby baby and desired to be at the breast for 2-3 hours all the time. His teething, walking and speech were delayed. His weight was not increasing in the last 2 years. He was very cranky for the last 3 weeks.

During pregnancy his mother had guilt for not marrying the boy of her parent's choice. She was feeling guilty that she was not able to earn and give back to her parents what they had invested in her education. All her life she was a very sincere child dominated by her mother and grew up being afraid to take a stand for herself, except when it came to her marriage. She was experiencing low's and could not stand criticism. She had great fear of failure. Till the 6th month of pregnancy she had no interest in herself and a low mood. She suffered post partum blues.

This boy wanted to be very clean and would wash all his cars. He did not like to have a bath. He would be more active at night playing with his ball. He feared water, insects and was fond of dark chocolate. Thermally he was a hot patient. He was very caring towards his elder sister who was apparently healthy.

Appetite- good, demands apples, porridge, guava

Thirstless

Sleep- Prefers to sleep on one side

Family history:

Mother- I.B.S and depression

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Paternal Grand Father- Type 1 D.M, Born with staghorn calculi removed one kidney soon after birth, Bypass was done, Expired

Maternal grandfather- Aortic stenosis

Maternal grandmother- Mood swings, O.C.D

On Examination- The right ascending colon was stony hard.

See also
A Case of Renal Stones with Endometriosis and Hepatomegaly Responds To Homoeopathy

Appearance of child – Very Pale, distressed, afraid, timid, looking down, emaciated, dull, sitting in one position and crying when approached. Child was looking smaller for his age.

Anamnesis of the case:

Here we have a child who has a strong family history of syphilitic miasm yet, his constipation was more psoro-sycotic and it was not congenital. The constipation had made him sedentary. His milestones were delayed. Initially I thought of Carcinosin. However, his constipation alternating with diarrhea (alternating state of symptoms) is a sign of psora) and his tendency for retention of stool is a sign of sycosis.

in a child (uncommon). I prescribed **Sulphur 0/1** on 18th July 2021, one dose daily to begin with.

Follow up on 22nd July 2021 – He is able to pass gas and straining at stool has reduced. Earlier he would pass gas three times a day and now he is able to pass gas all throughout the day and even in his sleep. Passes small quantity of stool little by little, semisolid type.

Now no mucus in stool. Abdomen is still distended however, soft on touch not stony hard. Earlier he would suffer terribly with bloating if he ate a biscuit, two days ago he ate biscuits and had no problems. He is no longer dull but has become playful. Pallor of the face has reduced. Sulphur 0/1 dose reduced to alternate days.

Follow up on 1st August 2021 – His mother informed that he is doing well and the pediatrician has put him on a stool softener and laxative. In 7 days he will undergo rectal biopsy under anesthesia in order to confirm whether ganglion cells are present in the distal colon. Sulphur 0/1 reduced to twice a week.

Follow up on 8th August – Since last 5 days he has not passed stools and soiled only twice. Abdomen is swollen and fecal matter can be felt on palpation. Rectal biopsy was postponed to 13th August 2021. He wants to eat sweet porrige. Goes for bath more readily now. Child was silent, dull, abdomen was soft on examination. Sulphur 0/2 was started daily dose from 8th August 2021.

Follow up on 17th August 2021 –His father informed me that the boy is not well. He is straining all the time and not taking enough food and water, just like before. I increased his dose to Sulphur 0/2 twice a day.

Follow up 0n 18th August 2021– Rectal biopsy was done successfully and histopathology report confirms the diagnosis of Hirschprung's disease with no ganglion cells present. He is passing stools better than before but the straining still persisted. Same medicine was continued with reassurance to the father.

Follow up on 19th September 2021 – Yesterday patient passed normal stool, well formed. He gets nightmares. Overall 60% improved. He has good appetite and asks for food. He was also given enemas every day as per guidance of their pediatrician. For the first time I saw this child jumping and playing in my clinic. He was also talking and smiling. Abdomen was very soft on palpation. Prescription given was Sulphur 0/2 reduced to once a week.

Follow up on 31st October 2021 – Eating has increased to double the quantity. Shows more confidence. He stopped breastfeeding during the day. Able to pass stools without any help. Stool is hard. Stool softener has been prescribed by the pediatrician to make the process painless. Drinks less water. Sulphur 0/3 was prescribed once a week.

Follow up on 3rd December 2021 – Child is mentally cheerful, playful, very energetic and confident. Great appetite. No distension of abdomen, passing stools once or twice a day. Weight gained in the last 4 months is 3kgs. Also can used to strangers in a short time than before. He has also started to talk a lot and is willing to share his things with others.

Follow up on 18th December 2021– Child is well and playful. The family has relocated themselves to another state and child has no complaints. Continues to be on

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This case evokes certain questions as to how homoeopathic medicines were able to manage this child suffering from Hirschprung disease in absence of ganglion cells. I believe homoeopathy has always something at the back to offer for hopeless cases. Hopeless because the best pediatric surgeons in Jehangir hospital Pune, India were planning for a 3-stage surgical procedure. Homoeopathy rewarded this child of 3 years and his parents for never giving up.

Four Lab reports below:

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December 18, 2023 RESEARCH VETERINARY

• by Elaine Lewis, Shana Lewis

It was the wife who needed a remedy!
Did you guess which one?

About the author

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Dr Darshan Shah

April 18, 2022 at 6:45 am

Interesting read Dr Peres!
How persistently you kept giving Sulphur is worth noting!

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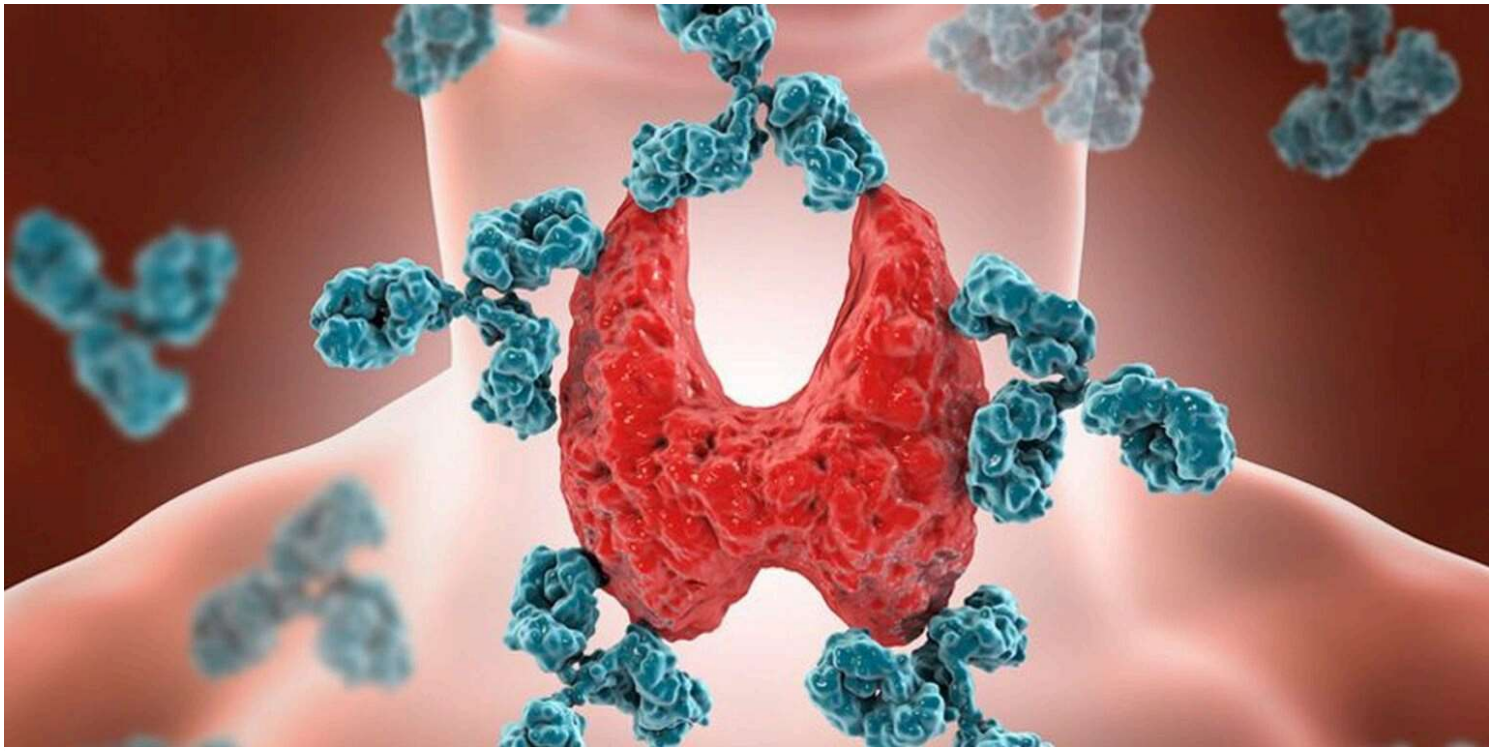
Clinical Cases

Sub-Acute Thyroiditis Post Covid-19

April 19, 2022 • Add Comment • by Rajiv Peres



Dr. Rajiv Peres shares a case of post Covid Sub-Acute Thyroiditis in a man of 46. The patient presented with severe burning from right ear to the neck.

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On 16th August, 2021 A 46- year- old male, who works as helper in the fabrication workshop presented with complaint of pain in right ear extending down to the lower aspect of right side of the neck since June 2021. He was unable to swallow his food normally for the last 15 days.

He complained of severe burning from right ear to the neck with sensation as if someone is eating his ear. He wanted to have a cold rain water bath. He could not tolerate any noise and got very irritated, wanting to beat his children when they made noise.

He would feel tired easily while speaking. His voice was weak and I could not understand his words, since articulation was indistinct and forced. He spoke hastily and there was a considerable amount of shortness of breath. He would get fever in the evenings at 4pm with chills, heat and body ache for the last 4 months.

Since Covid in April 2021 there was aching pain in both calf muscles and his body felt shaken up the last 15 days (beginning of August 2021). After suffering from Covid his thermal state had changed to his being a chilly patient.

Two months ago in April 2021, he had headaches and body aches, vertigo <talking associated with chest discomfort and was diagnosed as Covid positive.

In July 2021 he had severe pain in the right ear and neck, was getting fever on a daily basis and he could not go to work. In end of July 2021, he visited the local health centre's ENT O.P.D and an ultrasound was done which revealed Multinodular Goitre with ill-defined nodule in right lobe.

At the same time his T3 level was raised (2.47ng/dl), T4 was raised (17.6ug/dl) and TSH was low (0.02u1U/ml. On physical examination the neck swelling was visible.

Physical Generals:

Appetite: Doesn't like to eat although hungry; he had a salty taste in his mouth. Since he was on antipyretic medicines for fever, he had a running nose which relieved him partly.

Cravings: He loves ice creams and custard and cakes. However, at present he avoids it consciously.

Stool: Constipated since last 15 days, scanty stool. Earlier he use to pass stools thrice a day.

Sleep: Disturbed by dreams. In dreams he would see that somebody had caught his throat. He also had a dream that he was discussing and trying to identify his mysterious sickness.

Thermals: Chilly patient

He had become impatient and angry due to months of suffering from fever, no work, no diagnosis and the whole family was afraid that he had cancer. In his locality three people had been found to be suffering from cancer, and this frightened his family all the more. He was an honest, well-behaved man but at his

See also
Revisiting: Polio Party!

Anamnesis of the case:

The first issue was to correctly diagnose the case, hence I decided to refer this patient immediately to endocrinologist Dr. Newman Correa. Dr Newman advised a Radio Isotope scan done on 11th August 2021 which confirmed that it is not malignancy but thyroiditis.

He prescribed some painkillers and the patient began feeling better. I knew that this relief would be short lived. Exactly 5 days later, the patient presented with neck and ear pains to my out-patient department. I thought that we should prescribe something befitting his present state of inflammation.

When I examined his enlarged thyroid, the right side felt spongy. I referred to Kent's Repertory – External Throat Goitre, Right and Goitre Painful. I had to select between Iodium and Spongia. I decided to prescribe Spongia because in Spongia the thyroid enlargement is spongy and secondly in concordant Materia Medica of Frans Vermeulen it is written that "Toasted sponge contains a small percentage of Iodine".

Thirdly, the pace of slow onset of symptoms of Spongia matched the description of the patient's symptoms as described by Dr J.T Kent, like for example the night aggravation and also the marked anxiety and fear of death with suffocation.

The 1st prescription was given on 16th August 2021 – **Spongia 30**, three times a day for five days. One may call this a pathological prescription or a phase remedy.

Follow up on 23rd August 2021 – The patient said that immediately on the first day of starting Spongia he got a fever. He usually got a fever 4-6 pm but this time it was rather 6-8pm. He did not take any antipyretic, and then on day two after commencing taking Spongia, no fever but he started with coryza that was thick, yellow and he felt relieved every time it was discharged.

The severe burning pain in throat was 100% relieved. The breathlessness also improved but was not completely back to normal. He was able to resume his work at the workshop from 23rd August 2021. No prescription.

See also
A Case of Autism

Follow up on 30th August 2021– Patient returned with complaint of burning pain radiating from left ear down to left lobe of thyroid (old symptom which was there at the time he contracted Covid in April 2021). He had developed strong craving for ice cream since 29th August 2021. No prescription was given

suffered from pains in left leg since last 8 days probably due to over working.

He had to strain to pass stools. He had breathlessness after exercise. He would also feel slightly giddy, better after eating sweets. Craving for ice cream was very marked. Here we took the opportunity to prescribe his constitutional remedy – **Phosphorus 30** (second prescription), twice a day for three days.

Follow up on 13th September 2021 – In the first 3 days of beginning Phosphorus 30 the left ear pains were 80% relieved. Thereafter in between, the pains returned and disappeared especially while riding his motorbike. Better by inserting cotton in to the ears.

Then his right ear pained. The pain in left side of thyroid was present when the ear pains appeared and also during sneezing. However, the pain was not continuous as before. After starting Phos 30 the constipation improved. Breathlessness which was during eating improved 10%. No giddiness. Craving for ice cream still persisted but avoids eating it. Left leg pain is okay. Overall he feels less afraid. He can even do mental work which he was avoiding all this time. No medicine was given.

Follow Up on 29th November 2021 – Patient had a follow up visit with endocrinologist and all his thyroid readings were in normal limits. No conventional medicine was prescribed. Homeopathically also no medicine was prescribed. No burning, no giddiness, no constipation. no craving for ice creams.

This case shows us that constitutional medicine will bring all the good if given at the right time. Although we were able to identify Phosphorus symptoms during the first visit, it would not have been correct to prescribe it, since the thyroid gland inflammation was more striking and Phosphorus had little role to act there. Homoeopathy displayed it precision in totally curing this case of thyroiditis.

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Homeopathic Trauma

January 20, 2010 • by Maria T. Bohle

A trauma case in which quick application of a high potency homeopathic remedy saved a life.

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Clinical Cases

Utility of Dreams in Homoeopathic Practice

January 18, 2022 • Add Comment • by Rajiv Peres

Rajiv Peres shares three cases in which the patient's dreams played a part in finding the simillimum. Magnesium carb, Veratrum carb and Natrum carb were remedies revealed dreams.

Case # 1 – Irritable bowel syndrome

On 2nd June 2020 A 31-year-old unmarried woman, Chef by profession, came along with her mother at the correct time of appointment (dressing was also very proper) and presented with complaints of severe dysmenorrhoeas since about 2 years. She experienced this ever since she got a uterine clean up done for her uterine polyps.

She had menses for 24 days and endometriosis and her sexual drive vanished. A USG done in 2013 confirmed a few endometrial cysts and endometrial polyp. She

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Her dysmenorrhoea began on the day of ovulation with unbearable abdominal pain every hour. Nothing helped. Her menarche was at 12 years but she always had profuse menses lasting for 8 days.

Her haemoglobin used to be low in childhood and 9mg/dl was the highest recording. She became sexually active at 12 years of age. Her mother said that the daughter always had love relationships and was a rebellious child. The mother described the patient's adolescence as a problematic one.

She hardly attended classes, was always busy with boyfriends and relationships. She often cut her wrist due to disappointments in relationships. She could hardly concentrate on studies as her moods were changeable.

She failed her I.H.M course exams several times and wanted to pursue modeling, however her mother objected. Her father supported her and brought her on track. She never listened to her mother.

At 22 years she got pregnant and had advanced into the 5th month. Her parents were worried about their name in society and warned her that her career will be over if she continues the pregnancy, so she underwent an abortion.

It was very painful physically as well as emotionally. Till today she cannot forgive herself for allowing that abortion. She doesn't want to get married nor have children as she feels God will punish her with a deformed child. However, she loves children and will entertain and play with her friend's kids.

She cannot bear to see injustice done to anybody's children. She will go out of her way to help them and spend any amount of money to see them happy. She will not

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She is also overprotective about her younger sister who is 5 years younger. Her sister studies in Pune and when she returns to Goa she keeps a close watch on whom she is dating. However, Pune is out of her reach to do surveillance and so the patient feels helpless.

After the abortion she became serious and her teachers forced her to appear for exams which she passed. Today she is well placed in life and has achieved a lot. Her mother calls her an exemplary child now.

She has fear of being alone and getting rejected. Hence, she gives her very best at everything. She always feels that her mother, although a teacher, never expressed love towards her. Her mother by nature was unemotional towards her but very kind and patient towards her students at school.

Her mother would promise her that if she spoke the truth she would not be punished. But when she spoke the truth, her mother gave her severe punishment. Thereafter she began telling lies.

Her mother didn't like hugs and kisses, but when her sister was born, she observed that her sister was given much affection. At that time, she believed she was an adopted child and used to get dreams that her real family is coming to take her.

She felt that something was wrong with her because her mother didn't give her love. Her mother would leave her in the neighborhood and go to teach school. At that time her neighbor, a woman, molested her. She didn't tell her parents since they would never believe her, but to this day she sees that woman interacting with other children and worries about their safety.

RESEARCH VETERINARY

sacrificed many things happily to provide service to her. Her mother requested her not to put her in an “old age home”. The patient promised that she will never do such a thing and would always take care of her.

She has fear of people going away from her, (presently her boyfriend) but this originated in her childhood. Her father once had an affair and she remembers her parents fighting and her father telling her that she might have to be away from her mother.

She has been with this boyfriend for 10 years now and the last two years he fights with her for sex but she cannot satisfy him because of her bowel pains. They are so intense that she can hardly sleep. In her childhood till the age of 22 she could never sleep before 2 am.

Since the time of the abortion, she over thinks whenever she has to make a decision. The abortion made her emotional and she breaks into a cold sweat from every part. When she gets angry with others, she is patient but when she fights with her boyfriend, she physically assaults him and then she regrets behaving that way.

At such times she fears he might leave her and go away. She doesn’t mean to hurt him but her anger is so violent that she may even punch the wall. She wants a peaceful mind because presently she is thinking of the worst case scenarios. She wishes that she communicated better with her mother, however she feels her father is more broadminded. Her mother has fixed ideas about what is right and nothing beside that exists.

The biggest regret for her is that she got pregnant and that she had the abortion. She loves going for nature trekking and for road trips where she can experience

RESEARCH VETERINARY

She is thermally chilly, thirstless and sleeps in the foetal position on her left side. She can sense if a person is genuine and guided her father on whom to rent his shop to. She loves reading books because they take her into an imaginary world.

She seeks refuge in her phone to divert her mind and her boyfriend complaint that she is paying more attention to the phone. She likes music when she is sad but not otherwise.

See also
Homeopathy in Obstetric Disorders

Family history: Her father had bipolar disease and hemiplegia at 50 years due to aneurism, Type 1 D.M and HTN. Her maternal grandmother suffered from Parkinson's and D.M. Paternal grandmother also suffered from Parkinsons. Paternal grandfather also suffered from cerebrovascular accident at 45 years but survived till 80 years.

1st Prescription Colocynthis 200, 4 doses (Acute prescription) **June 2nd, 2020**

Colocynth was chosen based on sudden, violent cramping, being sleepless and restless with pains. Also, concomitant of irritability and painful breasts during menses

Follow up after 15 days – After the remedy she felt very relaxed and would not fester her brain with over thinking like before. On 6th June she got her menses but unlike earlier there was no breast tenderness nor irritability.

RESEARCH VETERINARY

Everything was going fine until two days before ovulation and suddenly hunger increased, and she was constipated and restless. Then she complained of terrible gripping infra-umbilical continuous pain, as if squeezing a knot in the intestines. It was >lying in bed with something hot on her tummy, hard pressure helps, going out and walking helps (gentle motion).

After the pain subsides, she needs to eat something which is followed by bloating of abdomen then she feels tightness, no energy to do anything and anxiety about things out of her control in general. Amelioration after stool, although not easy and >after flatulence. Since the pain has returned, she believes the old medicine will not work.

Colocynthis 1M, 1 dose given. Immediately pain disappeared within 2 minutes. Advised SOS dose with succussion.

Follow up after 28 days – Pain in abdomen reappeared around the time of ovulation. When Colocynthis 1M was taken it immediately resolved it. Overall, pain lasted only for 2 days and this time it was bearable. Usually it would go on for many days.

Follow up after 1 month– Pain in abdomen reappeared around the time of ovulation. Intermittent pain returns after 3-4 hours. Two days before the pain appears she gets bloating of abdomen and bit usually she has a flat tummy. Also she becomes thirstless 2 days before pain comes, which results in constipation.

Appetite increases during pain and is aggravated after eating. Overall she feels less tired, not overly stressed out and has peace of mind. Colocynthis settled the pain 60%. Overall this pain's frequency has reduced a lot in the last 2 months and it comes only 3 times a day.

RESEARCH VETERINARY

Also the intensity has reduced, now only on the first 3 days the intensity is more and needs Colocynthis every 2 hours but doesn't seem to help. Before the pain would last for 5 days.

Mag-Carb 1M, single dose was prescribed as her constitutional remedy-. July 2nd, 2020. **Magnesium because of dreams (that her real parents are coming to take her and also dreams seen as remedy response) and also due to repressions.**

Here the pathology of **spasms** >walking in open air and neglected feeling is again indicative of magnesium. The centre point or nucleus of this case is love and care. On one side she is impulsive and on the other side uncommunicative and going into a shell. The whole range of responses revolves around love and care (available or not).

This remedy is not conscientious but rather has an emotional mind. Intense, deep, thoughts, very difficult to remove from mind (cannot forget memories good or bad), one side retaliates and other side withdraws e.g. after abortion. Oscillating between pain and pleasure. Hypersensitive, hyper reactive and the tubercular miasm is dominant.

The central idea of Magnesium-carb from Materia Medica is, the lack of care, protection and nourishment as a dependent infant. This is confirmed through her dreams: dreams of being lost in the forest and dreams being lost at home.

Forest is a fixed symbol of danger. A place inhabited by ghosts and dangerous animals and the place where mysterious things happen like in fairy tales as well as lost in the magical world of the unconscious. In this case the dreams were indicative of Magnesium Carb.

RESEARCH VETERINARY

Follow up on 5th day – The first two days she was very emotional and had dreams which she never normally gets. Then from the third day onwards she observed that she is sleeping better and her pain disappeared. She is feeling much calmer and not so anxious. She is greatly appreciating homoeopathy.

Follow up after 15 days – Also after the remedy she got certain unusual dreams as if she is in a third degree competition on stage and has to answer certain awkward questions on stage. She woke up disturbed and for the first time could discuss her dream with her boyfriend.

She has changed from introvert to someone who is able to speak up. For the first time she refused and said no to do things because she was already tired. Usually, she would do things because she felt too guilty to say 'No'. She was also able to talk to her Mum with ease on issues like suicide.

She as fewer fights with her boyfriend and had sex with him which she just didn't feel like having before. Overall 90% better. Felt immense peace and realized that she never desired to be a chef but her mother showed her that line. She only wanted to be happy and give others happiness which she already has and that it's not necessary to be perfect to impress her family.

Follow up after 4 months– No recurrence of complaints. No new complaints. Treatment stopped.

Note: In this case the dreams started only after the prescription of Magnesium. This is because often repressed feelings, as we see characteristically in Magnesium's, will surface only after taking the remedy. Hence the dream is confirming that the simillimum is correct and acting.

Rajiv Peres

On 6th July 2020 A 40 year old married women who was trying her best to conceive presented with severe skin eruptions all over her body along with horrible itching since last 2 months. The eruptions were also on the scalp which prevented her from sleeping.

She would also suffer from headaches on and off. One year ago she had received Medorrhinum 200, 1 dose for left ovarian cyst producing menorrhagia and even allopathy was not helping. She was a shy housewife, very religious and spent her time in taking care of her mother- in-law and husband.

See also
Revisiting: And Now For Something Completely Different-- A Remedy For Raj

There was deep seated sadness since she had not been able to bear a child. Also there was worry about constructing a new home. but funds were not sufficient. She was a hot patient who was thirsty for hot drinks and desired for sour food stuffs. When she developed some bloating of the abdomen, she perceived it as if she had become pregnant until a scan cleared that delusion.

She had a very persistent dream of cats pursuing her at least 8 times a month. There was no special fondness for cats in real life. There were no special characteristics in this case. But the dream was a strange one. I looked it up under the rubric dreams of cats pursuing him (Nux-v, Sil, Verat-Alb).

herself pregnant and that she will be delivered soon. I prescribed Verat-Alb 200, 1 single dose.

Follow up after 15 days– Felt a lot of peace on the first 4 days of starting the medicine. Skin eruptions improved by 65% one the 3rd day. Also, the headaches that would occur completely disappeared. She was well for 7 months at one stretch.

Case # 3 – Swollen Ankles in a Woman of 32

A 32 year old woman recently married, presented with complaints of swelling in both ankles and extreme tiredness since last 3 months. For the last 3 months she had been running around to get arrangements for her wedding. She was under tremendous pressure due to non-cooperation from her siblings, two brothers. She had to work twice as much each day.

She is a teacher by profession and has to stand for long periods. Due to tension she ate more and her weight increased considerably. Also, she is prone to ankle injury, twisted while dancing.

Angered very easily especially with her siblings and with her brother who always discouraged her and a certain girl friend who criticized her. By nature she is sensitive to rudeness and weeps quietly.

She is not basically a fighter but rather a family type of girl. Very caring of her brother's and family's honour. Of late her digestion is not good and she suffers from diarrhea easily. Bloating of abdomen.

Appetite- good. Craving for sweets. Thirstless. Thermal-Chilly patient

RESEARCH VETERINARY

Sleepless till 1 A.M. due to thoughts of unpleasant events of past. Falls asleep while travelling to work.

Dreams- Repeated dreams of going on a journey at least thrice a week with family members around and wakes up with the dream in the morning.

On Examination: Eyes- Pallor+ Blood Pressure- 120/80 mmHg

Anamnesis of case:

Boenninghausen's Therapeutic pocket book was consulted: 1)**Dream of Journeys. 2) Dreams constantly ongoing after waking.** The only remedy covering both these rubrics; **Natrum-Carb.**

Phatak mentions under Natrum-carb great debility from exertion, anemia, irritable and occupied with sad thoughts. Anxiety, fearfulness and gastric weakness by slightest errors in diet further confirmed the remedy. Prescription made on 9th January 2020 Natrum-Carb LM1, 1 Single dose. Advised to take iron supplement and later resume exercise once she feels stronger.

Natrum carb is mainly indicated in cases of psychological and physical exhaustion because it has a big effect on nerves and digestion. Another striking feature is that Natrum-carb needs to have something in the mouth, and the distended belly is better after diarrhea.

Although Natrum carb lives through periods of sadness and depression, it can be happy too. Mood can be changeable, suddenly happy and suddenly angry and aggressive. And they dislike certain people like Sepia and Ferrum.

doesn't fall asleep while traveling. Last night she got a dream of returning home after travelling and saw her late mother and late grandmother receiving her at home. Thirst has improved. Less irritable than before. This is a case where the prescription was based on a dream since in this one-sided case nothing else was characteristic.

What are Dreams?

Freud claimed that the dream is a façade of psychic phenomena behind which its meaning lies hidden. It's a meaning already known to the dreamer on some level, but maliciously, so to speak, withheld from consciousness.

Dreams are not disturbers of sleep, but rather its guardians against disturbances. Dreams are the most common and the most direct expressions of the unconscious psyche, providing us clues in cases where there is an apparent paucity of mental/emotional symptoms.

All dreams are not equally important. The big ones often remain with us for a lifetime: 'I will never forget this dream'. Just as no two people are alike, no two people dream the same dream exactly for the same reason.

The key to find its usefulness is to understand it. Even when the homoeopath does not understand a dream, it can still be effective as a form of compensation for the patient. Many things, including homoeopathy can be effective without fully being understood.

Dr N.M Choudhary opines that a special study of dreams is essential because dreams are as guides for a homoeopath which specify a particular deviation of the

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Important cures have been recorded based on dreams alone. Hence a homoeopath needs to apply the full armory of our art to understand dreams. For example, we can see in the Staphysagria dream fights, battles, wars, telling her to finally stand up to the perpetrator.

They reflect the dreamer's anticipation of future alterations of consciousness. Take Sepia for instance, who initially loves and is dedicated to her family. Yet she can have dreams of killing her family members or of running away from them to find peace –even of killing her newborn baby.

For a long time, these patients can consciously suppress these feelings, but their dreams may reveal much earlier their inner self. Or the Carcinosin patient, who dreams about failure in examinations since he is 'not allowed to fail', a condition imposed by his parents or self-imposed.

Even when a dream is not found in the proving of a remedy, it still can relate to the essence of that remedy as evident in our 3rd case in which she was feeling deserted by two of her brothers, thereby taking a flight into fantasy in the form of a journey which helps to get totally disconnected from her forsaken environment.

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Rajiv Peres

Dr. Rajiv Rui Viegas Peres M.D(Hom) Associate Professor, Dept of Organon of Medicine, Aarihant Homoeopathic Medical College, Bhoyan Rathod, Gandhinagar, Gujarat. Pin 382721 Received Best Teacher's Award 2010-11, Received Hahnemann Award 2018, Received Excellence in Homoeopathy Award in April 2022, Active Member of H.E.R.I Mumbai.

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Clinical Cases

Plantar Wart on a Woman of 23

August 17, 2021 • 1 Comment • by Rajiv Peres

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Homeopath Rajiv Peres treats a woman of 23 for a painful plantar wart. Local symptoms, a serious demeanor and family history led to the simillimum.

On 11th November 2020 a 23-year-old unmarried girl presented with complaint of a wart on plantar surface of left great toe. She had wrapped it up with a piece of gauze since it was extremely painful. She had this complaint for the last 3 months and had taken homoeopathic treatment from another doctor (Antimonium Crudum) which had failed. The wart would itch, worse by touch and worse in winter. It felt very hard and horny while examining it. A closer look revealed it to be like a cauliflower and it pained like needles.

Thermals- Chilly patient

X

Thirst- good

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Eliminations- good

Sleep- refreshing

She was sensitive to damp weather which made her sad. She also had a tendency for growths e.g., styes on eyes, lipoma on back and scalp. Her mother had suffered from depression and had been on psychiatric medications until she expired from a myocardial infarction at age 48. Her father suffers from warts on his body. He remarried and lives separately but provides monetary support to his two daughters.

She lives with her sister. Most of the housework is done by her sister since she has to travel a lot (53kms one way). She is extremely quiet, serious look on face and avoids eye contact. When she lies down and closes her eyes to sleep, she feels there is somebody else in the room watching her. She could not identify if it was some robber or ghost or something else.

X

11th November 2020 RESEARCH VETERINARY

This is a one sided case. I referred to Kent's repertory

See also
Argentum Nitricum Case

1)Warts horny

2) Warts painful

3)Warts sensitive to touch

4) warts itching

5) Delusion specters, ghosts, spirits, sees.

Prescription: Thuja 200, 3 doses were given. November 11th, 2020

Follow up on 30 November 2020– After taking 3 doses of Thuja pain in the wart reduced on the 3rd day and after that she did not need to tie gauze for cushioning. . Itching stopped by the 5th day and the wart turned hard.

On the 7th day it began turning black. She also was developing another little wart on her right ring finger medial aspect which she had forgotten to mention before, and this wart disappeared.

full of smiles. She began to mix more with her colleagues at college.

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30th November 2020

Follow up on 11 December 2020– She came very excitedly to show me that there was no sign of plantar wart left. Her faith in homoeopathy deepened.

X

11th December 2020

Warts can be psoric, sycotic or syphilitic/tubercular. Psoric warts are itching, sycotic ones are flat, hard or cauliflower-like and syphilitic/tubercular warts are hairy and bleed easily. Hahnemann classified warts under local affections, not caused by traumas (Aphorisms 189-190).

Suppressing sycotic warts is also known to give rise to organic heart disease. Removing syphilitic warts can lead to serious complications as happened to my other patient who had surgery for a bleeding wart from his back and shortly was detected suffering from Parkinson's disease. The aim of therapy is not in first instance to make the symptoms disappear but to understand what happens inside

Revisiting Mystery Illness?

We are told that the Thuja tree loves to abide in wet, swampy places, and its habitat extends from Pennsylvania northwards to Canada. It is not by accident that the symptoms and conditions of this drug are brought out on or made worse by exposure to wet and dampness.

Grauvlogl listed Thuja in his hydrogenoid group which contains remedies like Calc, Dulc, Nat-s, Rhus-t., all having aggravation from cold wet weather. Thuja is generally a left sided remedy and patients may seem very serious by appearance.

They live a secluded, mysterious life, preferring to live alone and afraid of marrying. Seasonal depression in winter is also a well known aspect of this remedy. The feeling of being watched is described in Kent's materia medica as well as the idea that the soul and body are separated.

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About the author

Rajiv Peres

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Martine Jus

September 16, 2021 at 7:23 am

Very nice case Dr. Rajiv and good example of miasmatic prescription and healing from inside out.

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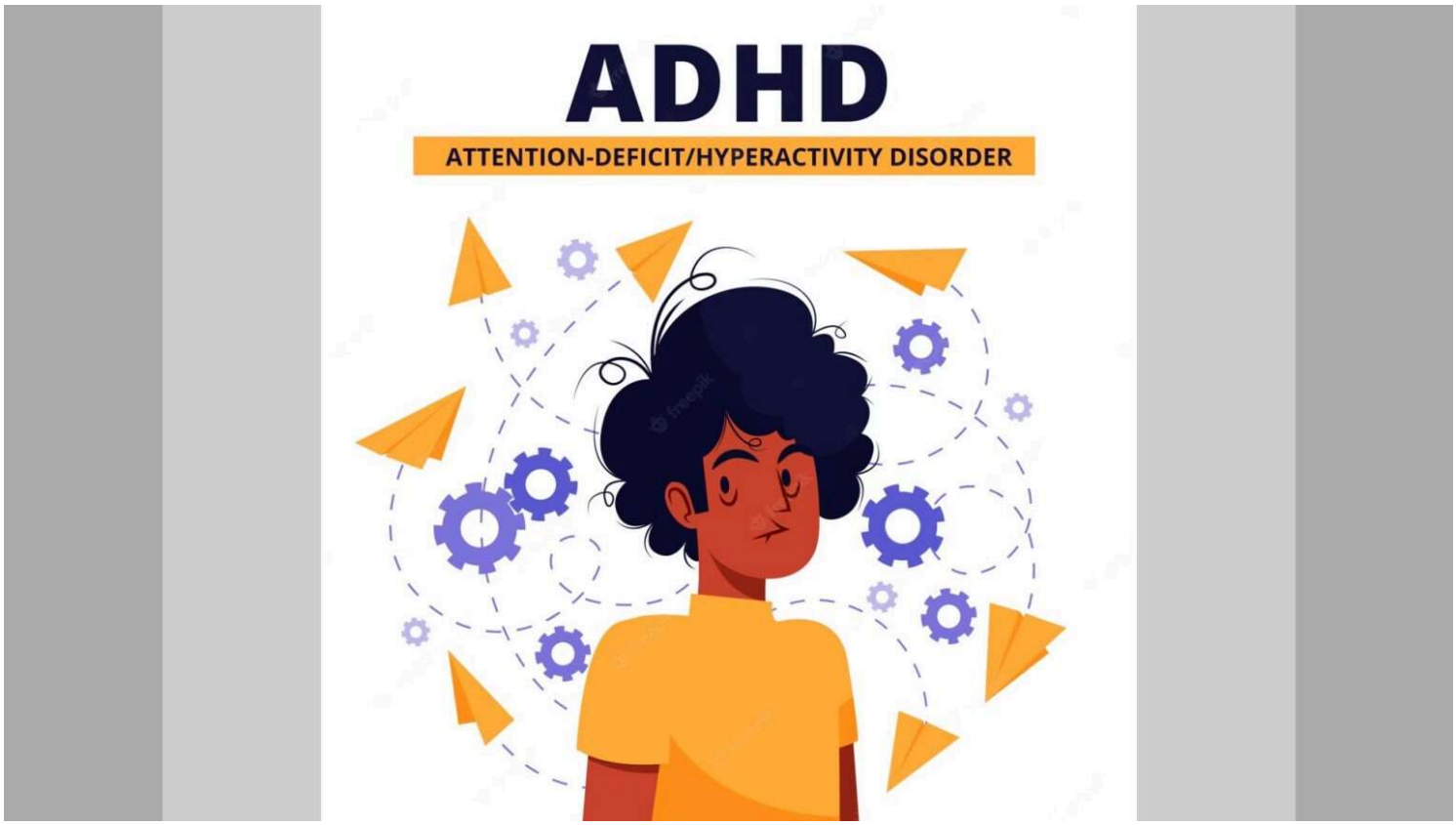
Clinical Cases

ADHD with Bipolar Disorder in a Man of 31

February 19, 2021 · 2 Comments · by Rajiv Peres



Dr. Rajiv Peres presents a case of bipolar disorder in a man of 31. Delusion he has done wrong, suicidal disposition, malicious, discontentment and highly manipulative were among the symptoms leading to a series of remedies which were curative. A very well managed case.

complained that he faces a lot of difficulty in concentration and doesn't feel like doing anything. He just feels like eating, at times overeating. He looked obese, around 93Kgs.

Tiredness felt in the morning and he doesn't wake up. He was an engineering student but dropped out and joined Bachelors in Commerce (a course offered to students after high school and intermediate studies). His reason for selecting the Commerce stream was that he wished to do business and never wanted to do a 9 am to 5 pm type of job. Presently he regrets this decision.

He's was a chilly patient and hated the rainy season. He preferred summers and desired sweets. He feels afraid of crowds due to anxiety. At this point he was holding himself responsible for his failure in life. He had fear of not reaching his potential because of his laziness. He had regrets that during his school days he did not participate in inter-class debate competitions or learning a musical instrument.

He suffered a lack of confidence. The stammering made him feel like a loser and he felt stale within himself. At class ten he suffered from obsessive compulsive disorder. He was always a hyperactive child and enjoyed manipulating others and enjoyed watching others fight for the trouble he created.

He had suicidal thoughts of hanging himself, because in comparison to his classmates he could not achieve anything in life. He said that he should support his parents at this age but it is the reverse, and that he had achieved nothing. When he would quarrel with his father he would say 'Die' to him.

Details of Family History of illnesses:

Father suffers from bipolar disease

Mother has Renal calculi, fibro-adenoma of breast.

Sister has obsessive compulsive disorder

Paternal grandfather had asthma

Maternal grandmother suffered from mental illness

Anemnesis:

I used these Complete Repertory rubrics:

1) Delusion Imagination, wrong: he has done

2) Suicidal disposition

3) Fear in a crowd.

His strong family history of sycotic-syphilitic miasm along with depression and the self-reproaching behaviour led me to prescribe **Aurum Met 200, 1 single dose**.

Follow up after 45 days– He had already been put on mood regulating psychiatric medications as well as psychotic medications on advice of a psychiatrist. He complained of catching cold easily. He would still not resist eating ice-cream.

Feels better after smoking (addiction). Also, he said that he cannot express himself, doesn't know what words to speak and that he is in a fight with himself. Also, he had developed a new fear of barking dogs. He could not tolerate correction. He had even raised his hand on his father. He liked to watch a lot of travelling videos. I decided to prescribe **Tuberculinum 200, 1 single dose.**

See also
Presentation of Pulsatilla

Follow up after 2 months – His mother complained that whatever he wants the parents have to give it immediately (bossy). He would punch the cupboard when angry. He does many things but leaves things unfinished. He used to spend at least 8 hours a day on social media. He would break things unknowingly. His room was always messy. Now he wanted to drop out of commerce stream and join computers (changeable). He was angry with himself for not achieving or having purpose in his life. There were several conflicts with his father. When he gets angry, he is afraid of killing someone. I selected **Sulphur 10M, 1 dose**. Sulphur is a complementary medicine to Tuberculinum.

Follow up after 7 months– He was better for nearly for 6 months. He stopped the antidepressant medication within a month. However, three weeks back he tried to hang himself with a bedsheet but suddenly stopped himself saying 'I have to prove myself to the world'.

He appeared very slim as he had reduced from 93kgs to 73kgs by running 10 kms every day. Even if he suffered cramps he wouldn't stop. He would read many self help books to improve himself.

He stopped social media, as he wanted to live in the real world. He said that universities cannot provide any knowledge to him, and that he can learn simply by reading in his library. However, his concentration had diminished while reading and he had to read the same matter over and over again and still didn't understand it.

The last 3 weeks he was crying a lot out of anger. He loves to sit by himself alone. He said that his mind had twice the thoughts of a normal person and that made him very intuitive. He said, "If anyone tries to offend me I will fuck him in such a way that the person won't even realize who did it".

He wanted to manipulate everyone. He wanted to play mind games to win the confidence of his parents so that they give him the car to drive. He was brought to homoeopathic treatment by his uncle who was sitting outside.

The patient told me "I can kill my uncle and feel nothing about it." He had broken a chair at home 3 days ago. He complained of insomnia and tachycardia 150/m and said that the ADHD medications were responsible for it (researched by him).

See also
Formica Rufa - A Case of Anxiety and Insomnia

He craved for a lot of coffee which calmed him down. There was such a rage on his face (almost like a hard-core criminal). He felt impulses to murder people as he went for his morning run. I prescribed him **Nux Vomica 50 M, 1 dose** based on inclination

Follow up after 1 month– He appeared so calm and cool. No suicidal thoughts at all. He would not run 10 kms at 6am because now he began experiencing fatigue. Exercise which was not so important to maintain his mood anymore. On his own he stopped the ADHD medicines which corrected his tachycardia.

Now he can sleep earlier and wake up late in the morning. His mother was more relaxed since there was no aggressive behavior at home with his father. In fact, there were minimal quarrels. His mind did not have racing thoughts. No remedy was needed.

This case demonstrates how timely judicious use of antimiasmatic remedies in a certain sequence is essential to restore harmony. We began the treatment with the anti-syphilitic remedy Aurum Met because this case had a lot of deep miasmatic load clearly evident in his family history of illnesses.

This was followed by Tuberculinum since he was by nature very nasty, malicious due to discontentment, provocative and highly manipulative. Tuberculinum also covered his fear of animals (dogs) and desire for ice cream.

He also had addictive behavior with desire for things harmful to him. His changeability of mind was seen in his academics. I further supported him with two antipsoric remedies, Sulphur and Nux-Vomica based on indications.

Nux Vomica did the greatest good by calming him down, normalizing his sleep and cancelling the bad effects of medications which were arousing the mind of the patient instead of calming it down. Higher potencies were used in this case because the susceptibility was higher, the presence of ample of characteristics and on account of the violent nature of the disease.

Follow up after 3 months

Two months ago (August 2020) his mother who is a nurse suffered from Covid 19, his father and sister both got affected, except him. He is very stable in mind and says that he is fully self-sufficient and not needing any medical treatment. He advocates homoeopathic treatment to others. His mother recovered but his sister is not doing so well. He worries about her since she is showing some signs of mental illness. He has no active problem. He drives the car wherever his mother wishes to

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About the author

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2 Comments

Martin Earl

February 26, 2021 at 5:59 pm

What a fine case! Attention to detail and accurate analysis are demonstrated throughout. Thank you Dr. Peres.

Reply

Laurie Teal

April 2, 2021 at 2:00 pm

Wow, great case! Thank you for sharing.

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Clinical Cases

Acute Infective Osteoarthritis in a Woman of 70

June 17, 2022 • Add Comment • by Rajiv Peres

Dr. Rajiv Peres shares a case of acute infective osteoarthritis in a woman of 70. Shifting pains and aggravation at night, along with astute analysis by Dr. Peres led to the simillimum.

Name: LD

Female, Age 70

Has 2 daughters, one who is unmarried lives with her.

Background history —

I first saw this patient in May 2020. She appeared lean, thin, shy and presented as a case of acidity with retrosternal pain before food, aggravated by spicy and oily things, also worse by eating butter and masala items.

She had gall bladder polyps since many years.

She also complained of sleeplessness which dated back to depression since about 4

RESEARCH VETERINARY

She was worried how to bring up her two daughters. One is already married and she has a granddaughter.

In Dec 2019 she developed right tonsillar cyst. Right tonsillectomy done.

History of Recurrent sinusitis. She also complained of pain in right ear which comes suddenly and disappears slowly.

She used to get pain in the right knee < ascending, locking of right knee joint and was advised total knee replacement. Also, she suffered from numbness of feet which improved by walking about.

She was an emotional person and didn't want to complain much. She was afraid to be alone and afraid of thieves, when her unmarried daughter goes to work. Feels better with consolation. She craved coffee.

Rx Pulsatilla 200, 1 single dose

In August 2020 at follow up, she reported that only the acidity was mildly improved but otherwise no improvement from the remedy. I observed that her gait was like a duck. Also, she had stiffness of back while rising up in the morning. She had difficulty in ascending stairs. There was constant worry about her daughter. She had marked craving for cheese.

Rx Calcarea Carb 200, 1 single dose

Polyps still persisted despite Rx.

Present complaint:

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Since 14thth June 2021 she had very severe acidity after lunch which she has at 1.30 pm. Lunch includes 3 tablespoons of Kanji, then 15 minutes later, upper G.I discomfort started. Burning commenced at 2.15pm. At 6.15pm again burning increased for a few minutes and then she got relief. At 9.30 pm she had plain water and again burning started.

See also
Answers to April Case Quizzes

On 16th June 2021 her right knee started hurting, relieved by cold compresses, unable to sit on commode and couldn't even tolerate cold compress as it was raining very heavily.

This was an acute crisis as narrated by the daughter over the phone. Before I could go to see her, I asked the daughter to give her 3 doses of Lycopodium 200 on 16th June 2021. I was considering the problem originating in right knee and shifting to left knee. However, there was absolutely no relief but on the contrary her condition worsened day by day until she was completely limited to the bed. She was able to sit in bed but not stand. She could not eat anything. Pains were changing from right knee to left.

On 17th June 2021 she worsened, especially at night time

18th June 2021: Crying in pain which was unbearable now second knee (left) started

RESEARCH VETERINARY

That was when I went for a home visit. No orthopedic doctor was willing to make a home visit due to Covid19 scenario.

18th Evening a home visit. Patient was lying in bed on her back, all surroundings very clean. The left knee was massively enlarged (3 times bigger than the left), venous engorgement seen and hot to touch. She was not in a position to bend it. Would not like any pressure.

Right knee was also warm on touch but 3 times less swollen as compared to the left. The excruciating pains would be worsened at night preventing her from sleeping. Unable to stand at all. Weeping while telling the symptoms.

Daytime she feels hot and at night she felt chills in the body. Only able to sit up in bed. Can't even sit on the commode without help of daughter. Ailment from could not be traced.

There was fullness of abdomen with mild nausea feeling with fear. Fear was due to the burning in epigastrium triggered by any kind of food including beverages like coffee, tea and even water. She was always aggravated after eating and had sour eructations. Afraid to eat. Also, it was observed by the patient that even in summer she had icy cold sweat. At present not much sweating.

After I examined her joints, she began complaining of pain in throat. On examination of throat: Septic tonsillitis of left side and the uvula was massively swollen pale and had a whitish tip pointing downward (like icicles). She was prone to such septic lesions even in the past. Patient was asked what was troubling her the most? She said left knee pain. I inquired "What about your acidity?" She said it is hardly troubling her at present.

Mastitis in a Woman of 30

Diagnosis : **Acute infective osteoarthritis secondary to septic tonsillitis**.

Rx: Kali Bichromium LM1 Twice a day for 2 days **–** prescribed on 20th June 2021.

Reasons for prescribing Kali Bichromium;

1) I referred to Boger's synoptic key initial repertory section page 48 for shifting pains rubric

2) I used night aggravation (syphilitic) to eliminate remedies. I was left with Pulsatilla, Ledum Pal and Kali-Bi. Pulsatilla had been tried in the past but without any success. Ledum Pal has coldness of parts better by cold application, whereas in this case the affected part is warm to touch and better by cold application.

I read all these 3 drugs from Materia Medica and in Allen's Keynotes under Kali Bi. I found the PQRS symptom of this case Oedematous, bladder-like appearance of uvula.

Follow up on 21st June.

In the morning she first experienced some vertigo and then began walking by holding the walls. Vertigo was an old symptom that had returned after the remedy.

22nd June : Able to walk without any support

Home visit Follow up on 10th July. Patient walking absolutely normally. Both knees were cold on touch and appeared symmetrical in contour.

Follow up on 22nd August 2021

She came walking to my clinic with lots of gifts for me. No complaints of knee pains, walks well. Both knees cold on touch, no tenderness. On examination of throat: Bladder like swelling of uvula restored back to normal as can be observed in the photograph. Sleeps well. Eats well. Blood pressure 130/80mmHg.

This case highlights the role of the homoeopath at the bedside and how the whole phenomenon has to be perceived in resolving chronic diseases.

Uvula Aug 22nd after Kali Bi

Knees – Aug 22nd

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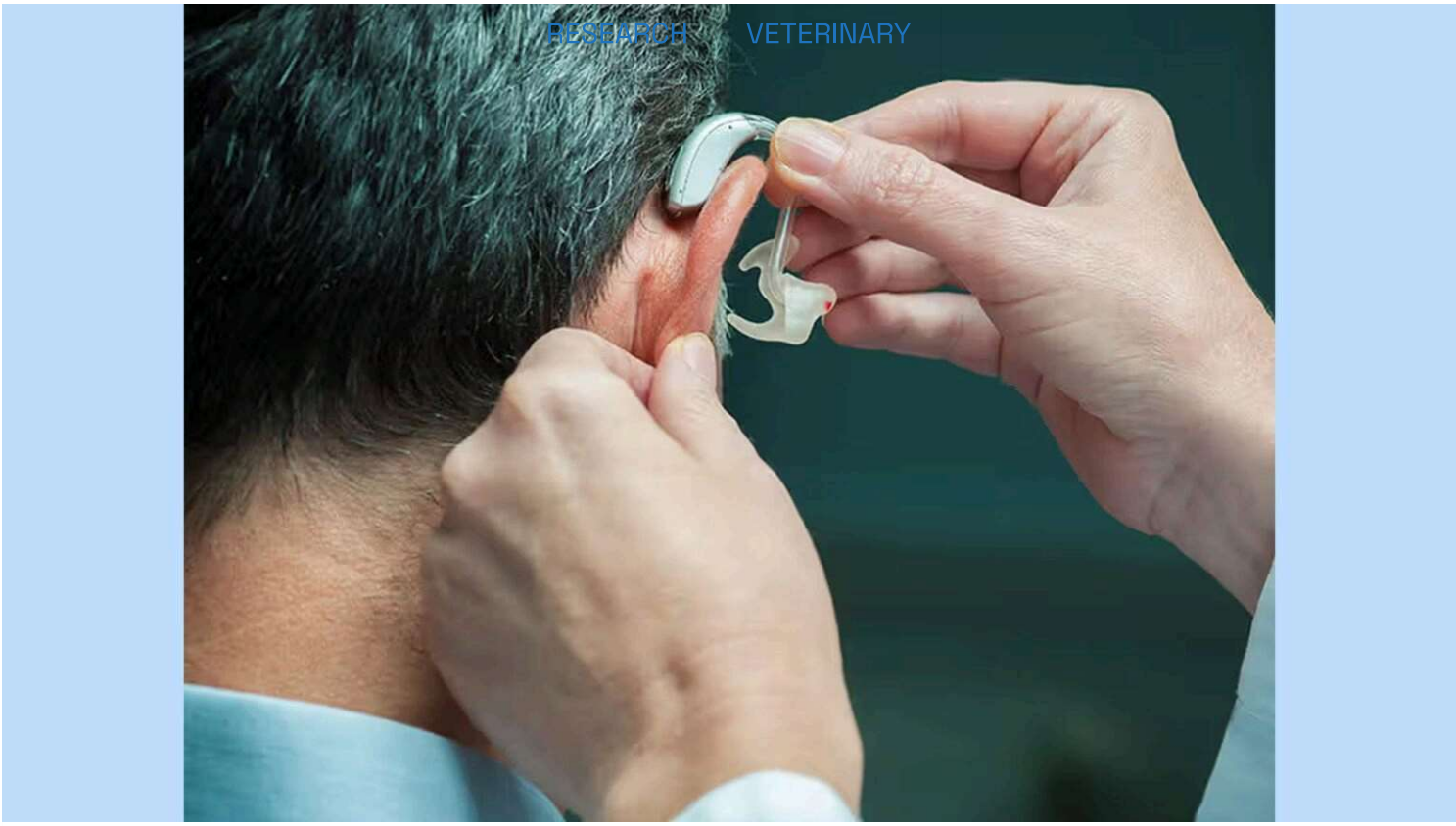
Clinical Cases

Right Sided Hearing Impairment Post Covid

August 17, 2022 • 1 Comment • by Rajiv Peres



Dr. Rajiv Peres shares a case of post-Covid hearing impairment in a woman of 50. Ailments from embarrassment and sleepless before midnight due to flood of thoughts were symptoms leading to the simillimum.

30th December 2020: A 50- year-old married lady, mother of three children and a college teacher by profession presented with complaint of blocked feeling in right ear, with hearing impairment of right ear since 8th November 2020. No history of pain in right ear. This was an ailment from covid infection which she suffered on 8th November 2020.

She had fever for two days, body ache for 4 days and cough for 15 days. She did not take any treatment for it. However, post covid she never felt fully recovered. Past history of old ear perforation in right ear. Usually, such perforations heal

RESEARCH VETERINARY

Family history: Father expired due to myocardial infarction age 51
Mother suffers from hypertension and cervical spondylosis
Paternal grandfather died of stomach cancer
Paternal grandmother had diabetes mellitus
Maternal Grand Father died due to cancer of lung
Mother's side – 3 Aunts died of cancer
Elder sister suffers from hypothyroidism
Younger sister suffers from S.L.E

Considering that the cold had settled in the ear, I prescribed **Kali-Sulph 1M**, 1 dose as an acute remedy.

Follow up end of January 2021: No relief in blocked feeling in right ear with hearing impairment, Confusion of mind also not improved. No medicine was prescribed but patient was advised to visit an ear specialist.

Follow up on 19th June 2021– Patient was informed by the ear specialist in February that there is nothing wrong with the right ear and that her hearing should return in a few weeks. As per the audiogram, the right ear had mild conductive hearing loss. The rest was all within normal limits.

She complained of upper backache, better by stretching, worse by leaning forward while sitting. No menses for last 4 months. USG abdomen showed uterine polyps. She also had a peculiar sensitivity: whenever she killed an ant her eyes would itch a lot. She feels worse after eating mushrooms since the birth of her third child. She was feeling tired easily.

See also
Psoriasis in a Man of 63

I considered giving her the chronic remedy which usually helps her. Hb=9.8 ESR=28. Prescription was **China 200**, 1 single dose

Follow up on 19th October 2021– This time patient presented with two complaints; first was relapse of trigeminal neuralgia in right side of mouth. Also, ailments from eating sour things and from mental overexertion.

Pain worse at night, worse by touch of tongue, worse by talking. There was a program in college in which she had be a moderator and she spent some sleepless nights in anticipation. Shifting pain come and disappear suddenly. Worse on beginning to speak, or when brushing teeth or also while eating.

She felt the need to move continuously. Wants to be alone only with her children and husband. Her disposition had changed from a usually very quiet, gentle, shy lady into an irritable person. She would go to bed late due to tension.

Her college authorities were harassing her and her husband for not taking Covid vaccinations. Both are teachers and were forced to do a RTPCR test every week. They were embarrassed by the higher authorities and threatened that their salary would be stopped.

She was not convinced about the concept of this vaccine because a number of people she knew had suffered side effects of vaccination. Her eldest son is a

Due to her son's condition, she remains house bound. She is also embarrassed to go around with him because he gets very violent at times and beats both parents. Although this lady is only 50 years old, her hair is completely white making her look as if she is 70 years old.

See also
A Case of Acne Rosacea

Also the hearing impairment bothered her a lot during her classes as she could not listen to the queries of her students. She would feel very embarrassed. It was almost one year since she suffered from Covid and still the hearing impairment continued.

Her other complaint was numbness in her right hand, worse while writing. She would forget names of her favourite students which hadn't happened before.

I reviewed the case thoroughly since a remedy like China that had helped her previously, had failed to register and effect a cure. I knew that this case needed a far deeper acting remedy and secondly that this medicine should cover hearing loss without organic disease.

I repertorised this case using the following Rubrics: 1) Ailments from embrarassment 2) Sleepless before midnight because of flood of thoughts.

I read materia medicas. Allen's Keynotes: " nerves "worn out", after business embarrassments, unable to sleep.

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Boger writes: early senility, symptoms suddenly change place, bashful so can't have others present. Dunham says: complaints from excitement. Emotional in extreme. Intense people. Numbness of limb laid on. The more they think about their sensations the greater they become. Slow memory, slow comprehension. Confusion of mind in presence of strangers. Itching that is neurotic, meaning the more she scratched the more it itches. Dr Luc writes: Impaired hearing in elderly without any organic defect of the ear.

Oct 19, 2021 –Ambra Grisea 200 (indicated nosode), 1 single dose.

Follow up on 11th February 2022– After the remedy given on 19th October 2021 the right sided hearing impairment was completely gone. Shifting pain in jaw absent. Feels upper backache only if she carries a lot of weight. No remedy given.

This case teaches us how to perceive the whole phenomena (Aphorism 8 Organon of Medicine) otherwise we shall not be able to restore the sick to health.

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Rajiv Peres

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Sudhakar

August 19, 2022 at 10:00 am

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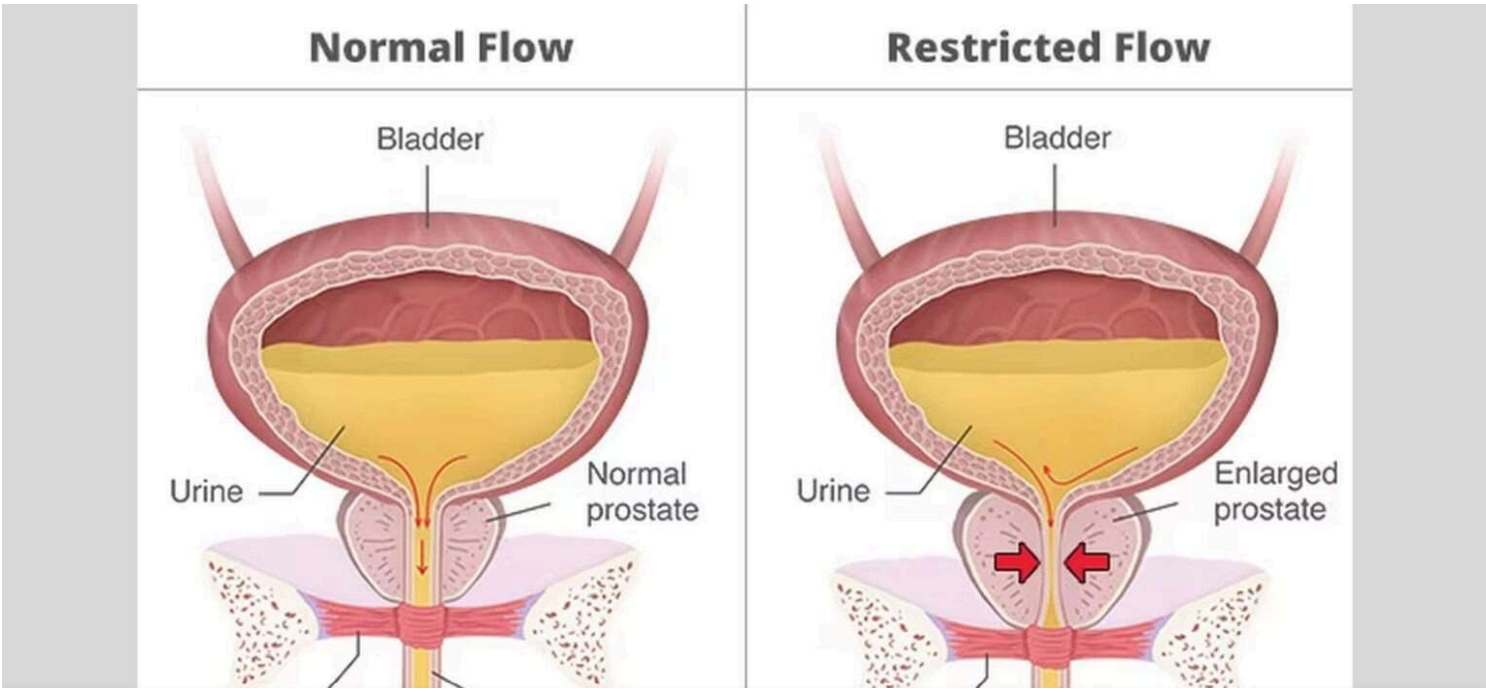
Clinical Cases

Urine Retention in a Man of 79

October 17, 2022 • 1 Comment • by Rajiv Peres



Dr. Rajiv Peres shares a case of urine retention in a man of 79. Enlarged prostate, urine drop by drop and micturition interrupted were among the symptoms leading to the simillimum.

Name: Mr. F. A

Age: 79 Years

Date of Case Taking: Feb 12, 2022

Probable Clinical Diagnosis: Acute urine retention secondary to prostatomegaly. (revealed on USG and 3 storage symptoms: frequency, urgency & nocturia)

On February 12, 2022 this 79 year old man was brought to my clinic by his daughter in law at 7pm. He was a known case of diabetes mellitus for the last 30 years. He complained that he was not able to pass urine for the last 2-3 days. He carried with him a USG report ordered by another doctor on the same day which stated that he had prostatomegaly.

His lower abdomen was massively distended and he was finding it difficult to breathe normally. He complained of stinging pain during micturition. He was able to pass only 2-3 drops. He also suffered from fever since the afternoon of the same day.

His problem of frequent urination was aggravated at midnight to 12.30am. He was able to pass urine only on standing, in sitting he was not able to pass urine. He was afraid of drinking water due to no urination. He avoided eating food.

LOCATION	DURATION	MODALITIES
Lower urinary system Retention	Since last 2-3 days Stinging pain during micturition. Inability to pass urine with fully distended bladder. Passes only 3 drops then	<Night 12-12.30am Urination only in standing position. <sitting

Evaluation of Symptoms of Acute Totality

- Boger Boenninghausen's Repertory was used.

1. Prostate gland enlarged, swelled p. 429 (Causation) Calc-c, Con, Puls, Sabal, Staph, Sulph
2. Urination drop by drop (strangury) p.435 Calc-c, Con, Puls, Staph, Sulph
3. Micturition interrupted p. 437 Con, Puls, Sulph, Sabal
4. From my knowledge of Materia Medica this modality "Can urinate only when standing" (Con, Sars)

See also
Depression

Materia Medica References for Conium

1. Allen's Key notes- Great difficulty in voiding urine; flow intermits; prostatic affections p.93
2. Boger's synoptic key- Urine stops and starts; >standing. Prostatic dribble p. 178
3. Vermeulen's Concordant Materia Medica- Frequent urination at night. Feeling of pressure on the bladder. Much difficulty in voiding. Dribbling in older men. pg360

Other remedies that repertorized out:

- **Sabal Serrulata-** There has to be constant desire to pass urine at night. Cystitis from prostate enlargement. Sediment in urine. Starting flow of urine is difficult and painful. Paresis of bladder sphincter; incontinence on exertion like lifting & laughing, absent in our case.
- **Pulsatilla**– Spasmodic pains in bladder after urination. Urine dribbles when emotionally upset. Urging to urinate on lying on back. Interrupted flow. Haematuria after urination, absent in our case.
- **Sarsaparilla**– Severe smarting at last drop (conclusion) of urine.

- **Staphysagria**– Important for cystitis in young married women. There is pressure upon the bladder, feels it did not empty. Patient urinates in thin stream or drop by drop. Burning in urethra when not urinating, absent in our case.

Note: Sarsaparilla was eliminated because there were no sediments in urine, nor there was smarting at conclusion of urination. Pulsatilla was eliminated since there was no emotional element involved anywhere in the case. Staphysagria was ruled out since there was no burning when not urinating. Sabal serrulata was also not given because this is not a case of paresis of bladder sphincter.

See also
Suspected Enteric Fever in a Man of 65

Final Prescription dated 12 February 2022

- **Conium Maculatum LM 0/3, 8 drops every hour**.

Potency Selection

- Here we have an old man with enlarged prostate with not many characteristics hence the LM scale was considered. One hourly repetition was considered because this case is an acute emergency and repetition alone can stimulate the response in this old patient with low susceptibility.
- Later on LM 6 was given (8-3-22).
- He was only on anti-diabetic medications and no other medicines.

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Recent Investigations in August 2022

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Lessons

- This case taught me that catheterization is not the only way out in a case of sudden urine retention. We learn by facing such emergencies with

- LM potencies helped to not only restore the flow of urine, but also to reduce the size of his prostate by half in less than a month's time.
- The most recent USG report repeated 6 months later suggests increase in dimensions of prostate gland along with volume. Although symptomatically the patient is doing well, this treatment may not have been curative but palliative in nature.

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Eta Brand

November 11, 2022 at 9:18 am

Thank you Dr Peres, this case gives me hope in getting a good outcome for urine retention. I tried to help a client male 70yrs who was already catheterised and waiting for prostate surgery to reduce the size of the prostate. This surgery has been performed for him 7 years prior. In his case he had a blocked catheter tube and he was back in hospital and then re-catheterised while on a wait list. I use bioregulatory medicine – HEEL remedies. I did try Sabal, as well as some indicated herbal remedies. Also used 30C Chimaphila initially. Perhaps the potency was too low, but seemed well indicated. The problem was because he was catheterised it was impossible to tell if the remedy was working. This patient had also become dehydrated because he was afraid of drinking. Once he started the remedies he felt more secure to drink and this was also after he was recatheterised and his urine flow was unimpeded. I think that he was not educated appropriately after his first episode of enlarged prostate, and the drivers for the growth were never addressed. I am a naturopath and tried my best for this client. He says he will return once he has his surgery. Being catheterised for months while waiting for surgery is fraught. This is supposed to be a first world health system. In his case he should have been treated as urgent to prevent further harm. Your case gives me hope. thanks for sharing.

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ROLE OF HOMOEOPATHY IN MOLLUSCUM CONTAGIOSUM IN CHILDREN (3-12 years)

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ABSTRACT

Molluscum contagiosum is a common cutaneous viral infection in children. It is a benign but nonetheless frequently troublesome viral infection that generally affects young children. Many studies have shown that, it comprises nearly 1% of all the skin diseases and its incidence has increased nearly fourfold during past twenty years.
Homoeopathy has excellent scope in the treatment of molluscum contagiosum. The treatment is targeted towards the root of the illness and hence homoeopathy brings about lasting cure rather than temporary relief.

OBJECTIVES

To study safe and effective treatment of *Molluscum Contagiosum* without any side effects.

Keywords

Benign, Molluscum contagiosum,Homoeopathy,*silicea.*

INTRODUCTION

Skin is the largest organ of the body and it forms about sixteen percent of its total mass. It is connecting link between the internal organs and the outer world.
Molluscum contagiosum is one among them caused due to *molluscum contagiosum virus (MCV)*. It commonly affects the children. Many studies have shown that, it comprises nearly 1% of all the skin diseases and its incidence has increased nearly fourfold during past twenty years.
Molluscum contagiosum being a contagious disease, it poses embarrassment for school attending children. Cosmetic purpose is another important reason for which treatment is sort.
Though *Molluscum contagiosum* is self limiting disease, some patients may develop complications, such as secondary bacterial infection, chronic conjunctivitis and punctuate keratitis. Hence treatment is needed to prevent above said complications

Conventional mode of treatment is curettage or cryosurgery which has to be done repeatedly. Moreover the utility of curettage and cryosurgery is limited when the lesions are too small and too many. Formation of scar as a sequel of such treatment is high.
In this study, I have made a sincere attempt to understand the essential nature of *molluscum contagiosum*,

its different manifestation and homoeopathic approach, which is not been done systematically so far. Hence there is need to study in detail the effectiveness of homoeopathic treatment of *molluscum contagiosum* in pediatric age group.

SKIN

Skin and its accessory structures – hair and nails, along with various glands, muscles, and nerves – make up the ***integumentary system***. ***Dermatology*** is the medical specialty that deals with the diagnosis and treatment of integumentary system disorders.[50]

Skin covers the entire external surface of the body, including the external auditory meatus, the lateral aspect of the tympanic membrane and the vestibule of the nose. It is continuous with the mucosae of the alimentary, respiratory and urogenital tracts at their respective orifices, where the specialized skin of mucocutaneous junctions is present. It also fuses with the conjunctiva at the margins of the eyelids, and with the lining of the lachrymal canaliculi at the lachrymal puncta.[46] It is the largest organ of the body in both surface area and weight.[50]

FUNCTIONS OF SKIN

The integumentary system contributes to homeostasis by protecting the body and helping regulate body temperature. It also allows you to sense pleasurable, painful, and other stimuli in your external environment.

The integumentary system helps maintain a constant body temperature, protects the body, and provides sensory information about the surrounding environment. Of all the body‘s organs, none is more easily inspected or more exposed to infection, disease, and injury than the skin. Although its location makes it vulnerable to damage from trauma, sunlight, microbes, and pollutants in the environment, the skin‘s protective features ward off such damage. Because of its visibility, skin reflects our emotions (frowning, blushing) and some aspects of normal physiology (such as sweating). Changes in skin colour may also indicate homeostatic imbalances in the body. For example, the bluish skin colour associated with hypoxia (oxygen deficiency at the tissue level) is one sign of heart failure as well as other disorders. Abnormal skin eruptions or rashes such as chickenpox, cold sores, or measles may reveal systemic infections or diseases of internal organs, while other conditions, such as warts, age spots, or pimples, may involve the skin alone. So important is the skin to self-image that many people spend a great deal of time and money to restore it to a more normal or youthful appearance.

The numerous functions of the integumentary system (mainly the skin) include thermoregulation, storage of blood, protection, cutaneous sensations, excretion and absorption, and synthesis of vitamin D.

DIAGNOSIS OF SKIN DISORDERS

The key to successful treatment is an accurate diagnosis. Keen eyes and a magnifying glass are all that are needed for a complete examination of the skin. Sometimes it is best to examine the patient briefly before obtaining a full history: a quick look will often prompt the right questions. However, a careful history is important in every case, as is the intelligent use of the laboratory.

HISTORY

The key points to be covered in the history should include descriptions of the events surrounding the onset of the skin lesions, of the progression of individual lesions, and of the disease in general, including any responses to treatment. Many patients try a few salves before seeing a physician. Some try all the medications in their medicine cabinets, many of which can aggravate the problem. A careful inquiry into drugs taken for other conditions is often useful. Ask also about previous skin disorders, occupation, hobbies and disorders in the family.

EXAMINATION

To examine the skin properly, the lighting must be uniform and bright. Daylight is best. The patient should usually undress so that the whole skin can be examined, although sometimes this is neither desirable nor possible. The presence of a chaperone, ideally a nurse or a relative, is often sensible, and is essential if examination of the genitalia is necessary.

DISTRIBUTION AND MORPHOLOGY

A dermatological diagnosis is based both on the distribution of lesions and on their morphology and configuration. See if the skin disease is localized, universal or symmetrical. Note negative as well as positive findings. Always keep your eyes open for incidental skin cancers which the patient may have ignored.
After the distribution has been noted, next define the morphology of the primary lesions. Many skin diseases have a characteristic morphology, but scratching, ulceration and other events can change this. The rule is to find an early or _primary' lesion and to inspect it closely. What is its shape? What is its size? What is its colour? What are its margins like? What are the surface characteristics? What does it feel like? Most types of primary lesion have one name if small, and a different one if large.

There are many reasons why you should describe skin diseases properly.

Skin disorders are often grouped by their morphology. Once the morphology is clear, a differential diagnosis comes easily to mind.

If you have to describe a condition accurately, you will have to look at it carefully.

You can paint a verbal picture if you have to refer the patient for another opinion.[26]

TERMINOLOGY OF LESIONS

Primary lesions
Primary lesions of the skin can be categorised under following types,
Flat lesions

- *Macule*: a small (<1cm), circumscribed area of colour change without elevation or depression of the skin.
- *Patch*: a larger (>1cm) area of colour change without skin elevation or depression.
- Elevated lesions

- Solid lesions
    - *Papules* (<0.5 cm in diameter).
    - *Nodules* (>0.5 cm in diameter).
    - *Wheals*: pink, rounded, or flat-topped elevations due to edema in the skin.
    - *Plaques*: plateau-shaped structures often formed by the coalescence of papules.
- Fluid-filled lesions
    - *Vesicles*: <0.5 cm in diameter and filled with serous or clear fluid.
    - *Bullae*: 0.5 cm in diameter and typically filled with serous or clear fluid.
    - *Pustules*: <0.5 cm in diameter and filled with purulent material.[26,32]
    - *Abscess*: Localized collection of pus in a cavity, more than 1 cm in diameter. Abscesses are usually nodules, and the term _purulent bulla' is sometimes used to describe a pus-filled blister that is situated on top of the skin rather than within it.[26]
    - *Cysts*: 0.5 cm in diameter; represent sacs containing fluid or semisolid material (Unlike in bullae, the material within a cyst is not visible from the surface).

- Depressed lesions
    - *Erosions*: superficial loss of epidermis with a moist base.
    - *Ulcers*: deeper lesions extending into the dermis or below.

Other lesions

- *Erythema* is redness caused by vascular dilatation.
- *Angioedema* is a diffuse swelling caused by oedema extending to the subcutaneous tissue.
- *Tumour* is harder to define as the term is based more correctly on microscopic pathology than on clinical morphology. We keep it here as a convenient term to describe an enlargement of the tissues by normal or pathological material or cells that form a mass, usually more than 1 cm in diameter. Because the word _tumour' can scare patients, tumours may courteously be called _large nodules', especially if they are not malignant.
- *Papilloma* is a nipple-like projection from the skin.
- *Petechiae* are pinhead-sized macules of blood in the skin.
- The term *purpura* describes a larger macule or papule of blood in the skin. Such blood filled lesions do not blanch if a glass lens is pushed against them (diascopy).
- *Ecchymosis* is a larger extravasation of blood into the skin.
- *Haematoma* is a swelling from gross bleeding.
- *Burrow* is a linear or curvilinear papule, with some scaling, caused by a scabies mite.
- *Comedo* is a plug of greasy keratin wedged in a dilated pilosebaceous orifice.

  Open comedones are blackheads. The follicle opening of a closed comedo is nearly covered over by skin so that it looks like a pinhead-sized, ivory-coloured papule.
- *Telangiectasia* is the visible dilatation of small cutaneous blood vessels.
- *Poikiloderma* is a combination of atrophy, reticulate hyperpigmentation and telangiectasia.

Secondary lesions

These evolve from primary lesions.

- *Scale* is a flake arising from the horny layer.
- *Keratosis* is a horn-like thickening of the stratum corneum.[26]
- *Crust* may look like a scale, but is composed of dried blood or tissue fluid.[26, 32]
- *Ulcer* is an area of skin from which the whole of the epidermis and at least the upper part of the dermis has been lost. Ulcers may extend into subcutaneous fat, and heal with scarring.
- *Erosion* is an area of skin denuded by a complete or partial loss of only the epidermis. Erosions heal without scarring.
- *Excoriation* is an ulcer or erosion produced by scratching.
- *Fissure* is a slit in the skin.

Sinus is a cavity or channel that permits the escape of pus or fluid.

- *Scar* is a result of healing, where normal structures are permanently replaced by fibrous tissue.
- *Atrophy* is a thinning of skin caused by diminution of the epidermis, dermis or subcutaneous fat. When the epidermis is atrophic it may crinkle like cigarette paper, appear thin and

translucent, and lose normal surface markings. Blood vessels may be easy to see in both epidermal and dermal atrophy.[26]

- *Lichenification* is an area of thickened skin with increased markings.[27,32]
- *Stria* (stretch mark) is a streak-like linear atrophic pink, purple or white lesion of the skin caused by changes in the connective tissue.
- *Pigmentation*, either more or less than surrounding skin, can develop after lesions heal.

Having identified the lesions as primary or secondary, adjectives can be used to describe them in terms of their other features.

- Colour (e.g. salmon-pink, lilac, violet).
- Sharpness of edge (e.g. well-defined, ill-defined).
- Surface contour (e.g. dome-shaped, umbilicated, spire-like).
- Geometric shape (e.g. nummular, oval, irregular, like the coast of Maine).
- Texture (e.g. rough, silky, smooth, hard).
- Smell (e.g. foul-smelling).
- Temperature (e.g. hot, warm).

Dermatologists also use a few special adjectives which warrant definition.

- *Nummular* means round or coin-like.
- *Annular* means ring-like.
- *Circinate* means circular.
- *Arcuate* means curved.
- *Discoid* means disc-like.
- *Gyrate* means wave-like.
- *Retiform* and *reticulate* mean net-like.

Configuration

After unravelling the primary and secondary lesions, look for arrangements and Configurations that can be, for example, discrete, confluent, grouped, annular, arcuate or dermatomal. Note that while individual lesions may be annular, several individual lesions may arrange themselves into an annular configuration. Terms like annular, and other adjectives discussed under the morphology of individual lesions, can apply to their groupings too. The Koebner or isomorphic phenomenon is the induction of skin lesions by, and at the site of, trauma such as scratch marks or operative incisions.

Special tools and techniques

A special diagnostic tools and techniques can be used to diagnosis the skin conditions, such as *magnifying lens, wood's light, diascopy, photography and dermatoscope.*[26]

MOLLUSCUM CONTAGIOSUM

DEFINITION

Molluscum contagiosum is a common cutaneous viral infection in children. It is caused by infection with a DNA virus of the *Molluscipoxvirus* genus.[27,43,48]

The word Molluscum contagiosum comes from the Latin word named *MOLLUSCUS* means SOFT characterised by pea sized semiglobular pearl like lesion with minute central depression.[1]

It is a benign but nonetheless frequently troublesome viral infection that generally affects young children.[57]

SYNONYMS

Molluscum sebaceum; Molluscum epitheliale;[1,11] *Epithelioma contagiosum;* [1,11,15]

Epithelioma molluscum; [1,11] *Dimple wart.*[15]

HISTORY

Molluscum contagiosum is a cosmopolitan human disease; several reviews describe the disease and the virus.[16] Its characteristic appearance was first described in 1817 by Bateman, who labelled disorder ―molluscum‖, a common term then for pedunculated lesions, and described it as ―contagiosum‖ to signify its apparent transmissibility, which he felt was due to the ―milky fluid‖ which could be expressed from the lesions. He differentiated the infection from molluscum fibrosum (neurofibromatosis). In 1841, Henderson and Paterson each described in this fluid cellular elements with large intracytoplasmic inclusion bodies (subsequently termed Henderson-Paterson, or molluscum bodies), which they felt were responsible for causation and transmission of the diseases. Subsequent reports of transmission of infections to humans by direct inoculation of lesion material supported an infectious etiology. The findings of tiny ―elementary bodies‖ within the molluscum bodies by Lipschutz in 1911, and of disease transmission by a ―filterable agent‖ by Juliusberg in 1905 and Wile and Kingery in 1919, suggested viral agent.[16,24] In 1933 Goodpasture and Woodruff described the inclusions and elementary bodies of molluscum contagiosum compared with those of fowl pox and concluded that the etiologic agent was a poxvirus. Since 1980, this relatively inconsequential illness at times has occurred in patients with AIDS as a tormenting opportunistic infection, which in Western countries amounts to a 5% to 20% incidence among homosexual men with AIDS.[16]

AETIOLOGY

Molluscum contagiosum is caused by a large brick-shaped DNA poxvirus with an ultra structural resemblance to vaccinia virus.[56] It has features intermediate between the orthopox and parapox groups. It infects humans, causing characteristic skin papules. It cannot be grown in tissue culture or eggs, and, although not readily transmissible to laboratory animals, has been shown to produce typical changes on human skin cultured on immunoincompetent mice. Restriction endonuclease and PCR analyses of MCV DNA have identified two main types, MCV-1 and MCV-2, with two much rarer types, MCV-3 and MCV-4.[9,48] MCV-1 is more prevalent than MCV-2.[48]

Molluscum contagiosum is caused due to Exciting cause and categorized under individual acute disease. In this molluscum contagiosum virus acts as an exciting cause.

Large numbers of MCV particles can be extruded from skin lesions, and large amounts of viral DNA can readily be extracted from virions. MCV has not been grown in established cell cultures, but virus from skin lesions has been propagated in human foreskin xenografts. The recognition of MCV transcriptional control elements in genetically engineered vaccinia virus indicates that MCV has a replication strategy similar to

other poxviruses.
The MCV genome is a covalently closed, linear, double-stranded DNA of 190 kbp and 63% G+C. Restriction enzyme cleavage analysis of the DNAs of several hundred isolates from different parts of the world initially suggested two genome subtypes, subsequently a third, and recently a fourth, although the different DNAs cross-hybridize extensively by Southern blotting. The significance between restriction map differences and viral biologic differences is unknown; all DNA subtypes produce the same apparent disease.
Genomic DNA of MCV subtype I has been sequenced (GenBank No. U60315; 190,289 bp). Of 182 potential encoded proteins, 105 have homologs in variola virus DNA that are likely to be essential for virus replication based on correlation with known function orthopoxvirus proteins; however, MCV generally lacks corresponding sequences for proteins involved in immune surveillance and modulation. Of the 77 predicted MCV proteins without correlates in orthopoxviruses, 36 show potential to be host-interactive homologs. In vitro studies indicate these are isologs of cellular glutathione peroxidase,class I MHC protein, two apoptosis inhibitors, two polypeptides that bind IL-18, and a chemokine antagonist.[16]

EPIDEMIOLOGY

Molluscum contagiosum virus infection occurs worldwide and appear specific to humans.[57] Virus occurs throughout the world, most commonly causing disease in childhood. Type 1 MCV is found in the majority of infections (76–97%), and whilst there is no relationship between virus type and lesional morphology or anatomical distribution. The disease is common, but its incidence in most areas is not reliably known.[9]
It commonly affects children and sexually active adults as well as immunocompromised individuals.[51]
The disease is endemic with a higher incidence within institutions and communities where there is overcrowding, poor hygiene, and poverty.[22]
The incidence of disease is 2% to 8% in some populations and is more common among 10- to 12-year-old children in developed countries than in developing countries, such as Fiji and the DRC, where the peak incidence is reported between ages 2 and 3 years and 1 and 4 years, respectively. In New Guinea, a prevalence of 22% with an incidence of 6% in children younger than 10 years of age has been reported. The disease occurs sporadically, although it can become endemic, particularly in institutions such as children's day care or boarding schools, or in communities with poor hygiene and overcrowding. Contact transmission has occurred nosocomially, by tattooing, wrestling, or by swim team members sharing towels. Abundant lesions are common in atopic individuals who may acquire a patchy and irritable eczema around sites of infection known as eczema molluscatum. Genital molluscum sometimes coincides with other sexually acquired diseases, including AIDS, and may signal sexual abuse of a child; otherwise, children may acquire lesions on the arms, or most often, the upper torso.
The different DNA subtypes do not affect different body locations, as occurs in infections with human herpesviruses type 1 and 2. In one study of 261 patients, MCV subtypes I, II, and III were detected in a ratio of 226:32:3 (183). Usually, specimens from different parts of the body are the same DNA subtype as are isolates among contacts; however, on rare occasions, mixed infections have occurred. Genital MCV infection has recently become much more common based on studies in the United States and Great Britain.[16]

AGE

Molluscum contagiosum is more common in infants and children younger than 5 years of age.[32,42] Age of peak incidence is reported as between 2 and 5 years. The disease is rare under the age of 1 year, perhaps due to maternally transmitted immunity and a long incubation period.[9]

SEX

Molluscum contagiosum is more common in boys than in girls.[42]

PREDISPOSING FACTORS

1. Impaired cellular immunity.
2. HIV infected patients.[9,48]
3. Atopic dermatitis.[48,57]
4. Topical steroids and other topical immunomodulatory drugs.[9,51]

MODE OF INFECTION

1. By direct skin or mucous membrane contact.[9,16,20,57]
2. Bath towels, swimming pools, and turkish baths.
3. Individuals involved in close contact sports (e.g., wrestling).
4. Koebnerization.[57]
5. Indirectly by means of fomites by virus entry through breaks in the epidermis or in the infundibular portion of the hair follicle. [16,43,48]
6. Autoinoculation.[20,48,57]
7. Contact transmission has occurred nosocomially, by tattooing, wrestling, or by swim team members sharing towels.[2,16]
8. In hot countries where children are lightly dressed and in close contact with one another, spread within households is not uncommon.
9. Infection of children through sexual abuse is presumably possible. However, to a greater extent than warts, molluscum contagiosum is seen quite commonly on the genital, perineal and surrounding skin of children, and abuse should not be regarded as likely unless there are other suspicious features.[9]
10. Epidemiological studies suggest that transmission may be related to poor hygiene and climatic factors, such as warmth and humidity.[1]
11. Contact with contaminated objects, such as clothing or toys, etc.[22]

PATHOGENESIS AND PATHOLOGY

The typical molluscum contagiosum lesion consists of a localized mass of hypertrophied and hyperplastic epidermis extending down into the underlying dermis, without breaking the basement membrane and projecting above the adjacent skin as a visible tumour. There are increased mitotic figures in the germinal layer, above which are pathologic changes in the nuclei and cytoplasm. As the surface cells are approached, these lesions become more and more pronounced.[16]

Molluscum contagiosum virus (MCV) enters the basal keratinocyte and increases the rate of cell division to twice that of normal skin, probably by inhibition of normal keratinocyte apoptotic differentiation programmed by specific MCV encoded proteins. In prickle cell layer, mitosis declines as viral DNA synthesis increases. The cellular proliferation produces lobulated epidermal growths that compress the papillae until they appear as fibrous septa between the lobules. The basal layer remains intact. Each cell enlarges in size and the cytoplasm is filled with a large hyaline acidophilic granular mass known as molluscum bodies, which pushes the nucleus to the edge of the cell. These bodies are present in large number in the cavity which appear near the surface of the centre of a fully developed lesion.[15,24] Inflammatory changes in the dermis are absent or slight. But in lesions of long duration, there may be a chronic granulomatous infiltrate.[9,51]

Studies of Cellular kinetics demonstrated three distinct stages of evolution in growth; an early stage, in which epithelium nuclei divide, a middle stage, in which epithelium division diminishes, and a late

stage, in which dermal endothelial cells and fibroblasts becomes activated. Inflammatory cells may be present in all three stages.[42]

The core of the lesion consists of degenerating epidermal cells, with inclusion bodies, and keratin, which is produced by uninfected cells. Fully developed lesions are loculated, and there is little inflammatory reaction in the corium unless secondary bacterial infection has occurred. The tumour-like appearance of lesions is from hypertrophy of epidermal keratinocytes because of the presence of virus-packed inclusion bodies and hyperplasia of uninfected basal cells.

Lesions are relatively devoid of cells involved in the immune response, including NK and Langerhans cells, although T cells may be present in the perilesional dermis. Infected keratinocytes no longer display b2-microglobulin, possibly because of complexing in the endoplasmic reticulum between an MCV homolog of MHC glycoprotein and cellular b2-microglobulin. MCV does not appear to encode an epidermal growth factor homolog; however, intense staining of transferrin and EGF receptor has been observed on molluscum bodies, but not on surrounding uninfected keratinocytes. MCV appears to provoke little immunity; patients under immunosuppressive therapy, and some AIDS patients, may have widespread and recurrent lesions. The lesions are noteworthy for the absence of reactive cells, and virus- specific antibodies are demonstrable in about 70% of patients; many patients develop antibodies after treatment for MCV (e.g., curettage). Antibodies against MCV do not react with different poxvirus genera. Lesions may persist in some patients for as little as weeks or as long as 2 years, with no sign of inflammation, which may be an effect of an MCV chemokine antagonist. Repeated attacks are relatively common in situations in which opportunities exist for reinfection, such as in children's day care centres and among sexually promiscuous adults.[16]

Specific antibodies have been found in about 58–73% of patients with molluscum contagiosum, and, perhaps due to unrecognized infection, in about 6–16% of controls, but these have not been demonstrated to have a role in disease clearance.[9]

HISTOLOGY

Molluscum lesions are acanthomas consisting of hyperplastic and hypertrophied epidermal cells which proliferate in a downward fashion into the dermis. Cells are filled with intracytoplasmic inclusion bodies, so called Henderson-Paterson bodies, which are eosinophilic ovoid structures in the lower malphighian layer. In the upper epidermis, they become more basophilic and may be as large as 35 µm in diameter.[42]

- *Circumscribed multilobular epithelial proliferation* with central keratinisation.
- *Intracytoplasmic* inclusions, at the periphery eosinophilic and towards the centre of the tumor more basophilic.
- Associated mixed or lymphocytic infiltrate.
- Occasionally lymphocytes are activated and enlarged.
- **Variant:** Molluscum contagiosum *folliculitis*: Involvement of follicular epithelia with inclusion bodies and associated mixed infiltrate.
- The histological changes are pathognomonic. When the inflammation is intense or in folliculitis, the inclusion bodies may initially be masked and the infiltrate mistaken for a lymphoma until deeper sections unearth the classic changes.[31]

CLINICAL FEATURES

1. The typical lesion of molluscum contagiosum are discrete, dome shaped, umbilicated waxy papules. [1,9,22,32,42]
2. They may be skin coloured, [2,9,22,42] pink or white. [1,9,20,32,42]
3. A small central punctum frequently is visible.[32,42]

4. If lesions are squeezed between the fingers, a cheesy or sebaceous-looking matter issues from the hilum.[1,13]
5. A lesion starts as a tiny papule and progresses to a size of 5–10mm in 6-12 weeks
6. Small lesions may join to form a plaque (_agminate form‘).[9,51]
7. Lesion may appear vesicular because of a translucent quality.
8. The size may vary from 1 to 5mm, few lesions can occur as large as 10 to 15 mm called as giant molluscum or molluscum contagiosum giganteum.[15,22,42]
9. Usually multiple. May be present in groups or may be widely disseminated on the skin and mucosal surfaces.[1]
10. They are rarely pedunculated (molluscum contagiosum pediculatum).[15]
11. Usually there is no itching or tenderness and no generalized symptoms.[22]
12. Lesions can occur anywhere on the body, but mostly on face, eyelids, neck, chest, axillae, sides of trunk, fold areas of extremities, and genitalia in children.[13,27,32] Palms and soles are rarely involved.[9,22,27]
13. After trauma, or spontaneously after several months, inflammatory changes result in suppuration, crusting and eventual destruction of the lesion.[9,20]
14. The disease usually lasts for 6 to 9 months,[9,14,41] but occasionally persisting for as long as 4 years.[9,14] Although individual lesions persist for only about 2 months.[9,41]
15. Lesions usually resolute spontaneously by forming erythema, pus and crusting.
16. Depressed scars or anetoderma-like lesions can remain when mollusca clear.[9]
17. Eczematous dermatitis occurs around the molluscum in 10% of cases known as molluscum dermatitis. [9,27,32]
18. In patient with chronic eczema or even atopic eczema, especially in areas of skin treated with glucocorticoids (local immune deficiency), hundreds of these mollusca contagiosa may develop: eczema molluscum.[15]
19. Multiple and widespread lesions are reported in atopic individuals and in immunosuppressed.[27,32]
20. Lesions on eyelids may produce conjunctivitis and/or keratitis.[9,27]
21. Usually not associated with sexual abuse or immunodeficiency in infants and children.
22. May occur as a sexually transmitted disease in sexually active adolescents and young adults.
23. Linear arrangement of lesions may be present, due to autoinoculation (Koebner phenomenon).[1,32]

DIAGNOSIS

1. The diagnosis of molluscum contagiosum is usually established on the basis of clinical appearance alone.[16,29,32]
2. Smears, made from the cheesy material expressed from the lesion is crushed between two slides and stained with Giemsa and Wright‘s stain show homogenous pear-shaped molluscum bodies. [2,16,27,32]
3. Skin biopsy reveals Henderson-Paterson bodies, which occasionally is used for large or atypical lesions.[27,32]
4. The distinctive umbilication can be seen more easily with a dermatoscope or after freezing.[9]
5. Demonstrating poxvirions by electron microscopy.
6. Diagnostic PCR methods are reported.
7. Occasionally, solitary lesions on the face or neck may be misdiagnosed clinically as basal cell

carcinoma.

8. Solitary tumours on the sole of the foot, although rare, also pose a clinical diagnostic problem.[16]

DIFFERENTIAL DIAGNOSIS

1. Varicella or Chickenpox. [24,29,42,57]
2. Verrucae or Plain warts.[15,24,32,51]
3. Juvenile xanthogranuloma.
4. Folliculitis.
5. Furunculosis.[42]
6. Lichen planus.[24,51]
7. Milia.[15,24,32]
8. Closed comedones.
9. Cryptococcosis.[24,32]
10. Syringomas.
11. Epithelial and intradermal nevi.
12. Sebaceous adenomas.
13. Histiocytomas.
14. Seborrheic and atopic dermatitis.
15. Basal cell epitheliomas.[24]
16. Genital herpes.[40]

COMPLICATIONS

1. Pruritus is sometimes a significant problem, particularly in those patients with underlying atopic dermatitis.
2. Chronic conjunctivitis and punctuate keratitis may develop in patient with eyelid lesions.
3. Secondary bacterial infection can occur, particularly if patients scratch their lesions.[57]
4. Eczematous patches often appear around mollusca.
5. Traumatized or over-treated lesions may become secondarily infected.[26]
6. Inflammation of molluscum contagiosum lesions is sometimes seen.[8]
7. Many a times though the skin has been cleared of the molluscum lesions, the core of the molluscum is not completely scraped off which can cause recurrence of this infection repeatedly.
8. Sometimes the cheesy matter in the centre of molluscum lesion gets infected with fungus, which spreads to all adjacent areas giving rise to white patchy discoloration and itching.

9. Recurrent molluscum can give rise to scarring, disfigurement and consequently mental trauma (Depression, low confidence in some cases).[40]

GENERAL MANAGEMENT

1. Avoid going to swimming pools, communal baths. [57]

2. Patients with Molluscum contagiosum should avoid sharing of personal items (eg, razors, bath towels) and contact with other fomites.[1,57]
3. Patients with Molluscum contagiosum should avoid scratching to prevent autoinoculation.
4. Obstetricians should be aware of the risk of vertical transmission of Molluscum contagiosum, and they should take precautions to prevent transmission during vaginal delivery.[1]

PREVENTION

- Prevention of spread may be enhanced by avoiding trauma to the site of involvement as well as avoiding scratching.
- Auto-inoculation may be decreased by treating existing lesions.[57]
- Chlorination of swimming pools.[5]
- One must refrain from squeezing or disturbing the lesion to prevent its spread.
- School children should not come in direct contact with infected child.
- Public toilets, swimming pools should be hygienically maintained.
- One must not share personal items of use such as towels, shaving blades, clothes, etc.
- Recurrent infections or skin lesions like eczema should be properly treated.[40]

TREATMENT

HOMOEOPATHIC CONCEPT OF TREATMENT

Homoeopathy has excellent scope in the treatment of molluscum contagiosum.[35,40] The treatment is targeted towards the root of the illness and hence homoeopathy brings about lasting cure rather than temporary relief.

Homoeopathic treatment not only helps in getting rid of the existing molluscum contagiosum but it also helps in removing the tendency for this condition to recur. Also the method of healing of the molluscum is without the use of any surgical aids and hence it helps in preventing scarring and other such side-effects that can occur due to surgery.[40]

Molluscum is predominantly *Sycotic* disease. So it requires an Anti-sycotic medicine to cure the case.[1,6]

In most cases the lesion disappears even without any treatment in a couple of months. However some lesions may persist for some time and require intervention. The drugs found useful in molluscum contagiosum include *Brom, Calc-ar, Calc, Kali-i, Sulph, Sil,* and *Thuj*. [1,20] *Calc* and ***Sil*** have been found very useful. After the correct dose of medicine, the lesions start disappearing after an inflammatory reaction with erythema and itching.[20]

Silicea as an internal remedy ranks first, and *Teucrium* next. *Bryonia, Bromine, Calc. Ars., Lycopodium, Nat. Mur.* and *Potass. iod.* complete the list.[13] Other remedies like *Sulphur, Thuja, Arsenicum, Iodum* are also beneficial.[17]

The question of ‗to treat or not to treat' becomes more complicated in patients with atopic dermatitis, who are at greater risk for secondary infection of the lesions. It is also challenging to treat the condition during swimming season because the lesions are known to spread in water.[30]

In §72 He says The diseases to which man is liable are either rapid morbid processes of the abnormally deranged vital force, which have a tendency of finish their course more or less quickly, but always in a moderate time-these are termed acute diseases; or they are diseases of such a character that, with small, often imperceptible beginnings, dynamically derange the living organism, each in its own peculiar manner , and cause it gradually to deviate from the healthy condition, in such a way that the automatic life energy, called vital force, whose office is to preserve the health, only opposes to them at the commencement and during their progress imperfect, unsuitable, useless resistance, but is unable of itself to extinguish them, but must helplessly suffer (them to spread and) it self to be ever more and more abnormally deranged, until at length the organism is destroyed; these are termed chronic disease. They are caused by infection with a chronic miasm.

J.H.Allen:

New growths are in themselves a life study; when I speak of new growths, I mean all of a benign or malignant origin; all are due to miasmatic origin and to miasmatic influence upon the life force. When we speak of new growths, we mean of course, false growth, abnormal growths, or falsifications in parts and organs of the body.

H.A.Roberts

In the secondary period of sycosis al most every disease that may arise takes on the inflammatory nature in some form; it may be acute, subacute or chronic. Sycotic manifestations are characterised by slowness of recoverySycosis never gives a true ulcer; the sycotic manifestations are more overgrowth of tissue than destructive of tissue. There are many warts and warty growths; these are sycotic signposts. The sycotic skin manifestations tend toward overgrowth or extra deposits pg230 232

Dr. Harimohan Choudhry:

Psora Vesicles of the itch- voluptuous, tickling, itching. Sycotic Wart and warty growths, sycotic manifestations are charecterised by slowness of recovery

Dr. Subrata Kumar Banerjea.

Vesicular eruptions are generally sycotic 122
Molluscum contagiosum(syco-psoric)123, 167
Vesicular eruptions which do not heal quickly are sycotic124
Sycosis has vesicular eruptions 153

Phyllis speight

Psora Vesicle of the itch-volumptous tickling and itching
Sycosis warty eruptions or growths.

MOLLUSCUM CONTAGIOSUM IN HOMOEOPATHIC LITERATURE

Clarke:

Clarke's Dictionary Of Practical Materia Medica.
A Dictionary of Practical Materia Medica
by John Henry Clarke M.D.
Molluscum contagiosum is seen in the clinical section of calcarea carb, silicea and sulphur.

Robin Murphy ND

Lotus Materia Medica. By Robin Murphy ND
Molluscum contagiosum is seen in the clinical section of, silicea and sulphur.

Rajan Sankran
Spirit of Homoeopathy
By Rajan Sankran
Interview with Dr. R. Sankaran by S.M. Gunavante Published in "The Homoeopathic Heritage", June 1990
Dr. Sarabhai Kapadia had a case of molluscum contagiosum. He took a full history, but could not get any characteristic symptoms. After an hour of taking the case, he saw the child scratching the head. The mother said that whenever the boy is sleepy, he does this. On the basis of Kent's Repertory: "Head: itching of scalp, sleep, when going to",
In section concomitants
Concomitants need not always be general symptoms. Sometimes, they are particular in a part of the body but have no pathological basis for their existence. My teacher successfully prescribed Agnus castus in the case of a child with molluscum contagiosum using the symptom "Itching of scalp when going to sleep". Dr. Sarabhai prescribed Agnus castus (perhaps 1M) and the molluscum disappeared soon, though the remedy does not cover the complaint.

HOMOEOPATHIC THERAPEUTICS

Some homeopathic medicines found to be efficacious in cases of Molluscum contagiosum are,

Belladonna

Fine complexion and delicate skin; dryness; bright redness; burning heat; throbbing pains; pains appear and disappear suddenly; wildly delirious, restless, sensitive, nervous; child jovial and entertaining when well but violent when sick.

- Red, inflamed molluscum.
- Burning of the skin, also felt by the hand and it continues to burn after touching the skin, as though a hot stove has been touched, very characteristic.
- Red, hot and shining redness of the skin, with dryness, and swelling of the parts.

Bromium

Hot patient; fatty, fair; great weakness and easily overheated then sweat profusely sensitive to drafts; glandular affinity; tremulous; better by eating; quarrelsome and/or friendly, cheerful and fairly happy.

- Molluscum commonly appear on face, arms and shoulders.
- Sensation of something being alive in the skin.
- Worse warmth or warm, damp weather.

Calcarea arsenicum

Chilly patient; anemic; tendency for epilepsy and nephritic conditions; infantile hepato-splenomegaly; restless, anxious and emotional child; dreads to be alone.

- Pearly eruptions.vesicular, small and shiny inappearance.[51]

Calcarea carbonica

Calcarea carbonica is an effective medicine for treating the molluscum contagiosum.[35]
These children are typically soft, over-fat, fair, chilly, and lethargic.[12] Children with red face, flabby muscles, who sweat easily and take cold readily in consequence. Large heads and abdomens; fontanelles and sutures open; bones soft, develop very slowly. Curvature of bones, especially spine and long bones; extremities crooked, deformed; bone irregularly developed. Head sweats profusely while sleeping, wetting pillow far around. Profuse perspiration, mostly on back of head and neck, or chest and upper part of body. Difficult and delayed dentition with characteristic head sweats, and open fontanelles. During either sickness or convalescence, great longing for eggs; craves indigestible things; aversion to meat.[3]
Obstinacy; slight mental effort produces hot head. Averse to work or exertion.

Apprehensive; Forgetful, confused, low-spirited. Warts on face and hands.[7]

Carcinosinum

Carcinosinum is indicated if the mental and emotional symptoms indicate it. Nevertheless, some physical signs are often seen in this remedy: the Molluscum contagiosum.[37,45]

Causticum

These are people who live with the feeling that they have a Damoclean sword hanging above their head. There has been a dramatic incident in their lives. For example, after a very difficult labor and birth, the infant is fearful, whimpering, and cries when others cry (out of compassion, since misfortune has befallen them). Indeed, these children live in constant fear that new worries will materialize. They cannot go to bed alone at night, they fear the dark, and are often afraid of dogs. We often observe weakness of some kind. These children also are late in learning to walk.
We may see paralysis following an injury at birth, or after convulsions or exposure to cold (for example, facial paralysis from cold). These children are sensitive to dry cold. A dry wind from the north always makes them hoarse, as does air conditioning: the throat burns with pain, and they prefer to drink ice-cold water.
Frequently, warts will be present, often small, widely scattered warts of the molluscum contagiosum type, or larger warts near the edge of the fingernails. These children may stutter or pronounce words poorly, which often earns them some visits to the speech therapist. At times dictatorial, they can play on their weakness in order to maintain those around them under their domination. Finally, we may observe enuresis (involuntary urination). The child is inclined to wet the bed during the first hours of sleep at night, and may also urinate involuntarily at times when coughing or running.[19]

Dulcamara

Chilly patient, with skin affections brought on or worse by exposure to cold, damp, rainy weather; restless and irritable.

- Ailments after taking bath in swimming pool.
- Humid eruptions on face, genitals, hands etc.
- Flat, pearly eruptions.
- Worse cold in general, damp, rainy weather.[51]

Juglans cinerea

Dr. Paine (eclectic) says: "The Juglandin, as I have previously remarked, acts as a direct stimulant and tonic to the cutaneous surface; hence, I have used it in chronic eczema, herpes, pemphigus, rupia, acne, impetigo, ecthyma, lichen, prurigo, icthyosis, molluscum, and all other forms of cutaneous diseases, and have found it to act with more certainly in these affections than any other preparation or single drug that I have used.[21]

Medorrhinum

Here is a key constitutional remedy for the "sycotic" terrain denoted by Hahnemann. These individuals have a problem with time. They are constantly projecting into the future. "What comes next?" This question, which is constantly on their lips, ruins the present for them.
In the family history there are cases of cancer and chronic rheumatism. Medorrhinum infants sleep flat on their stomach, rear in the air. They often have a red rash (erythema) on the buttocks. The children are sensitive to humidity. Their legs are constantly in motion while they are seated.
In the eyes, we find chronic conjunctivitis, with the lids stuck together in the mornings, and astigmatism.
Amelioration at the seaside is a good symptom of this remedy. On the skin, we find a large number of small molluscum pendulum around the neck. "Time is money."

Medorrhinum tries to control time. These individuals are constantly projecting their minds into the future, making them clairvoyant, which makes this a remedy for mediums who predict the future. On the other hand, lack of control, or anarchy, leads to skin tumors and cancer.[19]

Natrum muraticum

Great emaciation; loosing flesh while living well; throat and neck of child emaciate rapidly during summer complaint. Great liability to take cold. Irritability: child cross when spoken to; crying from slightest cause; gets into a passion about trifles, especially when consoled with. Children slow in learning to walk.[3] Child will be slow in learning to speak. Small and underweight child.[12] Warts on palms of hands.[7]

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Silicea

Umbilicated eruptions with offensive pus. Itching only in daytime and evening.[1]

Extremely chilly patient; profuse, offensive discharges; glandular affinity; large head and distended abdomen, weak ankles; [1,51] open fontanelles and sutures;[1] slow in learning to walk; constipation, stool being partly expelled recedes back again; all symptoms worse by cold except stomach complaints; children are obstinate, head strong, cry when spoken kindly to, nervous, apprehensive, oversensitive, irritable and fearful.

- Tuberous spots on skin of light red color.
- Eruptions heal with difficulty and suppurate easily.[51]

Sulfanilamidum

Indicated in molluscum granulosum.[47]

Sulphur

Molluscum in a child; body and limbs covered with soft, round, smooth, apparently painless tumours with broad base. At first of the colour of the skin, then assuming a bluish, and finally a purple or pinkish hue; found on puncture to contain a semi-fluid, sebaceous matter. These tumours vary in size from that of a large bean to a filbert, and were found in all stages of development at the same time, about eighty in number. After Sulphur, no new tumours formed, and the old shrivelled up, without discharging.

- Dr. C. Wesselhoeft.[23,54]

Teucrium marum verum

Indicated remedy in molluscum contagiosum.

Thuja occidentalis

It is a remedy for molluscum.[4] Chilly patient; dark, fleshy children with greasy face; dark hair and unhealthy Skin, looks dirty with brownish spots; perspiration on uncovered parts, smells sweetish and strong; complaints worse damp, humid weather; lazy.

- Eruptions only on covered parts
- Umbilical form of eruptions.[51]

In elderly children, we obtain history of nightmares, dreams of falling and someone chasing and startling in sleep. Here too *thuja* works very well. The remedy works from within outwards. The eruptions become big and they burst open and then subside.[55]

Tuberculinum

It has a good role in establishing cure if given as intercurrent.[1]

CONVENTIONAL TREATMENT

Surgical removal of molluscum contagiosum by curettage has been used for many years. Children will usually need prior application of topical anaesthetic cream with strict observance of the maximum safe dose. Damage to the lesions by squeezing the contents or insertion of a pointed cocktail stick may stimulate inflammation and clearance.

Cryotherapy is effective and commonly used in older children and adults, but needs to be repeated at 3–4 weekly intervals. The carbon dioxide or pulsed dye lasers have produced useful effects but like curettage, can cause scars. Photodynamic therapy has also been used with effect.

Many topical agents can be used to produce mild to moderate inflammation and hence potentially stimulate the development of an immune response against the virus. Cantharidin, trichloroacetic acid and diluted liquefied phenol are strong irritants which can both cause pain, blistering and scarring but with careful application and appropriate dilution can increase lesion clearance. Topical salicylic acid preparations, tretinoin, adapalene, nitric oxide cream and potassium hydroxide solution all lead to an irritant reaction but if the strength of preparation and the frequency of application are adjusted, individuals can tolerate repeated treatments until resolution occurs.[9]

However, a Cochrane Database analysis of treatments for molluscum contagiosum, which identified only five therapeutic studies of high quality, found that no single intervention is convincingly effective for the treatment of molluscum contagiosum.[57]

Few of the commonly used conventional therapies are as follows:

Freezing/Cryotherapy

The lesions are frozen with liquid nitrogen or dry ice at an interval of 2-3 weeks until the lesions are cleared. Though this method is quite effective it sometimes causes hypopigmentation or hyperpigmentation and scarring.

Evisceration

The core of the lesion is excavated with help of sharp instruments like scalpel, sharp tooth pick, edge of a glass slide. Patients themselves can carry out this procedure if carefully taught. This method is though not applicable to children as the procedure can be really painful.

Scraping/ Curettage

The lesions are scraped off with the help of sharp instruments. Use of topical anesthetic agents is advised to combat the pain. The method has an advantage of providing a reliable tissue sample for the confirmation of diagnosis of Molluscum Contagious.

Electrosurgery/ Laser Cautery

The lesions are burnt either with electric cautery or Laser beam is used to burn the spots.

Squeezing

A local anesthetic cream is applied to the area and left on under a plastic film for one hour before the procedure. Then the lesion is squeezed out with the help of forceps or sharp sticks.

Tape stripping

Sterilized adhesive tapes are repeatedly applied and removed over the lesions and removed so that the superficial epidermis is effectively removed. However, repeated use of the same strip is likely to spread the virus to adjacent, uninvolved skin.

Chemical applications

Which are prepared with metal silver as the base can prevent the bacterial infection and hence enhance the process of recovery.[40]

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INSECT GROUP OF MEDICINES AND ITS UTILITY IN COMPLAIN OF URINARY SYSTEM

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Keywords- Group symptoms, urinary system, urogenital disorders, Homoeopathy, ureter stones, Insect group of remedies

Abstract: In the urinary system the organ which is involved are kidneys, ureter, Bladder and urethra. The function of kidney is excretion of waste products Like urea, uric acid, creatinine etc. Maintenance of water balance,
Maintenance of electrolytes balance, maintenance of acid-base balance, Hemopoietic function, regulation of blood pressure and regulation of blood Calcium level.

Urinary tract infection is a common problem despite age and sex Worldwide. Some of the most common bacterial infections, affecting 150Million people each year worldwide. The estimated economic burden is more than 6billion U.S. dollars, about 40% of women and 12% men experience at least one symptomatic urinary tract infection during their lifetime, and as many as 40% of affected women show recurrent urinary tract infection. In pregnant women in India is reported to range from 3% to24%. Now a day, some common diseases are day by day increasing like urinary tract infection, urine incontinence, renal stone, ureteric stone, bladder stone, hematuria, urethral stricture, urethritis, lower urinary tract infection and cystitis, retention of urine etc. If there is any disturbance in function of kidney, symptoms like burning micturition, pedal edema, strong persistent urge to urinate, cloudy urination, painful urination, usually pain in right/left lumbar region, honeymoon cystitis etc. may develop. All these symptoms are present due to some causes like bacterial cause. Viral cause, low water intake, sexual intercourse etc. In modern science these diseases are treated with antibiotics, analgesics and hydration therapy, but many antibiotics are resistant in many people and produced side effects. Calculi are also treated with surgeries. But the chances of recurrence are more and person suffers more with these diseases. In contrast to other therapy homoeopathy is cost-effective and without any side-effects. All urinary tract infections and kidney diseases can be well managed with homoeopathy. Homoeopathy believes in individualization. Medicine selection is based on totality of symptoms. Our materia medica is full of important remedies for urinary system disorders. As usual to grasp all the symptoms of all the medicines is always a difficult task. So, there are various approaches to study materia medica. One among these is group symptoms study. There are many common features of a group of medicine belonging to same sources. In homoeopathy we have animal kingdom, plant kingdom, nosodes, saracodes, imponderabilia sources from which medicines are prepared. If one studies common symptoms of each group one can found something similar. Insect group of medicine belongs to animal kingdom. They also share common features. Majority of insect group medicines have action on urinary system e.g., Medicine like Apis mellifica, Cantharis vesicatoria, Coccus cacti, Formica rufa, Vespa crabro etc. belongs to this group. Until now little work has been done on the insect group. So, I did this work to evaluate efficacy of insect group in urinary system disorders.

AIMS AND OBJECTIVES

To study common group symptoms of insect group of medicines

REVIEW OF LITERATURE

Excretion is the process by which the unwanted substances and metabolic wastes are eliminated from the body. A large amount of waste materials and carbon dioxide are produced in the tissues during metabolic process. In
addition, residue of undigested food, heavy metals, drugs, toxic substances and pathogenic organisms like bacteria are also present in the body. All these substances must be removed to keep the body in healthy condition. Various systems/organs in the body are involved in performing the excretory function, viz. Digestive system, Lungs, Skin, Liver etc. Although various organs are involved in removal of wastes from the body, their excretory capacity is limited. But renal system or urinary system has maximum excretory capacity and so it plays a major role in homeostasis. The urinary system is a passive biological system that removes excess,

unnecessary materials from the body fluids of an organism, so as to help maintain internal chemical homeostasis and prevent damage to the body. In the urinary system these organs are present. Kidney, ureter, urinary bladder, urethra. (3,4)

Functions of urinary system

KIDNEYS

- Excretion of metabolic waste products and foreign chemicals
- Regulation of water and electrolyte balances
- Regulation of body fluid osmolality and electrolyte concentrations
- Regulation of arterial pressure
- Regulation of acid-base balance
- Regulation of Erythrocyte Production
- Regulation of 1,25-Dihydroxyvitamin D3 Production
- Secretion, metabolism, and excretion of hormones
- Gluconeogenesis (3,4)

URETER

Its duct that transmits urine from the kidney to the bladder. There normally is one ureter for each kidney. Each ureter is a narrow tube that is about 12 inches (30 cm) long. A ureter has thick contractile walls, and its diameter varies considerably at different points along its length. The tube emerges from each kidney, descends behind the abdominal cavity, and opens into the bladder. At its termination the ureter passes through the bladder wall in such a way that, as the bladder fills with urine, this terminal part of the ureter tends to close.

URINARY BLADDER

Urine, excreted by the kidneys, collects in the bladder before disposal by urination (micturition). The urinary bladder usually holds 300350 ml of urine. As urine accumulates, the rugae flatten and the wall of the bladder thins as it stretches, allowing the bladder to store larger amounts of urine without a significant rise in internal pressure. Urination is controlled by the pontine micturition center in the brainstem. (3,4,7)

Common symptoms of urinary disorders

Symptoms of urinary disorders vary from person to person and based on the cause of the disorders. Common urinary symptoms include:

- Abdominal cramping
- Abdominal, pelvic or back pain that can be severe
- Bloody or pink-colored urine (hematuria)
- Cloudy urine
- Fever and chills
- Foul-smelling urine
- Frequent urination
- General ill feeling
- Leaking of urine
- Pain during sexual intercourse
- Pain or burning with urination (dysuria) (3,4,8)

URYNARY SYSTEM DISEASES AND HOMOEOPATHY

In renal diseases, like any other case, individualization process involves ascertaining the totality of signs &symptoms, a complete account of all the sufferings as described by the patient himself, his attendants and findings of special investigations. Here one can adopt 2 different approaches in accordance with the fact that whether, the case at the time of consultation demands an acute medicine or chronic constitutional treatment. This will solely depend on the severity & violence of the chief complaints causing distress to the patient.

Acute Renal manifestations

In cases with acute distress, for e.g. In Renal, vesical or ureteric colic, strangury etc, first of all it is necessary to relieve the patient of his sufferings. Moreover, the physician should also recognize the need of auxiliary measures, hospitalization, surgical or mechanical intervention etc. In a case of acute retention with intense supra-pubic discomfort and threatening shock, it is of prime importance to mechanically evacuate the bladder by catheterization. (10)

At this point, it would be suitable to quote Dr. Stuart Close—

—Circumstances sometimes arise when the strongest man & ablest prescriber, by reason of the great moral pressure brought to bear upon him, by the peculiarities of his patient, of the environment, or from lack of time, will be compelled to tide over a period of unendurable suffering by use of analgesics, or some other measure to meet extra-ordinary emergencies. He does this as a charitable concession to the weakness of human nature…., But time & circumstances are at least sometimes beyond his control. It is possible to violate the spirit by adhering too closely to the letter of law. Victory is sometimes gained be appearing to yield,

which is quite in accord with the principle of Similia, a sort of moral homeopathy‖. In acute emergencies, homeopathic medicines can act as quickly and sometimes even more efficiently as compared to other therapeutic systems, provided the correct medicine is administered in correct potency

Dr. H. Roberts, in his ‗Principles & Art of Cure by Homeopathy ', encourages us as follows—―The homeopathic physician recognizes an important principle in these serious states; the more acute the case, the more the infection strikes at the life of the patient, the more clearly indicative are the symptoms. The similar medicine works regardless of the name of disease towards a true & complete cure, without sequalae or constitutional involvement. (10)

Chronic Prescribing in Patients with Renal diseases

First of all, we should have a record of all the presenting complaints in their completeness, with special attention to duration, mode of onset, modalities & concomitant features of each individual symptom. Then the details concerning the Past Medical History and Family History are to be collected. The history of the treatment been taken by the patient till date, is also to be noted. Now the most significant turn comes where the interrogation is to be made as regards Physical generals & Mental generals, which though apparently seem to be unrelated to the case, yet they serve as the backbone of homeopathic prescribing!!

In case of mental symptoms, one should investigate the life situation of the patient with type of response. Emotional characteristics are very difficult to be elicited by direct questioning; hence the physician has to be tactful in approach & keen in perception to record them. Anger, loves, hates, anxieties, fears, phobias, irritability, relationship to loved ones, personal preferences concerning company or solitude, apathy, general mood, self-confidence etc., furnish as valuable features. Dreams too deserve attention. The mental faculties of the patient can be investigated by recording peculiarities related to intellect, memory, delusions, concentration powers, and comprehension ability. (10)

GROUP STUDY OF INSECT GROUP OF MEDICINES: -

Insects are invertebrate animals – without back bone – and are included in arthropods. Arthropoda is the largest, most dominant group and includes about 80% of known animal species. They are capable of flying. Entomology refers to study of insects. Insects are grouped in the kingdom under phylum arthropod & the class insects.

o Phylum: Arthropoda

o Class: Insect

Man had started the use of insects and insect products since time immemorial even at the cost of animal 's life. Insects have been under use inhuman civilization since prehistoric period as mentioned in our religious literatures like Vedas, puranas, the Ramayana, Mahabharata and charka Samhita. Some foreign travelers like Fahiyan and when son had also discussed the use of insects and insect 's product as medicine. As far as Homeopathy is concerned insects have a major role in the preparation of medicines.

CLASSIFICATION

Insect group is classified as follows: -

1. Hymenoptera
2. Lepidoptera
3. Coleoptera
4. Orthoptera
5. Hemiptera
6.Diptera
7. Siphonaptera

1. Hymenoptera (9)

- Apis Mellifica – Honey Bee
- Apium virus – Poison of Bee
- Formica rufa – Crushed Live Ants
- Vespa crabro – Common Wasp

2. Orthoptera

- Blatta americana – Great American cockroach
- Blatta orientalis – Indian cockroach

3. Lepidoptera

- Bombyx chrysorrhoea – brown tailed moth
- Bombyx processionea– procession moth

4. Coleoptera

- Canthris vesicatoria – Spanish fly
- Coccinella septum punctata – Indian lady bug
- Doryphora decemlineata – Colorado potato bug
- Triatema – kissing bug

5. Hemiptera

- Chenopodium glauci aphis – plant lice from Chenopodium.
- Cimex acanthia – Indian bed bug
- Coccus cacti – Coccineal insect (insect affecting Cactus).
- Pediculus capitis – head louse
- Pedicullus cooties

6. Dipteria

- Culex musca – culex mosquito

7. Siphonoptera

- Pulex irritans – common flea

Hymenoptera venum Effects: (9)

Functions as hastens that form immunogenic conjugates host proteins. Life threatening anaphylactic response of a sensitized human appears within minutes after administration of specific antigen and is manifested by respiratory distress often followed by vascular collapse or by shock without antecedent respiration difficulty.

- Cutaneous manifestations: Pruritus' and urticaria with or without angioedema. Localized, non-pitting, angioedema may occur which may be asymptomatic or cause a burning or stinging sensation.
- Gastro intestinal manifestations: Nausea, vomiting crampy abdominal pain and diarrhea.
- Respiratory system: Manifestations laryngeal edema, experienced as a lump in the throat, hoarseness or strider. Bronchial obstruction is associated with a feeling of tightness in the chest of audible wheezing. Angioedema of the epiglottis and larynx and to some extend in the hypo pharynx and trachea, causes mechanical obstruction and death.
- Cardiovascular system: Manifestable visceral congestion with a loss of intravascular blood volume leads to vascular collapse and death.

Important remedies

- Aphis chenopodii glauci
- Apis mellifica (Honey bee)
- Blatta Americana (Cockroach)
- Blatta orientalis (Indian cockroach)
- Cantharis vesicatoria (Spanish fly)
- Cimex lectularius (Bedbug)
- Coccinella (Lady bug) (1,2,5,6,9)
- Coccus cacti (Cocchineal)
- Culex musca (Culex mosquito)
- Doryphora decemlineata (Colorado potato bug)
- Formica rufa (Crushed live ants)
- Oniscus asellus (Wood louse)
- Pecten jacobaeus (Head louse)
- Pediculus capitis
- Pulex irritants (Common flea)
- Scolopendra morsitans
- Triatema (Red acraus of the fly)
- Trombidium muscae domesticate
- Vespa crabro (Live wasp) (1,2,5,6,9)

Insect themes:

Insect remedies are potentially huge in number and so studying the themes of many insect families is a challenging but fascinating process, especially as there are so many different types of insects with their own unique behavior.

The key characteristics of many of the insect remedies are as follows:

- Quick, fast, sudden
- Busy, industrious, active – effective or fruitless.
- Fastidious, order, linearity, communication.
- Irritability, anger, rage, violence. Attacking and being attacked.
- Sexuality, attractiveness or repulsion, sexual aggression, perversion, impotence, impersonal sexuality. (9)
- Appearance, needing to be attractive; beauty, clothing, and the opposite of feeling unattractive.
- Masculinity in women.
- Relationships, struggle with them. Superficial. Needing to be in groups but no strong sense of identity.
- Self-centered, demanding, egotistical. Needing attention. Contemptuous.
- Low self-esteem. Feeling dirty, shame about the body, self-disgust, self-hatred
- Appetite voracious or ability to do without food for long periods.
- Aversion to water. Hydrophobic.
- Swellings, puffiness, inflammation.
- Burning, stinging, biting pains.
- Affinity for urinary organs, joints. (9)

General features of insecta

Side affinity

Right

1. Apis Mellifica
2. Blatta Americana
3. Cantharis Vesicator
4. Coccinella Septumpunctata
5. Formica Rufa (1,2,5,6,9)

Left

1. Cimex Acanthia
2. Pulex Irritans
3. Vespa Crabro

Burning pain

- Apis mellifica: Burning, stinging, lancinating pain with excessive swelling, > Cold application, <By heat, slightest touch or pressure
- Formica Rufa: burning pain renewed from cold washing.

- Vespa crabro: - Burning > bathing with vinegar. Cold water applied first > then <.
- Bomyx Processionea: - Burning heat of skin
- Doryphora decemlineata: - Burning in mouth, throat, stomach, rectum and urinary passages. <Warm room > open air
- Cantheris Vesicator:- Raw, sore, burning & a sharp lancinating pain <slightest tough, >Warm application

Sensitiveness

- Apis Mellifica: - Great sensitiveness to touch.
- Cantharis vesicator :- Over sensitiveness of all parts. The slightest touch or approach aggravates the mental symptoms.
- Coccus cacti: -General sensitiveness to touch and pressure. Fauces are very sensitive. Brushing teeth causes cough.
- Doryphora Decemlineata: < touch and pressure

Thirst:

- Apis Mellifica: Thirst less except during chill stage of intermitted fever.
- Cantharis Vesicator: Burning thirst with aversion to drinking (picture of hydrophobia). In fever, thirst only after the shivering.
- Coccinella septum punctata: Symptoms of hydrophobia.
- Cocus cacti: Mouth and tongue dry, with much thirst. After dinner much thirst and when he drinks water, then chilliness.
- Cimex acanthia: Thirst during apyrexia, but little during chill stage, still less during heat stage and none during sweating.
- Pulex Irritans:- Thirsty , especially during headache(9) ***Swelling, dropsy, ascites:***
- Apis mellifica: - Oedema of skin and mucous membrane. Swelling or Puffiness up of variance parts. Pale waxy oedematous swelling with a red rosy hue. Ascites and anasarca. Dropsy of Apis is characterized by thirstlessness, transparency of skin and scant urine. Bag like swelling under the eyes. Dropsy of right ovary and right testicle.
- Blatta Americana: - Ascites, various forms of dropsy, yellow complexion. (Jaundice)
- Doryphora decemlineata:- Elastic swelling of whole body which will not pit on pressure. (Applicability in myxoedema). Swelling of feet
with burning.
- Vespa Crabro: – Face swollen and puffy, skin transparent and blanched. Baggy swelling of conjunctiva. Face, mouth and throat oedematous.
- Cantharis Vesicator: - burning redness and swelling of face, swelling and inflammation of lips. Dropsical swelling of hand, feet and abdomen.

Female complaints – overian affections.

- Apis mel:- Inflammation, induration, swelling and dropsy of the ovaries especially the right better by lying on right side. Sharp, cutting, stinging pain in the right ovary. Worse during menstruation. Ovarian tumors, with stinging pain like bees sting. Increased sexual desires. Tendency to abort at or before 3rd month. Amenorrhea of puberty. With congestion of head thirstlessness and intolerance of heat.
- Cantharis: - Inflammation of ovaries, burning pain, extremely sensitive. (9)
- Cimex acantha: - Shooting pain from vagina towards left ovary.
- Vespa crabro: – Left ovary markedly affected with frequent burning micturation. Menstruation preceded by a period of depression and constipation.
- Cocus cacti: - Indicated in menorrhagia and metrorrhagia. Dark clots with dysuria.

Skin manifestations – urticaria.

- Apis mellifica: -Urticaria like bee stings or stings from other insects with intolerable itching at night. Swellings after bites are sore and sensitive. Erysipelas with sensitiveness and swelling, rosy hue. Carbuncle with burning stinging pain. Eruptions like nettle rash all over the body.
- Formica rufa: - Nettle rash, red itching and burning. Profuse sweat without relief.
- Vespa crabro: - Erythema with intense itching and burning > bathing with vinegar. Wheals, swelling and macules with stinging burning and soreness. Cold water application first >, then <.
- Bomyx Processionoea :- Indicated in Urticaria- intense irritation, hard large areola formed. Tubercle with a red areola. Sensation as of a foreign body were under the skin. Itching <evening not relieved by anything. Burning heat of skin.
- Cantharis Vesicator:- Vesicular eruptions with burning and itching.Vesicules all one's body Which are sore and suppurating. Erythema from exposure to sunrays. Burns, scalds with rawness and smarting relieved by cold application, followed by undue inflammation. (9)
- Pediculus: - Psoric manifestation in children, Milliary eruption on inside of forearms and thigh. Horropilation all over.

Hemorrhage:

- Apis mellifica: - Dark hemorrhage from rectum, urine, uterus, respiratory organs.
- Cocuscacti :- Hemorrhage in large black clots especially from kidneysand uterus. menses too, too profuse lasts too long.
- Cantharis: - hemorrhage from nose, mouth, intestine, genital andurinary organs. Emission of blood in drops from urinary organsMenses early, copious, black blood.

Fever

- Apis mellifica: - Intermittent fever where chill occurs at 3pm with thirst. < from warmth followed by burning heat of whole body with absence of thirst and comes sweat with complete absence of thirst. Indicated in exanthematic fevers and fevers complicated with suppression of eruptions.
- Cantharis: - Cold & shivering. Thirst only after shivering cold. Perspiration especially on hands, feet & genitals. sweat smells of urine. Pulse full, hard and rapid.

Cimex acnthia:- intermittent fevers with weariness and inclination to stretch. Chilliness of whole body, pain in all joints as if tendons were too short, esp. knee joint. Chill < lying down. Thirst during apyrexia, but little during chill stage, still less during heat stage and none during sweat stage. (9)

Rheumatism

Formica rubra: - Rheumatic inflammation of eyes and spinal cord. Gout and articular rheumatism. Right side is more affected. Rheumatism comes with suddenness and restlessness. Patient desires motion, but pain worse from motion.

Apis mellifica: - Acute inflammatory rheumatism with burning, stinging and swelling. Pain < on any motion.

INSECT GROUP OF MEDICINES AND IT 'S UTILITY IN COMPLAINTS OF URINARY SYSTEM: -

Apis meilifica: -

o Burning and soreness when urinating.
o Can scarcely retain urine.
o When passed scalds severely.
o Incontinence of urine when coughing and sneezing.
o Frequent, painful, scanty, bloody urine, stinging pain and strangury.

Blatta Americana: -

o Pain in urethra while micturating.

Cantharis vesicatoria: -

o Kidney region very sensitive.
o Urine; Burning, scalding; with cutting intolerable urging and fearful tenesmus or dribbling.
o Gripping in bladder, renal colic amel; somewhat by pressure on glans penis, bloody urine.
o Constant urging to urinate, passing but a few drops at a time, which is mixed with blood like molten lead.
o Intolerable urging before, during and after urination. (1,2,5,6,9)
o Burning, cutting pain in urethra during micturation.

Coccus cacti: -

o Lancinating, violent pain from kidneys to bladder; with dysuria.
o Nephritic colic, constant urging to urinate, amel; after passing stools clots from the vagina in females.
o Staking pain along ureters.
o Burning pain in urethra while urinating.
o Frequent urination.
o Black red sediment, urinary calculi, urates and uric acid, haematuria, dysuria, lassinating pain from kidney to bladder.

Chenopodii glauci Aphis: -

o Voluptuous feeling in the glands.
o Burning in urethra.
o Frequent copious frothy micturition.

Doryphora decemlineata: -

o Burning in urinary passages, strangury, urethritis itching and burning.
o Inflammation of glans penis.
o Urethritis due to local irritation.

Formica rufa: -

o Urine bloody.
o Albuminous with urates.
o Paralysis of bladder.
o Double the quantity of urine, even at night.
o Urine like saffron bright yellow.

Oniscus asellus: -

o Cutting, burning in urethra.
o Tenesmus of bladder and rectum, with absence of stool and urine.

Pulex irritants: -

o Urine scanty with frequent urging with pressure on bladder and burning in urethra.
o Flow stops suddenly followed by pain, can 't retain urine.
o Irritable bladder before menses.

Vespa crabro: -

o Burning micturation in females.
o Dysurea with backache. (1,2,5,6,9)

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04

STUDY OF KNOWLEDGE OF BREAST CANCER AND ITS EARLY DIAGNOSTICS IN FEMALE TERTIARY HEALTH WORKERS

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ABSTRACT

OBJECTIVE- To study the knowledge of breast cancer, early detection methods and whom to consult after detecting abnormality among female tertiary health workers.
METHOD- This is a descriptive cross-sectional study of 70 female health workers age group more than 20 years carried out at various hospitals after taking consent.
RESULT- Being majority of young married doctor respondents, below the age of 40 years (81.4%) study was conducted, almost all the respondents are aware of breast cancer, 69 (98.5%). Majority of them got information from media (77.1%), followed by seminars (64.2%) and books (62.8%). Only 15.7% of respondents had a positive family history of breast cancer. Most participants were aware of BSE and thinks its useful tool (74.3%) but doesn't know about proper timing and method for BSE. They have been taught BSE (58.5%) out of which majority were taught by teachers (51.5%). 41.4% and 60% of respondents knew that BSE should be done monthly and should start after age of 20 respectively. One

respondent has discovered an abnormality. Respondents are relatively less aware about BSE 28 (40%). 45 (64.3%) and 16 (22.9%) think that BSE should be done by a doctor and trained nurse respectively. The level of awareness of sonomammography was high among respondents- 43 (57.1%), but only 8 (11.43%) had undergone sonomammography, because of 'not of proper age' 27 (38.57%).
CONCLUSION- Practice and attitude of breast cancer screening should be promoted among health workers and the general population.

KEY WORDS-
Breast self-examination (BSE)
Clinical breast examination (CBE)
Sonomammography

INTRODUCTION

A wide variety of diseases affect the breast ranging from benign to malignant. Benign breast diseases are more common than the malignant ones. [(1)] carcinoma however is the most typical malignancy in several countries. [(2)(3)(4)] Patients with breast lesions could complain of breast pain, breast lump, nipple discharge, nipple retraction, skin disease or eczema of the areola (in Paget's disease). Breast lump that is one of the most common types of breast lesion and is detected by: breast self-examination (BSE), clinical breast examination (CBE), and sonomammography. Early detection and prompt treatment have shown good results and are responsible for long survival in patients with carcinoma. [(5)(6)] Sonomammography, CBE are used for screening for early detection of carcinoma. Cancer screening tests play a polar role in reducing breast cancer-related mortalities. The American Cancer Society (ACS) recommends CBE and sonomammography for the early detection of carcinoma.[(7)] According to ACS recommendations, females should be aware of normal consistency of their breasts and should report to health care workers if there is any change in the consistency.[(8)(9)] Women should know the perks of BSE from their early 20s.The ACS has discarded BSE as an accurate marker as it doesn't increase the survival rate.[(10)] However, BSE appears to be a vital substitute accessible in rural areas wherever access to CBE and sonomammography is tough and would possibly still discover carcinoma early enough for treatment which might be offered to prolong women's lives and cut back suffering. For average-risk women in their 20s and 30s, they are suggested to go for CBE as a part of a periodic health examination, in the 40s CBE is used as an adjunct to radiological screening (mammography). The underlying premise for carcinoma screening is that it permits for the detection of breast cancers before they become palpable. It is proved according to different trials that screening-detected breast cancers are related to reduced morbidity and mortality. This study aims at assessing the knowledge, awareness and opinion of female staff working in a hospital.

MATERIALS AND METHODS

Study design
This is a descriptive cross-sectional study of female medical staff carried out at various hospitals.
Study population
The study population consists of female health workers of age group of more than 20 years.
Sampling procedures
Female health workers were included after taking consent. Convenience sampling was done to obtain the sample size.
Instruments and Data collection

A structured, pre-tested questionnaire was the tool of data collection, which contains information regarding the sociodemographic characteristics, knowledge of breast cancer, knowledge and practice of BSE, CBE and sonomammography.

OBSERVATIONS AND RESULTS

This study was conducted on 70 participants who were asked about 40 questions each from which 35 questions were found adequate for analysis. Studies have been done on knowledge, attitude, and practice of breast cancer screening in health workers of a tertiary health care centre.

Table 1: Socio-demographic data of respondents

Variables	
Age (years) (n = 70)	**n**
20-29	35
30-39	22
40-49	1
50-59	10
60-69	2
Marital status (n = 70)	
Single/never married	31
Married	39
Widowed	0
Highest educational level (n=70)	
Primary school completed	0
JSS completed	0
SSS completed	1
Tertiary school completed	0
No formal education	2
Others	67
Occupation (n = 160)	
Doctor	17
Nurse	9
Pharmacist	0
Laboratory staff	2
Office staff	9
Ward maid	1

Cleaner	9

A majority of the respondents in this study belong to the younger population. Majority of respondents are below the age of 40 years with 81.4%. Majority of respondents are Doctors making up the majority; 24.4% and nurses, office staff and cleaners making 12.8% each. Majority of respondents are married, 55.7%.

Table 2: Respondents' knowledge of breast cancer

Variables	
Ever heard of breast cancer (n=70)	**n**
Yes	69
No	1
Sources of information about breast cancer* (n=70)	
Books	44
Media	54
Hospital	41
Lecture	35
Conference/seminar	45
Friends	41
Have any of your relatives been diagnosed with breast cancer? (n=70)	
Yes	11
No	59
If yes, which relative? (n=52)	
Mother	0
Aunt	5
Sister	3
Cousin	3
Other relative	41

*Multiple response

Almost all the respondents are aware of breast cancer, 69 (98.5%). Majority of respondents got information about it from media (77.1%), followed by seminars (64.2%) and books (62.8%). Only 15.7% of respondents had a positive family history of breast cancer.

Table 3: Respondents' knowledge of breast self-examination

Variables	
Ever heard of BSE (n = 70)	**n**
Yes	52

No	18
Is BSE a useful tool for early detection of breast cancer? (n = 70)	
Yes	51
No	19
Have you been taught how to do BSE? (n=70)	
Yes	41
No	29
If yes, who taught you? * (n = 51)	
Parents	26
Teacher	36
Doctor	32
Nurse	16
Friend	6
Others	19
At what age should BSE be started? (n = 70)	
From puberty	10
From 20 years	42
No idea	18
How often should BSE be done? (n = 70)	
Weekly	4
Monthly	29
Yearly	9
No idea	28
What is the best time to do BSE? (n = 70)	
During menstrual flow	8
A week after period	29
During pregnancy	10
During feeding	7
No idea	34
BSE should be done by (n = 52)	
Doctor	32
Trained nurse	16

The individual	14
BSE is done by* (n=25)	
Inspecting the breast in the mirror	5
Feeling the breast with the hand	20
Feeling the armpit with the hand	0
Doing ultrasound of the breast	0
Sonomammography	0

*Multiple responses.

Most participants were aware of BSE and thinks its useful tool for early detection of breast cancer (74.3%). They have been taught BSE (58.5%), out of which majority were taught by teachers (51.5%) followed by doctors (45.7%) and parents (37.1%). Only 41.4% and 60% of respondents knew that BSE should be done monthly and should start after age of 20 respectively. Majority doesn't know about proper timing and method for BSE.

Table 4: Respondents' practice of breast self-examination

Variables	**n**
If you discover any abnormality during BSE, what will you do? * (n = 65)	
Do some lab tests	0
Pray over it	0
See a doctor	60
Other	5
Benefits of BSE* (n = 65)	
Familiar with breast texture	12
Early detection of breast cancer	50
Detection of abnormal changes	20
A good breast exercise	4
Do you practice BSE? (n = 70)	
Yes	41
No	29
If yes, how often? (n = 43)	
Weekly	9
Monthly	3
Occasionally	13
Rarely	18

If you have been practicing BSE, have you ever discovered any abnormality in your breast? (n = 46)	
Yes	1
No	45
If yes, what did you do? (n = 44)	
Prayed over it	0
Saw a doctor	30
Did nothing	1
Other	13
Do you think BSE is a good practice? (n = 17)	
Yes	52
No	8

*Multiple responses. BSE-Breast self-examination

Reasonable numbers of respondents claim that they do BSE 41 out of 70 – 58.5%. 9 (12.8%) stated that they did it weekly. While 13 (18.6%) said occasionally and 18 (25.7%) stated that they do BSE rarely. Out of them only 1 has discovered an abnormality. Out of 70 respondents 52 (74.3%) think that BSE is good practise and they 60 (85%) will see a doctor if they found any abnormality.

Table 5: Respondents' knowledge and practice of clinical breast examination

Variables	**n**
Ever heard of CBE? (n = 70)	
Yes	28
No	42
Is CBE a useful tool for detection of breast CA? (n=70)	
Yes	29
No	37
Do not know	4
CBE should be done by* (n = 70)	
Doctor	45
Trained nurse	16
The individual	3
Other	10
No Idea	5
CBE should be done using* (n = 70)	

Ultrasound	9
Sonomammography	36
Hand	18
Other	19
No idea	5
How often should CBE be done? (n = 70)	
Daily	9
Weekly	0
Monthly	7
Yearly	17
When abnormality is found on BSE	11
No idea	26

BSE=Breast self-examination, CBE=Clinical breast examination

*Multiple responses

Awareness of CBE is also slightly low among the respondents compared to developed countries- 28 (40%). From them 29 (41.4%) knew that CBE could be used for detection of breast cancer. 45 (64.3%) and 16 (22.9%) out of 70 think that BSE should be done by a doctor and trained nurse respectively. Most of the respondents do not know how CBE is done as 9 (12.8%) thought it is done using ultrasound, 36 (51.4%) thought CBE is done using sonomammography machine and another 24 (34.3%) have no idea. Furthermore, only 17 (24.3%) of the cases recognized that CBE should be done yearly while the rest have other incorrect responses.

Table 6: Respondents' knowledge and use of sonomammography

Variables	**n**
Ever heard of sonomammography? (n = 70)	
Yes	43
No	27
Is sonomammography a useful tool for early detection of breast cancer? (n = 70)	
Yes	43
No	0
Do not know	27
At what age should sonomammography be started? (n = 70)	
From puberty	14
From 20 years	1

From 40 years	20
After menopause	6
No idea	29
How often should sonomammography be done? (n = 70)	
Weekly	0
Monthly	0
Yearly	8
Every 3 years	1
When a lump is found on BSE or CBE	23
No idea	38
Have you ever done sonomammography? (n = 70)	
Yes	8
No	62
If no, why not? * (n = 60)	
Not old enough	27
Financial constraint	6
Sonomammography not available	4
Other	25

*Multiple responses

The level of awareness of sonomammography was generally high among respondents- 43 (57.1%) and same knew that sonomammography could be used as a tool for early detection of breast cancer. But only 8 (11.43%) had undergone sonomammography at least once. Others who haven't undergone sonomammography are not of proper age 27 (38.57%), 6 respondents have financial issues, while for 25 (35.7%) respondents there are some other reasons. In addition, 20 (28.57%) of the respondents noted that sonomammography should be commenced from the age of 40 years and above while the rest responded inappropriately. Similarly, only 8 (11.43%) of the respondents knew that sonomammography should be done yearly.

DISCUSSION

1**.** A majority of the respondents in this study belong to the younger population. Majority of respondents are below the age of 40 years with 81.4%. Majority of respondents are Doctors making up the majority; 24.4% and nurses, office staff and cleaners making 12.8% each. Majority of respondents are married, 55.7%.

2. Almost all the respondents are aware of breast cancer, 69 (98.5%). Majority of respondents got information about it from media (77.1%), followed by seminars (64.2%) and books (62.8%). Only 15.7% of respondents had a positive family history of breast cancer.

3. Most participants were aware of BSE and thinks its useful tool for early detection of breast cancer (74.3%). They have been taught BSE (58.5%), out of which majority were taught by teachers (51.5%) followed by doctors (45.7%) and parents (37.1%). Only 41.4% and 60% of

respondents knew that BSE should be done monthly and should start after age of 20 respectively. Majority doesn't know about proper timing and method for BSE.
4. Most respondents say that they do BSE 41 out of 70 – 58.5% and 9 (12.8%) stated that they did it weekly. Out of all only 1 has discovered an abnormality, while 52 (74.3%) thinks that BSE is good practise and they 60 (85%) will see a doctor if they found any abnormality.
5. Respondents are relatively less aware about CBE than developed countries- 28 (40%). 45 (64.3%) and 16 (22.9%) out of 70 think that BSE should be done by a doctor and trained nurse respectively. Most of the respondents do not know how to do CBE. Only 17 (24.3%) of the cases recognized that CBE should be done yearly while the rest have other incorrect responses.
6. The level of awareness of sonomammography was generally high among respondents- 43 (57.1%) and same knew that sonomammography could be used as a tool for early detection of breast cancer. But only 8 (11.43%) had undergone sonomammography at least once. The major reason behind not undergoing sonomammography was 'not of proper age' 27 (38.57%). 20 (28.57%) of the respondents noted that sonomammography should be commenced from the age of 40 years and above. Only 8 (11.43%) of the respondents knew that sonomammography should be done yearly.

CONCLUSION

Prevalence of the knowledge about breast cancer and its screening techniques are low in health workers also. Practice and attitude of breast cancer screening should be promoted among health workers and the general population. Sonomammography which is still the gold standard of breast cancer screening must be promoted for knowledge and benefit of the health workers and then the general population.

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Approach Of Homoeopathic Medicine In Acute Abdominal Pain

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What do you mean by the term Acute Abdominal Pain? A Lot of people get confused between a stomach pain which could be due to some gastric issues and the term acute abdominal pain. Acute abdomen refers to a sudden, severe abdominal pain and requires immediate diagnosis and cure. It is such a condition in which quick attention and treatment is needful. Abdominal pain is common and often miner. Abdominal pain is pain that occurs between the chest and pelvic regions.

Abdominal pain can be crampy, achy, dull and sharp or intermittent. Its also called a stomachache. Major organs located in the abdomen includes intestine, kidneys, appendix, spleen, stomach, gall bladder, liver and pancreas. Viral, bacterial or parasites infection that affects the stomach and intestine, may also cause significant abdominal pain. This type of pain can be described as localized, cramp like or colicky.

Localized pain is limited to one area of the abdomen. This type of pain is often caused by problem in a particular region. The most common cause of localized pain is stomach aches. Cramp like pain may be associated with diarrhea, constipation and bloating. In women, it can be associated with menstruation, miscarriage or complication in the female reproductive organ. This pain comes and goes and may completely subsides on its own without treatment.

Colicky pain is a symptom of more severe condition such as kidney stone. This pain across suddenly and make feel like as severe muscle spasms. Older adults and those who have HIV infection or who are taking immune suppressant may have less abdominal pain than younger or healthy adult with a similar disorder, and if the condition is severe, the pain may develop more gradually. Approximately 50% cases are admitted to general surgical unit urgently.

Abdominal pain has a large number of possible causes and so therefore a structured approach is compulsory. The treatment of pain is a collaborative effort. Causes can be divided in to six large categories including inflammatory, mechanical, nephrotic, vascular, congenital and traumatic. Who are in unstable condition have severe abdominal pain with concerning and abnormal vital sign such as fever, low blood pressure, increased heart beat and loss of consciousness.

Homoeopathic medicines are prescribed on the basis of individualization and symptom similarity by using holistic approach. On the basis of cause, sensation and modalities of the complains the appropriate medication is provided.

• Aconitum napellus: Hot, tense, enteritis. Sensitive to touch. Colic, no position relieves. Pains are intolerable, they drive him crazy; restless; at night. Abdominal symptoms are better after warm soup. Burning in the umbilical region.

• Aloe socotrina: Pulsating pain around navel, worse pressure. Cutting, gripping pain under the right ribs or in the right hypochondrium, right lower portion of the abdomen; excruciating before and during stool; all pain ceases after stool, leaving profuse sweating and extreme weakness; copious flatus.

• Belladonna: Distended, hot. Transverse colon protrudes like a pad. Tender, swollen. Pain as if clutched by a hand; worse jar, pressure. Cutting pain across; stitches on the left side of abdomen, when coughing, sneezing or touching it. Extreme sensitiveness to touch.

• Mag phos: Enteralgia, relived by pressure. Flatulent colic, forcing the patient to bend double; relieved by rubbing, warmth, pressure; accompanied with belching of gas, which gives no relief. Bloated abdomen, must loosen clothing, walk about and constantly pass flatus.

• Nux vomica: Flatulent distention with spasmodic colic. Colic from uncovering. Liver engorged, with stitches and soreness. Colic with upward pressure, causing short breath. Strangulated hernia.

• Plumbum metallicum: Excessive colic, radiating to all parts of body. Abdominal wall feels drawn by a string to the spine. Intussusceptions; strangulated hernia. Abdomen retracted, obstructed flatus with intense colic. Colic alternates with delirium and pain in atrophic limbs.

Polygonum punctatum: Griping pain, with great rumbling, nausea and liquid faeces. Flatulent colic.

• Dioscorea villlosa: Feeble digestive powers. Violent twisting colic, in paroxysms, as if intestines were grasped by powerful hand. Colic pains <from bending forward and while lying >on standing erect or bending backwards.

• Dulcamara: Colic from cold. Acts prominently on umbilical region. Cutting pain around the navel. Swelling of the inguinal gland.

Chamomilla: Flatulent colic, after anger with red cheeks and hot perspiration. Hepatic colic, acute duodenitis.

• Colchicum autumnale: Ascites. Borborygmi. Pain over liver region. Caecum and ascending colon distended. Autumnal dysentery; white mucus

Lycopodium: Hepatitis, atrophic form nutmeg liver. Pain shooting across the lower abdomen, from right to left. Abdomen bloated, constant sense of fermanetation, like yeast.

Mag phos: Enteralgia, relived by pressure. Flatulent colic, forcing the patient to bend double; relieved by rubbing, warmth, pressure; accompanied with belching of gas, which gives no relief. Bloated abdomen, must loosen clothing, walk about and constantly pass flatus.

Hpathy

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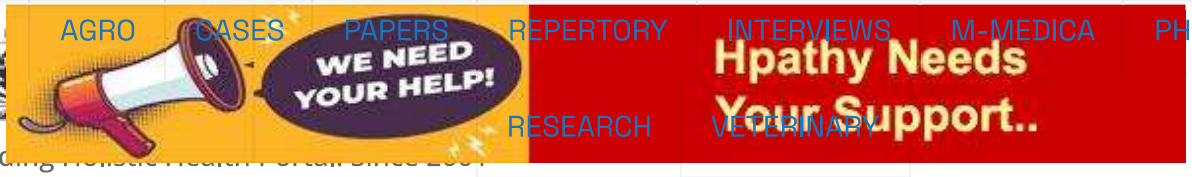

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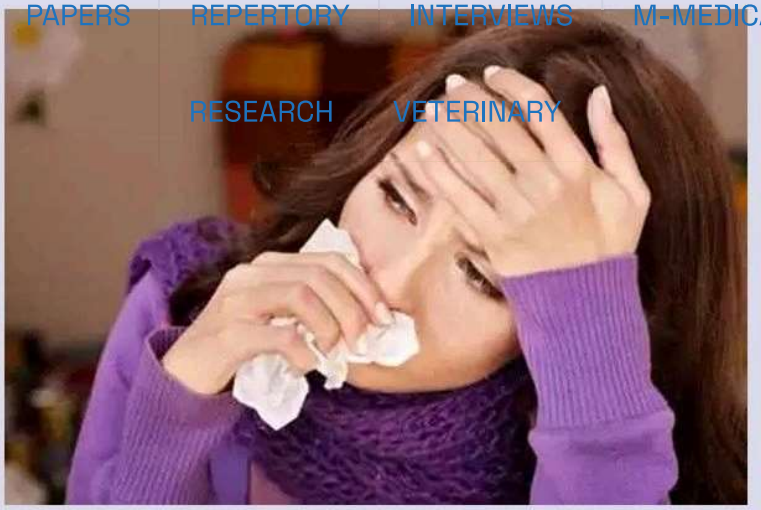
Obstinate Cough and Cold in a Woman of 31

February 18, 2023 • Add Comment • by Rajiv Peres



Dr. Rajiv Peres shares a case of obstinate cough and cold in a woman of 31. Emaciation most marked in lower extremities was a symptom that led to one of the remedies.

On 29th September 2022 A 31 year old lady doctor consulted me for complaints of cough that started the previous day. It was accompanied by dryness of mouth with thirst, mild soreness in throat. Irritation in throat was first, then cough. Cough would begin in the chest at the bifurcation of the trachea into right and left bronchus. She had the feeling that mucus was stuck at bifurcation of trachea. Itchy throat.

30th September 2022 – Dry cough with minimal sputum, sneezing and cough beginning from the throat. There is a foul odor coming from the mouth and throat. Cough is causing pain at bronchus. Drinking hot water helps itching in throat. Cough comes suddenly while inspiring.

and itchy. Cannot bear draft of air. Feeling of congestion in both ears. Expectoration is yellowish and there was also post nasal discharge. Sometimes with the sputum there is little tinge of blood.

Chest pain observed in left lower aspect of chest on and off. (father suffered T.B and mother haemarthrosis of left knee joint). She observed that expectoration is more frequent in early mornings. Voice was hoarse. Feels better by eating solid food.

Got fever (heat) since last 3 days followed by chilliness. Increased appetite with fever. Suspected H1N1. Took Nux Vomica 1M, one single dose on her own on 30th September 2022.

1st October 2022 – Lot of coughing in the morning along with coryza. Itching and soreness of throat less. Hoarseness increased. Feeling very drained. Mild fever, continuous running nose with watery coryza. Day by day feeling more and more exhausted.

Bad type of dryness of throat with increased thirst. Felt better by drinking water. Fever 100'F, frontal sinuses feeling tender with headache. Sputum thick yellow. Took head bath in order to visit the Temple, Head feels better by wrapping up including covering over face. Cough is worse on talking and while inspiring. Wheezing present. Dryness of throat marked so much so that she starts crying from the irritation. Cough with expectoration. The sputum is causing tickling inside. Sputum sometimes yellow, sometimes white and she needs to breathe from the mouth.

Took Hepar Sulph 200, 1 single dose on her own on 1st October 2022.

easy.

9th October 2022 – Cough still present. Sputum thick and sometimes thin, yellowish. She complained that she has lost weight in lower extremities only as compared to upper body. Despite not exercising for last 2 weeks, noticed that her tight jean pants are becoming loose in lower limbs.

Feeling tired easily. This time weakness was more than ever. Recalled that even during COVID (Jan 2022) and chicken pox (May 2022) that she experienced in this year earlier, she was good. Conjunctiva was pale. Haemoglobin reduced for no obvious reason.

She has started consuming tomatoes and beetroot to counter it. Bouts of cough take long to settle down. Thermally hot patient. Feeling very exhausted. More expectoration while bending down. Foul taste in mouth in the morning. While coughing feels upper chest is vibrating.

Expectoration feels stuck and relieved if she can expectorate. Has to thump the chest retrosternally to relieve herself. Now cough is starting from throat and not from bifurcation of trachea. Complaints of cough worse lying-in supine position. Prefers sweets to salty things. Has dewormed herself but no improvement. Wants to be in open air with ears covered. Voice was hoarse and unable to speak louder than whispering.

On 11th October 2022 – Suddenly she called up to speak about problems in her personal life. She informed me that her parents secretly planned a meeting with a boy and his family (marriage proposal). She thought that the boy may be visiting her

because the boy's family was so well dressed. The match maker did not even introduce her nicely to the family of the boy. She was asked to sit in one corner with the boy.

They began asking her questions: "What are your expectations?", "Will you travel from my home to the hospital where you work at present? And she was not able to reply appropriately as it was completely an unplanned event. The boy also told her that he had gone through her Instagram pictures which reflect her state of mind.

The place of meeting of the two families was also in a shabby locality. Until 3 days there was no reaction from the boy's family. Later upon asking her father she was informed that they were not interested. Now her father could not digest this and she has started isolating himself from her and her mother, sleeping separately in the same house. He was abusing alcohol and insulting her and her mother all the time. It was fully chaos at home.

She worries about her mother's and father's health. She felt greatly duped by her parents. Next day an aunt of hers came and told her to just get married to anybody, as it's a part of everyone's life. It's a contract. At last, she told me that she felt much relieved after speaking out her problem.

Anamnesis of the case done on 12th October 2022: In this the first thing to be done is to address the respiratory problem that is not getting fixed. Identify the important characteristics not only in the form of symptoms but also in terms of direction of disease, magnitude of disease.

Community Acquired Pneumonia (CAP) in a Man of 30

The problem started with tracheobronchitis as the beginning then gradually as time passed in between there was fever, some medicine taken. Now what are the things that I see very striking? If we make any mistake disease will affect her mind producing a psychological condition or much deeper pathology of respiratory issue.

At this stage we may not look into mental aspects of her condition. Prescription is not based on disease diagnosis. Anybody going through such a situation will have disturbance but it is the degree of disturbance that matters and if it aggravated the disease that is there.

The respiratory problem and disturbance of mind are concurrently running without impact on each other. The disturbance is not intense (judged by her manner of communication) and affecting day to day thinking, her decisions, her performance. Or, whether there are certain mental expressions coming out as evidence that really show that the situation is affecting her.

Events may be there with no strong effect, then there is nothing to consider at all. Don’t get confused between state of her mind, and the present condition. Two platforms are available: One is respiratory platform, the other is life situation platform.

In between lies the clinical diagnosis problem which may allow you to understand the management part. So, this is the square of todays problem. Hence, we get

sensation, modality, concomitant or you can have Boger's approach by judging pattern of response that is onset sudden, gradually progressing, Cold first settling in chest, ascending, progressively increasing and ending into weakness, or from particular level things are going into general.

But mind is not affected as far as respiratory concomitants are concerned. Do not add any interpretation of events to make it either concomitant or a mental state. We must be very careful. We have to prescribe now. We have an unresolving cough with characteristic modalities. Rubrics Considered: 1) Cough worse laughing, 2) worse talking: Arg-n, Cupr, Dros, Phos, Spong, Stann

3) bad taste in mouth in the morning. Only Arg-Nit.

Allen's KeyNotes mention in Arg-N that emaciation is most marked in lower extremities. This symptom was the anchor symptom of this case. If one looks into the core delusion of Argentum Nitricum, we realise that she feels despised and forsaken (abandoned), delusion that she is repudiated by his relatives. This is exactly the essence of our patient's life situation.

1st Prescription of Arg-Nit 200, 1 single dose administered on 12th October 2022 evening.

Follow Up on 13th October 2022– Took orange juice and later hot water. No aggravation of any complaints. Rather appetite has improved, not much cough, however slight irritation of throat present. Cough is now from throat and not from chest or bifurcation of trachea. Felt less exhausted. Came home after hospital duty and then cleaned her room, and still no drained feeling. Running nose stopped.

reduced considerably. Dreams that she was video gaming in which she was escaping something.

Follow up on 17th October 2022– Cough returned but now its from the larynx. Started after consuming some juice at neighbour's home. Intermittent cough. Worse on talking and laughing. Felt uneasy feeling in right side back as if she had some prolapse of intervertebral disc (Old symptom returning). Used to get this symptom on and off in the past. Felt better by pressure. No medicine given.

Follow up on 18th October 2022– No dry chest cough as was the case before. Cough only from throat. Stools had not been proper for long time (6 months) in the sense that not well formed and crumbled with difficulty in evacuation, needs to assist with finger. Thirst normalised and reduced as compared to last week during sickness. Tried cold things which do provoke cough.

Follow up on 19th October 2022– Overall better. Once dry cough starts gets continuous bouts which don't settle easily. Then coughs intermittently. Exhaustion has reduced by 80%. She was asked about the thinning of her legs. She said that now it has stabilised since the patient found that the pants which were loose a few days back are no longer so loose.

She was asked to monitor her haemoglobin and report. She complained of appearance of tinea like dry eruptions on right dorsum of hand which developed after exposure to sun. No medicine given.

Follow up on 23th October 2022– She complained that cough is same and feels that medicine is not taking her any further. Complained that her cough is like that of a

Tuberculinum 200, 1 single dose on 23rd October 2022. Reasons for prescription – Refer Boger's Synoptic Key: ever changing symptoms not responding to the best of prescriptions.

The prescriptions are not getting registered deeply due to the underlying miasm (Tubercular taint). Her mind is also changeable and undecided. She is interested in fashion designing but not clear of how to go about it. Obscurity of a clear-cut diagnosis also favours Tuberculinum.

Tuberculinum is worse by motion (talking, laughing), worse by exertion, better in open air. This patient had pattern of lowered vitality. H.C Allens keynotes we find "Takes cold easily without knowing how and where".

See also

Solution to last month's Case of 'Spino Cerebellar Ataxia'

Follow up on 24th October 2022 – She got stinky loose motions. Watery, 4 times since early morning. (Tuberculinum has 5am aggravation). Felt drained. Same night felt mild cramps in transverse colon. Has to pass stool if eats anything. Advised probiotic and oral rehydration solution.

25th October 2022– Cough became more bugging as before and diarrhoea better. Cough without any expectoration mostly in the morning. Felt poking pain and unable to pass flatus.

29th October 2022– Cough is 90% better. But in the morning, she saw a small eruption with mild itching. Was reassured that response is positive and that skin will not flare up like in the past. Explained that this is as a result of medication and not relapse of the disease.

3rd November 2022– She had a bad dream, in which some young male person is chasing her to kill her, the reason being that she is a non-Muslim and she tries a lot to dodge him, but in the end, gives up. There is another unknown girl with her and they were in some city with complicated buildings and complicated corridors.

He chases them with intention to kill. They both run and hide behind window and through toilet hole of old-fashioned toilet, then the girl asks her to bathe in some lubricant oil but the girl gets shot and dies. She tries all tricks even by taking someone's car but still she gets caught.

He had some weird gun like blazing fire and heat coming out. Like the ones used for welding. Then she chooses to go close to him and act as if she will wrap her arms around him and he fires. Before she could feel the pain, she woke up. She said that in the whole dream she was thrilled about the escape part and not scared in the least. She wanted to win; it was like a game.

Follow up on 7th November 2022– Feeling alright. Cough occasional only on excessive laughing. Tummy feels bloated once again. Stool slender and crumbles, needs to use finger to widen the anal opening. Drinking less water.

Follow up on 10th November 2022– No emaciation of lower limb, No cough, No skin

girl.

Complaint of losing temper soon. This happens usually one or two days before menses. But it has been 4-5 days. Gets highly irritated. At home she tries her best but at last she blasts as she cannot control. At work, tries to keep quiet or not to give opinion since she speaks very sharply.

She even taunted her boss that now “don’t speak sarcasm”. At the moment, she cannot bear the slightest contradiction, it angers her. Hence tries to keep away. She also understands that her bad behaviour is spoiling other people’s mood since they get offended too, just like her.

Irritated for example, if she is not told all the details or if somebody forgets what she had said earlier. Today she skipped her lunch on account of her stubbornness. Her boss had promised to offer lunch but at last minute he forgot. Complaint of gaseous distension. Not able to pass flatus easily, worse morning and evening. Stool slender, crumbles, scanty and has to use her finger to widen her anus.

It’s been one year that she has passed a good formed stool. Desires sour tangy foods. Uses lime over salads. When upset or sad, cannot even weep freely. At that time consolation aggravates and she wants to be by herself. Cannot bear draft of air from Air conditioner it results in headache. Desires hot food but prefers cold drinks. Face is dry, lot of dandruff.

1)Angry before menses 2) Stubborn 3) Sadness worse consolation 4) Cannot have opposition Cham, Caust, Kali-c, Lyco.

Follow Up on 4th December 2022: L.M.P 12th November 2022. Feels overall okay. No respiratory problems, no upper GI issues. But the end of November started with bad hair fall (old symptom). Scalp dry and dandruff present. No constipation if consumes vegetables, sometimes has to strain at stools but better in the last 5 days. No complaints as such. No medicine given.

Follow Up on 6th December 2022: Got her menses on 4th December 2022 this time pain was not bad at all, rather bearable. No troublesome PMS this time. On second day of menses watery coryza began with slight sore throat. Frontal and maxillary sinus slightly tender. Doesn't want to get exposed to draft of air nor wants fan. Desires to cover her face and ears. No medicine required as by next day coryza reduced on its own. No Cough.

Lessons: Acute remedies may relieve the fever or cold symptoms temporarily, but unless the PQRS symptoms and the mental concomitants of the case match with the remedy indicated from the homoeopathic materia medica, an actual recovery doesn't occur. Here the susceptibility of the patient was good providing clear cut indications of different remedies.

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I have anxiety of making mistakes

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Abstract: *The author presents a case of migraine where constitutional medicine was ineffective but an acute remedy helped her instantly giving a lasting permanent cure.*

A 24-year-old unmarried female clerk, visited on 4th August 2017 with c/o catching cold very easily with continuous sneezing and nasal obstruction worse at night. She also c/o recurrent headaches which began in the morning and lasts till evening since last 4 years; headache improved after sour vomiting . Other complaint was pain in the thighs and shoulders which the orthopedic doctor had declared as calcium deficiency. In the morning after waking up from sleep, her back would also hurt. In past history it was noted that she had a certain allergy of the eyes that had begun in class 5 and she has been taking treatment for it for last 10 years. Her eyes would specially itch in winter season. She desired raw mangoes and preferred cold drinks. She had aversion to milk+3. She could not tolerate spicy foods. Thirstless and chilly. No problem with stools.

She wore a sweater even on a hot summer day. She would be angry if her wishes were not listened to. She was especially concerned about her family because her father was not bothered about them and was worried about having a heart ailment. She would often tremble with fear. Her greatest desire was to have a good family life. She had problems in taking decisions due to confusion of mind. She also had anxiety of making mistakes. She never shows her sadness and felt better after crying. She was fond of slow music and so sensitive that she can't bear to see fights. She used to feel tired easily. This was a typical psoric constitution with general emaciation. Hence, *Calc-c* 200 single does was prescribed on 4th August 2017.

Follow up

- **11th September 2017**: Thigh pain and shoulder pain 80% better and no backache anymore. But she was still very desperate to get rid of her nagging left sided migraine headaches, which recurred every Sunday. Headache < eating and > vomiting+2 something sour. Pain was sharp type, no radiation but occurring periodically, < hot weather, > lying down but at that time she cannot fall asleep. Headache > gentle motion. Her eyes were red with the headache this afternoon. BBCR Repertory was referred for the following two rubrics:
- Head internal occurring every 7th day; Calc, gels, *Iris,* phos, saba, sang, sil, sul, tub.
- Head internal Vomiting Amelioration; Asar, Eupper, Ign, Iris, Tab.

Iris-versicolor is the finest medicine for gastric or hepatic headache associated with sour vomiting with prominent action on alimentary tract says EB Nash. William Boericke mentions the modality better by continuous motion.

Iris-versicolor 200 single dose was prescribed on afternoon of 11th September 2017 during acute attack. Within 2 minutes the headache disappeared.

15th June 2018: She got the headaches only once a month for the first 3 months but not as intense as before. After that no single episode of migraine. No shoulder nor thigh pains. No complaints whatsoever. Happily married.

12th February 2019: No headaches. Complaints of constipation, hard stools. Cold hands with numbness. Lumbago with excessive menses. Chilly, Fear of darkness, worried about future and family. Neck pains. Still prefers sour foods. Knee pains worse ascending. *Calc-c* 1M, 1 single dose prescribed.

LEARNING: Although *Calc* was her constitutional medicine, yet it was ineffective in dealing with this obstinate migraine tendency and an acute remedy like *Iris-v* helped instantly as well as to give a lasting permanent cure.

KEYWORDS: Acute left sided migraine, Sour Vomiting, Constitutional, *Iris-versicolor, Calc-c.*

Marriage is a burden

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CASE: A Lady of 42 years c/o Migraine, since 32 years

LOCATION	SENSATION	MODALITIES	CONCOMITANT
Head Since 32yrs (Lt side) (Lt – Rt)	Sees only half object. (Right side) Pain (after clear sight) Irritation Throbbing Hammer like sensation	< Ice-cream < Milk+++ < Butter+++ < Cold Air < Sun heat > Warmth > Close Room	Nausea Corners of mouth- cracks

PHYSICAL GENERALS:

APPETITE: - Good
THIRST: - Small quantity at smaller interval
DESIRE: - Sour+++, Salty+++, Sweet+++, Warm Food
AVERSION: - Highly seasoned food, ice-cream
STOOL: - Constipated, Black
URINE: - Normal
SLEEP: - After 3 am
DREAMS: - Teaching the students, Snake biting, Falling in valley
PERSPIRATION: - Scanty
THERMALS: Hot

MENSTRUAL HISTORY:
Cycle:- 4-5 days/ 28-30 days
During:- Pain in abdomen

FAMILY HISTORY

Mother and Father: Hypertension
Mother and & Maternal Uncle: Piles
Maternal grandmother: Paralysis

PAST HISTORY:

Chicken pox, Piles

DIAGNOSIS:

Migraine

MENTAL GENERAL

Loneliness- do not like to be disturbed.

Goodbye Forever!

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Abstract: *A classic case where an acute emotional imbalanced response was triggered in an individual in response to things done by others. The problem arose in the mind, but the body is expressing the same pattern freely.*

A 27year old unmarried male presented on 5th of March 2023 with c/o bleeding after stools (20 to 25 drops of bright red blood). No pain whatsoever. No constipation. First time bleeding appeared on 28th February 2023 in form of a streak of blood on the stool, especially towards the end of stool 2 drops of blood were noticed by the patient. On 2nd March 2023 soft stools but 5 drops of blood were passed at end of stool. 2 days later, 4th March 2023, he was stunned to see 20-25drops of blood at end of stool and stools mixed with blood. Painless stools. He was worried. When I saw him, he appeared upset. When I inquired into how it all began, he informed that on 11th February 2023 while playing a friendly football match he fell down and sustained blunt injury to his left knee. Initial swelling of left knee reduced after ice application. After this he observed a firm mass protruding from lateral aspect of left knee specially when he squats on the Indian toilet. On 14th February 2023 Valentine's Day he met a girl whom he was chatting for last 3 months. She seemed equally promising to him, but he maintained some distance from her as he had just met her. Later, while chatting next 2 nights, she inquired from him 'What do I mean to you?' He knew that another boy was after her, so he replied diplomatically saying that "you are like a colleague." This offended the girl, and she immediately disconnected the phone. She messaged him that "I won't sleep all night." When he inquired the reason, she replied "That's none of your business". This shattered him completely. He felt as though someone had hit his brain with a hammer. He could not stand this insult. It made him furious to see such an insensitive reply from a girl whom he loved and cared for. He switched his phone off and diverted his mind so that he might be able to get sleep. Next morning, he found a message from the girl 'Goodbye Forever'. This added to his misery. Soon he had a toothache, < inhaling cold air into mouth. No caries visible. He felt extremely offended and sad. He was just unable to forget the girl and her insult. From the next night onwards he could not sleep soundly. He would be awake till 2-3am and be sleepy during the day. He would wake up several times at night to pass urine or simply to check the time or was woken by wet dreams. Sleep was unrefreshing and even if he tried to sleep during the day, it could not refresh him for long. Always yawning. Usually, he hates smoking because the taste of nicotine doesn't go even after brushing several times but on 17th February evening as he smoked on insistence of a friend, he quite enjoyed it, and the taste did not bother him at all. On 20th February 2023 He met his ex-girlfriend on pretext of some work and asked her

to hug him, but she point blank refused and walked away. He was enraged at her behaviour but never showed it externally. He decided to teach her a lesson later. On 3rd March 2023 he was accused by his best friend for spoiling the sacred environment of the gathering of people- why?. He once again felt very bad but shut his mouth and walked off quietly. Next day he had an indurated fiery red pimple on left cheek and tip of nose. At the end of it all he felt that everyone wants to injure him. At work, since his sleep was incomplete, he would shout at others. Picking up quarrels. Refusing to follow orders. Insulting his siblings and mocking his colleagues. However, if his colleagues pointed out his flaws or contradicted him then he could not tolerate it. While travelling he would be very cautious to see if any vehicle might hit his injured knee, although there was no tenderness nor pain in it. He would often keep his hands on his knees as if trying to protect and cover it. He felt his legs were not supporting him well, hence while climbing stairs he would firmly hold on to the railing to make sure that even if he slips, he will latch on to the railing. He said that he was feeling like an old man while walking, like being unsure of his stability. He also got a boil just below his suprasternal notch with pus that oozed out and it healed leaving a keloid like scar. He could not bear much noise; it would anger him and then he would shout very loudly. Later, he felt guilty for having shouted in anger. His teeth and throat were also sensitive to slightest change in temperature of water (cold water) and in the mornings he would have a running nose on waking. Chilly, good hunger, can eat more even if has just eaten a meal. He felt lonely and wanted somebody to make love. He enjoyed watching girls pass by on the street (Lustful). He would speak everything in double meaning, but shy at the same time when it comes to practically doing it. On inquiring whether he felt anger, insulted or sad? He immediately replied that first he felt insulted and felt that his honour was wounded by both the girls and later on he felt sad thinking repeatedly 'How could they do this to me?'. I referred Dr RP Patel's corrected version of Kent's repertory for the following rubrics 1) Effects of honour wounded *(Ign, Nux-v, Staph*) 2) Lasciviousness

We have a choice between *Ignatia* & *Staphysagria*. Oversensitive to rudeness, easily excitable, highly emotional, worse from emotions, image conscious with vexation and reserved displeasure, insomnia after grief, we find in both. But the expression of toothache as a result of constant grinding of teeth in anger, prominent masseter's, sensitive to cold water and always angry are guiding features of *Staphysagria*. Boger's synoptic key mentions pains that move into teeth, imagines insults. HC Allen's keynotes says under *Ignatia* that it cannot bear tobacco smoking and under *Staphysagria* we find craving for tobacco. According to Boericke's Materia Medica in *Ignatia* we find painful haemorrhage after stool and stools are passed with difficulty, which is not the case with our patient. *Staphysagria* in Boericke's cites the symptom; dwells on sexual matters.

Prescription given on 5th March 2023 *Staphysagria* 1M, single dose.

Follow up

8th March 2023: Not a single drop of blood in stool ever since he began the homoeopathic medicine. Besides this, sleeping very deeply and waking up refreshed every morning. No longer short tempered or angry mood. Peaceful at workplace.

15th March 2023: No relapse of sleeplessness nor bleeding during stool. Feels strong in the knees and resumed daily walks. No longer worried about sustaining injury to left knee. On two occasions, was able to bear unwarranted insults from two different colleagues but did not retaliate. Later on, one of the colleagues apologised to him and made peace, the other colleague he forgave without holding any grudge. Gets acidity if overeats and realises importance of exercise.

LEARNING: This is a classic case where an acute emotional imbalanced response (Anger=hate) was triggered in an individual in response to things done by others. The problem arose in the mind, but the body is expressing the same pattern freely. Somatization occurs in *Staphysagria* as a result of suppression of emotions & hidden anger especially revolving around relationships. *Staphysagria* has pronounced action on Nervous system with great sensitiveness to least impression, either mental or physical. Herring calls this as Morbid sensitivity as he is fixed on insults (Sycotic). Least word seems wrong, hurts him very much, special senses become irritable, cannot tolerate noise, everything is painfully sensate.

KEYWORDS: Bubbled up---injured pride---high libido--- *Staphysagria.*

A Restless Soul

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A young man, 25yrs, came on June 18, 2018, complaining that he hadn't been able to eat in two years. He throws up if he consumes one extra roti. He has numerous plans, and if they don't work out, he immediately loses his appetite. Can't concentrate on one task at a time and is distracted by other tasks, leaving the earlier task unfinished and causing anxiety and hasty labour. Eats quickly. Believes he will throw up if he eats too much. He works for an IT firm; if requested to give a 30-minute presentation, he becomes exhausted before the end of the period, breathless, frets about what to do if the material ends quickly and lacks confidence. If the presentation is unsuccessful, performance will suffer, and there won't be a promotion or appraisal. He met a girl in 2015 with whom he had a meaningful relationship. He tried to propose to her, but she declined. He stopped eating as a result of the event, and he started waking up during the night. When he learned of her marriage to another a few months later, he found it difficult to accept the information. When questioned about their relationship, he responded that he made every effort to be there for her, used to travel great distances to see her, and would talk to her about his personal issues. But after being turned down, he gradually came to believe that money is the only thing that matters. He didn't have a good income back then. The only thing he could think of was, "Why not me? Is it true that I'm insufficient for her?" I made her my top priority and kept her above everyone else. I was upset about how far behind I am in my finances and appearance. She might think I'm stupid or that I'm unfit to be with her. Am I not that presentable? Perhaps the other man she married was more intelligent and well-groomed. I am unable to focus or adequately eat after that occurred.

If I try to plan anything, it never works out. I also suffered a substantial financial loss due to Bitcoin. Again, I didn't accept the loss. I made an effort to make up any losses I suffered. I make a lot of plans,

'Antagonism with Herself' from Kent's Repertory

Dr. Rajiv Rui Viegas Peres

ABSTRACT

"Antagonism with herself" means hate or extreme unfriendliness or active opposition to oneself. This is a subjective symptom seen in four different remedies found in Repertory of the Homoeopathic Materia Medica by Dr. J.T Kent, sixth American Edition corrected, revised and improved by Dr. Ramananlal P Patel. This article is to explain how the four different remedies (Anacardium, Aurum-Met, Kali-Carb & Lac-Can)1 given in Kent's repertory under the rubric, Antagonism with herself can be comprehended in context to homoeopathic psychology with the help of examples from my clinical practice.

Keywords: Antagonism, Sadness, Pathogenesis

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Many a times we find rubrics in our homoeopathic repertories specially from mind section, that are extremely difficult to comprehend at first hand, but a deeper reflection along with co-relation of knowledge of psychology to homoeopathic materia medica and further integration of it with Rubrics from repertory finally yields clarity and then these rubrics become usable in our day-to-day clinical practice. These rubrics could also be understood from a miasmatic perspective but that requires strict individualisation.

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Antagonism with oneself is an inherent trait in these above-mentioned remedies as per Kent's repertory, the underlying miasm and environmental stimulus help to maintain the disease and contribute to the pathogenesis. The psychological evolution of these remedies is what is my attempt through this article.

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STUDYING STAPHYSAGRIA FROM PRACTICE THROUGH ORGANON

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Case 1 of Chronic Sinusitis with trapezitis

Abstract: This is a case of an old looking artist who presented with sinusitis as a presenting complaint but it was later revealed that he was obsessed with sex but had to suppress his drive due to ill health of his girlfriend. Staphysagria helped to relieve his trapezitus as well as sinusitis related headaches.

Keywords: Suppressed sex----Anger violent----Staph

Introduction: Sinusitis may be a common clinical condition and habit of smoking here acts as a maintaining factor but unless this kind of addiction is covered up by the indicated remedy his craving for smoking cannot be controlled.

A 41year old Artist (Tubercular built) visited my clinic on 18th June 2020 with complaints of trapping of some nerve along the upper border of left trapezium muscle since about 1 year. Pain was as if dislocated and >stretching. Even at night he would do stretching for long hours. He had neck pain issues since long and left sided migraine headaches since last 10 years headaches were at times very severe and he could not bear any noise, photophobia however he would have high sex drive. Headaches were due to recurrent sinus problem, since childhood. He loves having a lot of sex. Sex relieves his headaches. Although he didn't have any sexual problems, he highlighted the thing that he is very sexy and that any problem can be sorted out by having sex. His matra was "Sex is the solution to all his problems". His girlfriend complained of his high sex drive that he fights with her if she cannot have sex due to menses. He also has left hand numbness which doesn't permit him to play the guitar. He was so reserved that every question that I asked him, he would twist it and throw it back on me. His girlfriend admitted that he is good at covering up. It was very irritating to the physician the manner of his replies. When asked about anger he denied it out rightly and

said that anger transcends and that why should one react without need arising but his girlfriend confirmed that he had punched the refrigerator and the wall in anger and also broken several mobiles when they would fight or if he felt frustrated hearing her comments.

He is clean by habit and his girlfriend would ask him to clean the dishes. He would always talk in riddles and say that nobody understands him but if they don't get it it's okay. He said he didn't feel bad. But his girlfriend reminded him that whenever she insulted him then he would snap back. He was not talking to his two sisters who live in the village. He said that he doesn't need that. He travelled the world alone. He had no friends. When he met his girlfriend, he was very sad. Presently He lives with his girlfriend and said that his only fear is that she might leave him. He would contradict his girlfriend and justify his action assertively when she complained that he has habit of playing mental games. He knows how to get the truth from her by asking seeming irrelevant questions. When she met him 10 years ago, he was a strong believer in God but then something went wrong and now he exists without religion. In the past he had attempted suicide twice by consuming sleeping pills due to girlfriend's relationship problems. He was prepared to kill anyone who might threaten to harm his girlfriend.

History of dashing against the door and suffering from a seizure. He had a good timing for humour. His lips and teeth were dark due to smoking 6 cigarettes a day as he was trying to give it up. He could be very creative with light decoration or quick to learn things but should be in a mood. 2 years ago there was a time where their relationship was strained and as they were fighting he ran naked in the colony (He says that was a way to gather attention), she thought that he lost it and wanted to leave him but he pleaded her to stay. He confessed that he is very content with life and said that he doesn't think much as if one thinks much then one ends up taking wrong decisions. And one who thinks fails to act hence all time should be spent in acting. So directly act. He said my girlfriend thinks that I am serving her but actually she is the one who is serving him. There was a lot in his past but he was unwilling to reveal said that it was a long story and doesn't want to remember it. His girlfriend told that he is very emotional and gets influenced easily. His needs were eat, sleep and sex. Sex is the most important he stressed. He was fond of sweet things +2 and spicy also. Hot patient. His mother expired of Pulmonary tuberculosis and the doctors operated her and fucked her lungs. Father is only having hypertension. He fights for injustice only if it directly concerns him or his girlfriend. His girlfriend had health issues due to which she could not satisfy his sexual appetite for the last 2 years and hence they were always quarrelling. He also has complaint of numbness of left toe specially while riding the car. Repertoriation 1) Fear his wife will desert him 2) Throws things in anger. **Staphysagria 200**, 1 single dose was selected also because of the suppression of sexual desire on account of his girlfriend's ill health and due to shamelessness of sexual matters whereas otherwise he is a very blocked person.

Follow up after 25 days- Neck pains reduced not gone as yet and still feels need to stretch the neck, but overall, he's sinus attacks have reduced to much less as well as his headaches and he is not as restless as he used to be.

Discussion: Usually, these types of individuals are never seeking self-help. It is always a loved one who forcefully brings them for medical treatment. We find in his family history strong tubercular-syphilitic taint which predisposes him to have a tubercular diathesis.

Conclusion: Sinusitis can be helped by constitutional treatment which in this case was achieved with Staphysagria remedy.

References: Case was repertorised with help of Repertory to Practical materia medica by Written by Dr Mohinder Singh Jus. Publisher-Homoeosana Switzerland in 2017.

Case 2 of PCOS

Abstract: This is a case of a teenage girl balancing between her demands of romantic love and love from parents and family. The insults from parents due to disapproval of the boy selected by her leading into PCOS complaints.

Keywords: Honour wounded----Anger suppressed----PCOS

Introduction: This case shows the struggles faced by a girl if she dares to choose her life partner and specially the added opposition imposed by her own family members generating negative feelings and suppression of menses.

On 8th July 2019 a 21 year old girl presented with complaints of Poly cystic ovarian syndrome since last 4years. Menses irregular. Complaints of constipation and bloating. In June month she did not have her menses. There was lot of pressure and worry about the future as her studies were coming to an end and she desired to be independent and settled. She was in love with a boy belonging to a different religion and her own mother humiliated her in front of society by spreading false stories that she is about to split up from her boyfriend since she had heard them arguing over the phone. Her mother tried to initiate proposals for her, also brought the priest home and sprinkled holy water assuming that her boyfriend had done black-magic to win her daughter. Her mother was damaging her image since last 5 years, this subjected the patient to undergo lot of humiliation and she felt like slapping her (But cannot out of respect for her mother).

Usually, she is the type who confronts directly people who spread rumours face to face. Her father was her support in the beginning but now she realized that her father had leaked out her secrets to her mother. Both her parents had disrespected her boyfriend by not inviting him to their home when he was in need of shelter, rather they insulting him. She cannot accept that her parents have disrespected her boyfriend. Now her boyfriend has gone abroad to earn money for their future. Still, they are questioning his intentions and suspecting that he will cheat her. Since childhood her mother has dominated her. Her elder brother is always

favoured and he can bring his girlfriend home and stay although they are not yet married and even physical relation is permissible because she has given full liberty for him. He can even call her with bad names and she doesn't have a problem. This brother of her used to molest her when she was small and when she reported it to her mother. Her mother told that she must be telling lies. Since then her brother is very rude to her and doesn't want to give her any right to ancestral property. She hates the presence of her elder brother.

She fully understands that they are all waiting for her to leave. With all this going on in her mind she wonders where is her respect as a daughter. She has fear of becoming insane (daily stress), fear of losing her father, her boyfriend and being alone. By nature, she is very short tempered and highly emotional. She can't bear injustice, cannot forgive nor forget. When feels she is being attacked, she walks away, isolates herself and chooses not to talk to anyone and act rude and tough. Feels very lonely and depressed. Does not cry much like before. Consolation aggravates. Her mood is changeable and she wants her freedom. She is fond of sweets and peanut butter. Hot patient, thirstless. Considering her Anger with silent grief, The wounding of her honour and sensitive to injustice. I prescribed **Staphysagria 200**, 1 single dose

Follow up after 6 months- Got her menses 20 days after beginning the medicine. USG abdomen was done but it still showed PCOS. No menses in August, September 2019. She complained that her brother was plotting against her. Her menses stain was difficult to wash, she had become mistrustful about everybody, Time passed slowly, her memory was failing. When she used to be alone in the room, she used to feel that something is around her. There was desire to travel and went for a trip to Kashmir, not once her mother phoned her to inquire how she was. Here she got sexually involved with her boyfriend and developed tremendous fear of pregnancy. She also had craving for apples+2, Oranges+1. Hot patient with fear of existence. Considering the above state I prescribed Medorrhinum 200, 1 single dose

Follow up after 3 months- No menses still. There was lot of pent-up anger seen on her face which she was suppressing. She craved for peanut butter. Loss of weight to 59 kgs due to stress, earlier she was 70 kgs. I prescribed her **Staph 10 M**, 1 single dose and advised for USG of abdomen.

Follow up after 4 months. Got menses regularly. Felt calm.

Discusssion: Higher potencies were preseferred because this girl was affected at the level of emotions and honour, insults of long standing require dynamism in medicine to hold and health. As the totality changed so also the remedy was different, however Staphysagria stood out as the constitutional remedy for this case.

Conclusion: Staphysagria harbours lot of insults, anger with silent grief, emotional causes of diseases (Psycho-somatic diseases). Remedy helped to restore the menses.

References: Hahnemanian textbook of classical homoeopathy for the professional-by Luc de schepper published by B.Jain publisher 2007

Case 3 of Stye on Right eyelid

Abstract: This case is an example of psycho-somatic development of style as a result of ego hurt due to deprivation of recognition from his superiors.

Keywords: Humiliated----by superior----result stye

Introduction: Catholic priests live by vows of chastity and service at community level. They are assigned tasks by their superiors and it is the superiors that validate their work by apraisals.

on 25th May 2020 a 38 year old catholic priest presented with complaints of pain and swelling in right eyelid,<moving the eyelids, cold feeling in right eye since 3 days, Feeling as if sand is there in the right eye. >warm application. He was hot patient and thirstless. He is diabetic since last 2 years. Problem began after conflict with other priests; the senior priest sidelined him while preparing yearly planner of events for their Parish. He felt very humiliated. He announced a 1 month vacation and left for home. Although he was at home yet he was unhappy. Could not accomplish any work. He also complained of a scratchy throat since today morning with feeling as if someone is chocking him from inside. Also another younger priest had recently joined and wanted to have his bedroom as it was very spacious. He out rightly refused it. He had an old aunt whom he looked after. As a priest he had given his 100% to the betterment of the parish however he could not tolerate this injustice and had almost decided to resign from his profession. Luckily another spiritual guide advised him to stick on. He was very angry but had to shut his mouth. Every suggestion he gave was turned down. The senior priest was highly influential and dominating. All this had made him sleepless. On examination it was found that he was developing a stye. Considering the Anger with vexation and suppressed anger. Ailments from wounded honour I selected **Staphysagria 1M**, 1 single dose.

Follow up after 4 days- After the medicine he felt that obstruction feeling like while blinking his eyes had disappeared. No sand like feeling. He could sleep better and felt a lot of peace within; On the second day he could apply his mind and do much work. He rejoined the same parish and aborted the idea of resignation. He occupied the same spacious room as previously. The cherry on the cake was he received a transfer within a week to another parish which was a huge blessing to his missionary work.

Follow up after 1 month- No recurrence of the complaint. Keeps in good health.

Discussion: Stye is a benign tumour produced in the eyelid a symbolic representation of blocked emotion of anger. A feeling of reserved displeasure producing anger and ultimately tumour.

Conclusion: Stye resolved with staphysagria and prevented him from losing his vocation, once again making him submissive towards his higher calling.

Reference: Keynotes and characteristics of materia medica by H.C Allen 2th edition published by Indian books & periodicals Publishers.

Case 4 of obsessive-compulsive disorder

Abstract: Acne in adolescence coupled up with O.C.D and effiminate features with concentration problems.

Keywords: Masturbation----O.C.D----Suicidal disposition

Introduction: This case is about the evolutionary journey of a disease in a boy who was ambitious but under influence of strong syphilitic miasmatic forces culminated into crash at academics and finally ending into suicide at a tender age.

On 6th February 2018 A 17 year old boy presented with complaints of pimples on face which leave bad scars. This problem began when he was in class eight (13 years). He went to a dermatologist and took treatment. 6 months later developed washing mania. Was referred to a psychiatrist and after 6 months of her treatment improved. He had a voice and body language which was feminine. On account of this his friends in higher secondary school made mockery of him. His second problem was excessive sleeping and weakness. He was also so lazy that he didn't even pick up his used underwear; his mother would wash it for him. Since he was the only child he was also pampered a lot. He seemed obese and all the time he was hooked to the internet and so addicted to it that his parents had to remind him to pass his stools. Spent sleepless nights watching pornography and masturbated everyday 3-4 times. He was brought up in a religious was so there was tremendous guilt within him. He could not bear criticism. He would demand for new clothes every weekend and harass the parents if demands were not complied to. He would throw water on the mother, point the knife to the father and beat him up also in order to get a new bike. The he would bunk college which created a bad image of him in college. He failed his class eleventh exam and Initially he had joined higher secondary in the science stream as it was prestigious thing to do before his friends and society soon it was realized that he couldn't cope. His father pleaded to the principal and changed his stream to arts. Yet he failed due to bad company of friends. He was highly ambitious. He aspired to be a great historian and do PhD in history and also to meet the queen of England. He felt hopeless since his father could not afford this much and insisted on sending the father abroad in order to earn money like other people's parents were doing. He liked everything Royal, antique things, special violin, also he liked a girl who was from a high caste. But it was a secret love, he was too shy to express and feared being rejected. His other important fear was his image being spoilt hence he was very choosy of his company and only wanted to deal with high class people except his higher secondary friends. He would lie to his father that he is going to college and enjoy rides with his friends. Every day he would

find a new fault and quarrel with his parents. There was history of mental illness on his mother's side and this child was born after several years when the mother was nearing fourty. He was obsessed with collecting death certificates of this ancestors and that was his favourite pastime. The officers at the birth and death registry were fed up with his visiting them. His other dream was to be the sultan of Oman just because he was born in Oman. He desired sweets+2 and was chilly, thirstless. Desired cold drinks and had aversion to vegetables. I prescribed him **Staphysagria 10 M**, 1 single dose.

Follow up after 1 month- After Staphysagria he sweated more and old eruptions returned in more intensity. Started completing his work on time (Assignments), He became good to his parents. Allowed his father to use his new bike. In the whole month there was just one quarrel. He was less irritable. He stopped masturbation. Now thinks of friends just as a part of life and focuses on career. Gave up eating non-veg and reduced 2 kgs.. He passed his eleventh class. He was kept on placebo for 6 months. In this period he went with his family to a vacation in Daman and Diu, where they had some ancestral link. Unfortunately, 7 months later he suddenly commited suicide by hanging himself without any provocation. He asked his mother to prepare soup and said that he was going for bath but instead went inside his bedroom and ended his life. The whole village was shocked because outside he had maintained a very good image but his parents suffered immensely from his ill mannered behaviour. The father accepted his death saying that if he had lived then he would have completely diminished their family name and honour. This case demonstrates the syphilitic dimension of Staphysagria.

Discussion: Staphysagria although has syphilitic aspect yet it was unable to halt the miasmatic activity leading into sudden death.

Conclusion:Even constitutional medicine can sometimes fail to yield positive results if the environment(Internal and external) is not condusive towards positivity.

References: Essence of materia medica by George Vitholkas

Case 5 of Asthma

Abstract: This case is of a young boy who suffered from harrassments at his boarding school leading to breathing issues.

Keywords: Harassed----Anger suppressed----Asthma

Introduction: Orphan students are often mistreated by their superiors in boarding schools since there is nobody to stand up for such kids. These conflicts produce breathing problems which can get overlooked by treating physicians.

On 27th January 2020 a 17 year old boy presented with complaints of asthma since last 5 years < in humidity, > outdoors. > sitting, < lying down. He loves football but exertion worsens his asthma then he has to stop running. His asthma is worse at night on going to

sleep. He had an abashed look on his face. On inquiry it was revealed that his asthma issue began 5 years ago when he was put in a boarding school. Since he is dark in skin colour and an orphan boy, the warden of their hostel would punish him without reason. She made him do all the cleaning and threatened to send his home. He came from a broken home. His father deserted them when they were young. His mother served as a maid and hence had to keep him and his other brother in boarding school. His brother is a successful footballer and he isn't. This pains him a lot. He was full of anger for the warden and one day he fired bad words to her. In 2019 he was thrown out of that boarding and now trains at a football club. He had strong fear that his mother will also disown him just as his father did. Considering the suppressed anger with vexation and his wounded honour. I prescribed Staphysagria 10 M, 1 single dose.

Follow up 11th November 2020: All these ten month he was completely fine. Never needed an inhaler. He presented with nose block worse morning and night. Feels better walking in open air. His tongue was mapped. He felt hungry soon after meals. Frightened to seek help. No medicine given. Advised steam inhalation, warm drinks and cover himself.

Follow up 9th January 2020: All fine and pursues his football training and I often see him cycling in the evenings.

Discussion: If the emotional cause like the vexation generated at the boarding school was not ciphered then the case would never reach to staphysagria a prescription since this remedy doesn't have much respiratory symptomatology in its proving.

Conclusion: The emotional injury and the pent up anger against the warden produced the obstacle of Asthma which came in way of his career, staphysagria helped to resolve the problem. Although he could not succeed to be a footballer yet he is free from Asthma.

References:Lectures on homoeopathic materia medica by Dr J.T Kent published by Indian books & periodicals publishers.

Case 6 of Dysmenorrhoea with hypothyroidism

Abstract:A housewife suffering from anger pangs resulting into deep dissatisfaction in her personal life sought help in my homoeopathic O.P.D for anger management treatment

Keywords: Anger violent----Dysmenorrhoea----Insomnia

Introduction: The lady was divorced once and presented for help in resolving her anger issues associated with dysmenorrhoea and hypothyroidism. She did not want to go through another divorce.

On 27th August 2020 I came across a 44 year old women who presented with complaints of uncontrollable anger which had lead to an divorce in her first marriage. She had a 7 year old son but there were constant fights at home with her second husband who is also a divorcee

and she could not stand him anymore. They were not having any physical relation for a long time. She was weeping while narrating about her discords with her present husband. Whenever they would fight she would contact the NGO and that would infuriate the husband and he would come to beat her. She tried taking video's and in anger slammed her phone to the floor. She had sleeplessness trouble since these thrifts with her husband. He would insult her very badly with bad language and holds grudges for long time. She was a fighter who was seeking for peace and love. She would easily become angry and break things as well as beat her child; thereafter she feels bad and cries thinking what she has done. She suffered from severe dysmenorrhoea at the time of menses. Menses were regular 30 days cycle. She suffered from stitching headaches if she fasted. She spoke hurriedly and confessed that she was impatient. In recent months she had developed hypothyroidism and had undergone an operation for fibroid uterus. Her real problem was her uncontrollable anger when some injustice is done unto her which was responsible for her divorce in first marriage also. She was just 24 years old then and had got married only because he was not asking for dowry at the time of marriage but she realized it later that he was an alcoholic and he used to physically abuse her. Then she went into a fighting mode not knowing when to stop. Now she fears that this second husband will leave her and go. This second husband was not a responsible person.

In her childhood there was lot of tension at home because her father was an alcoholic and used to hit her mother. Her father was not responsible about the family. He had kicked the mother when she was in her mother's womb. She had to be sheltered in an ashram. Here she came to know God.

Thermally: Chilly patient

I consulted Kent's repertory 1) Throws things in anger 2) Ailments from mortification. I prescribed **Staphysagria 1M**, 1 single dose on 27th August 2020.

Staphysagria is an emotional person and dependant type, who is sensitive to rudeness. Suppression of emotions is the central idea. These emotions find an outlet on the physical plane as gripping dysmenorrhoea, stitching headaches, insomnia, hypothyroidism and much later on the emotional plane we find in the proving, very peevish; she wishes to throw from her everything which she takes in her hand. Like so many of us staphysagria is the victim of her expectations and desires, especially revolving around relationships. Staphysagria becomes ill from conflicts around her due to the great indignation about things done by others. They usually present with an anxious expression, disposition can be quarrelsome at times but basically they are shy of opposite sex, moody, depressed and suicidal.

Follow up 1st October 2020 –Anger had reduced despite husband still giving her bad words yet she wants love from her husband as in physical relations.(demanding sex and fixed on that is sycotic element) Now even if husband shouts she remains quiet. She is relieved by

consolation. No headache since the homoeopathic medicine has been started. Menses dysmenorrhea less painful. She weeps when she feels hurt and prays to God to save her marriage. No medicine given.

Follow up 12th February 2021- Her Anger is well controlled. No headaches, Menses is regular. Minimal fights with husband. She decided to give up meat after watching a seminar. Does regular meditation. No medicine was given.

Follow up 2nd April 2021- She reported of getting angered easily and husband raises hand on her. She meditates. She wants her husband to show her love by caressing her. Once again, she was feeling sleepless due to this stress. There was an insulting event that had disturbed her. Her present husband's ex-wife was still in contact with her husband and they celebrated their son's birthday together. She feels hurt because her son and she were not invited for the celebration. She feels that this ex-wife should not any contact with her husband. She said that she would commit suicide if he gave her divorce. (Staphysagria has suicidal thoughts but fear of death which is a tubercular element). Staphysagria 10 M, 1 single dose given.

Discussion: Staphysagria helped to calm down this agitated, impulsive and hurried married lady.

Conclusion: Dysmenorrhoea, Insomniaimproved as well as her second marriage was saved from being ruined with timely use of staphysagria.

References: Kent's Repertory published by Indian books & periodicals publishers.

Case 7 of Insomnia with bleeding per Rectum

Abstract: This case is of an an injured pride which resulted into sleeplessness problems which progressed to bleeding per rectum in event of disappointment in love.

Keywords: Bubbled up---injured pride---high libido

Introduction: Disappointment in love is a common occurrence in life but the way each lover suffers is individual expression depending upon his constitution, miasm and sensitivity.

A 27year old unmarried male presented on 5th of March 2023 with complaints of bleeding after stools (20 to 25drops of bright red blood). No pain whatsoever. No constipation. First time bleeding appeared on 28th February 2023 in form of a streak of blood on the stool, especially towards the end of stool 2 drops of blood were noticed by the patient. On 2nd March 2023 soft stools but 5 drops of blood were passed at end of stool. On 4th March 2023 he was stunned to see 20-25drops of blood at end of stool and stools mixed with blood. Painless stools. He was worried after that and decided to consult me. When I saw him, he appeared upset from the face. When inquired into how it all began, he informed that on 11th February 2023 while playing a friendly football match he fell down and sustained blunt injury to his left knee. Initial swelling of left knee reduced after ice application. After this he

observed a firm mass protruding from lateral aspect of left knee specially when he squats on the Indian toilet. On 14th February 2023 Valentine's Day he met a girl whom he was chatting for last 3 months. She seemed equally promising to him but he maintained some distance from her as he had just met her. Later on, while chatting next 2 nights, she inquired from him 'What do I mean to you?' He knew that another boy was after her so he replied diplomatically saying that you are like a colleague. This offended the girl and she immediately disconnected the phone. She messaged him that I won't sleep all night. When he inquired the reason, she replied "That's none of your business". This shattered him completely. He felt as though someone had sledged his brain with a hammer. He could not stand this insult. It made him furious to see such kind of insensitive reply from a girl whom he loved and cared for. He switched his phone off and diverted his mind so that he might be able to get sleep. Next morning, he found a message from the girl 'Good Bye Forever'. This added more to his misery. Soon he started with a toothache, worse by inhaling cold air into mouth. No caries visible. He felt extremely offended and sad. He was just unable to forget the girl and her insult. From next night onwards he never could sleep soundly. He would be awake till 2-3am and sleepy during day. He used to wake up several times at night to pass urine or simply to check the time or woken by wet dreams. Sleep was unrefreshing and even if he tried to sleep during the day, it could not freshen him up for long. Always yawning. Usually, he hates smoking because the taste of nicotine doesn't go even after brushing several times but on 17 February Evening as he smoked on insistence of a friend, he quite enjoyed it and the taste did not bother him at all. On 20th February 2023 He met his ex-Girlfriend on pretext of some work and started asking her to hug him, but she point blank refused and walked away. He was enraged at her behaviour but never showed it externally. He decided to teach her a lesson later on. On 3rd March 2023 he was accused by his best friend for spoiling the sacred environment of the gathering of people. He once again felt very bad but shut his mouth and walked off quietly. Next day started with indurated fiery red pimple of left cheek and tip of nose. At the end of it all he was feeling that everyone wants to injure him. At work place since his sleep would be incomplete then he would shout it out on others. Picking up quarrels. Refusing to follow orders. Insulting his siblings and mocking his colleagues. However, if his colleagues pointed out his flaws or contradicted him then he could not tolerate it. While travelling he would be very cautious to see if any vehicle might dash his injured knee, although there was no tenderness nor pain in it. He would often keep his hands on his knees as if trying to protect and cover it. He felt his legs were not supporting him well, hence while climbing stairs he would firmly hold on to the railing to make sure that even if he slips, he will latch on to the railing. He said that he was feeling like an old man while walking, like being unsure of his stability. He also got a boil just below his suprasternal notch and pus oozed out of it and it healed leaving a keloid like scar. He could not bear much noise; it would anger him and then he would shout very loud. Later on, he felt guilty for having shouted in anger. His teeth and throat were also sensitive to slightest change in temperature of water

(cold water) and in the mornings he would have a running nose after waking up. Chilly patient, good hunger, can eat more even if has just eaten a meal. He felt lonely and wanted somebody to make love. He enjoyed watching girls pass by on the street (Lustful). He would speak everything in double meaning, but shy at the same time when it comes to practically doing it. When inquired whether he felt anger, insulted or sad? He immediately replied that first he felt insulted and felt that his honour was wounded by both the girls and later on he felt sad thinking repeatedly 'How could they do this to me?'.

I referred Dr R.P Patel's corrected version of Kent's repertory for the following rubrics 1) Effects of honour wounded (Ign, Nux-v, Staph) 2) Lasciviousness

We have a choice between Ignatia & Staphysagria. Oversensitive to rudeness, easily excitable, highly emotional, worse from emotions, image consciousness with vexation and reserved displeasure, insomnia after grief, we find in both. But the expression of toothache as a result of constant grinding of teeth in anger, prominent masseter's and sensitive to cold water and always angry are guiding features of Staphysagria. Boger's synoptic key mentions under staphysagria pains that move into teeth, imagines insults. H.C Allen's keynotes says under Ignatia that it cannot bear tobacco smoking and under Staphysagria we find craving for tobacco. According to Boericke's Materia Medica in Ignatia we find painful haemorrhage after stool and stools are passed with difficulty, that is not the case with our patient. Staphysagria in Boericke cites the symptom; dwells on sexual matters.

Prescription given on 5th March 2023 **Staphysagria 1M**, 1 single dose.

Follow up after 3 days on 8th March 2023: Not a single drop of blood in stool nor a strip of blood over the stool ever since began the homoeopathic medicine. Besides this sleeping very deeply and waking up refreshed every morning. No longer short tempered and in angry mood. Much peace at work place.

Follow up on 15th March 2023: No relapse of sleeplessness nor bleeding during stool. Feels strong in the knees and resumed daily walks. No longer worried of sustaining injury to left knee. On two different occasions was able to bear unwarranted insults from two different colleagues but did not retaliate. Later on one of the colleague apologised to him and made peace, the other colleague he forgave without holding any grudge. Gets acidity if overeats and realises importance of exercise.

Discussion: This is a classic case where in an acute emotional imbalanced response(Anger=hate) was triggered in an individual in response to things done by others. The problem arose in the mind but the body is expressing the same pattern freely. Somatization occurs in staphysagria as a result of suppression of emotions & hidden anger especially revolving around relationships. Staphysagria has pronounced action on Nervous system with great sensitiveness to least impression, either mental or physical. Hering calls this as Morbid sensitivity as he is fixed on insults (Sycotic). Least word seems wrong, hurts

him very much, special senses become irritable, cannot tolerate noise, everything is painfully sensate.

Conclusion: Staphysagria helped to reduce his morbid sensitivity bringing back his sleep and peace of mind.

References: Repertory of the homoeopathic materia medica by Dr J.T Kent sixth American edition corrected, revised and improved by Dr Ramanlal P. Patel published by Dr R.P Patel's institute of homoeopathy, Vadodara, Gujarat.

Staphysagria- Background and Uses

Teste remarks that Staphysagria seeds were used in some countries for stupefying and catching fish causing numbness. This pungent plant was used earlier against lice. Therefore the name lice grains or lice pepper is not surprising but rather speaks of a psoric constitution favouring pests. . This plant appears erect and stately against a fence as well as modest and delicate in the bed of other flowers. Horticulturist highly recommend it for cultivation at the fence as it is extremely noticeable, towering above the surrounding plants. Rightly are they called "the garden Aristocrats". This majesty beauty of the plant is found in the patients also. The Staphysagria persons are elegant, often haughty, with a delicate sensitivity and are too dignified to show their true feelings, thereby suffering from reserved displeasure.

Staphysagria has a wide spectrum of usage both in chronic as well as acute cases. It is a valuable remedy for injuries, for example in cuts, lacerated tissue, perineum and very useful in stitching pains remaining in operative wounds after abdominal surgery. Staphysagria has a pronounced effect on the nervous system, with great sensitiveness to the least impression, either mental or physical, as is observed in cases as well. Hering says 'Morbidly sensitive, the least word seems wrong, hurts her very much; special senses become irritable, cannot tolerate; touch, odour, noise, and taste, everything is painfully sensate. Clarke says it produces long lasting vertigo, accompanied by continued nausea as in seasickness.

Staphysagria also affects the eyes; it has a great reputation for recurrent styes that leave indurations and for scurfy margins to the lids. Hering says it is useful in styes, nodosities, chalazae on eyelids, one after another sometimes ulcerating. It is useful in a stye which does not suppurate and break, but remains as a hard nodule. T.F Allen mentions that 'it is extremely valuable for the cure of tumours of the lids; chalazion; staetoma. Scrofulous opthalmia, styes in lids, edges inflamed and hard'. Thus the basic process of inflammation is followed by induration, indicates the sycotic miasm of the drug. Its action in case of post traumatic urethritis with recurrent urinary infections accompanied by constant urge to urinate has been really astonishing and eventually goes into sycotic or tubercular phase. Severe burning of urethra even when not urinating is a peculiar symptom of staphysagria(Nash). In women, coition is painful because the external parts are excessively sensitive. This property makes it a remedy of extreme value to women in the early days of

married life. They have fear of indulging in sex, they may have vaginismus in consequence with painful sex. After happening once, at a certain point in sex after foreplay they freak out, they lock up and cannot proceed because of fear. Staphysagria when taken increases the confidence level.

It is also one of the best for affections of the prostate gland in old men especially with piles, with frequent urination and dribbling of urine afterwards. One of the characteristic symptom mentioned by T.F Allen is "thin stool passes unconsciously, with sensation as if flatus would pass; several thin stools". The seeds are known to produce vomiting and salivation, and is a remedy for toothache; there are caries in which teeth crumble and grow black & brittle. Teeth which have been long decayed rapidly becomes hollow. This speaks of the syphilitic tendency. It is also of great value for bone troubles, exotoses and inflammation of the periosteum, helpful in chronic gout with nodosities. Staphysagria shows a strong reaction on the skin, and is indicated in skin diseases. They tend to develop scalp eczemas, eruptions due to fungus on the scalp (tinea capitis) right from birth. These eruptions can look very similar to Mercurius: With thick crusts and a lot of pus beneath. If you press these crusts with the hand, thick yellow pus will come out. If you remove the crusts raw skin appears. The scalp eczema stinks, burns and itches. The eczema extends on the scalp, face and ears. Symptoms are worse after washing. Not only eruptions on the head, but also other humid eruptions have a bad smell. Even the sweat smells foul.

Staphysagria is most used for eczemas and fungus in testicles and around the groin. The skin is scaly, fired, shows thick crusts and bleeds. The underwear is always blood smeared. The itching changes location when scratched. Staphysagria has crawling not only on the skin but also in other places of the body like hands and feet. Crawling gets along the whole image of this remedy. Staphysagria shows in most cases an extraordinary preoccupation with sexuality. Staphysagria displays already even in small children a higher interest in sexuality than normal. Entering school is a difficult phase. They don't want to go to school because of lack of interest in learning. They day dream and forget what he has read. They have separation fears from home (homesick). Make trouble by painting breasts and genitals on the walls of public toilets. They are afraid of being sent to a boarding school.

In puberty it becomes stronger however he withdraws, surfs lewd sites on the internet, purchases pornographic magazines. But he is too shy to come in contact with the opposite sex. His thoughts and dreams are not aimed at his career but mainly occupied with sexuality and tends to indulge in too much masturbation. He spends too much time in his room, will not take part in family life, refuses to talk about his behavior, and reacts mysteriously and aggressively if talked of. He is ashamed and has feelings of guilt and thinks he has done something bad. If he grows up in a surrounding where sex is considered taboo and is scolded when found flirting with a girl or when she told her parents that her interest in sexuality was abnormal, then they feel restricted to live up to their sexuality. The inner anger increases

and masturbation as well. Staphysagria is very prone to addiction, as adolescents they are likely to be "drop outs" due to memory loss in consequence to his habits and his inner anger also comes up, when he consumes tobacco, drugs or alcohol. This fixation and obsession about sexuality is found in both sexes. The display of sycosis is accompanied with loathing of life.

Appearance

General appearance marked by extreme nervous excitement; face wears an anxious expression; shuffling gait, hands tremble, cannot retain anything in their grasp, not even long enough to drink water without spilling it. Suited to patients who are pale, sunken with blue rings around them, worn out and exhausted as a result of sexual excesses and specially self abuse, hands. Nose is picked and pointed. The face looks younger than its years, with smooth skin and very fine wrinkles and a characteristic radiation of fine wrinkles from the corners of the eyes. Gums pale, spongy, bleeding when touched. Salivation. Canine hunger even when stomach is full. Sleepy all day; lies awake all night; body aches all over. Violent yawning and stretching, bringing tears to the eyes. Great tenderness and weakness all through the body. Desire for stimulants. Craving for tobacco, wine and brandy and begin smoking right from the age of seven. They are tall, and extremely thin, with bony angular faces, characteristic stoop of the shoulders and sharp bony noses. When walking they often keep both arms stiffly by their side, which looks very incongruous, since his gait is usually a languid lope. This 'Washed out' effect version of Staphysagria is generally a combination of sweet, wild and subdues types psychologically. While talking she swallows continually. Serious, silent, occupied with himself, he speaks but little. Phlegmatic, prostrated in mind and sad, but not weeping. Indisposed to serious work. Disposition can be quarrelsome at times. Basically they are shy of the opposite sex, moody depressed, prefers solitude with disposition to suicide. Scrofulous and gouty diathesis.

Mind

Staphysagria is sensitive to rudeness, emotional, shy and introverted. He is afraid of losing the control since they feel sexually excited easily. Suppression of emotions and hidden anger is the central idea. Like so many of us, staphysagria is the victim of her expectations and desires, especially those revolving around relationships. In the female, complaints are often due to enforced continence during absence of husband or from widowhood and staphysgria has been called as the WIDOW'S REMEDY. They feel easily insulted but seldom show their anger. Confrontation is too painful, and it hurts her pride, rather than openly expressing her anger as does Nux-Vomica she will resort to resignation and submissiveness because her indignation finds no natural outlet, Hence the fury is seen by way of enormous eruptions. She is too dignified to fight (delusions: of humility of others while she is great; suffering from pride, envy or chagrin) Once in a way he gets rough, shouts and scolds. Especially if he is married to a dominating woman. He defends himself seldom and mostly swallows his anger.

Staphysagria becomes ill from the conflicts around her (great indignation about things done by others or by himself; grieves about consequences). They are aggravated by mental exertion. He remains silent because he is afraid that his wife could leave him. After receiving Staphysagria they become daring to speak their opinion. Hahnemann in chronic diseases Volume I, p 120 explains that during the treatment of such a suppressed psychological state, a case of long-term suppression, possibly a situation requiring staphysagria, judicious adjustments of the dose(split method), might bring up well-hidden feelings of anger and sadness very rapidly, and the patient may claim to be "very sensitive" to anything in the environment: smells, toxic substances, etc. It is as if the reawakening of the senses that now have difficulty coping with the challenge. This reawakening of senses is following the direction of cure according to Hering. And we also see progression from numbness/paralysis, which is syphilitic by nature, to hypersensitivity, a psoric condition.

Trigger factors- ailments from denial of deserving position, grief, from disappointed love, from anger, from masturbation and from rudeness. A negative delusion gets created through horrific event like that of a patient who was raped as a child by her father. It is clear that they cannot come to terms with this incident and the shame it brought on her. These staphysagria emotions, if kept suppressed, must find an outlet on the physical plane as is evidenced in griping, twisting pain in abdomen, colic attacks after indignation, needle-like stitches in the extremities, especially in the muscles, headaches, chronic cough only in daytime, insomnia after grief, speechlessness, trembling, loss of hair, and much later on the emotional plane as we find in proving, throwing things at the person who offend. Also the delusion of grandeur generated by recurrent failures in finding the ideal partner, one she believes to be her sexual and spiritual equal.

Here we need to differentiate Natrum Mur from Staphysagria. Both have strict upbringing, a lot of arguments in the family, worse consolation and contradiction, insult, silent grief, dissatisfied, introverted, resentful, fear of losing and feel unwanted. Staphysagria has addictive behaviour which Natrum doesn't have. Staphysagria is chilly and thirstless whereas Natrum is hot and thirsty. Staphysagria is afraid of being left alone, about future, fears that something bad could happen, fear of his own shadow whereas Natrum Mur has fear of robbers. Both express angers differently; Staph can be either very abusive and threatening to kill not only themselves but also other close ones, wants to set things on fire or else he will remain silent due to exercising excessive controls. Staphysagria is more dependent type and thinks his wife will run away from him whereas in Natrum mur; who when so deeply hurt, will completely cut off his relationship silently "abaissement", withdraws into the room for every little thing and will brood on the sorrow and will have an inner ability to stand independently. The will, though governed by emotions, is strong and gives it a fair amount of rigidity and sustenance. Do not believe that Natrum mur is better than staphysagria in this respect because Natrum mur is more malicious with anger than

staphsagria. Staphysagria dislikes meditation whereas Natrum Mur becoming addicted to recalling disagreeable memories of the past and for the purpose of thinking of them and indulging in the grief it causes (rumination which is difficult to shake). One can call this "the cultivation of depression". Staphysagria has dry warts cauliflower like sycotic excrescenes behind the glans penis and glandular vegetations of vagina. Whereas Natrum mur has warts on palms of hands.

Staphysagria is a contradictory remedy as Ignatia. It is having annoyance like Colocynthis especially since both are very justice conscious (also Caust) and it is sensitive like Natrum mur.

Complementary remedies: Colocynthis and Causticum.

Antidote: Camphora

Miasmatic classification

Staphysagria is mainly PsoroSycoSphiliticTubercular. The following is a selection of staphysagria symptoms with its miasmatic classification.

Psoric

Sensitive and easily insulted

Post operative colics <eating and drinking

>Warm

Guilty after shouting in anger

High libido

Always yawning which relieves

Lot of appetite

Fear of losing something

Ailments from wounded honour and injured pride

Burning, Stinging pain <touch

Guilty feeling after masturbation

Sycotic

Demanding for sex and fixed on that

Suppressed anger

Guilt feeling and hangs in a state of shamelessness

Fixed on insults

Introvert

Breath and gums malodourous

Syphilitic

Addiction begins early in childhood

Abusive, calling bad names, throwing things, strongly enraged

Cadevorous sweat

Hopeless

Teeth already black and broken

Tubercular

Always swallows during speaking

Moody

Cracking the fingers

Demands sex although it doesn't do good

Strong appetite in spite of full stomach

Tired during day and wakeful during night

Strong night sweat

Empty feeling in stomach which doesn't get better after eating

Suicidal thoughts but fear of death

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Approach Of Homoeopathic Medicine In Acute Abdominal Pain

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What do you mean by the term Acute Abdominal Pain? A Lot of people get confused between a stomach pain which could be due to some gastric issues and the term acute abdominal pain. Acute abdomen refers to a sudden, severe abdominal pain and requires immediate diagnosis and cure. It is such a condition in which quick attention and treatment is needful. Abdominal pain is common and often miner. Abdominal pain is pain that occurs between the chest and pelvic regions.

Abdominal pain can be crampy, achy, dull and sharp or intermittent. Its also called a stomachache. Major organs located in the abdomen includes intestine, kidneys, appendix, spleen, stomach, gall bladder, liver and pancreas. Viral, bacterial or parasites infection that affects the stomach and intestine, may also cause significant abdominal pain. This type of pain can be described as localized, cramp like or colicky.

Localized pain is limited to one area of the abdomen. This type of pain is often caused by problem in a particular region. The most common cause of localized pain is stomach aches. Cramp like pain may be associated with diarrhea, constipation and bloating. In women, it can be associated with menstruation, miscarriage or complication in the female reproductive organ. This pain comes and goes and may completely subsides on its own without treatment.

Colicky pain is a symptom of more severe condition such as kidney stone. This pain across suddenly and make feel like as severe muscle spasms. Older adults and those who have HIV infection or who are taking immune suppressant may have less abdominal pain than younger or healthy adult with a similar disorder, and if the condition is severe, the pain may develop more gradually. Approximately 50% cases are admitted to general surgical unit urgently.

Abdominal pain has a large number of possible causes and so therefore a structured approach is compulsory. The treatment of pain is a collaborative effort. Causes can be divided in to six large categories including inflammatory, mechanical, nephrotic, vascular, congenital and traumatic. Who are in unstable condition have severe abdominal pain with concerning and abnormal vital sign such as fever, low blood pressure, increased heart beat and loss of consciousness.

Homoeopathic medicines are prescribed on the basis of individualization and symptom similarity by using holistic approach. On the basis of cause, sensation and modalities of the complains the appropriate medication is provided.

• Aconitum napellus: Hot, tense, enteritis. Sensitive to touch. Colic, no position relieves. Pains are intolerable, they drive him crazy; restless; at night. Abdominal symptoms are better after warm soup. Burning in the umbilical region.

• Aloe socotrina: Pulsating pain around navel, worse pressure. Cutting, gripping pain under the right ribs or in the right hypochondrium, right lower portion of the abdomen; excruciating before and during stool; all pain ceases after stool, leaving profuse sweating and extreme weakness; copious flatus.

• Belladonna: Distended, hot. Transverse colon protrudes like a pad. Tender, swollen. Pain as if clutched by a hand; worse jar, pressure. Cutting pain across; stitches on the left side of abdomen, when coughing, sneezing or touching it. Extreme sensitiveness to touch.

• Mag phos: Enteralgia, relived by pressure. Flatulent colic, forcing the patient to bend double; relieved by rubbing, warmth, pressure; accompanied with belching of gas, which gives no relief. Bloated abdomen, must loosen clothing, walk about and constantly pass flatus.

• Nux vomica: Flatulent distention with spasmodic colic. Colic from uncovering. Liver engorged, with stitches and soreness. Colic with upward pressure, causing short breath. Strangulated hernia.

• Plumbum metallicum: Excessive colic, radiating to all parts of body. Abdominal wall feels drawn by a string to the spine. Intussusceptions; strangulated hernia. Abdomen retracted, obstructed flatus with intense colic. Colic alternates with delirium and pain in atrophic limbs.

Polygonum punctatum: Griping pain, with great rumbling, nausea and liquid faeces. Flatulent colic.

• Dioscorea villlosa: Feeble digestive powers. Violent twisting colic, in paroxysms, as if intestines were grasped by powerful hand. Colic pains <from bending forward and while lying >on standing erect or bending backwards.

• Dulcamara: Colic from cold. Acts prominently on umbilical region. Cutting pain around the navel. Swelling of the inguinal gland.

Chamomilla: Flatulent colic, after anger with red cheeks and hot perspiration. Hepatic colic, acute duodenitis.

• Colchicum autumnale: Ascites. Borborygmi. Pain over liver region. Caecum and ascending colon distended. Autumnal dysentery; white mucus

Lycopodium: Hepatitis, atrophic form nutmeg liver. Pain shooting across the lower abdomen, from right to left. Abdomen bloated, constant sense of fermanetation, like yeast.

Mag phos: Enteralgia, relived by pressure. Flatulent colic, forcing the patient to bend double; relieved by rubbing, warmth, pressure; accompanied with belching of gas, which gives no relief. Bloated abdomen, must loosen clothing, walk about and constantly pass flatus.

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"TO STUDY THE IMPORTANCE OF CAUSATION IN HOMOEOPATHIC PRESRIPTION WITH SPECIAL EMPHASIS ON PLANT KINGDOM."

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Abstract:
Homoeopathy gives great importance to causation. Causation is one of the elements of symptoms, which when strong and genuine, is of much benefit in the remedial diagnosis, and so far we have come across several successful cures made by remedies selected on this basis.

In the field of medicine, the word "Cause" has been used since ages. Physicians knew that there can not be diseases without a cause. Homoeopathy goes further and propagates that there is a cause in the dynamic level that comes to activity much before the invasion of microbes. This dynamic cause should be removed to cure a patient. As per the concept of homoeopathy, the cause behind every disease is derangement of the vital force by the dynamic noxious influences called miasms. This is the real cause that flows in to effect in the form of sickness. Hence, tolle causam can be related with both orthodox medicine and homoeopathy, but for the former it is about removing the material cause and for the latter it is the removal of a dynamic cause.

Another expression of cause in homoeopathy is causation, which are the factors responsible for a symptom produced in an individual patient. We know that causation, location, sensation, modalities, and concomitants are the components of a symptom. It is not mandatory to have all these components in a given symptom. The causations and modalities mentioned in the materia medica and also in the repertories are the exciting causes that can result in the production of symptoms in a sensitive or susceptible individual. Our body is sensitive to the external world and reacts to any stimuli on the basis of individual sensitivity and susceptibility developed as a result of the miasmatic background. Some external influences can activate the latent psora and the signs and symptoms are manifested externally. Here, the indicated medicine similar to the signs and symptoms of the patient can be given to achieve a cure.

KEYWORDS
Homoeopathy, causations, symptoms, complementary medicines, alternative medicines, constitutional

Medicines and there causes:

Abies Nigra:

It is useful in indigestion in those persons, who abuse tea drinking, tobacco Smoking or tobacco chewing.

Actea Spicata:

Aliments from change from change of weather and temperature, slight exertion worse from cold air, night, touch, and from fatigue and mental exertion.

Abrotanum:

Rheumatism from suddenly checked diarrhea or other secretion

Aconitum Napellus:

Complaints from exposure to dry cold air, dry north or west winds, getting Chilled, when perspiring, Suppressed sweat, from fright specially amenorrhea,
Anger, shock, etc. Cough from dry cold wind and draught of air.

Actea Racemosa:

Aliments from mental strain, anxiety, fright, disappointed love, exertion and child bearing, mania and from disappearance of neuralgia. Menses delayed or suppressed by mental emotion, from cold or from fever. Rheumatism from using arm in sewing, typewriting, piano playing

Aethusa Cynapium:

Complaints during dentition or hot summer weather, after milk, mental retardation

Agaricus Muscarius:

Blood poisoning fright, frostbite, mental exertion or excitement overexertion Alcoholism and sexual excess.Chilblain after exposure to cold, epilepsy from suppressed eruptions.

Agnus Castus:

Bad effect of suppressed gonorrhoea, complaints from onanism

Allium Cepa:

Catarrhal discharge from north –eastern winds, getting wet.Colic from by getting feet wet, over exertion from cucumber, and salads.Neuralgia of stump after amputation, phlebitis after forceps delivery

Aloe Socotrina:

Aliments dye to fast food and packed food.Constipation from artificial food bottled food and pregnancy. Sedentary habits and poor diet.

Apocynum cannabium:

Dropsy after typhus, typhoid, scarlatina or cirrhosis after abuse of quinine, Cough during pregnancy.

Arnica Montana:

Bad effect of mechanical injury, over exertion, retention or incontinence of Urine after labour. Aliments from spiritual liquors or charcoal vapours.

Abies Canadensis:

Uterine displacement due to defective nutrition and debility. Aliments due to excessive loading of stomach

Abroma Agusta:

White ulcer at mouth of prepuce caused by excessive passage of sugar in the urine. Weakness of heart worse on movement. Aliments of skin, in summer.

Actea Spicata:

Aliments from change of Weather. Complaints after slight exertion. Hypersensitive to cold. Joints swell,cannot touch or move.Tingling sensation specially in old age.

Aesculus Hippocastanum:

Aliments in morning and after stool. Complaints on walking ,lying, and stooping. Aliments after passing urine.

Ailanthus Glandulosa:

Worse after suppressions.Faint on rising up, or vertigo aggravated after lying down.
Aliments after sight of food.

Allium Sativum:

Least change in diet causes trouble.Aliments due to cold air and during menses.

Alstonia scholaris:

Complaints after exhausting diseases. Diarrhea immediately after eating

Anacadrium orientale:

Complaints worse after mental exertion. Aliments due to emotions like, anger, fright, care etc. Stepping hard, Motion.Aliments from draft, open air, cold etc. Dyspepsia long after eating.

Andrographis paniculata:

Worse during fever. Fever comes at 11am and then again at 7-8 pm. Aliments due to worms.

Artermisia vugaris:

Epilepsy after fright and other violent emotions; after masturbation. Aliments during menses

Arum Triphyllum:

Headache from too warm clothing. Worse due to overuse of voice. Aliments from talking and singing.

Asafoetida:

Worse at night ,during rest, from warm application. Suppressed skin symptoms produce nervous disorder. Orbital neuralgia worse at night. Bad effects of Mercury

Asarum europaeum:

Nausea worse after eatinngEyes feel stiff, burn worse in sunlight. Aliments in dry cold weather and emotion

Avena sativa:

Aliments due to defective nutrition. Morphine causes nervous exhaustion. Post diphtheritic paralysis.

Belladonna:

Aliments from draft of cold air and haircut. Convulsion during dentition. Sunstroke

Berberis vulgaris:

Rheumatic and gouty complaint due to disease of urinary organs.Chest complaints and cough after operation for fistula.Aliments from jarring, stepping hard, rising from sitting , fatigue ,urinating, twilight.

Bryonia alba:

Aliments from chagrin, mortification and anger.Complaints when warm weather sets in after cold days, from cold drinks and ice in hot weather. After taking cold or getting hot in summer, from chilling when overheated and from exposure to draft of cold wind.Aliments from suppressed discharges, menses, milk or eruption of acute exanthema. Diarrhoea during spell of hot weather, from cold drinks when over heated and from fruit or sauerkraut.

Bellis Perennis:

Ill effect of cold drinks, when overheated. Affections due to cold wind, blows, fall, Injury, accidents, childbirth.Exposure to wet or getting chilled when overheated. Overwork, overexertion,surgical operation.

Bovista:

Aliments due to inhalation of charcoal fumes. Worse from menses, hot weather.

Aliments from getting warm, cold food, wine, coffee, and full moon .Easily intoxicated.

Baptisia tinctoria:

Fever with chill around 11am. Worse humid, heat, fog, indoor.Dyspnoea from weakness in chest.

Capsicum annum:

Worse uncovering, open air, cold water and slight drafts. Shivering after drinking. Burning constriction worse between acts of deglutination.Bursting headache worse coughing.

Cardus marinus:

Worse lying on left sideProfuse diarrhea due to rectal cancer Aliments from beer, eating, touch and motion.

Caulophyllum thalictroides:

Aliments during pregnancy.Aliments due to suppressed menses. Complaints worse in open air.

Ceonathus americanus:

Aliments due to cold weather.Unable to lie on left side.

Cicuta virosa:

Aliment after injury to brain.Aliments due to jar, noise and touch. Jerking tearing in coccyx, especially during menses. Worse during dentition and after suppressed eruption.

Conium maculatum:

Aliment after seeing moving objects.Aliments after exertion, rising arms, injury and sexual excess.Worse lying down, turning or rising in bed.

Convallaria majalis:

Worse in warm room.Palpitation from least exertion. Aliments due to heart diseases.

Crocus sativa:

Worse, lying down, hot weather, warm room. Aliments in morning, before breakfast.
Aliments during puberty and pregnancy.

Croton tiglium:

Worse least food or drink.Cough as soon as he touches the pillow, must get up.
Aliments after washing and during summer weather.

Cactus Grandiflorus:

Aliments from climacteric, headache and neuralgia. Ill effects of sun, dampness, disappointment in love, grief.

Calendula officinalis:

Traumatic affectionsPost - operative complaints. Traumatic neuroma. Neuritis from lacerated wounds.

Cannabis sativa:

Aliments from exercise, exertion, talking, walking, lying down, going upstairs. Aggravated by touch, open air heat.Worse at night after midnight and after a meal, from coffee, liquor, tobacco.

Caulophyllum thalictroides:

Aliments during pregnancy, parturition and lactation. Haemorrhage after hasty labour. Haemorrhage after want of tonicity. Haemorrhage after abortion. Uterine debility causes habitual abortion.

Chamomilla:

Complaints from anger, especially chill and fever. Toothache from coffee, during menses or pregnancy.Diarrhoea from cold, diarrhoea from anger.Diarrhoea from chagrin. Diarrhoea during dentition. Diarrhoea sfrom abuse of tobacco. Convulsion of children from feeding by mother after a fit of anger. Ailments from abuse of opium or morphine.

Chelidonium majus:

Ailments due to change of weather. Ailments from liver or lung disease.Malignant ulcers.
Convulsions due to worms, during dentition and during puerperium.Chronic effects from concusion of brain and spine. Tetanus from getting splinters into flesh. Ailments from suppression of eruptions, brain diseases.

Cina:

Ailments due to worms, especially ascarides. Bad effects of pertussius.Complaints after exposure to cold.

Cinchona officinalis:

Broken down from exhausting diseases.Ailments from loss of vital fluids such as haemorrhage, excessive lactation, diarrhoea, suppuration etc. Ailments from malaria. Dropsy after acute diseases.Headache after sexual excess or haemorrhage.Bad effects after abuse of tea or chamomilla tea.

Coca:

Ailments from mental and physical strain of a busy life. Bad effects of mountain climbing or ballooning. Bad effect due to abuse of stimulants, alcohol and tobacco.

Cocculus indicus:

Ailments from riding in a carriage, boat, rail or car. Ailments of drunkards.Bad effects of loss of sleep. Bad effects from mental excitement, night watching, anger and grief.

Coffea cruda:

Ailments from sudden emotion and pleasurable surprises. Ailments from weeping.

Colchicum autumnale:

Ailments from grief and misdeeds of others. Bad effects of night watching. Complains from smell of cooking food.

Collinsonia canadensis:

Haemorrhoids in later months of pregnancy.

Colocynthis:

Ailments from chagrin, anger with indignation. Complaints after diarrhoea and suppression of menses.

Cyclamen europoeum:

Ailments from suppressed grief. Ailments from terrors of conscience. Ailments from duty not done.Ailments from bad act committed.

Digitalis purpurea:

Complaints due to menopause.After effects of scarlet fever—dropsy.

Dioscorea vilosa:

Bad effects from abuse of tea, especially flatulence.

Drosera ratundifolia:

Cough after measles. Laryngeal phthisis after whooping cough.

Dulcamara:

Catarrhal rheumatism or skin affections due to exposure to cold, damp rainy Weather. Ailments from sudden change in hot wather. Anasarca after malaria, rheumatism or scarlet fever.

Dropsy after suppressed sweat or eruptions or exposure cold.Diarrhoea from change of warm to cold weather.

Bad effects of abuse of mercury.

Echinacea augustifolia:

Aliments after operation and injury.

Equisetum hyemale:

Worse at close of urination.Worse on right side, movement, pressure, touch and sitting down.

Eucalyptus globules:

Aliments due to slow digestion.Worse periodically.

Eupatorium Perfoliatum:

Cough after measles or suppressed intermittents.

Euphrasia officinalis:

Bad effects from fall, contusions or mechanical injuries of external parts.Coryza from warm, south wind.Dropsy after loss of vital fluids.Dropsy after abuse of quinine.Dropsy after suppressed intermittents.

Gymnema sylvestre:

Aliments due to long standing diabetes mellitus.Worse coitus

Geranium maculatum:

Aliments after profuse hemorrhages, pulmonary and from different organs.

Gossypium herbacium:

Nausea with inclination to vomit before breakfast.Worse motion

Gratiola officinalis:

Worse drinking too much water.Vertigo during and after meals.Aliments during summer, motion and after drinking coffee.

Gelsemium sempervirens:

Nervous affections due to onanism in both sexes.Bad effects of fright, fear, exciting news and sudden emotions. Diarrhoea from anticipation. Change of weather.General depression from heat of summer or sun.

Hamamelis Virginia:

Incised, lacerated or contused injuries from fall. Chronic effects of mechanical injuries.Traumatic conjunctivitis.Uterine hemorrhage from riding rough roads. Bad effects from loss of blood.

Helleborus niger:

Melancholy in girls at puberty, after typhoid, when menses fails to return after appearing. Paralysis after meningitis.After effects of scarlet fever or tuberculosis hydrocephalus.

Diarrhea during dentition.

Hydrastis Canadensis:

Bad effects from abuse of alcohol-derangement of gastric and hepatic functions. Bad effects of mercury or potassium chloride.After effects of Syphilis.

Hyoscyamus niger:

Convulsions of children from fright or worm trouble. Convulsions in children after an attack of measles.Bad effects of unfortunate love—often causes epilepsy. Intense sleeplessness of irritable, excitable persons from business embarrassment.Paralysis of bladder after labour.

Hypericum Perforatum:

Bad effects of mechanical injuries of spinal cord, and spinal concussion.Pain after a fall on coccyx.Injuries from needles, splinters and rat bites.Nervous depression due to wounds or surgical operations.Bad effects of shock. Bad effects of fright.Bad effects of mesmerism. Headache after a fall on occiput.Convulsions after blows on head or concussion.

Hydrocotyle asiatica:

Aliments after ulceration of womb.Difficult in maintaining the upright position.

Hyoscyamus niger:

Worse after emotions like fright and jealousy.Worse, at night during menses after eating when lying down.Aliments due to touch and during sleep.

Ignatia amara:

Spasmodic laughter from grief.Bad effects of long continued grief — mental and physical exhaustion.After effects of anger or disappointed Iove.Complaints mainly convulsions in sleep-in children when reprimanded or scolded. III effects from bad news.III effects from vexation with reserved displeasure. III effects from suppressed mental sufferings.III effects of shame and mortification.Bad effects of tobacco and smoking.Constipation from carriage riding or due to habitual coffee drinking.Proplapse ani from over-lifting.

Ipecacuanha:

Nausea from tobacco.Nausea of pregnancy.

Kalmia latifolia:

Aliments from, lying on left side, bending forward and looking down.Worse in sun heat.

Aliments in cold weather

Ledum Palustre:

Abuse of alcohol causing gouty and rheumatic complaints. After effect of iredectomy—haemorrhage into the anterior chamber.Punctured wounds from sharp pointed instruments as awls or nails.Bad effects of rat bites, stings of insects, especially mosquitos. Long remaining discolouration agter injury.

Lobelia Inflata:

Headache with nausea and vomiting and prostration from tobacco.Abuse of tea or tobacco causes faintness, weakness and an indescribable feeling in epigastrium.

Lycopodium clavatum:

Ailments of drunkards. Ailments from anger.Ailments from fright.Ailments from chagrin, mortification.Ailments from vexation with reserved displeasure.Ailments from mental exertion. Ailments from over-lifting. Ailments from over-eating. Ailments from sexual excesses. Ailments from abuse of alcoholic drinks.Ailments from deep-seated progressive chronic diseases.Constipation since puberty.Constipation since last confinement.Constipation when away from home.

Complaints after maltreated pneumonia.Bad effects of onion, bread, wine, tobacco smoking and chewing.

Lathyrus sativus :

Aliments after influenza and exhaustive diseases.Aliments after lathyrus poisoning.

Lilium tigrinum:

Worse due to warmth of room.Aliments after motion, walking and standing.Worse consolation.

Lycopus virginicus:

Aliments due to excitement and exertion.Aliments started after become abuse to heart remedies.Worse after thinking about complaints.Aliments after heat and lying on right side.

Melilotus officinalis:

Worse rainy and changeable weather.Approach of storm Motion and 4 pm

Mezerium:

After effects of vaccination, eczema and itching eruptions. Headache after slight vexation.Headache on slightest touch.Nuralgic pains after zona.Ailments from abuse of mercury—bone affections.

Millefolium:

Ailments from over-lifting, over exertion or a fall. Profuse hemorrhage from wounds, especially after fall. Haemoptysis after injury.Haemoptysis in haemorrhoidal patients.Haemoptysis from rupture of blood vessel.Painless bleeding after miscarriage.

Painless bleeding after great excertion.Painless bleeding after abortion.Cough after suppressed menses.Cough after suppressed haemorrhoids.Cough after a fall from height.

Cough after violent exertion.

Nux Moschata:

Complaints of pregnancy.Diarrhoea in summer.Diarrhoea from cold drinks.Diarrhoea in autumn.Diarrhoea from boiled milk.Diarrhoea during dentition.Diarrhoea during pregnancy.Eating a little too much causes headache, nausea and vomiting from wearing pessaries. Cough from over-heating.

Nux Vomica:

Ailments from want of exercise-sedentary habits. Modern life style.Aliments from taking tobacco, coffee and alcohol.Irregular diet and over-eating. Long continued mental exertion and loss of sleep. Sedentary habit and sexual excess.

Opium:

Ailments from fright.Ailments from charcoal vapors'.Ailments from inhaling gas.Ailments of drunkards.Spasm of children from seeing strangers, from nursing after fright of mother and from crying. Involuntary stool after fright.Involuntary stool from paralysis of sphincter.Retention of urine after labour.Retention of urine from excessive use of tobacco.Retention of urine in nursing children.Persistent diarrhoea after abuse of drugs. Paralysis of brain or convulsion from suppression of acute exanthemata.

Ocimum sanctum:

Aliments after remittent fever.Toothache , worse at night, on touch and from cold.Aliments due to lack of concentration.

Plantago major:

Periodical prosopalgia, worse 7 am to 2 pm.

Podophyllum peltatum:

Ailments from over-lifting or straining-prolapse of uterus.Ailments from prolapse of uterus.Ailments from abuse of mercury.

Phytolacca decandra:

Rheumatism and neuralgia after diphtheria, gonorrhoea, and syphilis and from abuse of mercury.Parotid and submaxillary glands indurated after diphtheria or scarlet fever.

Pulsatilla nigricans:

Ailments from puberty, have never been well since that time Ailments from grief, anger, fright.Ailments from overstudy.Ailments from eating rich food, fat food, cake, pastry, sausage, ice cream etc. Ailments from deranged stomach.Ailments from heat of the sun.

Ailments from loss of vital fluids.Ailments from sexual excesses.Ailments from suppression of menses.Ailments from abuse of tobacco, quinine, iron, mercury, tonics, sulphur etc.Ailments from after measles.Ailments during pregnancy and lactation.Ailments from getting wet.Diarrhoea from fruits, cold food or drinks, ice cream etc. Suppression of menses from getting feet wet.Styes from eating fat, greasy or rich food or pork.

Ratanhia:

Ailments of early months of pregnancy—toothache.

Rananculus Bulbosus:

Bad effects of alcoholic beverages—spasmodic hiccough, delerium tremens.Ailments from sedentary habit.Ailments from needle work, typewriting, piano playing etc.Ailments from atmospheric changes.Ailments from sudden exposure to cold while overheated or mice-versa, pleurisy or pneumonia.Intercostal rheumatism from wet stormy weather.

Intercostal neuralgia after herpis zoaster.

Rheum:

Ailments from dentition.Ailments from abuse of magnesia.

Rhododendron:

Ailments from thunder-storm, especially electrical storm in nervous persons.Toothache in spring.Toothache from change of weather.Toothache from thunder-storm.Toothache from windy weather.Rheumatic pain in limbs from wet, cold, windy weather. Induration and swelling of the testicle after gonorrhoea or rheumatic complaints.

Rhus Toxicodendron:

Ailments from getting wet, especially after being overheated. Ailments from exposure to cold and dampness lying on damp –ground.Ailments from over-exertion.Ailments from trauma.Ailments from spraining or straining a single part, muscle or tendon.Ailments from overlifting, particularly from stretching high up to reach things.Ailments from too much summer bathings in lake or river. Headache from beer, from least chagrin.Paralysis from getting wet on lying on damp ground.Paralysis from overexertion.Paralysis from parturition.Paralysis from sexual excesses.Paralysis after malaria or typhoid.

Rumex Crispus:

Ailments from exposure to cold, mainly hoarseness.

Ruta Graveolens:

Ailments from mechanical injuries of bones and periosteum. Ailments from sprains, fractures and dislocations.Lameness after sprains.Phthisis after mechanical injuries to chest.Aching in and over eyes, blurred vision after using eyes at fine work, watch-making, engraving or looking intently.Amblyopia or Asthenopia from overexertion of eyes, overuse in bad light, fine, sewing and over-reading at night.Constipation from inactivity or impaction following mechanical injuries.

Rhus venenata:

Profuse watery stool at 4 am.Aliments from heat of bed.

Robinia pseudacacia:

Headache due to gastric complaints.Aliments due to hyperchlorhydria.

Salix nigra:

Aliments due to excessive sexual desire.Marked nervous disturbances before and during menses.

Senega:

Worse walking in open air and during rest.Aliments from pressure and touchCough aggravated after lying on right side.

Sabina:

Ailments from abortion or premature labour.Retained placenta from atony of uterus.Menorrhagia during climacteric in women who formerly aborted.Inflammation of ovaries or uterus after abortion or premature labour.

Sabadilla:

Ailments from worms—nervous diseases, twitching,convulsive, tremblings, catalepsy etc.Headache from too much thinking.Headache from too close application or attention.

Headache from worms.

Sambucus Nigra:

Ailments from violent mental emotions, anxiety or grief.Ailments from excessive sexual indulgence.Ailments from abuse of arsenicum.Ailments from fright.

Sanguinaria:

Ailments during menopause—headache, flushes of heat, leucorrhoea, burning of palms and soles etc.

Secale Cornutum:

Ailments from lifting—miscarriage.Ailments from injury—gangrene.Ailments from sexual excess.Ailments during pregnancy and after delivery.Ailments during menopause.

Ailments from suppression of menses, lochia, milk or sweet.

Staphisagria:

Mental effects from onanism and sexual excesses.Memory weak, indifferent, apathetic from sexual abuse. Ailments from fright, envy or chagrin. Indignation.Trembling and exhaustion and getting sick from being insulted.Effects of mechanical injuries from sharp cutting instruments and surgical operations. Colic after lithotomy or cophrectomy.Frequent urination after difficult coition and labour.Cough after tobacco smoke.Fig warts after abuse of mercury.

Stramonium:

Mental symptoms, especially loquaeiouseness from suppressed menses.pupils dialate when child reprimanded.Vontiting from seeing a bright light.Convulsions from sight or bright light, mirror or water.Metrordagia and delirium from retail placenta.
Fear and fright from darkness.

Symphytum:

Ailments from mechanical injuries, blows, bruises, thrusts on the globe of the eye. Pain in eye after blow of an obtuse body, snow-ball strikes eye, infant thrusts its fist into the mother's eye.Pinching pain and soreness of periosteum after an injury. Bad effects from abuse of arsenic and many modern drugs.

Tabacum:

Ailments from cerebral irritation.Amaurosis from atrophy of retina or optic nerve.Ailments from travelling in ship-deathly nausea, pallor, coldness etc.Diarrhoea from excessive smoking.Palpitation from lying on left side.Ailments from abuse of tobacco.

Thuja Occidentalis:

Ailments from badly treated or suppressed gonorrhea. Ailments from abuse of tea, coffee, fats, tobacco, onions, sweets, sulphur and mercury. Ailments from vaccination.
Ailments from walking or riding. Headache from sexual excesses, over-heating and from tea.

Terminalia arjuna:

Aliments after heart disease both organic and functional.

Urtica urens:

Worse from cool moist air and bathing. Aliments from snow air and touch.

Veratrum album:

Cholera after fright. Aliments during pregnancy. Diarrhea with cramps and prostration after fright. Ailments from abuse of opium, alcohol and tobacco.
Pain in limbs in wet weather.

Veratrum Viride:

Headache, nausea and vomiting from suppressed menses. Ailments from exposure to sun heat, especially sunstroke.

Valeriana officinalis:

Aliments due to hysteria and over sensitiveness.Otalgia from exposure to draught and cold

Verbascum Thapsus:

Aliment from change of temperature. Aliment from talking sneezing and biting hard.
Worse at 9 am to 4 pm.

Viburnum opulus:

Aliments after lying on affected side. Worse in a warm room, evening and night.

Vinca minor:

Weakness due to excessive menstruation.Hemorrhage from fibroids.

Viscum album:

Worse in cold stormy weather. Aliments after movement and lying on left side.
Worse become chill while hot.

Xerophyllum :

Worse, application of cold water. Aliments in afternoon and evening.

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"EFFICACY OF CONSTITUTIONAL REMEDIES IN MANAGMENT OF DIABETES MELLITUS TYPE 2"

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INTRODUCTION: -
"Diabetes mellitus is a clinical syndrome characterized by hyperglycemia due to deficiency ordiminished effectiveness of insulin "Efficacy of Constitutional Remedies in Management of DMT2

KEYWORDS
Homoeopathy, Diabetes mellitus, constitution, insulin, diabetes type 2.

CONSTITUTION: -
According to Stuart close: - "Constitution is that aggregate of hereditary characters, influenced more or less by environment, which determines the individual's reaction, successful or unsuccessful, to the stressof environment"
Type of constitutional: -

1. Scrofulous constitution
2. Hydrogenoid constitution
3. Leucophlegmatic constitution

NEED OF STUDY

Diabetes mellitus is a syndrome – ubiquitous and dynamic. WHO predicts that India will have largest number of diabetics, around 80.9 million, by 2030. Research finding in conventional medicine put toward the limitations & side effects of hypoglycemic agents, insulin therapy, zinc, overdose also side effects of sweeteners.

In view of the alarming rise of diabetes, the holistic therapy of homoeopathy is very beneficial for the sake of ailing humanity. Homoeopathic literature is full of information regarding the management of Diabetes. The number of medicines as well as clinical experiences regarding Diabetes Mellitus are increasing day by day hence to accommodate all these growing information a well selected repertory is needed. There are so many repertories available in the field of Homoeopathy and now a days the practitioners are using them in finding out the similimum according to the symptoms presented by the diabetic patients. Still a need is felt among practitioners to find out the more useful repertory in cases of diabetes mellitus to deal with patient's complaints. Among the various repertories, Homeopathic Medical Repertory by Robin Murphy, contains information from all the existing repertories & correction from various sources.

Thus, this repertory must contain all the rubrics related to symptomatic complaints appear in a patient suffering with diabetes mellitus. This work is not intended to be one more addition to the rich and varied homoeopathic literature, but to reiterate the value and importance of Homeopathic Medical Repertory.

AIMS:

- Evaluate the effectiveness of constitutional remedies for treatment of DMT2

OBJECTIVE:

- To understand the role of constitutional remedies in treatment of DM Type 2
- To understand the which potency is more effective in treatment of DM Type 2.
- To prevent the complication and recurrence and provide the cure in rapid and gentle way.

REVIEW OF LITERATURE:

Diabetes Mellitus is probably one of the oldest diseases known to man. It was first reported in Egyptian manuscript about 3000 years ago. In 1936 the distinction between type-1 and type-2 DM was clearly madetype-2 DM was first described as a component of metabolic syndrome in 1988. Type-2 DM is the most common form of DM characterized by hyperglycemia insulin resistance and relative insulin deficiency DMT2 results from interaction between genetic environmental and behavioral risk factor. It is estimated that 366 million people had DM in 2011 by 2030 this would have risen to 552 million the number of people with DMT2 is increasing in every country with 80% of people with DM living in low- and middle-income countries DM caused 4.6 million people would have DMT2 by the year 2030.Literature search has shown that there are few data available on the prevalence of DMT2 in Africa asa whole. The majority of the DM burden in Africa appears to be DMT2, with less than 10% of DM cases being DMT2.In 2011 center for disease control and prevention report estimates that DM affects about 25.8 million people in the US in 2010 with 90 to 95% of them being DMT2.As a result of this trend, it is fast becoming an epidemic in some countries of the world with the number of people affected expected to double in the next decade due to increase in ageing population thereby adding to the already existing burden for healthcare providers, especially in poorly developed countries. This review is based on a search of midline, the Cochrane database of systemic reviews, and citation lists of relevant publication. Type 2 diabetes occur mostly in people aged over 40years. However, an increasing number of younger people, even children, are being diagnosed with type 2 diabetes. The first-line treatment is diet, weight control and physical activity. If the blood sugar(glucose) level remains high despite these measures then tablets to reduce the blood glucose level are usually advised. Insulin injection is needed in some cases. Other treatment includes reducing blood pressure if it is high, lowering high cholesterol levels and also using other measure to reduce the risks of complications. Type 2 diabetes tends to develop gradually (over weeks or months). This is because intype 2 diabetes you still make insulin (unlike in type 1 diabetes). However, you develop diabetes because

1) You do not make enough insulin for your body's needs;

2) The cell in your body do not use insulin properly. This is called insulin resistance. The cell in your body become resistant to normal levels of insulin. This means that you need more insulin than you normally make to keep the blood sugar (glucose) level down.

SIGNS AND SYMPTOMS

Signs and symptoms of type 2 diabetes often develop slowly. In fact, you can have type 2 diabetes for yeand not know it. Look for:

- Increased thirst, Frequent urination, Increased hunger, Unintended weight loss, Fatigue, Blurred vision, Slow-healing sores, Frequent infections, Areas of darkened skin, usually in the armpits and neck.

HOW INSULIN WORKS

Insulin is a hormone that comes from the gland situated behind and below the stomach (pancreas).

- The pancreas secretes insulin into the bloodstream.
- The insulin circulates, enabling sugar to enter your cells.
- Insulin lowers the amount of sugar in your bloodstream.
- As your blood sugar level drops, so does the secretion of insulin from your pancreas.

THE ROLE OF GLUCOSE

- Glucose comes from two major sources: food and your liver.
- Sugar is absorbed into the bloodstream, where it enters cells with the help of insulin.
- Your liver stores and makes glucose.
- When your glucose levels are low, such as when you haven't eaten in a while, the liver breaks downstored glycogen into glucose to keep your glucose level within a normal range.

RISK FACTORS

Factors that may increase your risk of type 2 diabetes include:

- **Weight, Fat distribution, Inactivity, Family history, Race, Age, Prediabetes, Gestational diabetes, polycystic ovarian syndrome.**

COMPLICATIONS.

Although long-term complications of diabetes develop gradually, they can eventually be disabling or even life-threatening. Some of the potential complications of diabetes include:

- **Heart and blood vessel disease, Nerve damage (neuropathy), Kidney damage, Eye damage, Diabetes increase sleep, Slow healing, Hearing impairment, Skin conditions, Sleep apnea, Alzheimer's disease.**

HAHNEMANN AND CONSTITUTION-

Dr Hahnemann gives as a fair idea on the importance of the constitution in aphorism 5 of the organon of medicine, wherein he states "useful to the physician in assisting him to cure are the particulars of the most probable exciting cause of the acute diseases, as also the most significant points in the whole history of the chronic disease,to enable him to discover its fundamental cause, which is generally due to chronic Miasm. In these investigations, the ascertainable **physical constitution** of the patients (and intellectual character, his occupation, mode of living and habits, his social and domestic relations, his age, sexual function etc., are tobe taken into consideration. Thereafter, at least at 20 places he mentions about the constitution in different context. He mainly refers constitution to the inherent nature of the individual. Hahnemann usedthe word Beschaffenheit in German, which usually translated as constitution in relationship to the Latin root "constitution" in homoeopathic works. Chamber Dictionary defines constitution as the natural condition of the body or mind; disposition.

HOMOEOPATHY AND DIABETES

Diabetes is a disease, the origin and the cause of which has little known and hidden in obscurity, has naturally taxed the energies of medical profession in all ages. Hence there is a vast array or various medicines which have been prescribed for this compliant. Historically diabetes been treated with great number of specifics proposed for its treatment and it is not surprising. The reason for this being the irremediable character of the disease[25].

CONSTITUTION AND DIABETES

Constitutional approach means where the mind, physical make up, general behavior, along with particulars of the disease will be considered in the totality. There is a long running debate aboutthe consideration of mind for prescribing by homoeopaths. And one more important thing is which aspect is to be given importance or the whole, for this master Hahnemann has explained in his organon of medicine in aphorism number 211 which reads, "This holds good to such an extent, that the state of the disposition of the patient chiefly demandsthe selection of the homoeopathic remedy[27]".

Remedy which covers the mental state and the general symptoms of the patient has a greater possibility of curing than the one that covers the particulars[27].

Diabetes is a constitutional disorder and it is an off shoot of constitutional defects (genetic factors and altered immunity) having an impact on the entire constitution of an individual. Hence it calls for an in-depth constitutional approach for its cure. Homoeopathy is based on theprinciples that disease is a total application of body. Moreover, homoeopathy recognizes importance of underlying causes such as genetic and inherited factors as the root of any ailmentof the body. Homoeopathic constitutional medicine prescribed in such conditions covers those criteria and so it is very crucial in management of deep rooted diseases[25].Concept of disease in homoeopathy is that disease is a total affection of mind and body, the disturbance of the whole organism. Individual organs are not the cause of the illness but the disturbance at internal level (i.e., life-force or vital energy). Therefore, homoeopathy does not believe in giving different medicines for different afflicted parts of body but rather give a constitutional remedy which will cover the disturbance of the whole person.

H A ROBERTS OPINIONS ABOUT DIABETES

The view point of the modern psychologist reflects the theory that the vast majority of human illnesses are traceable to dysfunctions of the glandular system. He saw that the function of some of the ductless glands is to secrete a minute quantity

of the specialized product in the system a secretion that has a vital bearing on the health of the. whole constitutions. In many cases this secretion of a normal gland is so minute that itapproaches the homoeopathic attenuation. Like homoeopathic remedies these glands also helps in maintaining the health with infinitesimal amounts of the secretions, we can hardly fail to see the important relationship this homoeopathic remedy may hold to the manifestations of the endocrine dysfunction andto the balance of the ductless glands. His observation about insulin that once insulin is given patient tends to depend on it and thereis little hope of establishing normal balance.

H A ROBERTS SPEAKS ABOUT CONSTITUTIONAL APPROACH FORDIABETES

We find many suitable remedies for sugar in urine in the repertories and most of the remedies listed are deep acting and have their respective emotional states. Diabetic patient presents with the subjective symptoms which will guide us to the remedy or hemay give a history of emotional shock preceding the present affliction that will lead to you a remedy. The symptoms are clearly marked such that the constitution cannot be overlooked, sometimesit is indicating a constitutional remedy which has not proved to produce sugar imbalance. If thepatient improves, we are justified by adding this as a clinical note to the existing. With this medicine if the general health is raised even though the lower sugar threshold remains the same not to be worried because we may safely rely on the remedy which maintainsgeneral improvement and not to be too anxious over the sugar output.

RICHARD HUGES ON DIABETES

It must always be of high importance, but it is not in the nature of the case and by the confession of its advocates, curative. Sometimes indeed under its use nature relieved of much ofher burden, asserts her recuperative power and when the pristine consequences. But too often hediabetic regimen proves but a continuous and most irk some palliative that the least abatement of its rigid restrictions is followed by an increase in the malady and the patient at length succumbs under pulmonary disease, carbuncle, or simple exhaustion of the power of the life. Until we can do more than cut off the supplies, until we can attack the morbid process itself we cannot consider ourselves in a position to cure diabetes.

When we talk about disease like diabetes, we take in consideration terms of management ratherthan cure, this is because general management measures like dietary measures and daily exercise etc are mandatory, hence along with constitutional remedy general management has a vital role in the cure and management of diabetic patients which not only treats the patients superficially but also drives the symptoms away and heals the patient from within. Undoubtedly one can prove that homoeopathy is the medicine of future.

As diabetes is a disease which shows constitutional disturbance and it has great geneticpredisposition and chances of heritable transmission so also this condition is a truly chronic in its form so this is a true chronic disease with miasms in its background. We cannot be specific about the Miasm of the diabetes as it can establish itself in all the three miasmatic states and so we can consider it as a multi miasmatic disease. The expression of diabetes in different miasmatic states is discussed below.

MIASMATIC BACKGROUND OF DIABETES

Predisposition to beta cell destruction is the main causative factor in primary Idiopathic diabetes mellitus. The presence of this predisposition corroborates with the basic conception in homeopathy about the natureand origin of all Chronic diseases. We must keep in mind Dr. Kent's 7th observation in this context. He arrived at the observation by treating several such incurable patients. Homoeopathically, Non-insulin dependent Diabetes Mellitus is either due to Psora or Sycosis or both. Psora leads to functional deficiency, Sycosis leads to incoordination and a combination of the two leads to simultaneous presence of both the conditions. These cases do not generallyrequire exogenous insulin but if persist for a long time, being maltreated or non-treated, cellular destructionmay finally

take place and non-Insulin dependent cases may turn to be Insulin dependent. Until then, the prognosis ofthese cases is better and the patients may be cured as the condition is reversible. But the medicinal treatment must be supplemented by proper dietetic management and physical exercise to reduce obesity. Diet control and adequate physical exercise alone may help to control the progress of these conditions. If obesity is reduced, Insulin receptor becomes much more effective and the Insulin resistant state steadily improves resulting in normalcy of blood sugar level. But unless the predisposition is corrected by anti-miasmatic constitutional treatment thepatient will not be cured and slightest error in diet and regimen will lead to a relapse of the condition[16].Diabetes mellitus comprises the pseudopsoric miasm. The pseudopsoric miasm is also known as Tubercular miasm. It is a combination of both Psora and Syphilitic miasm. Tubercular miasm is usually characterized by problem child i.e., slow in comprehension, dull, unable to keep a line of thought, unsocial,morose. He/she gets relief from offensive foot or axillary sweat which when suppressed often induces lung troubles or some other severe disease. The patient's mental symptoms tend to be ameliorated by an outbreak of an ulcer. The slightest bruise suppurates; the strong tendency is to the formation of pustules. Asa general rule, the patient is very intelligent, keen observer and a programmatic planner who wants his life always busy but possesses a sedentary lifestyle.

INDICATION OF MIASM

As the miasm progress and predominates, weight loss, depreciation and destruction are the first indicationof this miasm. Other indications are cosmopolitian habits, mentally keen but physically weak. Symptoms are ever changing. Rapid response to any stimuli (e.g. any slightest change of weather or atmosphere).

Emaciation instead of taking proper diet and drink, tendency to cough and cold easily, desire and cravingunnatural things to eat, with desires and cravings for narcotics such as tea, Coffee, **tobacco** and any other stimulants have often their origin

in psoric or tubercular miasm. They sometimes have constant hunger and eat beyond their capacity to digest or they have no appetite in the morning but hunger for othermeals.

THERAPEUTIC APPROACH TO DIABETES MELLITUS

There are many different modes of intervention in case of diabetes mellitus through homoeopathy.Physicians do use majorly three modes they are

Drugs in tincture form- Mother tinctures

Drugs involving the sectors(dilutions) - Acute remedies

Drugs covering the constitution

MOTHER TINCTURES AND THEIR INDICATIONS

ABROMA AGUSTA

Great uneasiness feeling of extreme prostrationLoss of flesh with rapid emaciation

Burning sensation all over the body with thirst for large quantities of water.

CEPHALANDRA INDICA

The grand medicine for diabetes mellitus and insipidus Glycosuria with intolerable burning sensation all over the body.

Especially adapted to people oversensitive to noise and external environment.Dryness of mouth with thirst for large quantity of water at a time.

CHIONANTHUS VIRGINICA

Diabetes mellitus with high specific gravity, Frequent micturition with bile and sugar in urine. Pancreatic disease and other and glandular disorder.

GLYCERINUM

Profuse and frequent micturition and increased specific gravity and sugar It is long deep acting remedy building up tissues and so it is of great use inmarasmus, mental and physical debility, diabetes etc. It seems to improve the general state of nutrition in its secondary action.

GYMNEMA SYLVESTRA

It is almost specific for diabetes mellitus

Decreases sugar in urine, patient puts on flesh and weight, appetiteimproves. Mental physical sexual spheres improves predominantly Profuse urination with large quantities sugar and feels weak after passing it.

HELONEAS DIOICA

Diabetes 1st stage urine profuse clear saccharine Lips dry stick together with great thirst restlessnessemaciation. Mentally irritable and melancholic

Albuminuria acute or chronic during pregnancy with drowsiness unusually tired.Sensation of weakness dragging and weight in the sacrum and pelvis with great languor prostration are excellent indications.

ACID PHOSPHORICUM

Young people who grow rapidly and who are overtaxed mentally andphysically. Debility from loss of vital fluids

Bad effects from grief anguish care o disappointed love

Frequent and profuse urination forcing the patient to rise often in the night

RHUS ARROMATICA

Diabetes with large quantities of low specific gravityurine. Pale albuminous urine

Severe pain before or at the beginning of the micturitition causing greatagony in children.

SYZYGIUM JAMBOLINUM

The most powerful remedy in diabetes mellitus Causes a marked diminution ofsugar in the urine.

Polydipsia polyuria and profound prostration and emaciation. Especially suited to people who suffer withchronic dyspepsia.

HOMOEOPATHIC DILUTIONS USED ON TOTALITY

ACETIC ACID:

Adapted to pale lean persons with lax, flabby muscles; face palewaxy. Diabetes with intense, burning, insatiable thirst

Violent burning pains in the stomach and chest, followed by coldness of skin

and cold sweat on the forehead.

ARGENTUM METALLICUM:

Diuresis urine profuse, turbid with a sweet odor. Frequent micturition. polyuria Emaciation and great weakness. Tall, thin, irritable persons. Ailments from abuse of mercury. Constitutional effects of onanism.

COCCA:

Persons who are wearing out under mental and physicalstrain. Longing for alcoholic liquors and tobacco. Incarcerated flatus; raises with noise and violence, as if it would split theesophagus. No appetite but for sweets.

Diabetes with impotency.

CUPRUM ARSENICOSUM:
Renal inefficiency and uremia, garlicky odour.
Diabetes urine with a high specific gravity; increased acetones and diabeticacid. Cramp in the calves. Worse after midnight, only relieved by getting out of bed and standing. Ulcers gangrene.
Boils on the scrotum, Purulent white discharge from the urethra [gleet]tingling and burning in the urethra pain in the prostrate and penis.

INSULINUM:
Restores the lost ability of oxidizing carbohydrate and storing glycogen inthe liver. In a persistent case of skin irritation, boils or varicose ulcerationwith polyuria.

KALI BROMATUM:
Adapted to large persons inclined to obesity. Nervous restless cannot sit stillmust move about or keep occupied; hands and fingers in constant motion.

LACTICUM ACIDUM:
Excessive thirst frequent and copious micturition; urine contains sugar.Skin rough and dry; obstinate constipation; tongue dry sticky gastric ailments. Debility and emaciation exertion.

LYCOPUS VIRGINICUS:
Diabetes mellitus and insipidus from some derangement of the central nervous system or sympatheticus. Copious flow of clear urine of great density, containingsugar, intense thirst; great emaciation.

NATRICUM SULPHURICUM:
Dryness of mouth and throat; great thirst for very colddrinks; Voracious appetite with boring pain; disgust while eating.
Increased urination especially at night, pains in small of back with burningurine. Worse in rainy weather, from water in any form.
Always feels better in warm dry air.

PICRICUM ACIDUM:
Emission profuse followed by great exhaustion.
Priapism, satyriasis. Brainfag; of literary or business people; slightest excitement,mental exertion or overwork brings on head ache.

PLUMBUM METALLICUM:
Constipation stools hard lumpy black like sheep dung.
Excessive and rapid emaciation general or partial paralysis; extreme, withanemia and great weakness.

SULPHURICUM ACIDUM:
Chilblains with gangrenous tendency. Carbuncles boils and otherstaphylococcal and streptococcal infection
Heartburn, sour eructations, craving for alcohol.

URANIUM NITRICUM:
Excessive thirst nausea vomiting ravenous appetite eating followed byflatulence abdomen bloated.
Complete impotency with nocturnal emissions. Organs cold, relaxed sweaty.
Diuresis, incontinence of urine. Burning in urethra with very acidurine. Unable to retain urine without pain.
Great emaciation, debility and tendency to ascites with general dropsy.

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MATERIALS AND METHODS(METHODOLOGY)

The cases will be collected from following sources-

- O.P. Ds of Naiminath Homoeopathic Medical College, Hospital and research centre, Agra.
- I.P. Ds of Naiminath Homoeopathic Medical College, Hospital, and research centre, Agra.
- Peripheral OPDs of Naiminath Homoeopathic Medical College, Hospital, and research centre, Agra
- Rural Health Camps conducted by Naiminath Homoeopathic Medical College, Hospital, andresearch, Agra

Study duration

18 months duration

Selection of sample

30 cases.

INCLUSION CRITERIA: -

- Patients in age group 35 years to 60 years.
- Both genders.
- Patients suffering from subjective symptoms of Diabetes Mellitus.

EXCLUSION CRITERIA: -

- Patient having blood glucose level above 400mg/dl.
- Patients do not give consent to withdraw the conventional treatment, he has been taken.

Study design

- The research design is prospective, non-controlled experimental design.

Selection of tools

Data collection

Data collection will be done by interviewing the patients during first and subsequent follow-up.

Does the study require any investigation or intervention to be Conducted on patients or other humans or animals? If so, pleaseDescribe briefly.

Yes, appropriate investigation or intervention will be conducted on patient.

Basis of Selection of Drug:

Individualistic / constitutional / Anti-miasmatic were given to them according to the presenttotality of symptoms.

Auxiliary Line of Treatment:

Counselling for recording stress, anxiety and other host related factors favoring the disease,Diet correction if necessary & life-style modification.

Criteria of Improvement:

The results were calibrated into the following categories:

MARKED IMPROVEMENT: General improvement at all levels. A feeling of well-being of thepatient mentally and physically. Improvement in symptoms and signs.

MODERATE IMPROVEMENT: Moderate symptomatic improvement of the patient. Generalimprovement only at certain levels.

NO IMPROVEMENT: No improvement at any level. No improvement in any sign and symptoms,but treatment still going on.

MASTER CHART

Sr. No.	REG. No.	DATE	NAME	AGE	SEX	RELIGION	PRESCRIBED REMEDY	FASTI BEFOR T/T
1	13464	29/08/2018	Alka Srivastav	46	F	Hindu	Ignatia Amara	15
2	87895	03/09/2018	Aarti Gupta	38	F	Hindu	Sulphur	21
3	45017	11/08/2018	Satish Chand Sharma	65	M	Hindu	Phosphorus	18
4	45998	05/09/2018	Munna	51	M	Hindu	Lycopodium	14
5	46334	09/09/2018	Ram Kishan	64	M	Hindu	Phosphoric Acid	23
6	45885	11/09/2018	Mhod Akram	43	M	Muslim	Sulphur	25
7	38762	13/09/2018	Shajahan Begum	48	F	Muslim	Natrum Mur	20
8	47314	19/09/2018	Dhan Singh	45	M	Hindu	Nux Vomica	18
9	48178	25/09/2018	Amar Singh	42	M	Hindu	Staphisagria	20
10	50033	03/10/2018	Hari Shankar Sharma	62	M	Hindu	Nitric Acid	17
11	59401	05/10/2018	Rakesh Gupta	52	M	Hindu	Natrum Mur	25

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12	64086	06/10/2018	Tahira	42	F	Muslim	Sulphur	20
13	49097	08/10/2018	Ashok Kumar	67	M	Hindu	Phosphoric Acid	19
14	53221	15/10/2018	Boby Sharma	43	F	Hindu	Ignitia Amara	24
15	58551	21/10/2018	Wahid Akhtar	42	M	Muslim	Staphisagria	15
16	49329	06/08/2018	Rehan Ahmed	50	M	Muslim	Arsenic Alb	25
17	45330	26/07/2018	Bittan Devi	46	F	Hindu	Phosphorus	17
18	61242	05/08/2018	Suresh Chand	39	M	Hindu	Nitric Acid	24
19	62530	12/08/2018	Rambabu	65	M	Hindu	Lycopodium	22
20	49097	20/08/2018	Ashok Jain	43	M	Hindu	Nux Vomica	16
21	42989	05/10/2018	Mahima Devi	60	F	Hindu	Pulsatilla	12
22	43641	16/09/2018	Rajkumari	41	F	Hindu	Phosphoric Acid	18
23	180841	05/09/2018	Rishab Sharma	41	M	Hindu	Fluoric Acid	14
24	48418	08/09/2018	Vijay Kumar	55	M	Hindu	Lycopodium	15
25	51151	14/06/2018	Sabbir Ahemd	39	M	Muslim	Sulphur	22
26	39605	12/07/2018	Shalini Devi	42	F	Hindu	Sepia	17
27	11453	14/09/2018	Vinod Singh	55	M	Hindu	Thuja	12
28	51058	04/10/2018	Bani Singh	47	M	Hindu	Ignatia amara	19
29	48049	10/10/2018	Kamla Devi	48	F	Hindu	Phosphoric Acid	17
30	46104	16/10/2018	Dharmendra Singh	51	M	Hindu	Sulphur	19

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OBSERVATIONS & RESULTS

Age Distribution 30 patients belonging to the age group 35- 60 were selected for study. Among the30 patients maximum prevalence of Diabetes Mellitus was noted between 41-50 years of age(50%).The second highest prevalence was found in age group 51-60 (40%) and next age group30-40 yrs (10%).The distribution is presented in table below, also the diagrammatic representation is furnished.

Age	**30-40**	**41-50**	**51-60**
Patient	3	15	12
Percentage	10%	50%	40%

Representation of patients according to Domicile

Domicile	**Cases**	**Percentage**
Rural	12	40%
Urban	18	60%

Representation of patients according to gender

Gender	**Cases**	**Percentage**
Male	20	67%
Female	10	33%

Representation of patients according to family History

Family history	**Cases**	**Percentage**
Present	**22**	**73%**
Absent	**8**	**27%**

Observation of Remedies Used

Remedies	**Cases**	**Percentage**
Ignatia Amara	3	10%
Sulphur	5	17%
Phosphorus	2	7%
Lycopodium	3	10%
Phosphoric acid	4	13%
Natrum mur	2	7%
Nux vomica	2	7%
Staphysagria	2	7%
Nitric acid	2	7%
Arsenic album	1	3%
Pulsatilla	1	3%
Fluoric acid	1	3%
Sepia	1	3%
Thuja	1	3%

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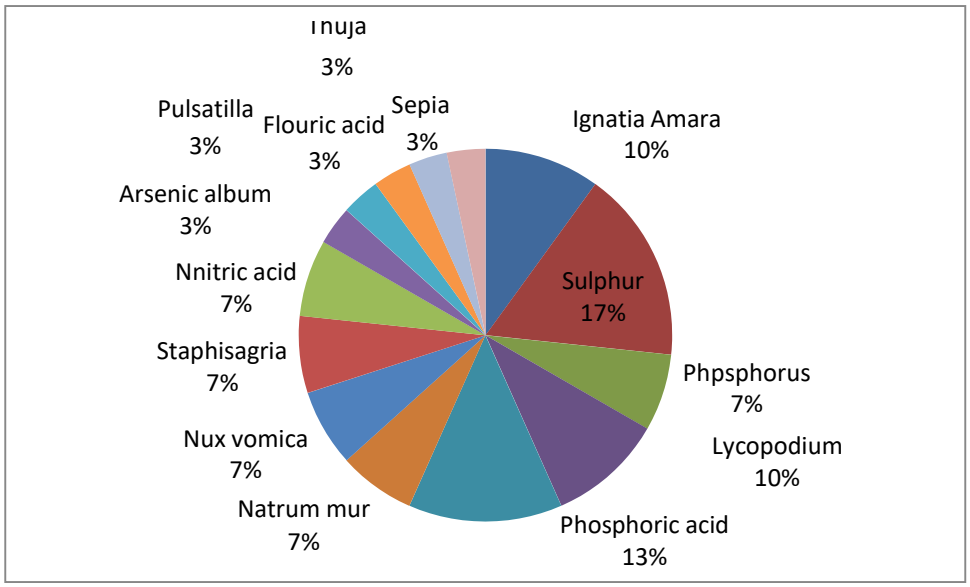

Fasting Blood Sugar Value Before and after Treatment

Before treatment	After treatment
150	90
210	140
180	110
140	200
230	100
250	180
200	80
180	90
200	80
170	230
255	140
190	230
246	154
150	150
250	175
175	100
240	135
220	240
160	86
120	200
182	126
142	110
156	100
225	255
170	100
127	150
190	240
175	94

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Observation of Symptomalogical Presentation of Diabetes Mellitus CasesChanges in presenting Clinical Features after treatment

Symptom	**Cases**	**>**	**%**	**<**	**%**	**N**	**%**	**D**	**%**
Increased thirst	20	12	60%	2	10%	4	20%	2	10%
Increased hunger	16	10	63%	3	19%	2	13%	1	6%
Loss of weight	5	3	60%	0	0%	2	40%	0	0%
Weakness	24	14	58%	4	17%	3	13%	3	13%
Blurred vision	5	2	40%	1	20%	1	20%	1	20%
Increased Urinary	11	5	45%	3	27%	3	27%	0	0%
Urgency									
Recurrent infections of the skin	10	6	60%	2	20%	1	10%	1	10%
Frequent urinary tract infections	14	10	71%	0	0%	2	14%	2	14%
Burning Sensation	20	14	70%	1	5%	3	15%	2	10%
Dryness of mouth	8	6	75%	0	0%	0	0%	2	25%
Numbness in the legs, feet or fingers	15	10	67%	1	7%	4	27%	0	0%

Case-No Patients N-No change D-Disappearance
<-Aggravation >-amelioration

Distribution of Presenting Complaint

Presenting complaints	**Number**	**Percentage**
Increased thirst	20	67%
Increased hunger	16	53%
Loss of weight	5	17%
Weakness	24	80%
Blurred vision	5	17%
Increased Urinary urgency	11	37%
Recurrent infections of The	10	33%
Skin		
Frequent urinary tract infections	14	47%
Burning Sensation	20	67%
Dryness of mouth	13	43%
Numbness in the legs, feet or fingers	15	50%

SUMMARY

This study was done on patient suffering from Diabetes Mellitus type 2. The objective of study was

- To understand the role of constitutional remedies in treatment of DM Type 2
- To understand the which potency is more effective in treatment of DM Type 2.
- To prevent the complication and recurrence and provide the cure in rapid and gentle way.

To educate the people by the cause and aware about the Homoeopathic treatment of DMT2

In the study of 30 cases there are 21 cases improved 8 cases are worse and 1 case has no change from the homoeopathic medicine which are selected by taking appropriate rubric from homoeopathicmedical Organon of Medicine, this modern Organon of Medicine arranged in alphabetical and more Nosological terminology in the form of rubric which are helpful to select the repertorization. Most ofrubric related to diabetic mellitus type 2 arranged in clinical chapter.Miasmatic evaluation of all the cases revealed sycosis to have maximum predominance as fundamental miasm in 20 (66.67%) cases. And psora, sycosis, tubercular miasms share equal predominance as dominant miasms in 9 (30%) cases each.

Constitutional medicines were given to all the patients and along with that general management guidelines in the form of diet charts and exercise guidelines were also explained. Follow up analysis of the patient's state and regularity of general management guidelines followed were assessed, patients who followed general management regularly along with constitutional treatment were 14cases out of which 12 cases showed marked improvement in their health status when compared to the other group with occasional andirregular general management habits. Hence, we can conclude that homoeopathic treatment with dietary and exercise guidelines when strictly implemented is the best method of approaching type 2 DM.

RESULT OUTCOME-

1. There is a significance difference in the prevalence of DMT2 male 20(66.67%) and female 10(33.33%)
2. APD, osteoarthritis and hypertension are the most common associated complaints observed alongwith DM in this study.
3. According to the miasmatic evaluation of the 30 cases taken for the study I found that Sycosis ispresenting maximum predominance as fundamental Miasm in 20 (66.67%) cases. And Psora, Sycosis, tubercular Miasm share equal predominance as dominant Miasm in 9(30%) cases each reported for the study. Pathological survey of the disease also reveals sycotic – tubercular
4. predominance
5. Along with the constitutional treatment general management in the form of diet chart and exercise guidelines were given to the patient and their effective application is also assessed on subsequent follow-ups.
6. According to the need of the cases some acute remedies were prescribed in between and alsoantimiasmatic remedies.

Evaluation of the symptoms before and after the treatment reveals that there is significant improvement in all the symptoms considered before and after treatment. Symptoms like hyperglycemia which was seen in almost all 30 (100%) cases, but after treatment only 10 (33.33%)cases only showed hyperglycemia that too with less intensity. And also noticed in the symptom weakness which is expressed by 23(76.67%) cases before treatment is minimized to 4 (13.33%) cases after treatment.

7. All the cases were worked out and the constitutional similimum was selected and patients wereobserved on follow ups initially spaced at a gap of 2 weeks and later 1 month duration.
8. Along with the constitutional treatment general management in the form of diet charts and exercise guidelines were given to the patient and their effective application is also assessed onsubsequent follow-ups.
9. Potency selection was done based on the standardized guidelines in the SCR according to thesusceptibility and sensitivity of the patient.
10. Few cases allopathic medication was gradually tapered and many were strictly on homoeopathictreatment alone.
11. According to the need of the cases some acute remedies were prescribed in between and also antimiasmatic remedies.
12. Diabetes according to the modern perspective is a disease of multicentric origin, with multi-dimensional presentation and so the most accurate approach is the holistic approach, where simple reduction of the blood glucose levels is not the motive instead it induces disease managing efficacy of the individual which is understood by the general well-being of the patient irrespective of the plasma glucose concentration.

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My encounter with Late Dr. Vishpala Parthasarthy

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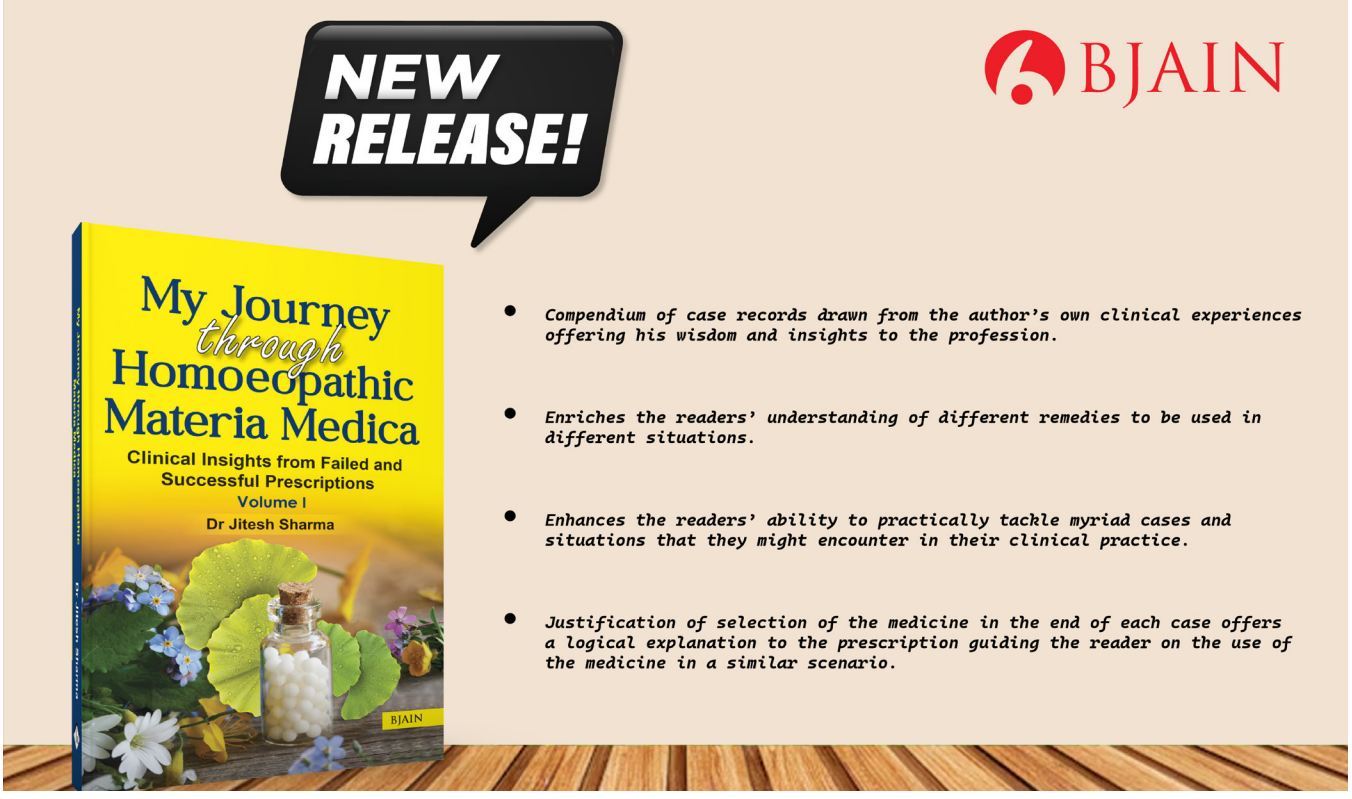
My first meeting with Late Dr. Vishpala Parthasarthy Madam was in September 2012 at hotel Villagio, state of Goa during a seminar organized by Njh team in collaboration with I.C.R based on the theme of cardiovascular and metabolic ailments and its homoeopathic management. Dr Vishpala Madam was wearing a green sari and a sweet smile on her face. I was pursuing my post graduate studies and had come there in pursuit of knowledge. Little did I know that I was going to be in the galaxy of modern pioneers.

It was a small gathering of around 40 homoeopaths. Amongst the great ones present there were Dr. N.L Tiwari Sir, Dr Phansalkar, Dr Prashant Tamboli, Dr A.T Jagose Sir, and of course the only lady who sat right in front was Dr Vispala Ma'am. My Post graduate colleagues from Belgaum, Karnataka had also come to witness the programme. We learnt about diabetes mellitus, cardiovascular problems and in the evening Dr Vishpala Madam spoke to us, she motivated us to bring out the unknown potential inside us through writings. It seemed all new then but her voice was very reassuring. I wanted to prove myself useful, however after the seminar ended, soon we got back into my old ways of balancing between studies and practice. Years rolled by and I used to closely follow Njh articles because it was helpful to select interesting articles for journal club meetings with our colleagues both during my internship as well as post graduate days. I was not a subscriber still. My journey as a writer began only in 2018 after my mother's death. Writing is what gave me solace. In November 2019 I met my teacher Dr.Shahala Nadaf Madam for the 21st All India Homoeopathic Scientific Seminar organized at Belgavi, Karnataka it just before covid 19 had been officially announced. Dr Shahala was one of the editors of Njh and she appreciated my articles which had appeared in the E-magazine Homoeopathy for Everyone. It was upon her insistence that I became a lifetime member and subscriber of Njh, When I started writing for Njh, there I came across Dr Shobha Shah and Dr Satish Kanodia who were both Njh core team members. I often began contributing articles to Njh, at that time I was working as an Assistant Professor in Shri Kamaxidevi Homoeopathic Medical College, Shiroda, Goa. During those years whenever I used to go for CME frogrammes I was getting acknowledged for my work which appeared in the Njh monthly magazine.

During Covid Njh organized webinar's and I used to enjoy attending them. One such programme that I clearly recollect now is the one on the theme of Headache and Dr Praveen Kumar shared some lovely cases. Post covid I migrated to Gandhinagar, Gujarat to teach as an Assistant Professor in Aarihant Homoeopathic medical college & R.I. My superior was also contributing articles to Njh and our department was making news. Soon I was made a member of an Author's group on whatsapp in which Dr Vishpala Madam would respond promptly in case I raised any

queries. Njh always provided me with new thought-provoking themes such as Anxiety, mind rubrics, paediatric problems, etc. It opened a whole new avenue before me and the editors did their bit to reframe the titles for my articles or sometimes by asking certain documents in order to confirm the authenticity of results. The covid issues were also very interesting as everyone in homoeopathy could find latest developments in terms of how it was managed. In August 2023, I had been to another such CME at Motiwala Homoeopathic Medical College, in Nashik, there I met a resource person who recognized me from the stage only because of reading my articles on Njh. During lunch break he asked me why I write for Njh as it was not a peer reviewed journal?. He asked me to write only in peer reviewed journals. For me personally, Njh gave me a free hand in writing my cases as they appeared or progressed in my clinical practice which no other journal allowed. Most peer reviewed journals made me fill up columns in a certain prescribed way and on account of this my cases lost its actual beauty. Njh did ask me for evidence of results but never made me change my way of presentation. I always looked 2-3 months ahead for themes and prepared in advance whenever possible. The last article which appeared was on Periodic table row 6. The next article on panic disorders was ready but our beloved Editora had left this world filling our hearts with sorrow. Never did she make it known to us of her illness. I regret not attending the seminar in Baroda last year, where Dr Vishpala herself had come, at least I could have seen this jewel a second time. Nevertheless when Njh announced Homoeoseminar 3.0 at Atal Bihari Vajpayee Auditorium, Rajkhot on 8th January 2024, I decided to pay my shradanjali to Late Dr Vishpala Madam by going there. Here I could meet the fabulous team of young editors of Njh, many of whom I have never seen before. I submit to you all with tons of gratitude for giving me a chance to share my clinical cases through my favourite journal Njh ever since my undergraduate days, where I would enjoy reading articles of Dr Jagose Sir, Dr Ajit Kulkarni Sir, Dr Praful Barwalia Sir, and many others. Dr Vishpala madam gave me the opportunity to write on this same platform. I cannot thank her enough! for this grand opportunity. Dr Vishpala made life of many young students like me. May her noble soul guide the homoeopathic world to persevere in propagating the seeds of homoeopathy. Her enormous contribution can never be forgotten!



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"COMPETENCY BASED DYNAMIC CURRICULUM AT FIRST B.H.M.S CLINICAL POSTING- Sample of two acute cases discussion"

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OBJECTIVE : To demonstrate integration of first year subjects(Organon, Materia Medica, Repertory, Pharmacy, Anatomy, Physiology) through an acute cases

Abstract: This case study aims to highlight the integration among st all first year subjects done to the O.P.D level cases observed by the first B.H.M.S students as prescribed by National commission for homoeopathy through the newly introduced Competency based dynamic curriculum (C.B.D.C) in 2023. This kind of integration would be an exhaustive exercise and needs a thorough study of the case prior to the actual evaluation, however, it fosters a comprehensive understanding of each case by making the results less subjective.

Methods: Successful acute cases at O.P.D level were selected whose prescription remedy was part of 1st year syllabus and after that drug was dealt by another teacher. The process of medical logic was applied to emphasize the knowledges of different first year subjects come together contributing to the similimum.

Results: The two acute cases met systematically with the prognostic factor for guidelines laid down in the Organon of Medicine for assessment of individual patient characteristics, disease progression and treatment response according to homoeopathic principles.

Conclusion: This study incorporates case-based learning at early first B.H.M.S level in order to familiarise medical graduates to utilise paraclinical subjects to enhance precision and efficacy of homoeopathic management. It encourages the young learners to utilise every subject that they learn, ultimately contributing to evolution of the patient centered healthcare.

Keywords: Acute case based learning----C.B.D.C----Integrated learning----Homoeopathic prescriptions

Case 1 18years Male Studying B.Com, thin, Emaciated

Date of case taking: 08/5/2024

Presented with complaints of breathlessness, 2 episodes requiring hospitalisation at Midnight. Presently on Budecot inhaler, Deriffilin Tab, Montelucas Tab since last 1 month. Has to sit up during attack and feels tightness of chest. Ailments from dust allergy. Worse by lying down specially at midnight. Expiration is difficult. No much expectoration. Tired easily while playing football. Decreased appetite. Thirst for small quantity often, prefers warm drinks since respiratory disease. He is diagnosed by Pulmonologist as suffering from Asthma.

Had to be convinced of importance of homoeopathic treatment to wean allopathic treatment. His younger sister is on strong Asthma treatment given by same pulmonologist and fully dependent on his medications. Mother is concerned about him but he is afraid of dying of suffocation hence doesn't want to stop allopathic treatment. Mothers suffers from allergies to dust. Father had hypertension.

On Examination: R.S- Wheezing present.

During an acute attack, excited by allergic condition, be it chemical irritant or industrial dust small airway restrict and narrowing due to smooth muscle bronchoconstriction, airway oedema with increased secretions and inflammation. These alterations basically occur as a result of hyperresponsiveness in extracellular matrix, airway smooth muscle and parenchyma.

Wheezing is a high-pitched piping or whistling sound resulting from partial airway obstruction. Wheezes are usually louder and more persistent during expiration. It has a musical quality occurring with either inspiration or expiration. The pitch of the wheeze is due to the linear velocity of air jet, which is broken into turbulent flow pattern of the airways and is not related to the size of the airway where it is produced. During attacks of asthma the wheezing sounds may be so loud that they can be heard without a stethoscope.

Uncommon features of this case are the decreased appetite, modality of better by sitting up, time of worsening of complaints being midnight. And the concomitant of thirst for small quantities of warm water often. All indicative of Arsenicum Album. Arsenicum album is a remedy for allergic problems. 1M potency was chosen as the symptoms are indicative of high susceptibility. Single dose. Placebo for 1 month. Aphorism no 5 tells that acute disease search for exciting cause. In repertory check for Asthma worse at midnight and better by sitting up.

Follow up after 1 month patient returned to inform that He could play football without getting tired. No episode of asthma. Appetite has improved. Overall, 70% improvement. Placebo continued. Inhaler reduced to once a day from twice a day. Gradual tapering planned.

Case 2 Mrs M.S Age: 47yrs Housewife Mother of two children

Date of case taking: 20th February 2024 Gandhinagar

Patient presented with complaints of severe pain in right trapezius after twisting her ankle while wearing high heels and hence developed pain in upper back dorsal region of back since 2 days. Pain progressively increasing therefore she rushed to the physiotherapist since yesterday which is being continued. She has difficulty in lifting the arms, shrugging the shoulders and tilting the neck. Patient had consumed Rhus tox but failed to relieve. Pain relieved by warm applications, better by rubbing, <by slightest draft of cold air, >lying only on back, >standing so last two days trying to stand and work at home. Pain makes her very restless but she doesn't change sides in bed. Rather lies straight in bed.

Prescription: Ruta 1M, 1 single dose on 20th February

Follow up on 21st February: Pain relieved by 50%

Follow up on 22nd February: Pain relieved by 70%

Follow up on 23rd February: Pain relieved by 95%

For repertorisation which is bridge between patient and Materia Medica we use repertory to find out which remedies are covered by the characteristic symptoms which in this given case are 1)Pain aggravated by draft of cold air 2)Modality of pain relieved by standing

Comparison is done with Arnica, Arnica is aggravated by lying on painful side hence it gets eliminated.

Referring Materia Medica of Allen's Key notes in Ruta, we find the symptom: Lameness after sprains(Exciting factor; Aphorism no 5), Backache relieved by lying on the back. Also ruta has affinity for fibrous tissues tendons of back. Also relieved by warm and restlessness is covered by Ruta

Pharmacy part helps to know source of drug and decide repetitions and power (Potency and scale selection).

Anatomy of Trapezius muscle will help us know the three tendon heads of insertion which have resulted in this muscular sprain, these are the same locations given by the patient expressed as points of tenderness.

The fact that patient is unable to shrug the shoulders or lift the arms and points of tenderness extending below the lower angles of scapula clearly fit with the surface markings of this 'V' shaped muscle in the middle of the back. Physiology or functional anatomy can be learnt through this case in relation to the Trapezius.

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Clinical Study on Spider Groups of Drugs with Special Emphasis on Tarentula Through the Cases Epileptic Convulsion

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ABSTRACT

I worked on patients suffering from Epileptic convulsion with age between 2 years to 10 years as inclusion criteria in the cases. It was observed through comparative study which verified the importance of keeping these symptoms. Patients were relieved to great extent by the medicines which are obtained by the totality of symptoms. Epileptic convulsion is the disorder characterised by a staring spell, uncontrollable jerking movement of the arms and legs, loss of consciousness or awareness, fatigue, body ache, Persistent EPILEPSY, weight loss, discomfort feeling, weakness & temporary confusion. Psychic symptoms such as fear, anxiety. Homoeopathic constitutional treatment based on the individual case is the most suitable treatment and would aim to heal the underlying physical crisis causing the Epileptic convulsion. The remedies work by stimulating the body's natural ability to heal itself, acting as a catalyst for healing. Homeopathy can be of assistance in retrieving normal health and treating any other physical issues and sequel related to Epileptic convulsion. Homoeopathic medicines can also prevent relapse of Epileptic convulsion.

Methods: Randomised controlled trial study design has been adopted to know the efficacy of homoeopathic treatment in cases of Epileptic convulsion and its complication. A total number of 30 patients, showing features of uncontrollable jerking movement of the arms and legs body ache, low grade EPILEPSY, discomfort, temporary confusion& weakness were selected who were fulfilling the inclusion and exclusion criteria. Follow up has been taken for two months with at least six visits. From guardian of every subject, a written informed consent has been taken.

Result: All data were calculated from the study of 30 individuals. Statistical tests regarding the various parameters were conducted and ratio of cure was found out in relation to the medicine used
Conclusion: Homoeopathic treatment, by considering the Repertorial approach, was more efficacious in cases of Epileptic convulsion. During treatment uses of placebo is also effective.

Keywords: Homoeopathic treatment, Repertory, Epileptic convulsion, Spider Group of Drugs, Tarantula.

INTRODUCTION

Epilepsy is a chronic noncommunicable disease of the brain that affects around 50 million people worldwide. It is characterized by recurrent seizures, which are brief episodes of involuntary movement that may involve a part of the body (partial) or the entire body (generalized) and are sometimes accompanied by loss of consciousness and control of bowel or bladder function. Seizure episodes are a result of excessive electrical discharges in a group of brain cells. Different parts of the brain can be the site of such discharges. Seizures can vary from the briefest lapses of attention or muscle jerks to severe and prolonged convulsions. Seizures can also vary in frequency, from less than 1 per year to several per day.

Signs and symptoms

Characteristics of seizures vary and depend on where in the brain the disturbance first starts, and how far it spreads. Temporary symptoms occur, such as loss of awareness or consciousness, and disturbances of movement, sensation (including vision, hearing and taste), mood, or other cognitive functions. People with epilepsy tend to have more physical problems (such as fractures and bruising from injuries related to seizures), as well as higher rates of psychological conditions, including anxiety and depression.

Causes

Epilepsy is not contagious. Although many underlying disease mechanisms can lead to epilepsy, the cause of the disease is still unknown in about 50% of cases globally. The causes of epilepsy are divided into the following categories: structural, genetic, infectious, metabolic, immune and unknown. Examples include:

- brain damage from prenatal or perinatal causes (e.g. a loss of oxygen or trauma during birth, low birth weight);
- congenital abnormalities or genetic conditions with associated brain malformations;
- severe head injury;
- a stroke that restricts the amount of oxygen to the brain;
- an infection of the brain such as meningitis, encephalitis or neurocysticercosis,
- certain genetic syndromes; and a brain tumor.

AIMS AND OBJECTIVES

The aim of this study is to apply group analysis to the Class Spider and to assess benefits of tarantula medicine for epilepsy treatment.

OBJECTIVE

- To study on the therapeutic utility of medicine belonging to spider group of homeopathic medicines in treatment of epileptic cases

- Study and compare the outcome of the formalized computer analysis to existing results and views of spiders for epilepsy treatment
- To study the homoeopathic management and its outcome through the various clinical cases of epilepsy in the patient of various age group ranging from 2 to 10 years.

REVIEW OF LITERATURE One seizure does not signify epilepsy (up to 10% of people worldwide have one seizure during their lifetime). Epilepsy is defined as having two or more unprovoked seizures. Epilepsy is one of the world's oldest recognized conditions, with written records dating back to 4000 BC. Fear, misunderstanding, discrimination and social stigma have surrounded epilepsy for centuries. This stigma continues in many countries today and can impact on the quality of life for people with the disease and their families. Multiple references to epilepsy can be found in the ancient texts of all civilizations, most importantly in the ancient Greek medical texts of the Hippocratic collection. For example, Hippocrates in his book *On Sacred Disease* described the first neurosurgery procedure referring that craniotomy should be performed at the opposite side of the brain of the seizures, in order to spare patients from "phlegma" that caused the disease . However, it was not until the 18th and 19th century, when medicine made important advances and research on epilepsy was emancipated from religious superstitions such as the fact that epilepsy was a divine punishment or possession. At the beginning of the 18th century, the view that epilepsy was an idiopathic disease deriving from brain and other inner organs prevailed. One should mention the important work in this field by William Culen (1710–1790) and Samuel A. Tissot whose work set the base of modern epileptology describing accurately various types of epilepsie. Homoeopathy is a holistic treatment approach and, as such, looks beyond a diagnosis to consider everything about an individual. Lifestyle, attitudes, personality, background, genetic factors, emotional states, and individual symptoms are all noted during a homoeopathic consultation and the design of a treatment plan.

Studies from India have reported incidence rates varying from 0.2 to 0.6 per 1,000 population. The incidence rates reported from India are comparable with developed countries and lower than most of the developing countries which ranged from 1.0 to 1.9 per 1,000 per year. Saha *et al*., reported an incidence rate of 0.42 per 1,000 per year from a 5-year longitudinal study in rural West Bengal, which was quite similar to the incidence rate of 0.49 per 1,000 per year reported by Mani *et al*., from the 1-year Yelandur study in rural area. However, the incidence rates reported from urban regions were quite variable with higher rate of 0.60 per 100 per year from an urban resettlement colony compared to 0.27 per 1,000 per year from urban area. The heavily concentrated migrant rural population in the urban resettlement colonies and slums in recent years might be one of the possible reasons for high incidence rate reported in urban resettlement colony. Thus, it is evident that there exists a wide rural-urban gap for incidence of epilepsy with likely hot spots in urban regions due to migrant rural population.

Table 1a: Prevalence of epilepsy in rural population of India

Author	Year of publication	Place of study	Study sample	Study instrument	Prevalence per 1,000	Remarks
Goel *et al.*[45]	2009	Dehradun, Uttrakhand	14,086 subjects through H-H survey of randomly selected villages	Modified WHO protocol	7.5	Screening followed by neurologic examination with the use of CT and EEG. Prevalence rate was 6.5/1,000 when neurocysticercosis was excluded
Sureka and Sureka[46]	2007	Churu tehsil, Rajasthan	172,442 subjects sampled through H-H survey	Standard validated Placencia's nine questions screening questionnaires	3.0	Case finding through H-H survey along with IEC activities, followed by neurologist confirmation using ILAE case definition
Murthy *et al.*[47]	2004	West Godhavari, Andhra Pradesh	74,086 subjects sample through H-H survey	Clinical assessment	6.2	All cases ascertained clinically had a plain and contrast CT
Saha *et al.*[48]	2003	West Bengal	20,842 subjects through H-H survey	Modified WHO protocol	3.6	Trained professionals screened the population followed by neurologist examination
Pal *et al.*[40]	1998	Bishnupur block, West Bengal	40,574 children aged 2-18 years through H-H survey and key informant interview	Screening questionnaire used in Ecuador	3.2	Prevalence of active epilepsy was 3.2/1,000 as per ILAE case definition and the prevalence was 5.5 (after adjusting for survey sensitivity)
Kokkat and Verma[49]	1998	Haryana	8,595 subjects in four adjoining villages through random survey	Elaborate screening instrument on seizure and paralysis	8.0	A cross-sectional survey of four adjoining villages was carried out. Epilepsy, active and inactive were defined
Kapur and Isaac[16]	1978	Bangalore, Karnataka	4,209 subjects through H-H survey	Indian Psychiatric Survey Schedule (Kapur *et al.*, 1974	10.4	The study cross-validated the simple inexpensive method of case identification against H-H survey
Murthy *et al.*[17]	1978	Raipur Rani, Haryana	3,500 subjects selected by health staff referral in one village and H-H visit by psychiatrist in other village	Use of vignettes and interviewing of key informants	3.7	Not a true epidemiological study as more than half of the case finding did not come from H-H survey
Nandi *et al.*[18]	1975	Barasat, West Bengal	1,060 subjects through H-H survey	Questionnaire schedule, case record schedule as per ICD (1965 R)	10.4	Case definition as per WHO tech report series (1960)no.185 with minor modification
Sethi *et al.*[19]	1972	Lucknow, Uttar Pradesh	2,691subjects through H-H survey	Questionnaire for assessment of psychiatric state of the family	2.2	Screening was conducted by team of clinical psychologist, physician with psychiatric training, and social worker followed by psychiatrist examination; sex specific rates: Male (4.1) and female (0)
Elnagar *et al.*[20]	1971	Hooghly, West Bengal	1,383 subjects through H-H survey	Case finding questionnaire	4.3	Case finding was followed by detailed work-up and psychiatrist examination
Gopinath[21]	1968	Bangalore, Karnataka	423 subjects through H-H survey	A survey questionnaire giving various symptoms of mental illness	2.4	A team of doctors, psychologists, and social workers interviewed the head of the household and elicited information about presence of these symptoms

WHO = World Health Organization, ICD = International Classification of Diseases, ILAE = International League Against Epilepsy, CT = computed tomography, H-H = house-to-house

Table 1b: Prevalence of epilepsy in urban and semiurban populations in India

Author	Year of publication	Place of study	Study sample	Study instrument	Prevalence per 1,000	Remarks
Singh *et al.*[54]	2012	Jamalpur, Punjab	15,750 subjects through H-H survey	Modified WHO protocol	7.2	Initial screening, followed by epileptologist confirmation using ILAE case definition. Inactive epilepsy, nonepilpetic seizure, and single seizure were excluded
Raina *et al.*[55]	2011	RS Pura, Jammu	3,966 children <10 years identified through H-H survey	Modified WHO protocol	2.0	Initial screening by Anganwadi workers followed by neurologist examination using ILAE case definition
Banerjee *et al.*[56]	2010	Kolkata, West Bengal	52,377 subjects through two-stage H-H survey of stratified random sample	NIMHANS screening questionnaire	5.7	Initial screening followed by neurologist examination using ILAE case definition
Banerjee *et al.*[57]	2009	Kolkata, West Bengal	16,979 subjects ≤19 years selected through two-stage H-H survey of stratified random sample	NIMHANS screening questionnaire	7.0	Initial screening by trained field workers followed by neurologist examination using ILAE case definition
Das *et al.*[58]	2008	Kolkata, West Bengal	5,430 elderly aged>60years selected through two-stage H-H survey of stratified random	NIMHANS screening questionnaire	2.6	Initial screening followed by neurologist examination using ILAE case definition. Prevalence of active epilepsy was reported

WHO = World Health Organization, ICD-10 DCR = International Classification of Diseases, 10th revision, Diagnostic Criteria for Research, ILAE = International League Against Epilepsy, NCC = Neurocysticercosis, H-H = House-to-house

Table 1c: Prevalence of epilepsy from mixed (both urban and rural) population in India

Author	Year of publication	Place of study	Sample	Study instrument	Prevalence per 1,000	Remarks
Pandey *et al.*[66]	2014	Chandigarh	3,684 children aged 1-18 years	Modified Placencia's screening questionnaires	6.2	6.99 for rural area, 5.48 for urban area, and 4.07 for active epilepsy. ILAE case definition was used
Shah *et al.*[67]	2009	Kashmir	15,218 children aged 6-18 years	A pre-structured questionnaire	3.2	Rural rate was 3.9 and urban rate was 2.96. ILAE case definition was used
Rajshekhar *et al.*[68]	2006	Vellore, Tamil Nadu	50,617 subjects through cluster sampling	Modified WHO protocol	3.8	Prevalence in the urban clusters more than twice that in the rural clusters (6.23 vs 3.04/1,000). NCC is the cause of nearly one-third of all cases in both the urban and rural regions
Srinath *et al.*[69]	2005	Bangalore, Karnataka	2,064 children aged 0-16 years through stratified random sampling	Multiple screening tools	10 (children aged 0-3 years) 7.0 (children aged 4-16 years)	The screening stage was followed by a detailed evaluation stage with use of ICD-10 DCR criteria. The rates were higher for rural followed by slum and urban
Mathai[74]	1971	Vellore, Tamil Nadu	258,576 subjects through a door-to-door survey	Elaborate checklist on seizure symptoms	8.97	The prevalence was9.8/1,000 for rural areas and 7.5/1,000forurban areas
Dube[73]	1970	Agra, Uttar Pradesh	29,468 subjects through H-H survey	No objective screening questionnaire	2.3 (active epilepsy) 3.2 (lifetime prevalence)	A team of psychologist, social worker, field investigator, and statistician did the initial screening which was not objective. Suspected cases were confirmed by psychiatrist

WHO = World Health Organization, ICD-10 DCR = International Classification of Diseases, 10th revision, Diagnostic Criteria for Research, ILAE = International League Against Epilepsy, NCC = Neurocysticercosis, H-H = House-to-house

DEFINITIONS AS PER DIFFERENT STANDARD TEXT BOOKS:

HARRISON:

A epilepsy (from the Latin *sacire*, "to take possession of") is a transient occurrence of signs or symptoms due to abnormal excessive or synchronous neuronal activity in the brain. Depending on the distribution of discharges, this abnormal brain activity can have various manifestations, ranging from dramatic convulsive activity to experiential phenomena not readily discernible by an observer. Although a variety of factors influence the incidence and prevalence of seizures, ~5–10% of the population will have at least one epilepsy, with the highest incidence occurring in early childhood and late adulthood.

HARSHMOHAN :

Epilepsy is a common neurological condition characterized by recurrent seizures (that usually occur unpredictably), loss of consciousness with or without body movements. It is derived from a Greek word Epi-upon, Leptos-seizures. It is also known as seizure disorder. Seizure is a phenomenon characterized by an excessive, hypersynchronous discharge of cortical neuronal activity (measured by EEG), featured by disturbances in consciousness, sensory motor systems, subjective well-being and objective behaviour.

CECIL:

Temporal lobe epilepsy (TLE), a subset of the seizure disorder family, represents a complex neuropsychiatric illness, where the neurological presentation may be complemented by varying severity of affective, behavioral, psychotic, or personality abnormalities, which, in turn, may not only lead to

misdiagnosis, but also affect the management. This paper outlines a spectrum of mental health presentations, including psychosis, mood, anxiety, panic, and dissociative states, associated with epilepsy that make the correct diagnosis a challenge.

CLINICAL FEATURES OF EPILEPSY

Epilepsy is caused by abnormal activity in the brain, seizures can affect any process your brain coordinates. Seizure signs and symptoms may include:

- Temporary confusion
- A staring spells
- Uncontrollable jerking movements of the arms and legs
- Loss of consciousness or awareness
- Psychic symptoms such as fear, anxiety or Deja vu

Symptoms vary depending on the type of seizure. In most cases, a person with epilepsy will tend to have the same type of seizure each time, so the symptoms will be similar from episode to episode.

Doctors generally classify seizures as either focal or generalized, based on how the abnormal brain activity begins.

Focal seizures

When seizures appear to result from abnormal activity in just one area of your brain, they're called focal (partial) seizures. These seizures fall into two categories:

- **Focal seizures without loss of consciousness.** Once called simple partial seizures, these seizures don't cause a loss of consciousness. They may alter emotions or change the way things look, smell, feel, taste or sound. They may also result in involuntary jerking of a body part, such as an arm or leg, and spontaneous sensory symptoms such as tingling, dizziness and flashing lights.
- **Focal seizures with impaired awareness.** Once called complex partial seizures, these seizures involve a change or loss of consciousness or awareness. During a complex partial seizure, you may stare into space and not respond normally to your environment or perform repetitive movements, such as hand rubbing, chewing, swallowing or walking in circles.

Symptoms of focal seizures may be confused with other neurological disorders, such as migraine, narcolepsy or mental illness. A thorough examination and testing are needed to distinguish epilepsy from other disorders.

Generalized seizures

Seizures that appear to involve all areas of the brain are called generalized seizures. Six types of generalized seizures exist.

- **Absence seizures.** Absence seizures, previously known as petit mal seizures, often occur in children and are characterized by staring into space or subtle body movements such as eye blinking or lip smacking. These seizures may occur in clusters and cause a brief loss of awareness.
- **Tonic seizures.** Tonic seizures cause stiffening of your muscles. These seizures usually affect muscles in your back, arms and legs and may cause you to fall to the ground.
- **Atonic seizures.** Atonic seizures, also known as drop seizures, cause a loss of muscle control, which may cause you to suddenly collapse or fall down.

- **Clonic seizures.** Clonic seizures are associated with repeated or rhythmic, jerking muscle movements. These seizures usually affect the neck, face and arms.
- **Myoclonic seizures.** Myoclonic seizures usually appear as sudden brief jerks or twitches of your arms and legs.
- **Tonic-Clonic seizures.** Tonic-clonic seizures, previously known as grand mal seizures, are the most dramatic type of epileptic seizure and can cause an abrupt loss of consciousness, body stiffening and shaking, and sometimes loss of bladder control or biting your tongue.

COMPLICATIONS OF EPILEPSY:-

Having a seizure at certain times can lead to circumstances that are dangerous to yourself or others.

- **Falling.** If you fall during a seizure, you can injure your head or break a bone.
- **Drowning.** If you have epilepsy, you're 15 to 19 times more likely to drown while swimming or bathing than the rest of the population because of the possibility of having a seizure while in the water.
- **Car accidents.** A seizure that causes either loss of awareness or control can be dangerous if you're driving a car or operating other equipment. Many states have driver's license restrictions related to a driver's ability to control seizures and impose a minimum amount of time that a driver be seizure-free, ranging from months to years, before being allowed to drive.
- **Pregnancy complications.** Seizures during pregnancy pose dangers to both mother and baby, and certain anti-epileptic medications increase the risk of birth defects. If you have epilepsy and you're considering becoming pregnant, talk to your doctor as you plan your pregnancy. Most women with epilepsy can become pregnant and have healthy babies. You'll need to be carefully monitored throughout pregnancy, and medications may need to be adjusted. It's very important that you work with your doctor to plan your pregnancy.
- **Emotional health issues.** People with epilepsy are more likely to have psychological problems, especially depression, anxiety and suicidal thoughts and behaviors. Problems may be a result of difficulties dealing with the condition itself as well as medication side effects. Other life-threatening complications of epilepsy are uncommon, but may happen, such as:
- **Status epilepticus.** This condition occurs if you're in a state of continuous seizure activity lasting more than five minutes or if you have frequent recurrent seizures without regaining full consciousness in between them. People with status epilepticus have an increased risk of permanent brain damage and death.
- **Sudden unexpected death in epilepsy (SUDEP).** People with epilepsy also have a small risk of sudden unexpected death. The cause is unknown, but some research shows it may occur due to heart or respiratory conditions. People with frequent tonic-clonic seizures or people whose seizures aren't controlled by medications may be at higher risk of SUDEP. Overall, about 1 percent of people with epilepsy die of SUDEP.

DIAGNOSIS:

To diagnose your condition, your doctor will review your symptoms and medical history. Your doctor may order several tests to diagnose epilepsy and determine the cause of seizures. Your evaluation may include:

A neurological exam. Your doctor may test your behavior, motor abilities, mental function and other areas to diagnose your condition and determine the type of epilepsy you may have.

Blood tests. Your doctor may take a blood sample to check for signs of infections, genetic conditions or other conditions that may be associated with seizures.

Electroencephalogram (EEG). This is the most common test used to diagnose epilepsy. In this test, electrodes are attached to your scalp with a paste-like substance or cap. The electrodes record the electrical activity of your brain. If you have epilepsy, it's common to have changes in your normal pattern of brain waves, even when you're not having a seizure. Your doctor may monitor you on video when conducting an EEG while you're awake or asleep, to record any seizures you experience. Recording the seizures may help the doctor determine what kind of seizures you're having or rule out other conditions. The test may be done in a doctor's office or the hospital. If appropriate, you also may have an ambulatory EEG, which you wear at home while the EEG records seizure activity over the course of a few days. Your doctor may give you instructions to do something that will cause seizures, such as getting little sleep prior to the test.

High-density EEG. In a variation of an EEG test, your doctor may recommend high-density EEG, which spaces electrodes more closely than conventional EEG — about a half a centimeter apart. High-density EEG may help your doctor more precisely determine which areas of your brain are affected by seizures.

Computerized tomography (CT) scan. A CT scan uses X-rays to obtain cross-sectional images of your brain. CT scans can reveal abnormalities in your brain that might be causing your seizures, such as tumors, bleeding and cysts.

Magnetic resonance imaging (MRI). An MRI uses powerful magnets and radio waves to create a detailed view of your brain. Your doctor may be able to detect lesions or abnormalities in your brain that could be causing your seizures.

Functional MRI (fMRI). A functional MRI measures the changes in blood flow that occur when specific parts of your brain are working. Doctors may use an fMRI before surgery to identify the exact locations of critical functions, such as speech and movement, so that surgeons can avoid injuring those places while operating.

Positron emission tomography (PET). PET scans use a small amount of low-dose radioactive material that's injected into a vein to help visualize active areas of the brain and detect abnormalities.

Single-photon emission computerized tomography (SPECT). This type of test is used primarily if you've had an MRI and EEG that didn't pinpoint the location in your brain where the seizures are originating. A SPECT test uses a small amount of low-dose radioactive material that's injected into a vein to create a detailed, 3-D map of the blood flow activity in your brain during seizures. Doctors also may conduct a form of a SPECT test called subtraction ictal SPECT coregistered to MRI (SISCOM), which may provide even more-detailed results.

Neuropsychological tests. In these tests, doctors assess your thinking, memory and speech skills. The test results help doctors determine which areas of your brain are affected. Doctor may use a combination of analysis techniques to help pinpoint where in the brain seizures start:

Statistical parametric mapping (SPM). SPM is a method of comparing areas of the brain that have increased metabolism during seizures to normal brains, which can give doctors an idea of where seizures begin.

Curry analysis. Curry analysis is a technique that takes EEG data and projects it onto an MRI of the brain to show doctors where seizures are occurring.

Magnetoencephalography (MEG). MEG measures the magnetic fields produced by brain activity to identify potential areas of seizure onset.

Accurate diagnosis of your seizure type and where seizures begin gives you the best chance for finding an effective treatment.

MANAGEMENT

Seizure type	*Choice 1*	*Choice 2*	*Choice 3*	*Choice 4*
Simple partial	Carbamazepine (alone/comb.)	Phenytoin	Primidone Lamotrigine Oxcarbazepine Lacosamide	Gabapentin Levetiracetam Zonisamide Tiagabine
Complex partial	Carbamazepine Lamotrigine	Phenytoin	Phenobarbital Zonisamide Oxcarbazepine	Valproic acid Primidone Topiramate* Tiagabine Vigabatrin**
Primary generalized	Valproic acid	Carbamazepine	Phenytoin	Phenobarbital
Tonic-clonic	Lamotrigine	-	Valproic acid	Topiramate Tiagabine
Absence	Lamotrigine* Ethosuximide	Zonisamide Valproic acid	-	-
Myoclonic atonic	Valproic acid	Clonazepam	Zonisamide	Felbamate* (alone/comb.)
Status epilepticus	Diazepam	Phenytoin	Phenobarbital	-
Psychomotor	Phenytoin	-	-	-
Lennox-Gastaut syndrome	Valproic acid Felbamate	Lamotrigine Topiramate Rufinamide	-	-

Work done in Homoeopathy:

HOMOEOPATHIC PERSPECTIVE OF EPILEPSY

Life is the invisible, substantial, intelligent, individual, coordinating power and cause directing and controlling the forces involved in the production and activity of any organism possessing individuality. Health is that balanced condition of the living organism in which the integral, harmonious performance of the vital functions tends to the preservation of the organism and the normal development of the individual. Disease is an abnormal vital process, a changed condition of, life, which is inimical to the true development of the individual and tends to organic dissolution.

INTEREPRETIONS OF THE TERM 'CONSTITUTION'

In Homeopathy, the term constitution seems to be used most frequently when referring to 'constitutional prescribing' to indicate the consideration of a wider, deeper totality than that called for by an acute episode. It is also used to differentiate between 'types' of patients by describing them according to various systems of classification, and in determining common and characteristic symptoms of disease.

Constitutional prescribing is not the same as chronic prescribing, since the patient does not have to exhibit any sign of chronic disease pathology to require a constitutional remedy. Constitutional prescribing does not simply address the present disturbance, but also the past and future. It is treating the patient's susceptibility (which may include the propensity to repeated acutes and any existing chronic disease), by addressing the inner disturbance which gives rise to outward disease symptoms. It treats the

manifest, the previously manifest, and also the potential to manifest. In this sense, it links in to the definition cited by Whitmont above, as does Margery Blackie's statement, 'The constitutional remedy is a picture of the sum total of the strengths and weaknesses of the person, mentally, emotionally and physically. It is in the early undiagnosable stages of illness that we must find the constitutional remedy.
Boger appears to regard the constitution as that which produces the characteristic, as opposed to common, symptoms of the disease. It is perhaps from this standpoint that Whitmont's complaint about a lack of differentiation between constitutional and non-constitutional factors arises.
The idea of constitutional typing arose long before Homœopathy: 'The conception of a patient in terms of healing agent is found even in Paracelsus ... 'stress in our drugs the cure and not the causes because the healing shows us the cause' and has its uses — 'According to the recognition of characteristic traits of a patient in an image of drug actions, one speaks in homœopathy of a lachesis case, of a sulphur man or a phosphorus type. The originally practical therapeutic consideration becomes a fruitful discovery and division principle for constitutions. However, like any model, the conception has also been misused. In Kathleen Priestman's introduction to Borland's Homœopathy in Practice she states, 'It has been found that certain remedies are indicated very frequently, and that many people exhibit symptoms which correspond to the symptom picture or 'drug' picture of each of these remedies. ... Unfortunately, over the years, it has become a common habit for homœopathic doctors to speak of the remedies as if they were the patients and vice versa.'
In Vithoulkas' writing, the term is generally used in the context of its strength (ie. a strong or weak constitution) when describing the response of an individual to morbific influences. He does not appear to advocate any kind of constitutional typing. 'The most important contribution of Hahnemann's exploration into the miasms is the concept that there exist layers of predisposition which underlie the waxing and waning of temporary ailments; these must be taken into account in treatment intending to be completely curative. In such cases, complete cure will take a relatively long time, while the prescriber systematically peels off layer upon layer of predisposing weaknesses by carefully prescribing each remedy based on the totality of symptoms in the moment. Hahnemann's miasms are extended to include all major disease diatheses as well as allopathic drugs and vaccines. However, many people regard Vithoulkas as one of the prime exponents of constitutional typing by remedy, resulting from his method of presenting remedies by their 'essences' and describing them in terms of patient
Constitution (Individual) Characteristic.

1. Emotional sphere
2. Intellectual sphere
3. Physical sphere

SUSCEPTIBILITY:

It is an inherent capacity in all living things to react to stimuli in the environment and represent a fundamental quality that distinguishes the living from non-living. It is the reaction of the organism to external influences.
Different types of roles which is played by it are:

- Maintaince of health.
- Evolution of constitution.
- Development of diathesis.
- Manifestation of disease.

- Process of recovery and cure.
- Evolution of drug picture.
- Manifestation of remedy(remedy reaction)
- Determination of dose and repetition.

SUSCEPTIBILITY AND HEALTH

An organism in perfect balance represents health. This fine balance, even the presence of adverse environmental factors, is a resultant of different processes that are going on within and within which maintain the optimum conditions. This fine regulation is feasible only as long as a normal response follows a given stimulus. This is possible only when the organism exhibits the normal susceptibility. Any change of this normal susceptibility will interfere the normal response. This interference of normal response will denote loss of balance as evidenced by the development of abnormal sensations and functions, which we call disease. As normal susceptibility is essential for the maintenance of health, disease results from the abnormal susceptibility.

SUSCEPTIBILITY AND CONSTITUTION

Constitution is that aggregate of hereditary characters, influenced more or lessby environment, which determines that individual's reaction successful orunsuccessful, or to the stress of environment.Thus a little reflection will readily convince us that the manifestations of thedifferent and hereditary plan or organizations will be determined by susceptibility. The final product, which we perceived by the attributes in the emotional, intellectual and physical spheres, therefore will be determined by susceptibility. Thus the constitutional type is a good measure of the susceptibility within.

SUSCEPTIBILITY AND DISEASE

Any organism is constantly required to adapt itself to its environmental conditions so that harmony is maintained. Thus, an organism is enable to lead a relatively normal life even in the face of adverse conditions. But there are limits to everything and when then limits of tolerance are reached, the process of adaptation also reach a breaking point. This is made known to the person by a feeling of uneasiness, which though vague, is sufficient enough to warn him that all is not well. Normal susceptibility leads to a state of good health characterized by good nutrition and a healthy outlook on life. Abnormal Susceptibility affects them in the first instance and interfere that the process of adaptation and thereby leads to development of disease. Thus signs and symptoms furnish the only indication of abnormal Susceptibility that exists within and of the disease that result.

Vitholkas, eloquently explains, "Once the basis of the health and healing was understood, Hahnemann applied his genius to the question of disease. In § 11 he writes: "when a person falls ill, it is only this spiritual, self acting (automatic) vitalforce, everywhere present in his organism, that is primarily deranged by the influence upon it of a morbific agent inimical to life".

Here we see clearly Hahnemann went far beyond his time, and was even in advance of us today, in stating that not only the disease but also its cause is dynamic. In other words it is not the microbes or the virus or the bacteria, nor even their virulent poisons on the biochemical level that cause disease, but rather their intimate nature, their vital force, their very 'soul'. And that is something "dynamic". Ortega say's: "Hahnemann, being the genius & visionary in medicine, not only established a method & a precise procedure for investigating and applying remedies for this evil of man; he also penetrated deeply

into the most intimate & essential part of our being, seeking by intuition to find the causes; verifying the condition of that perfectly definable & recognizable causal source of the subjacent evil which is inside us & which constitutes the point of departure or beginning of our destruction. Included in this initiative is the concept of the CAUSE-CAUSORUM. This source or germ of suffering & death is positive, demonstrable, & perfectly recognizable. He called it the MIASM.

Man's natural healing power is undoubtedly undermined, caused to deteriorate, and lessened as a restorative or reconstructive force by the presence of miasmatic condition- a profound and indelible stamp permanently imprinted on the being by repeated perversions, excesses or deficiencies in its functioning. The three miasms when combined, present a picture, which is very difficult to cure. Although one of the three miasms is only very active at one time, yet one cannot expect an easy condition during the hours of dominant miasm. We know that psora is universal and it prepares a ground for the other two. Hence it is difficult to find any individual who is either purely sycotic or syphilitic. The combination can be traced in dropsy, anasarca, the formation of large tumours, and various degenerative organic hypertrophies are the products of mixed miasm.

TARENTULA FAMILY

DOCTRINE OF SIGNATURE OF TARENTULA

1. Tarentuia hispania digs a vertical hole in the ground and covers l with the web so that it resembles the surroundings. Thus it lures its unsuspecting prey. Such Is the intelligence of the spider. Tarentula hispania patients are also extremely intelligent to the extend of being foxy and cunning.
2. The spider waits for its prey quietly and when the prey falls into its trap, it pounces on its prey with a sudden and violent attack and quickly goes back into its hole. This violence is seen in tarantula hispana patients in violent movements like twitching jerking and epilepsy. Tremulous violence in mental sphere also.
3. The spiders are well known for their amatory dance. During mating season the male spider dances a around the female.The female select one and kills and eat others. This violence and destructiveness 's seen in tarantula hispania patients also, They are active quick acting and very angry If contradicted. Very aggressive and progressing to a state of tearing clothes. Destructiveness more when he is being observed.
4. Spiders uses their webs to communicate with each other. A long string connects the legs of spiders. But the spider will not get caught in its own web although the strings are sticky. Here also we can see the cunning destructive nature of spider.

   Tarentuia hispania patients are also very cumnning. They know how to get the things they want. They are great manipulators prone to lying and deception- Kleptomania and feigning sickness. Tarentuia hispania patients will often magnify their symptom for secondary gains.
5. Hurried nature of tarentuta hispania patients are attributed to the hurried activity in the nests or tarantula hispanias, Tarantula hispania patients are compelled to move about constantly. Lower extremities are most restless. Tosses about in bed , when he wakeup bed is in complete disarray. Restlessness with anxiety. Apprehension and feels as if something bad will happen. Hurried and annoyed if people in front of them walk slowly. Walks very fast or will often run out of their restless compulsion. Industrious effective and highly productive in their work. Their hurried nature can be attributed to the poison which hyperacceIe rates their nervous system

6. Tarentula hispania migrate annually through a town named tarentum. Spiders got their names tarentula from this town.

Tarentula Hispanica

- **Hispanic**: digs a vertical hole in the ground and covers it with the web so that it resembles the surroundings luring the unsuspecting prey. Such is the intelligence of this spider. Such patients are extremely intelligent to the extent of being foxy and cunning. It pounces on its prey with a sudden and violent attack and quickly goes back into its hole. This violence is seen in patients with violent movements like twitching jerking and epilepsy. During mating season, after an amatory dance, the female spider selects one male spider for mating and kills others. If she does not get the required space after mating, she kills her mating partner. Such is the destructiveness and aggressiveness of T. hispanica.
- hispanica patients know how to get the things they want. They are great manipulators prone to lying and deception.

Hurried nature of T. hispanica patients is attributed to the hurried activity in the nests & to the poison which accelerate their nervous system. T. hispanica patients are compelled to move about constantly. Lower extremities are most restless. Restlessness with great anxiety & apprehension is present. They are industrious and highly productive in their work.

Sphere of Action: Venom has affinity for motor and sensory functions of nervous system resulting in severe restlessness and uncontrollable agitation. It affects the circulatory system and lymphatic leading to congestion, cellulites and lymphadenitis.

Constitution

It has a nervous and hysterical temperament with tendency to chorea. They are manipulative and cunning. It is suited especially to restless patients, and those who are changeable easily; from happiness to melancholy, from calm and gentile behaviour to violence easily.

Leading indications

- Restlessness, can never sit still. Restless mentality and physically, keeps in constant motion even though motion aggravates.
- Sensitive to music/better by music and rhythm, massaging, dancing and rubbing.
- Chorea and involuntary movements. Constant motion of different parts of body with special affinity to right arm and left leg. Movements stops only during sleep.
- Chilly, yet desire for and relieved in open air
- Aversion to colours red green and black
- Hysterical disposition, feigns sickness when observed, better when alone, sudden changes in mood.
- Complaints recur at the same time or period annually
- Hyperesthesia with sudden attacks of chorea
- Nymphomania, increased sexual desire going to a state of mania

Mind

- Hysteria and foxiness when she finds people observing her she feigns all sort of sickness like fainting and other manipulations. Feigning, demeanour, shy but actually very cunning.
- Destructiveness, insanity
- All complaints are relieved by music.

TARENTULA CUBENSIS

Since Tarentula Cubensis is prepared from a decomposed specimen, it has a pyogenic effect on the body which is the main point of differentiation between T. hispanica & T. cubensis.

Leading indications

- Haemotoxic: acts on blood, indicated for malignant suppurative conditions like carbuncles, felons, abscess and anthrax. Most severe types of inflammations and pains are met with by this remedy
- Periodicity: troubles occur at the same time every year
- Atrocious burning and stinging pains, violent, aggravated at night, patient is forced to get up and walk about
- Bluish purple hue of affected parts
- Early and persistent prostration in septic conditions and diphtheria
- Remedy for pains of death, soothes the last struggle
- Pthisis, especially about the genitals.
- Restless feet
- Intermittent fever aggravated at night with septic chills
- Lt sided chorea
- Whooping cough violence with dryness & hoarseness & and rawness of chest. After paroxysm gets out of breath
- Skin: Malignant suppurative conditions like anthrax and carbuncle. Felons, abscess gangrene etc. Red spots and pimples, bluish purple hue of affected parts. Good for carbuncles with atrocious burning pains. Abscess where pain and inflammation predominates, Scirrhus cancer of breast, senile ulcers.

Modalities: Since, they belong to family of spiders, the modalities are quite common.

- **Aggravations:** Periodicity, touch, cold, noise, damp, evening, hands in cold water, after menses and after coitus
- **Ameliorations:** Riding in a carriage, rubbing, relaxation, sweating, rhythmic music, and open air.

THERAPEUTICS

Homeopathy is one of the most popular holistic systems of medicine. Homeopathic medicines have a proven their efficacy in EPILEPSY . It helps by increasing patient's immune response and improving the overall health. Many medicines are proved in EPILEPSY in homoeopathic system but some important medicines are given below:-

MAT MED DRUGS WITH INDICATIONS ARANEA SCINENCIA

Common name ;- grey spider. They do not spin a web and is found on walls.

Indications –

Constant twitching of lower eyelids Eyes Inflamed, weak, watery and swollen Dull, stupid head ache in the postero nferior part of head, Sleepiness Intolerance of warm weather, all symptoms are <ed in a warm room

ARANEUM TELA

Source ; cobweb of black spider Found in cellars and dark spaces.

Leading indication
Symptoms appear suddenly with cool clammy skin
Disposition to sleep
Lowers the frequency of pulse by acting on arterial system
Numbness m hands and legs <ed by rest
Continued chilliness
Periodical diseases in broken down persons,
Cardiac sleeplessness with increased muscular energy could not be kept in bed- Dances and jumps about the room at night
Dry spasmodic asthma, harassing irritating cough.
Periodic head ache with extreme nervous erythism and obstinate intermittent

LATRODECTUS MACTANS
Picture of angina pectoris accompanied by restlessness and prostration
Chilliness especially icy coldness of extremities
Left sided remedy
Severe prostration but patient cannot lie still due to great restlessness
Constricting and cramping pains Heart

LATERODCCTUS KALIPO
Common name – New Zealand spider
Leading indications
Affected area scarlet red with burning and stinging pains
Lassitude and twitching
Pulse slow scarcely more than 12-14/minute
NERVOUS TWITCHING ALL OVER BODY
Intermittent fever, extremities cold and flaccid with cold clammy skin
Lymphangitis, whole area edematous and swollen

LATRODECTUS HASSELL
Common name – new saith water black spider

Leading indications
Chronic blood poisoning, arrests the intense pain in pyeamia
Great oedema of neighbor hood of wounds with paralysis of lower limbs
Constant delusion of flying
Vertigo with tendency to fall forward
Sever violent burning pains/ malignant conditions with pyeamia. Septic states with pain and sleeplessness.

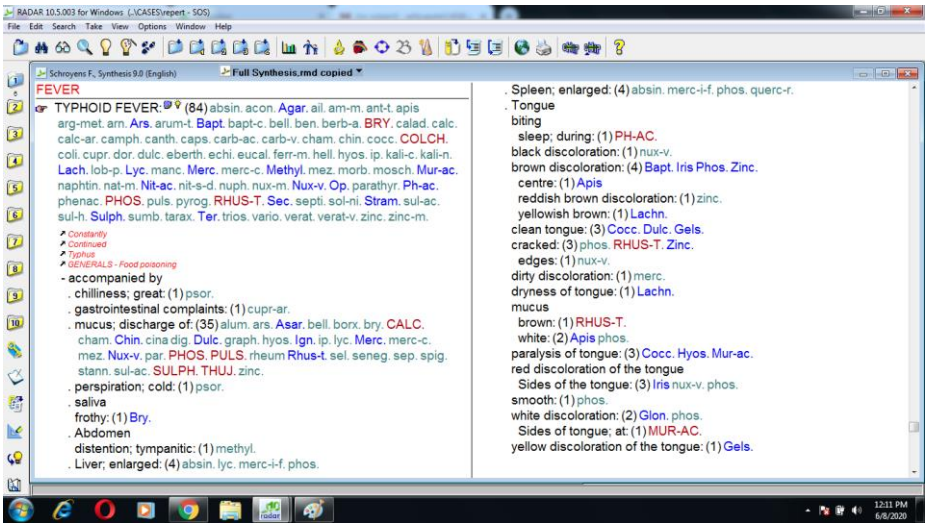
MYGALE LASSIDORA
Common name -Black cuban spider.TINCTURE OF WHOLE SPIDER IS — USED.

Leading indications
Chorea is the most important feature . twitching of facial muscles. Hot flushed face , head jerks to one side. Unsteady gait twitching and jerking of arms and legs. Limbs drag when walking. Words jerked out when an effort is made to speak
Constant motion of whole body , uncontrollable movements of hands and legs usually night
Violent twitching and jerking which stops only during sleep

THERIDION CURASSAVICUM
Common name-orange spider, found in orange tree,

Leading indications
Sensitive to noise , every shrill sound and reverberations penetrates her whole body especially teeth, increases vertigo which then causes nausea
Vertigo with nausea and vomiting on least motion, agg by closing eyes
Inclined to be startled
Time passes too quickly. Desire to occupy himself though he finds peace in nothing.
Aggravation- vibratory motions, w, step and closing eyes
Headache if others walk over the floor, hypersensitive to noise agg from motion
Hysteria, weakness coidness and trembling of whole body
Bites point of tongue during sleep
Constant desire to eat and drink but he does not know what to eat.
Sea sickness of nervous women. They shut their eyes to get rid of the motion of the vessel Traveling and motion sickness
Sensitiveness of spine, hyperasthesia, sits Sideways in a chair toavoid pressure of back of chair against spine.
Pthisis florida – violent stitches high up in the left chest through toback. Oversensitive to all external Impressions esp noise, cracking of paper drives her to despair. Sensitive to light , jar and motion. Sensitive to touch.
Canes and necrosis of bones/ rickets and scrofulous disorders of bones
Pain in left floating ribs, cardiac anxiety and pain.

REPERTORIAL APPROACH
In synthesis repertory-
Repertorium Homoeopathicum Syntheticum is a printed version of RADAR (RAPID AID TO DRUG AIMED RESEARCH).
It was given by Dr. Frederick Schroyens.
Synthesis 9.0/9.1 was published in 2004



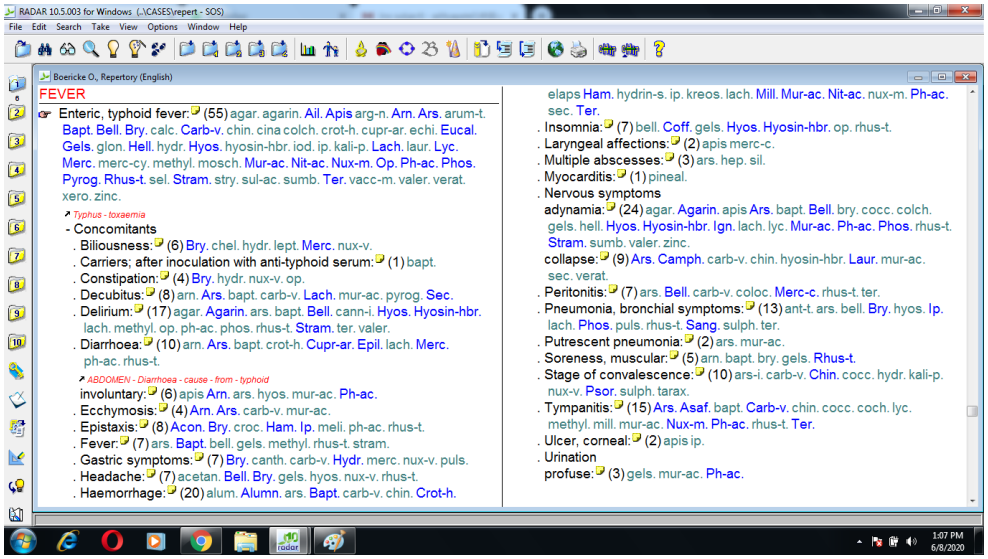
In synthesis repertory, under the rubric EPILEPSY 84 medicines is found.

In Murphy's repertory:-

Given by Robin Murphy was published in year 1993(First edition) and 1996 (Second edition) and 2017(Third revised edition)

Acet-ac, achy., acon., aeth., agar., ail., alum., alumn., am-c., ant-c. Ant-t., anthr., apis, arg. Arg-n., arn., ARS., ars-s-f., ARUM-T., asar., atro., BAPT., bell., bor., BRY., cadm-s., calad., calc., camp., cann-i., canth., caps., carb-ac., carb-an., CARB-V., caust., cham. Chel., CHIN., chin-ar., chin-s., CHLOR., cic., cimic., cina., cocc., COLCH., con., CROT-H., cupr., cupr-ar. Cyt-l., dig., dor., dulc., ECHI. Elaps,eucal. Eup-a.,eup-per., euphr., ferr., ferr-m., ferr-p., GELS., glon, graph., gymn., haem., ham., hell., hep., hydr., hydr-ac., hydrin-s., HYOS., ign., iod., ip., iris, kali-bi., kali-c., kali-m. Kali-n., kali-p., kreos., LACH., lach., laur., lept. Lyc., lycps., maland., mang., MERC., merc-c. Mer-cy., merc-i-r., methyl., mez., mill., mosch., MUR-AC. Nat-m., nat-s., nit-ac., nux-m., oci-s., op., par., petr., ph-ac., PHOS., plan. Plb. Psor., puls., pyrog., rheum. Rhus-g., RHUS-T., rhus-v., sang., sars., sec., sel., seneg. Sep., sil., spig., stann., staph., STRAM., stry., sul-ac., SULPHUR., sumb., tarax., tarent. Ter. Thuj. trio., tub., urt-u. Vac., valer., verat., verat-v., xan., xero, zinc.

BOERICKE REPERTORY



In boericke repertory, under the rubric EPILEPSY 55 medicines is found.

PATIENTS AND METHODS

Study design: The experimental study is made as per the "Randomized controlled clinical trial" method**.**

Study Population:

Study site: G.D. Memorial Homoeopathic Medical College & Hospital, Patna

Study Setting:

- Indoor Patient Department (I.P.D.)
- Outdoor Patient Department (O.P.D.)
- Other sources if possible

Ethical clearance requirement

Itwill be obtained from Ethical committee of the G. D. Memorial Homoeopathic Medical College & Hospital, Patna.

Inclusion criteria

- EPILEPSY coded A01.09 in ICD 10 version 2015 with at least 70% of symptoms.
- Pathological finding with EEG abnormal.
- Study on the EPILEPSY affecting between the age group of 2 to 10 years patients.

Exclusion criteria

- Following patients will not be taken for experiment, as it will affect the perfect outcome of research.
- Patient complicated with other illness including other EPILEPSY, influenza, and other serious diseases.

Sample size Calculation

Minimum 30 patients would be selected starting from 2 to 10 years of age of both sexes. Considering the inclusion criteria mentioned above.

Procedure:

STEP I: Extensive search & study of different books and journals with special reference to Synthesis Repertory.

STEP II: Gather exhaustive information from the Internet according to availability.

STEP III: Selection of 30 patients suffering from EPILEPSY.

STEP IV: Proper case taking will be done according to the standard case-taking Performa.

STEP V: Relevant investigation will be done as per need.

STEP VI: Inclusion and Exclusion Criteria will be fulfilled.

STEP VII: Analysis, Evaluation and Repertorization of the Totality of Symptoms using Synthesis Repertory will be done taking help of Computer- aided (Digital) Repertory.

STEP VIII: Medicine will be selected on the basis of nearest similimum and consultation of materia medica and senior teachers.

STEP IX: Potency, dose and repetition will be strictly arranged following strict Homoeopathic Principle.

STEP X: Follow up of the case at regular interval.

STEP XI: Statistical analysis of the result by using different standard statistical methods (if possible).

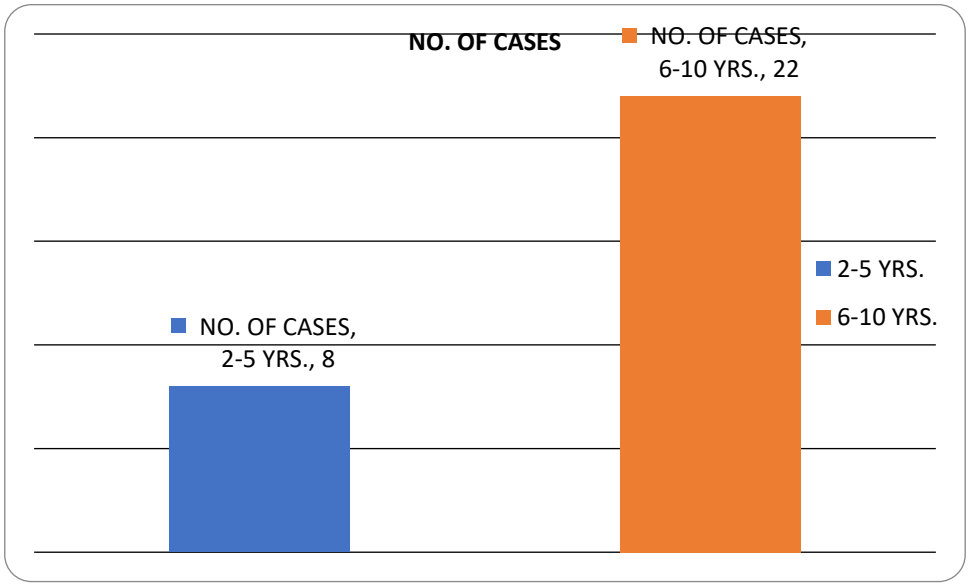
OBSERVATION

Total number of patients included during study of "**A CLINICAL STUDY ON ROLE OF MEDICINES BELONGING TO EPILEPSY FAMILY IN THE CASES OF EPILEPSY**" was 30.Following is the observations noted during the study.

AGE DISTRIBUTION IN THESE CASES

OBSERVATION-1

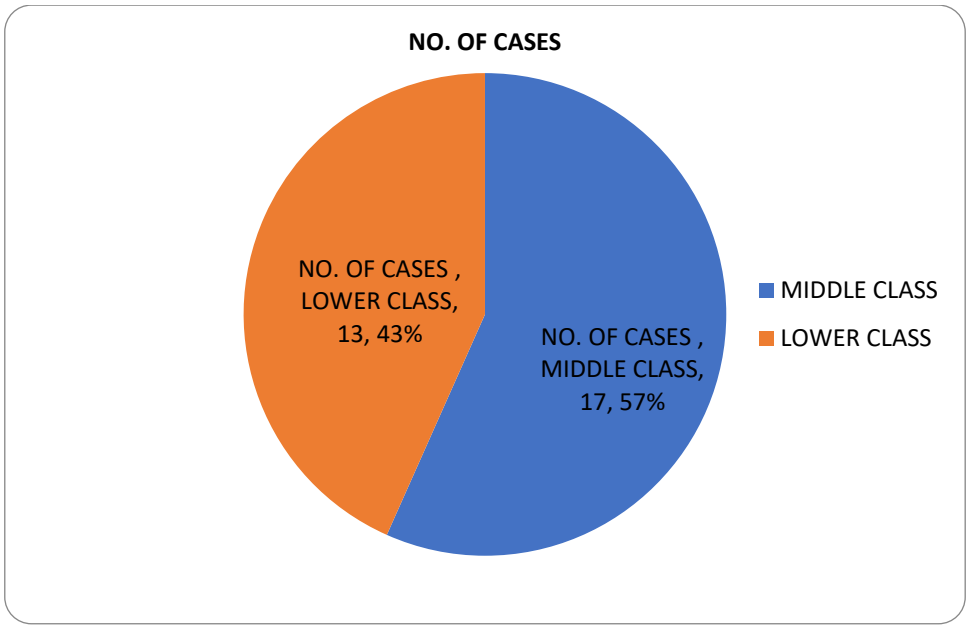
SL. NO.	AGE GROUP	NO. OF CASES	PERCENTAGE
1.	2-5 YRS.	8	26.67%
2.	6-10 YRS.	22	73.33%
TOTAL		30	100%



SOCIO-ECONOMIC STATUS IN THESE CASES

OBSERVATION-2

SL. NO.	SOCIO-ECONOMIC STATUS	NO. OF CASES	PERCENTAGE
1.	MIDDLE CLASS	17	56.67%
2.	LOWER CLASS	13	43.33%
TOTAL		30	100%



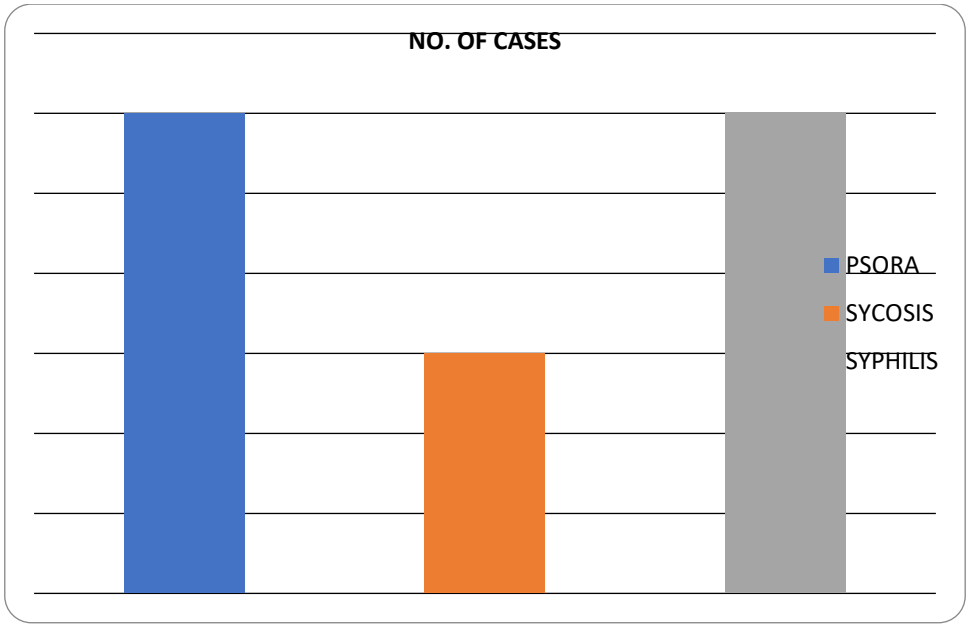
DISTRIBUTION OF HABITATE IN THESE CASES OBSERVATION – 3

SL. NO.	HABITATE	NO. OF CASES	PERCENTAGE
1.	URBAN	02	6.67%
2.	SUB-URBAN	26	86.66%
3.	RURAL	02	6.67%
TOTAL		30	100%

MIASMATIC TENDENCIES IN THESE CASES OBSERVATION – 4

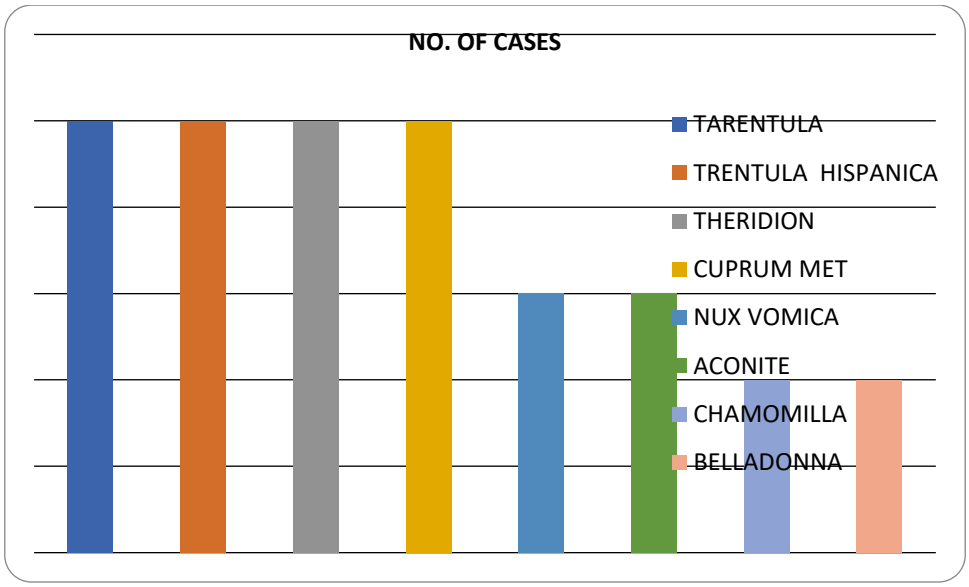
SL. NO.	MIASMETIC PRESENTATION	NO. OF CASES	PERCENTAGE
1.	PSORA	12	40%
2.	SYCOSIS	06	20%

3.	SYPHILIS	12	40%
TOTAL		30	100%



HOMOEOPATHIC REMEDIES USED IN THESE CASES
OBSERVATION - 5

SL. NO.	NAME OF MEDICINE	NO. OF CASES	PERCENTAGE
1.	TARENTULA	5	16.67%
2.	TRENTULA HISPANICA	5	16.67%
3.	THERIDION	5	16.67%
4.	CUPRUM MET	5	16.67%
5.	NUX VOMICA	3	10%
6.	ACONITE	3	10%
7.	CHAMOMILLA	2	6.66%
8.	BELLADONNA	2	6.66%
TOTAL		30	100%

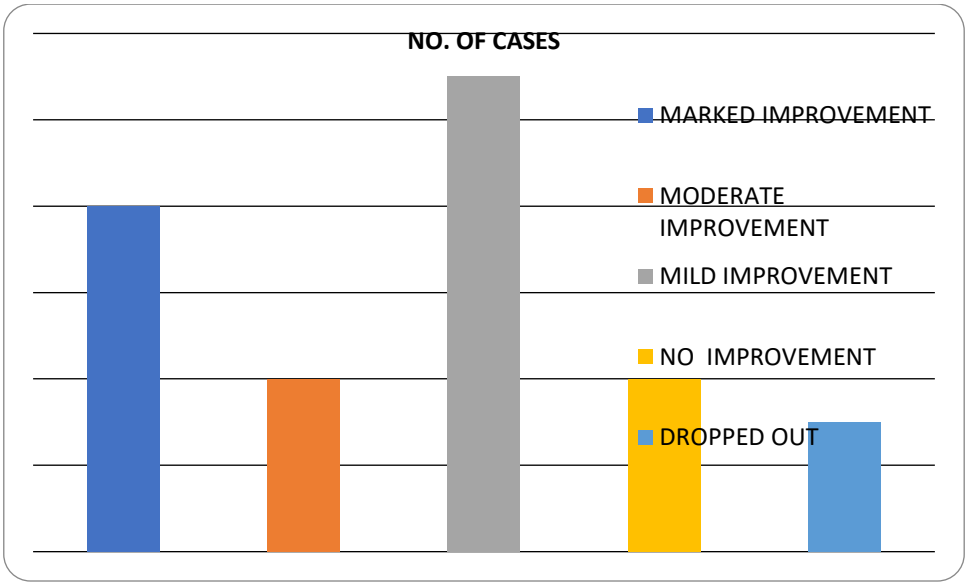


POTENCY USED IN THE CASES
OBSERVATION – 6

SL. NO.	POTENCY USED	NO. OF CASES	PERCENTAGE
1.	1M	2	6.67%
2.	30C	18	60%
3.	200C	10	33.33%
TOTAL		30	100%

RESULT OF HOMOEOPATHIC TREATMENT IN THESE CASES
OBSERVATION-7

SL.NO.	TREATMENT RESULT	NO. OF CASES	PERCENTAGE
1.	MARKED IMPROVEMENT	08	26.67%
2.	MODERATE IMPROVEMENT	04	13.33%
3.	MILD IMPROVEMENT	11	36.67%
4.	NO IMPROVEMENT	04	13.33%
5.	DROPPED OUT	03	10%
TOTAL		30	100%



In my study, Total 30 (100%) cases, 26.67% cases were marked improved, 13.33% cases were moderate improved, 36.67% cases were mild improved, 13.33% cases were no improved and 10% cases were dropped out.

STATISTICAL ANALYSIS OF THE DATA

Chi square test was performed to test the role of medicine belonging to spider groupin the cases of EPILEPSY. Among the five categories of assessment criteria i.e. marked improvement, moderate improvement and mild improvement were taken as positive response or effective and no improvement as well as dropped out was considered as negative response.

Ho: There is no difference in the treatment of EPILEPSY at (5 %) level of significance.

H1: The cure rate of the patient by EPILEPSY at (5%) level of significance.

RESULT OF THE PATIENT

Result	Number of cases	Percentage
Marked Improvement	08	26.67%
Moderate Improvement	04	13.33%
Mild Improvement	11	36.67%
No Improvement	04	13.33%
Dropped Out	03	10%
Total	30	100%

CHI-SQUARE TEST

	CURED (MARKED IMPROVEMENT & IMPROVEMENT)	**NOT CURED (NO IMPROVEMENT & DROPPED OUT)**	**TOTAL**
EXPERMENTAL CASES (MEDICINE)	**20** **E1=19.17**	**O = 5** **E2 = 5.83**	**25**

CONTROL CASES (PLACEBO)	**O = 3 E3 = 3.83**	**O = 2 E4 = 1.17**	**5**
TOTAL	**23**	**7**	**30**

1) DEGREE OF FREEDOM(DF)

DF=(R-1)(C-1) (R = Row, C = Column)

Total calculated value of Row (R)= 2-1=1

Total calculated value Column(C)= 2-1=1

DF=1*1=1

2)**PROBABILITY OF OUTCOME =1/1 = 1**

2) EXPECTED VALUE(E) =

E1= 25*23/30=19.17 (rounded off to two decimals)

E2=25*7/30= 5.83

E3=5*23/30=3.83

E4=5*7/30=1.17 (rounded off to two decimals)

The formula used for the calculation of Expected frequency is:

Row Total*Column Total/Grand Total

Total calculation of E1+E2+E3+E4=30

3) CALCULATION=

O	**E**	**O-E**	**$(O-E)^2$**	**$(O-E)^2 / E$**
20	**19.17**	**0.83**	**0.69**	**0.035**
5	**5.83**	**-0.83**	**0.69**	**0.118**
3	**3.83**	**-0.83**	**0.69**	**0.180**
2	**1.17**	**0.83**	**0.69**	**0.589**

$\chi^2 = \sum (O-E)^2 / E$

$= \sum (20-19.17)^2 / 19.17+(5-5.83)^2 / 5.83+(3-3.83)^2 / 3.83+(2-1.17)^2 / 1.17$

$= \sum (0.035+0.118+0.180+0.589)$

= 0.922 (calculated value)

Value of $\chi^2$from Table for DF = 1 is 3.84

CRITICAL VALUES												
	p value											
DF	**0.25**	**0.20**	**0.15**	**0.10**	**0.05**	**0.025**	**0.02**	**0.01**	**0.005**	**0.0025**	**0.001**	**0.0005**
1	1.32	1.64	2.07	2.71	**3.84**	5.02	5.41	6.63	7.88	9.14	10.83	12.12
2	2.77	3.22	3.79	4.61	5.99	7.38	7.82	9.21	10.60	11.98	13.82	15.20
3	4.11	4.64	5.32	6.25	7.81	9.35	9.84	11.34	12.84	14.32	16.27	17.73
4	5.39	5.59	6.74	7.78	9.49	11.14	11.67	13.23	14.86	16.42	18.47	20.00

5	6.63	7.29	8.12	9.24	11.07	12.83	13.33	15.09	16.75	18.39	20.51	22.11
6	7.84	8.56	9.45	10.64	12.53	14.45	15.03	16.81	13.55	20.25	22.46	24.10
7	9.04	5.80	10.75	12.02	14.07	16.01	16.62	18.48	20.28	22.04	24.32	26.02

Thus, with DF 1 and critical value 0.05 comes out as 3.84, but calculated value is 0.922which is less than 3.84.

Thus –

Calculated value < Critical value

0.922 < 3.84

- **NH is accepted.**
- **AH is rejected.**

- This implies that the values are independent

NULL HYPOTHESIS: EPILEPSY is not fully treated by homoeopathic medicine belonging to tarentula family.

DISCUSSION

The study under discussion was undertaken to show the efficacy of homoeopathic medicines in the treatment of EPILEPSY. The dissertation work is entitled **-"A CLINICAL STUDY ON ROLE OF MEDICINES BELONGING TO SPIDER GROUP IN THE CASES OF EPILEPSY"**, which was in accordance with the objectives of the study. The study encompassed patients from different age groups and socio-economic status. Randomized controlled trail study design was adopted to show the treatment of EPILEPSY.

The prevalence use of homoeopathic medicines, according to age, was found that 2-5 yrs. were 26.67% and 6-10 yrs. were 73.33% respectively.

The prevalence use of homoeopathic medicines, in accordance to income group, 6.67% Urban was found, 86.66% sub urban was found and rural was found 6.67%.

In the first case of Master RAGHAV KUMAR, he was suffering from high grade EPILEPSY with pain in the bodyache since last 15 days with appetite decreased associated with weakness since last 5 days. Symptoms aggravated after taking food. Analysis of case according to totality of symptoms, tarantula 30 was prescribed which improved his condition.

Similarly in the third case of MASTER KUNAL KUMAR, the patient was suffering from He was suffering from EPILEPSY since last 10 days with bodyache since last 7 days. Analysis of case according to totality of symptoms, Tarentula hispanica1M was prescribed which improved his condition.

The gradation of the outcome measures were checked out as marked improvement, moderate improvement, mild improvement, no improvement and dropped out.

Among the 30 cases that were given homoeopathic medicines, 8 were marked improved, 4 were moderate improved, 11 were mildly improved, 4 were no improvement, and 3 were dropped out.

So from the Total 30 (100%) cases, 26.67% cases were marked improved, 13.33% cases were moderate improved, 36.67% cases were mild improved, 13.33% cases were no improved and 10% cases were dropped out.

So from out of 30 cases 23 cases i.e. 77% were success and 7cases i.e. 23% were failure. So, from the above study, we see that the physiological action of tarentula in case of EPILEPSY presenting with twitchig in whole body is effective.

SUMMARY

My dissertation is on the **"A CLINICAL STUDY ON ROLE OF MEDICINES BELONGING TO SPIDER GROUP IN THE CASES OF EPILEPSY"**. Cases selected for the dissertation work were chosen with the help of my guides and senior faculty of my college. It was a fact to experience, that following the concept of the totality of the symptoms, could only bring out a meaningful result as far as patient is concerned.

The cases that have been observed in this dissertation follow the strict principals of Homoeopathy and analysis has been done using Synthesis Repertory in software format from RADAR 10.5.003.

I also experienced, that there are various aggravating factors like some, contaminated food and contaminated water intake, uncooked meat which need to be taken care of. This is because a factors, also from an important constituent of the causations, and proper evaluation needs to be done in this respect. Here the role of our medicine comes into play and it is seen that these cases respond well to homoeopathic medicines. Findings emphasize the need for life-course approach in prevention and management and also the need for focused and targeted programs. The increasing burden of epilepsy in India in coming years due to sociodemographic and epidemiological transition warrants public health community to give priority for this eminently preventable and manageable condition in healthcare delivery. However, a proper understanding of the epidemiology of epilepsy is required to discern and delineate factors that are of relevance (that can be modified) in prevention, management, and rehabilitation. Future studies need to move to nationally representative populations using well-defined methodologies for developing a strong public health response for prevention and control of epilepsy in India.

In my clinical study, it has been observed that the efficacy of homoeopathic medicinesbelonging to spider group in the cases of spider is very good, out of 30 cases cure rate could be achieved in 23 cases. Hence 77% cure effectiveness was achieved with homoeopathic medicines. 4 cases were not improved and 3 cases were dropped out. So I considered 23% cases as failure. This study has shown that the role of homoeopathic medicine belonging to spider group in the cases of spider group is very effective.

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MASTER CHART

SL.	Name of Patient	Sex	Age	O.P.D. No	Religion	Habitat	Date	Remedy	Status	Miasm	Result
1	Raghav Mishra	M	9 yrs	23180	H	SU	04.08.19	Tarentula-30	MC	Psoric	Moderate Improvement

2	Ajeet kumar	M	6 yrs	23814	H	U	12.08.19	Tarentula Hispanica 30	LC	Sycotic	Mild Improvement
3	Kunal Kumar	M	8 yrs	23983	H	SU	18.08.19	Therideon	MC	Psoric	Mild Improvement
4	Vicky Choudhari	M	7 yrs	24000	H	SU	24.08.19	Nux Vomica 200	MC	Syphilitic	Marked Improvement
5	Ajita	F	5 yrs	315	H	SU	28.08.19	Cuprum met 200	MC	Sycotic	Marked Improvement
6	Madhav Pandit	M	10 yrs	34	H	SU	1.09.19	Tarentula -30	LC	Syphilitic	Marked Improvement
7	Bablu Kumar	M	3 yrs	132	H	SU	8.09.19	Tarentula Hispanica 30	MC	Sycotic	Marked improvement
8	Lav Kumar	M	4 yrs	141	H	SU	14.09.19	Theridion 200	LC	Psoric	No Improvement
9	Pooja	F	9 yrs	355	H	SU	19.09.19	Tarentula 1M	LC	Sycotic	Marked Improvement
10	Mukesh	M	7 yrs	299	H	SU	27.09.19	Tarentula Hispanica 200	MC	Psoric	Mild Improvement
11	Raju	M	8 yrs	356	H	SU	07.10.19	Tarentula 200	MC	Psoric	Mild Improvement
12	Rohit Kumar	M	5 yrs	595	H	SU	14.10.19	Tarentula Hispanica 30	MC	Sycotic	No Improvement
13	Gunjan Yadav	F	4 yrs	897	H	SU	16.10.19	Theridion 200	LC	Psoric	Marked Improvement
14	Kajal Kumari	F	7 yrs	4041	H	SU	23.10.19	Placebo 200	MC	Syphilitic	Mild Improvement
15	Anshu Kumari	F	10yrs	3982	H	SU	02.11.19	Pulsatilla 30	MC	Sycotic	Moderate Improvement
SL.		**Sex**	**Age**	**O.P.D. No**	**Religion**	**Habitat**	**Date**	**Remedy**	**Status**	**Miasm**	**Result**
16	Kajal Verma	F	8 yrs	4043	H	Rural	11.11.19	Tarentula 30	LC	Syphilitic	Dropped out

17	Geeta Devi	F	9 yrs	4109	H	SU	28.11.19	Nux vomica200	MC	Sycotic	No Improvement
18	Dheeraj Pandit	M	7 yrs	4142	H	SU	30.11.19	Tarentula Hispanica 30	MC	Psoric	Mild Improvement
19	Shanti Devi	F	4yrs	4170	H	SU	10.12.19	Theridion 30	LC	Sycotic	Mild Improvement
20	Bhanu Pratap	M	7 yrs	3508	H	SU	15.12.19	Cuprum met 200	LC	Psoric	Mild Improvement
21	Kalpana Kumari	F	8yrs	3528	H	SU	03.01.20	Nux vomica 30	MC	Sycotic	Mild Improvement
22	Prashant Kumar	M	10 yrs	3560	H	SU	10.01.20	Theridion 1M	LC	Syphilitic	Marked Improvement
23	Akash Kumar	M	8 yrs	3399	H	SU	17.01.20	Nux vomica 30	LC	Sycotic	MarkedImprovement
24	Deepak Kumar	M	5 yrs	3440	H	SU	22.01.20	Cuprum met 30	MC	Psoric	Moderate Improvement
25	Virendra Prasad	M	7 yrs	3457	H	SU	27.01.20	Cuprum met 200	MC	Psoric	Mildd Improvement
26	Sunaina Devi	F	10 yrs	3513	H	SU	02.02.20	Aconite 30	LC	Psoric	Mild Improvement
27	Kalpana Devi	M	8 yrs	3528	H	R	06.02.20	Theridion 30	MC	Sycotic	No improvement
28	Lalita Devi	F	7 yrs	3340	H	SU	11.02.20	Cuprum met 200	MC	Syphilitic	Dropped out
29	Neha Kumari	F	7 yrs	3369	H	SU	26.02.20	Nux vomica.200	LC	Sycotic	Marked Improvement
30	Bablu Kumar	M	7 yrs	3484	H	SU	28.02.20	Cuprum met30	LC	Psoric	Mild improvement

Role of Homoeopathic Drugs in the Cases of Uterine Fibroids with Repertorial Analysis

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Abstract- Homeopathy is becoming increasingly popular in whole of the world. Now it is time to prove to the world what homeopathy can offer in surgical diseases. Homeopathic medicines cannot take the place of surgery but can be of great help to the patients, which do not want to go for surgery or cannot be operated upon due to various medical reasons. It is also ideal for underdeveloped and developing countries where financial factor play a major role in deciding the options for treatment. Homeopathic treatment for uterine fibroids can be very efficient and, in many cases, may be the only treatment you will ever need to get healthy again. The patients were assessed on the basis changes in the symptoms during the period of few weeks. In homoeopathic treatment we must observe symptoms of patients. There are some common symptoms of Fibroid:

- **Heavy uterine bleeding.**
- **Prolonged uterine bleeding during menstruation.**
- **Miscarriage**
- **Frequent or irregular periods.**
- **Frequent urination**
- **Pain during intercourse**
- **Backache**
- **Constipation**
- **Non cyclic pelvic pain.**
- **Cramps during menstrual periods.**
- **Weight gain.**

Keywords-Homoeopathy, uterine fibroid, myomas, true surgical diseases, similimum

INTRODUCTION

Uterine fibroids are benign tumors that originate in the uterus (womb). Although they are composed of the same smooth muscle fibers as the uterine wall (myometrium), they are much denser than normal myometrium. Uterine fibroids are usually round.

Types of Fibroids:
1.Intramural fibroids, the most common, grow in the wall of the uterus.
2.Sub serosal fibroids grow on the outside of the uterus. As they grow larger, they can cause pain due to their size or pressure put on nearby organs.
3.Submucosal fibroids grow just underneath the uterine lining and can crowd into the uterus cavity and lead to heavy bleeding and other more serious complications.
4.Pedunculated fibroids grow on small stalks inside or outside the uterus.

AIM AND OBJECTIVES

1.To ascertain the efficacy of homoeopathic medicines in the treatment of the case of UTERINE FIBROID.
2.To assess the utility of repertory in the treatment of the case of UTERINE FIBROID.
3.To establish the miasmatic influence in the case of UTERINE FIBROID.
4.Top used Homeopathy medicine for Fibroid Treatment

- Ammonium Carbonicum: It is another homeopathic medicine used for controlling fibroid problem. When blood looks black in color, clotted and extremely profuse during menstrual time at that time this medicine works as a wonder spell. This medicine also works effective for treating extreme pain in thighs during menorrhagia.
- Kali Carbonicum: Kali Carbonicum is best relief in case when bleeding from uterus continues for too long period and when it causes back pain.
- Ferrum Metallicum: Ferrum Metallicum is one such medicine, which is use for controlling excessive bleeding from uterus due to fibroid. This medicine has shown its best result in case

when there is excessive blood of pale and watery character flow from uterus.

- Ipecacuanha: It is another homeopathic remedy work effectively in case of fibroids for treating menorrhagia cases.
- Cinchona Officinalis and Ferrum Phosphoricum: Both Cinchona officinalis and Ferrum phosphoricum are excellent homeopathic medicines for curing fibroid in patients with anemia. It helps in improving the hemoglobin count in women who are suffering from fibroid. This medicine is a wonder spell for those women whose hemoglobin count have excessively went down due to extreme loss of blood and anemia.
- China Officinalis and Ferrum Met: Both are two well recognized Homeopathic medicines for successfully treating uterine fibroids where symptoms include heavy bleeding and Thalapsi Bursa Pastoris – Effective Homeopathic medicine for uterine fibroids with prolonged menses. Thalapsi Bursa is one of the top-grade Homeopathic medicines for treating uterine fibroids with prolonged menses. The menses continue for 10-15 days. Manses appear very frequently as well. The next menstrual cycle appears even before recovery from the periods has occurred. Menstrual bleeding is profuse, with the presence of large clots. Violent uterine colic during menses may also arise. Cramping pain in the uterus during menstruation in uterine fibroids cases is also suggestive of use of Thalapsi Bursa Pastoris.
- Calcarea Carb: Useful Homeopathic medicine for treating heavy periods from uterine fibroids. Calcarea Carb is a very useful Homeopathic medicine for treating heavy periods from uterine fibroids. Manses continue for long and may even appear early. Vertigo during menses may arise. Leucorrhea of thick, milky or yellow color is another complaint that may attend.
- Belladonna and Sepia Officinalis: Best Homeopathic medicines for uterine fibroids where menses are painful. Belladonna and Sepia Officinalis are well indicated Homeopathic medicines for uterine fibroids where the menses are painful. Belladonna is best prescribed where there is cramping pain in the uterus during menses, the menses are bright red in color and profuse. Use of Sepia Officinalis is recommended in case of griping, burning or bearing down pains during menses. menses start early and are quite copious. Fainting and chilliness during menses may attend. Homeopathic medicine Sepia Officinalis is also indicated for treating painful intercourse in uterine fibroids cases.
- Ustilago Maydis: Suitable Homeopathic medicine for uterine fibroids with dark menstrual bleeding. Ustilago Maydis is a highly suitable Homeopathic medicine for uterine fibroids where menstrual bleeding is dark. Clots may also be present in menstrual blood. Uterine bleeding may be stringy in nature.
- Sabina Officinalis: Homeopathic medicine for uterine fibroids where clots pass with menstrual blood. In case of menstrual bleeding with clots in uterine fibroid cases, Sabina Officinalis is a significant Homeopathic medicine. The slightest motion increases menstrual bleeding. Pain from sacrum to pubis is another attending feature. During menses, pain in uterus may be present that gets better by lying on the back. Uterine pain may extend to the thighs. Other symptoms include foul, acrid, corrosive, yellow leucorrhea.
- Fraxinus Americana: Excellent Homeopathic medicine for uterine fibroids with bearing down sensation. Fraxinus Americana is a top-grade Homeopathic medicine for uterine fibroids which is mostly recommended when the major indicating feature is a bearing down sensation in the pelvis from uterine fibroid.
- Thuja Occidentalis: Thuja is also excellent for treating pressure symptoms of urinary bladder by the fibroid, the patient complaint of difficulty in empty the whole bladder at one time. Patient having heavy metrorrhagia with heavy anemia.
- Trillium Pendulum and Kali Carbonicum: Wonderful Homeopathic medicine for uterine fibroids with back pain during menses. In uterine fibroid cases with back pain during the menstrual cycle, Homeopathic medicine Trillium Pendulum comes highly recommended. The pain may radiate to the hips from the back during menses. Tight binding of the back and hips provides relief. Menstrual bleeding is bright red and gushing. The slightest movement worsens uterine bleeding. Trillium Pendulum is also indicated for inter-menstrual bleeding every two weeks. Another attending feature is faintness from uterine bleeding. Homeopathic medicine Kali Carbonicum is

selected when there is violent back pain during menses. The pain gets better from sitting and pressure. The menstrual flow is also copious.

- Erigeron Canadensis: Homeopathic medicine for frequent urination in case of uterine fibroids.
- Sabina: Homeopathic Medicine for Uterine Fibroids causing labour-like pains in groin area, Sabina is the next significant Homeopathic medicine on the list for Fibroids in uterus. The key symptom for Sabina use is profuse, partly fluid and partly clotted menstrual bleeding. Based on this specific symptom I have found numerous Fibroids cases recovering wonderfully well under prescription of Sabina. Other symptoms are gushing uterine bleeding, increase of bleeding from slight motion and offensiveness in blood. Another characteristic symptom is pain from sacrum (small of back) to pubes during periods. Labour-like pains may also be present in sacrum and groin region during menses.
- Phosphorus, Lachesis and Ustilago: Top Rated Homeopathic Medicines for Uterine Fibroids, Homeopathic medicines Phosphorus, Lachesis and Ustilago are also know natural cures of Uterine Fibroids. The character of blood during the menstrual cycles decides which of the three to prescribe.

MATERIAL & METHODOLOGY

Material

1.Project site - Proposed study was undertaken at OPD/IPD/ Peripheral OPD of Sagar Homoeopathic Medical college Sagar.

2.Number of cases - 05 cases were included in the study.

3.Duration of study - The study was undertaken for a period of 12 months.

4.Procuring of medicine - Medicine were dispensed from the dispensing unit of Sagar Homoeopathic Medical College Sagar (M.P.)

Methodology:

1.Selection of cases: Selection of cases was done by random sampling method.

2.Inclusion criteria: Diagnosed/undiagnosed cases of Uterine Fibroid were included, irrespective of their age, caste, religion & duration of illness.

3.Exclusion Criteria: The cases without proper follow up were excluded from the study.

4.Diagnostic Criteria: The detailed case taking & clinical examination was carried out to clinch the diagnosis were advised as and when found necessary.

5.Case taking proforma: A case taking proforma was especially designed for the study with the approval of the guide.

6.Case taking: Detailed case taking has been done following Homoeopathic principles.

7.Analysis & Evaluation: Analysis & Evaluation of the symptoms was done according to the Homoeopathic principles.

8.Repertorization: Repertorization was done by using the repertory according to nature of the case.

9.Selection of Medicine: Selection of the medicine was done on the basis of Repertorial Analysis and Concept of totality.

10.Selection of Dose & Potency: Selection of dose & potency was done following Homoeopathic principles.

11.Follow up: Follow-up the cases were done till the establishments of cure.

12.Record: The patient's records were maintained to draw the conclusion.

13.Results: Following parameters were fixed according to the type of the response obtained after the treatment.

- Cure: Feeling of mental & Physical well-being with disappearance of all signs & symptoms for which patient initially approached, without any relapse.
- Improvement: Feeling of mental and physical well-being with relief in all signs and symptoms for which the patient initially approached.
- Status quo: No change in any complaint of the patient in spite of taking the medicine for a period of time.
- Worse: When there is increase in the symptoms, sign and disease continues with its pace and patient gets worse with passage of time.

CASE-1

Patient's Name	ABC
Age	49 Year
Sex	Female
Occupation	Housewife
Education	10th
Marital status	Married
Religion	Hindu

- PRESENT COMPLAINS: Metrorrhagia, Stitches pain in the nipple, itching around the

pudenda, menses is too late and scanty, Milky white leucorrhea

- CHIEF COMPLAINTS: Uterine Fibroid
- MODALTIES: Aggravation – Lying down
  Amelioration – While moving
- PAST TREATMENT HISTORY: NAD
- PAST HISTORY: NAD
- FAMILY HISTORY: Mother was also suffered from uterine fibroid

PERSONAL HISTORY	
Appetite	Normal
Thirst	Decrease
Desire	Salty
Aversion	Sweets
Stool	Constipation
PHYSICAL EXAMINATION	
B.P.	130/80 mm Hg
Respiratory Rate	14/min
Pulse	80/min

OBSERVATORY SYMPTOMS:

- Skin: Enlarged glands

REPERTORIAL RESULT
Conium mac

MENTAL SYMPTOMS: Indifferent

TOTALITY OF SYMPTOMS:

- Metrorrhagia
- Stitches pain in the nipple
- Itching around the pudenda
- Menses is too late and scanty
- Milky white leucorrhea

MIASMATIC DIAGNOSIS – Sycotic		
DIAGNOSIS	Uterine Fibroid	
TOTALITY OF RUBRICS		
Genitalia	Metrorrhagia	P No. 730 (R)
Chest	Pain,stiching,mammae	P No. 866 (R)
	Itching,vagina	P. No. 720 (R)
Genitalia	Menses,scanty	P. No. 728 (L)
Genitalia	Leucorrhoea,milky	P. No. 722 (R)

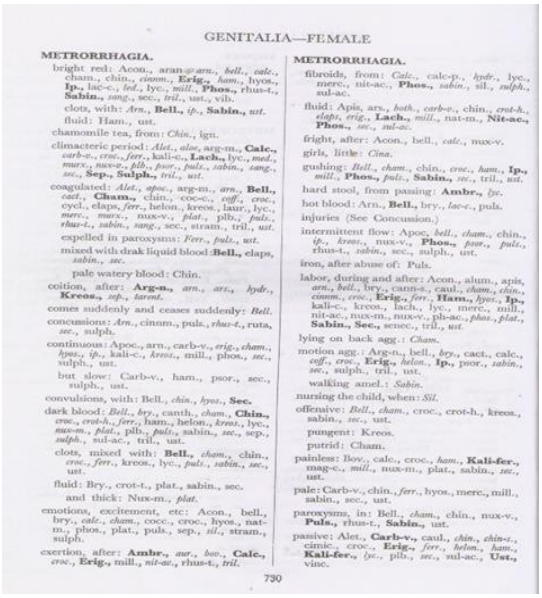
REPERTORIAL CALCULATION
Conium mac- 12/5
Cal fl-7/5
Apis-7/5

CASE FOLLOW UP SHEET

Date	Symptoms	Treatments
	Metrorrhagia	Conium mac 30 OD
	Delayed with scanty menses	Placebo 30 for 1o Days
10.02.17	Milky white leucorrhoea	
	Metrorrhagia	Conium mac 30 Singal Dose
20.02.17	Relief in pain in mammae	
07.03.17	Metrorrhagia	Hydrocotyle 200 One Dose Placebo 30 OD for 10 days
09.03.17	Pateint Feel Healthy	Placebo 30 OD
	All symptoms removed and patient feel healthy	

MASTER CHART

S.No.	IPD/OPD No.	Name	Age	Sex	Address	Marital Status	Religion	Prescription	Result
1	2854	ABC	49	F	Semra Sagar	Married	Hindu	Hydrocotyle 200	Cured
2	5140	DEF	52	F	Sadar Sagar	Married	Hindu	Cal carb 200	Improved
3	7033	GHI	43	F	Makroina Sagar	Married	Hindu	Phos 200	Cured
4	14114	JKL	49	F	Bahubali Sagar	Married	Hindu	Thuja 30	Cured
5	22624	MNO	40	F	Kapuriya Sagar	Married	Hindu	Cal carb 200	Cured



GENITALIA—FEMALE

METRORRHAGIA.

bright red: Acon., aran-a., arn., bell., calc., cham., chin., cinnm., **Erig.**, ham., hyos., **Ip.**, lac-c., led., lyc., mill., **Phos.**, rhus-t., **Sabin.**, sang., sec., tril., ust., vib.

clots, with: *Arn.*, **Bell.**, *ip.*, **Sabin.**, *ust.*

fluid: Ham., ust.

chamomile tea, from: *Chin.*, ign.

climacteric period: *Alet.*, aloe, arg-n., **Calc.**, *carb-a., croc., ferr.*, kali-c., **Lach.**, lyc., *med., murx., nux-v., plb., psor., puls., sabin., sang., sec.*, **Sep.**, **Sulph.**, *tril., ust.*

coagulated: *Alet., apoc.*, arg-n., *arn.*, **Bell.**, *cact.*, **Cham.**, chin., coc-c., *coff., croc.*, cycl., elaps, *ferr.*, helon., kreos., laur., lyc., *merc., murx.*, nux-v., *plat.*, plb., *puls., rhus-t., sabin., sang.*, sec., stram., tril., *ust.*

expelled in paroxysms: *Ferr., puls., ust.*

mixed with drak liquid blood: **Bell.**, elaps, *sabin., sec.*

pale watery blood: Chin.

coition, after: **Arg-n.**, *arn., ars., hydr.*, **Kreos.**, *sep., tarent.*

comes suddenly and ceases suddenly: *Bell.*

concussion: *Arn.*, cinnm., puls., *rhus-t.*, ruta, *sec.*, sulph.

continuous: Apoc., arn., carb-v., *erig., cham., hyos., ip.*, kali-c., *kreos.*, mill., phos., *sec.*, sulph., ust.

but slow: Carb-v., ham., psor., sec., sulph., ust.

convulsions, with: Bell., *chin., hyos.*, **Sec.**

dark blood: *Bell., bry.*, canth., *cham.*, **Chin.**, *croc., crot-h., ferr.*, ham., helon., *kreos.*, lyc., *nux-m., plat.*, plb., *puls.*, sabin., *sec.*, sep., *sulph.*, sul-ac., tril., ust.

clots, mixed with: **Bell.**, *cham.*, chin., *croc., ferr.*, kreos., lyc., *puls., sabin., sec.*, ust.

fluid: Bry., crot-t., plat., sabin., sec.

and thick: Nux-m., *plat.*

emotions, excitement, etc: Acon., bell., bry., *calc., cham.*, cocc., croc., hyos., nat-m., phos., plat., puls., sep., *sil.*, stram., sulph.

exertion, after: **Ambr.**, *aur., bov.*, **Calc.**, *croc.*, **Erig.**, mill., *nit-ac.*, rhus-t., *tril.*

METRORRHAGIA.

fibroids, from: *Calc.*, calc-p., *hydr.*, lyc., merc., nit-ac., **Phos.**, *sabin.*, sil., *sulph.*, sul-ac.

fluid: Apis, ars., *bell.*, *carb-a.*, chin., *crot-h., elaps, erig.*, **Lach.**, *mill.*, nat-m., **Nit-ac.**, **Phos.**, *sec., sul-ac.*

fright, after: Acon., bell., *calc.*, nux-v.

girls, little: *Cina.*

gushing: *Bell., cham.*, chin., *croc., ham.*, **Ip.**, *mill.*, **Phos.**, *puls.*, **Sabin.**, *sec.*, tril., *ust.*

hard stool, from passing: **Ambr.**, *lyc.*

hot blood: Arn., **Bell.**, bry., *lac-c.*, puls.

injuries (See Concussion.)

intermittent flow: Apoc, *bell., cham.*, chin., *ip., kreo.*, nux-v., **Phos.**, *psor., puls.*, rhus-t., *sabin.*, sec., sulph., ust.

iron, after abuse of: Puls.

labor, during and after: Acon., alum., apis, *arn., bell.*, bry., cann-s., caul., *cham., chin., cinnm., croc.*, **Erig.**, *ferr.*, **Ham.**, *hyos.*, **Ip.**, kali-c., kreos., lach., lyc., merc., mill., nit-ac., nux-m., nux-v., ph-ac., *phos., plat.*, **Sabin.**, **Sec.**, senec., tril., *ust.*

lying on back agg.: *Cham.*

motion agg.: Arg-n., bell., *bry.*, cact., calc., *coff., croc.*, **Erig.**, *helon.*, **Ip.**, psor., *sabin., sec.*, sulph., tril., ust.

walking amel.: *Sabin.*

nursing the child, when: *Sil.*

offensive: *Bell., cham.*, croc., crot-h., kreos., sabin., *sec.*, ust.

pungent: Kreos.

putrid: Cham.

painless: Bov., calc., croc., *ham.*, **Kali-fer.**, mag-c., *mill.*, nux-m., plat., sabin., *sec.*, ust.

pale: Carb-v., chin., *ferr.*, hyos., merc., mill., sabin., sec., ust.

paroxysms, in: Bell., *cham.*, chin., nux-v., **Puls.**, rhus-t., **Sabin.**, ust.

passive: Alet., **Carb-v.**, caul., *chin., chin-s.*, cimic., croc., **Erig.**, *ferr., helon., ham.*, **Kali-fer.**, *lyc.*, pib., *sec.*, sul-ac., **Ust.**, vinc.

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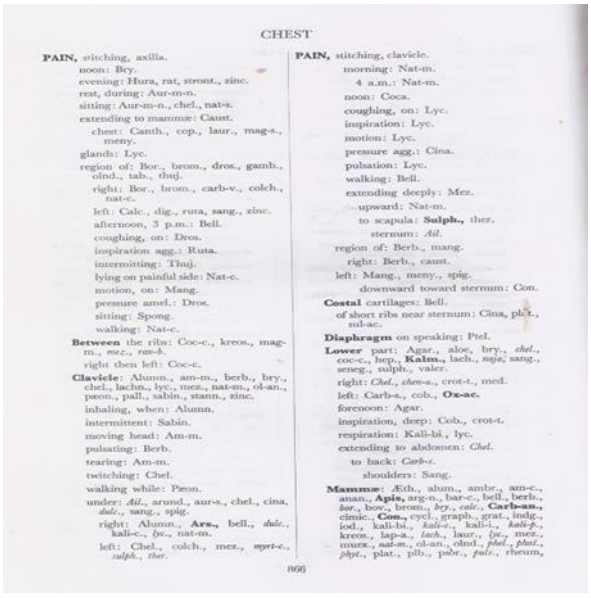

CHEST

PAIN, stitching, axilla.

noon: Bry.

evening: Hura, rat, stront., zinc.

rest, during: Aur-m-n.

sitting: Aur-m-n., chel., nat-s.

extending to mammæ: Caust.

chest: Canth., cop., laur., mag-s., meny.

glands: Lyc.

region of: Bor., brom., dros., gamb., olnd., tab., thuj.

right: Bor., brom., carb-v., colch., nat-c.

left: Calc., dig., ruta, sang., zinc.

afternoon, 3 p.m.: Bell.

coughing, on: Dros.

inspiration agg.: Ruta.

intermitting: Thuj.

lying on painful side: Nat-c.

motion, on: Mang.

pressure amel.: Dros.

sitting: Spong.

walking: Nat-c.

Between the ribs: Coc-c., kreos., mag-m., *sec., sus-b.*

right then left: Coc-c.

Clavicle: Alumn., am-m., berb., bry., chel., lachn., lyc., mez., nat-m., ol-an., paeon., pall., sabin., stann., zinc.

inhaling, when: Alumn.

intermittent: Sabin.

moving head: Am-m.

pulsating: Berb.

tearing: Am-m.

twitching: Chel.

walking while: Paeon.

under: *Ail.*, arund., aur-s., chel., cina, *dulc.*, sang., spig.

right: Alumn., **Ars.**, bell., *dulc.*, kali-c., *lyc.*, nat-m.

left: Chel., colch., mez., *myrt-c., sulph., ther.*

PAIN, stitching, clavicle.

morning: Nat-m.

4 a.m.: Nat-m.

noon: Coca.

coughing, on: Lyc.

inspiration: Lyc.

motion: Lyc.

pressure agg.: Cina.

pulsation: Lyc.

walking: Bell.

extending deeply: Mez.

upward: Nat-m.

to scapula: **Sulph.**, ther.

sternum: *Ail.*

region of: Berb., mang.

right: Berb., caust.

left: Mang., meny., spig.

downward toward sternum: Con.

Costal cartilages: Bell.

of short ribs near sternum: Cina, plb., sul-ac.

Diaphragm on speaking: Ptel.

Lower part: Agar., aloe, bry., *chel.*, coc-c., hep., **Kalm.**, lach., *naja*, sang., senec., sulph., valer.

right: *Chel., chen-a.*, crot-t., med.

left: Carb-a., cob., **Ox-ac.**

forenoon: Agar.

inspiration, deep: Cob., crot-t.

respiration: Kali-bi., lyc.

extending to abdomen: *Chel.*

to back: *Carb-s.*

shoulders: Sang.

Mammæ: Æth., alum., ambr., am-c., anan., **Apis,** arg-n., bar-c., bell., berb., *bor.*, bov., brom., *bry., calc.*, **Carb-an.**, cimic., **Con.**, cycl., graph., grat., indg., iod., kali-bi., *kali-c.*, kali-i., *kali-p.*, kreos., lap-a., *lach.*, laur., *lyc.*, mez., murx., *nat-m.*, ol-an., olnd., *phel., phos., phyt.*, plat., plb., *psor., puls.*, rheum,

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DISCUSSION, SUMMARY AND CONCLUSION

The study "Role of homoeopathic in the cases of uterine fibroid with repertorial analysis" was undertaken keeping in view of the gravity, incidence, morbidity and probable solutions to counter this clinical experience. Present study was undertaken to assess the clinical sign and symptoms. After careful repertorization homoeopathic medicine was prescribed on the basis of on totality of symptomatic medicine which was prescribed on the basis of totality of symptoms. The study was limited to 10 patients, the selection of whom was based over the criteria fixed at the outset. The cases were diagnosed clinically as having Elephantiasis. and were randomly selected from the outpatient department of repertory, Sagar Homoeopathic Medical College, Sagar (M.P.) Clinical experience in case of Elephantiasis.

Age: The incidence increases above the age of 20 to 50 presentation is usually in the 50s.
Sex: Female.
Weight: This is more common in fatty female.
Geographically: Uterine fibroid is present uniformly all over the world.
Diet: No specific.
Drugs: Immunosuppressive drug and hormonal drugs cause higher incidence of uterine fibroid.
Locations: In uterus.
Character of uterine fibroid:
The first symptom is usually fever irregular and painful menstrual period and abdominal pain.
Back pain.
Frequency in urinating.
Constipation and distended abdomen.

Miasm
Elephantiasis cover Sycotic Miasm and psoric background.
Indicated Medicine: The treatment of uterine fibroid was based on totality of symptoms according to which Silicea, thuja carb belladonna sepia Phos. & proved to be the most effective medicine.
Potency: The maximum effective potency is 30,200.
Result: In this study of 05 Cases 1 cases are Improved and 5 is cured.

Summary: The study "Role of homoeopathic drugs in cases of the uterine fibroid with repertorial analysis'' was undertaking with following objects to ascertation the efficacy of homoeopathic medicines in the treatment of the case of Uterine fibroid, to assess the utility of repertory in the treatment of the case of uterine fibroid., To establish the miasmatic influence in the case of Uterine fibroid., To establish the repertorial construction in the case of uterine fibroid. The study was undertaken for a period of one year in O.P.D./I.P. D of Sagar Homoeopathic Medical College Hospital & Research Center, Sagar (M.P.), 10 Cases of Uterine fibroids were selected for study. The case history was taking on a proforma specially prepared for the study. Presenting symptoms and clinical examination were carried out to diagnosis the patient suffering from Uterine fibroid. After detailed case taking, repertorization by done using Kent's repertory. Medicines were prescribed on the basis of repertorial analysis and concept of totality of medicine and were dispensed from hospital dispensary. Follow up of the cases were taken periodically as per gravity of disease ranging from 1 to 2 months. following salient

features have evolved from the study: It is specially in Female at the age between 20 to 50 years. The great majority of cases occur in Low socio economic persons. The uterine fibroid more comment in fatty female. Most commonly found in the age of 50 year. The Uterine fibroid have covered the Sycotic miasm. The effective remedy is Silicea, thuja, calcarea carb, Phosphorus, belladonna, sepia. The maximum effective potency is 30 and 200. A thorough study of 10 cases was done in 12 months duration, where each case was studied on the basis of totality of symptoms in an unbiased manner. This establishes the superiority of homoeopathic system of treatment in cases of Uterine fibroid.

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A STUDY IN PATIENTS OF LAPAROSCOPIC MEDIAN ARCUATE LIGAMENT RELEASE

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AIM- To study pre-operative and post-operative management of patients of laparoscopic median arcuate ligament release

METHOD- A study of 10 patients presented in surgical OPD of tertiary care hospital of radiologically proven median arcuate ligament syndrome over a period of 12 months. Patients requiring surgery were selected for the study. All the patients underwent laparoscopic Median arcuate ligament release. Post-operatively celiac artery doppler was done in all the patients. Asymptomatic patients and those undergoing open surgery for median arcuate ligament release were excluded from the study.

RESULTS- Median arcuate ligament syndrome presents most commonly between 3rd and 5th decades with male preponderance. Commonly presenting with epigastric pain or postprandial fullness. Radiological investigations are pivotal in the diagnosis and postoperative assessment. Laparoscopic median arcuate ligament release is an extremely effective surgery having substantial reduction in symptoms post operatively.

CONCLUSION- Laparoscopic release of median arcuate ligament was found to be effective in substantially reducing the symptoms most commonly chronic abdominal pain ofthe patients of median arcuate ligament syndrome with short post-operative stay. Radiological investigations prove useful in diagnosis and post-operative evaluation. Early surgical intervention significantly improves the symptoms and prevents future complications including intestinal ischemia and need for emergency laparotomy surgeries. There is significant improvement in post operative blood flow based on post-operative investigations such as celiac artery doppler studies done on post operative day 1.

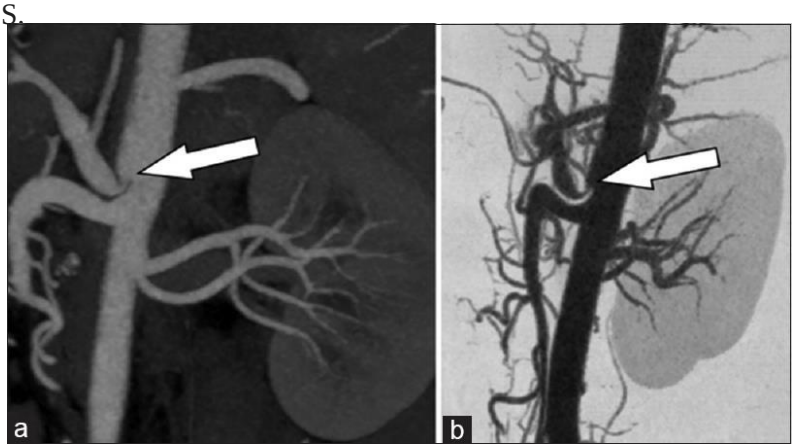
KEYWORDS-
Median arcuate ligament syndrome, Laparoscopic release of median arcuate ligament,Chronic abdominal pain

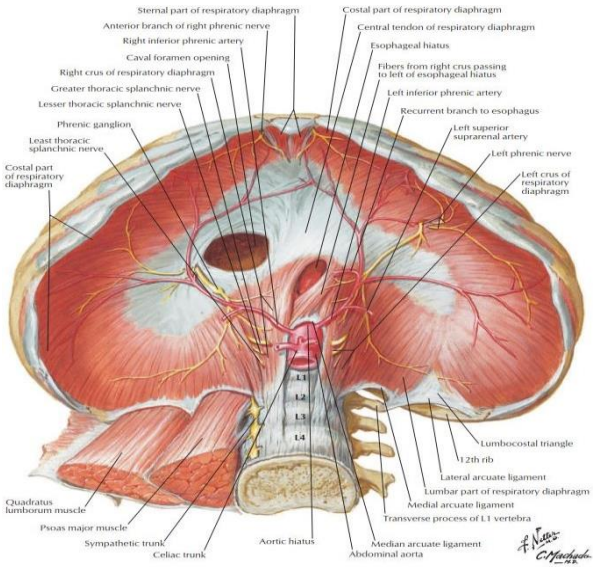
INTRODUCTION-

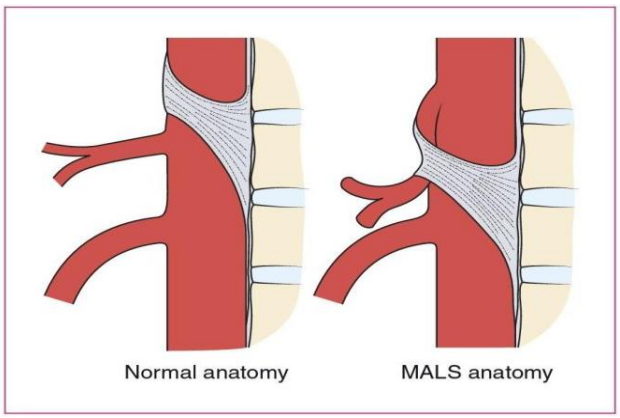
Median arcuate ligament syndrome (MALS) or Dunbar syndrome is a rare clinical disease and diagnosis of exclusion characterized by compression of celiac trunk by median arcuate ligament, prominent fibrous bands.

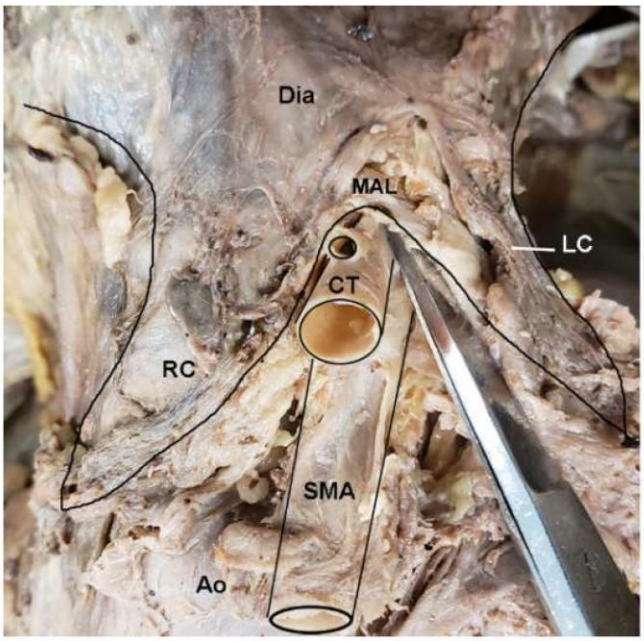
Median arcuate ligament forms the fibrous arch forming a junction between right and left crura of diaphragm. It forms the antero-superior boundary of aortic hiatus at the level of 1st lumbar vertebra just above the origin of celiac artery. There may be low riding of the fibrous attachment of or the diaphragmatic cruras themselves may lie lower down covering the celiac artery causing its compression. Alternatively celiac artery may have a higher origin leading to similar picture. External compression on celiac artery by median arcuate ligament leads to triad of symptoms whichincludes postprandial epigastric pain, vomiting and weight loss. Presenting clinical symptoms are various gastrointestinal symptoms like chronic postprandial epigastric pain, nausea, vomiting, abdominal fullness, weight loss, anorexia, sometimes, abdominal pain during body exercise caused by an intermittent visceral ischemia. It may cause foregut ischemia due to inadequate collateralsor mid gut ischemia due to diversion of blood to foregut. Besides the extrinsic vascular compression, Median arcuate ligament syndrome has a multifactorial etiology and it has been suggested as a neurogenic disease resulting in altered sensation and pain from the somatic nerves in the splanchnic plexus.

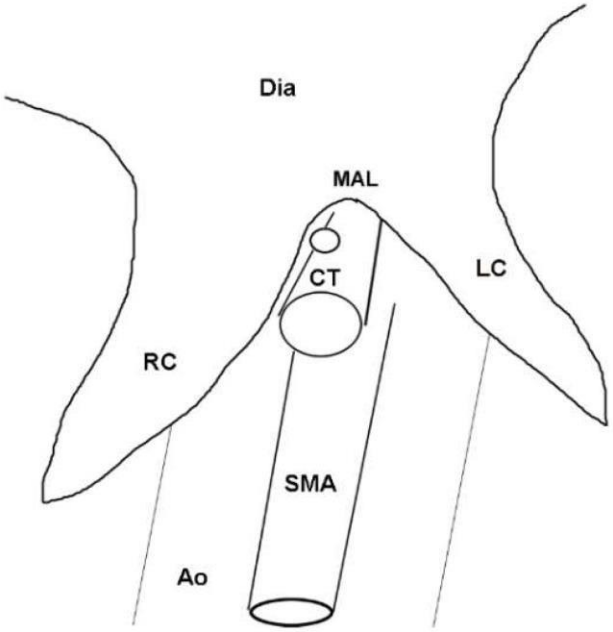
MALS is ordinarily diagnosed after the exclusion of other more common conditions; however, variety of imaging and diagnostic modes, including Duplex ultrasonography, contrast enhanced computed tomography, CT angiography, MR angiography, gastric tonometry and angiography can suggest findings consistent with MALS.











Degree of external compression can be estimated with help of percentage of stenosis seen in angiogram

Treatment options include release of median arcuate ligament (open, laparoscopic or robot-assisted)and open vascular reconstruction. Laparoscopic approach for the correction of MALS is consideredto be feasible and safe.

Key operative steps of Laparoscopic Median Arcuate Ligament Release,

-Left lobe of liver is retracted using bowel grasper and stomach retracted using Babcock's forceps.

-Lesser omentum is divided along the lesser curvature to enter lesser sac.

-Esophagus identified, dissected and umbilical tape is used to retract esophagus

-Right and left crura of diaphragm are dissected till Aorta is visualized.

-Dissection done and aorta is traced in above downward direction till origin of celiac trunk isreached.

-Fibers of median arcuate ligament around celiac artery are dissected until no external compressionis present over celiac artery

On intraoperative exploration, the celiac artery was found to be encased and partially compressed by fibrotic tissue in each patient. In each case laparoscopic excision of fibrotic tissue, celiac plexus and ligament division was performed. Intra-operative doppler can be performed to evaluate real- time change in compression and dissection can be continued till adequate reversal of compression is achieved.

MATERIALS AND METHODS- A study of 10 patients presented in surgical OPD of tertiary care hospital of radiologically proven median arcuate ligament syndrome over a period of 12 months. Patients requiring surgery were selected for the study. All the patients underwent laparoscopic Median arcuate ligament release. Post-operative celiac artery doppler was done onpost operative day 1 in all the patients.

INCLUSION CRITERIA-

1. All patients with Median arcuate ligament syndrome (MALS) and radiologically confirmed external compression of celiac artery by medial arcuate ligament and underwent laparoscopic median arcuate ligament release.

EXCLUSION CRITERIA-

1. All patients with incidental radiological finding of celiac trunk compression but asymptomatic.
2. All patients who underwent surgery through open approach.

RESULT-

1. Age distribution

In our study, it was observed that 4 out of 10 patients that suffered from MALS were of 31-40 yearsof age (40%) followed by the age group of 41-50 years (30%). It was observed that younger and older spectrums of the age group were less frequently found to be suffering from MALS.

2. Gender distribution

In our In our study, MALS was observed to have male preponderance with 8 out of 10 patients (80%) being male and only 2 of the 10 patients were females.

3. Chief complaint

Complaints	**No. of patients**	**Percentage**
Epigastric pain	3	30%
Postprandial fullness	3	30%
Weight loss	1	10%
Vomiting	2	20%
Anorexia	1	10%

In our study 5 presenting complaints were observed of which 3 out of 10 patients presented with epigastric pain (30%) or postprandial fullness (30%) as presenting complaint. Weight loss and anorexia were found least commonly (10%) as the chief complaint although these were frequently found as associated complaints with either epigastric pain or postprandial fullness. 2 out of 10 patients (20%) presented with complaint of non-bilious, non-projectile vomiting containing food particles.

4. Radiological investigations

Percentage of compression on angiogram (%)	No. of patients	Percentage
20 to 30%	2	20%
30 to 40%	3	30%

40 to 50%	3	30%
50 to 60%	1	10%
60 to70%	1	10%

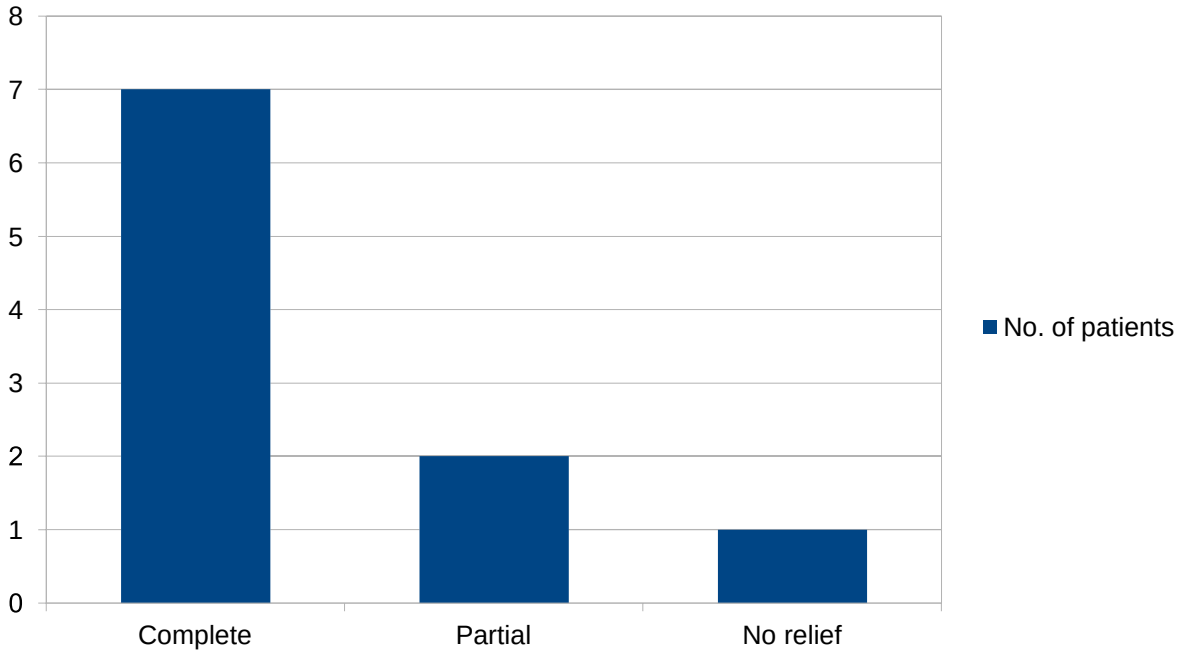
Angiogram is considered as an important tool in assessing the severity of the disease and subsequently predicting the chances of complications and prognosis post operatively. In our study itwas observed that 3 out of 10 patients had 30-40% compression of the celiac artery and other 3 out of 10 patients had 40-50% compression thus 60% of the patients had 30-50% compression and 80%patients had less than 50% compression.

5. Examination

Finding	No. of Patients	Percentage
Abdominal bruit	4	40%
Abdominal tenderness	1	10%
Abdominal Distension	2	20%
No positive findings on examination	3	30%

In our study, on examining the patients of MALS auscultatory abdominal bruit was most commonlyobserved finding present in 4 out of 10 patients (40%) and in 3 out of 10 patients (30%) patients the examination revealed no abnormalities. Abdomen was found to be distended in 2 out of the 10 patients (20%) and 1 patient (10%) had abdominal tenderness.

6. Post-operative relief of symptoms



In our study, it was observed that complete relief from symptoms could be achieved in 7 out of 10 patients(70%) and no relief in just 1 out of 10 patients(10%). 2 out of 10 patients(20%) had partial relief from the symptoms. Overall, 90% of the patients showed improvement from their pre- operative state after laparoscopic release of median arcuate ligament.

7. Post operative celiac artery re-establishment of blood flow

Re-establishment of bloodflow	No. of patients	Percentage
Complete	10	100%
Partial	0	0%
None	0	0%

Celiac artery doppler is done on post operative day 1 to evaluate the adequacy of the laparoscopic median arcuate ligament release. In our study all 10 patients (100%) achieved complete re- establishment of blood flow on post operative celiac artery doppler study.

SUMMARY

In our study, these are the findings that we have summarized,

- Majority of patients presented in 3rd-5th decade of life with a mean age of 34.6 years
- Male preponderance (80%) was noticed in cases of medial arcuate ligament syndrome.
- Epigastric pain (30%) and Postprandial fullness (30%) are the most common chief complaintin our study

followed by vomiting (20%). The other symptoms that we noticed in our study was anorexia (10%), weight loss (10%).

- Mean percentage of celiac artery compression in the patients was 35.5%
- On examination, abdominal bruit was most commonly observed finding present in 40% patients and in 30% patients the examination revealed no abnormalities. Abdomen was foundto be distended in 20% patients and 10% patients had abdominal tenderness.
- Complete reversal of symptoms could be achieved in 70% of patients and partial relief in 20% of patients. 1 patient in the study continued to have postprandial pain after undergoing laparoscopic median arcuate ligament release.
- Celiac artery doppler was done on post operative day 1 and 10 out of 10 patients (100%) achieved complete re-establishment of blood flow marking adequate release of median arcuate ligament.

RESULT

- We successfully treated 9 out of 10 patients through laparoscopic median arcuate ligamentrelease.
- 1 patient continued to have symptoms despite the surgery and will need further work-up forthe cause of symptoms.
- Post-operative celiac artery doppler done on post operative day 1 showed complete re-establishment of blood flow in 10 out of 10 patients.

CONCLUSION

Median arcuate ligament syndrome presents most commonly with epigastric pain or post postprandial fullness. Clinical examination and radiological investigations like CT or MR angiography or CECT abdomen form the basis of the diagnosis after excluding other possible conditions.

Early surgical intervention prevents future complications including intestinal ischemia and need for emergency laparotomy surgeries There is significant improvement in post operative blood flow based on post-operative investigations such as celiac artery doppler studies. Laparoscopic surgery has additional benefit of having shorter post operative stay, less post operative pain and more cosmetic suture line

Following laparoscopic median arcuate ligament release 90% of the patients having shown improvement in symptoms post operatively and there was complete re-establishment of celiac arteryblood flow in all 10 out of 10 patients (100%) as evident by celiac artery doppler done on post operative day 1 which marks sufficient release of median arcuate ligament.

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A STUDY TO UNDERSTANT 50 MILLESIMAL POTENCY AND ITS UTILITY IN CURRENT HOMOEOPATHIC PRACTICE.

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ABSTRACT

1. To understand the need of 50 Millesimal Scale Potency when other scale of potencies were already in use.
2. To understand in depth the guidelines given by Dr. Hahnemann regarding use of 50 Millesimal Potencies, his experiences and observations regarding the same.
3. Using 50 Millesimal Scale in acute and chronic cases to appreciate the changes in patients as indicated in the 6th edition of Organon of Medicine.

INTRODUCTION

Guidelines given in the 6TH edition of Organon of Medicine by Dr. Hahnemann for 50 Millesimal Scale.

50 Millesimal Scale	Aphorism Number	Description
Preparation	270, 271	• 1 grain of 3rd trituration i.e. 3C • Dissolve it in 500 drops of a solution (100 drops alcohol+400 drops distilled water)=The Mother Potency (1:500) • Mix above 1 drop in 100 drops of alcohol & give **100 Succussions=0/1** • Soak No 10 sized 500 globules with 0/1 • Above one globule in 1 drachm vial, dissolve in 1 drop of distilled water, add 100 drops of alcohol in it & success it 100 times. This is **0/2.**
Steps to be followed for dispensing the medicine	246	• Select with all circumspection, the aptly homoeopathic medicine. • Use a highly potentised dose (50 millesimal), dissolved in water. • Every dose should be the smallest as far as possible. • ***It is very important that the degree of potency of each dose deviate somewhat from the previous & subsequent ones.*** • It should be administered after each definite period of time.

From what Potency to start	246 & 270	In both acute & chronic cases start from lowest degree of dynamization & advance is made to higher degrees as & when necessary, in gradually ever more powerful but mildly acting degrees.
Preparation of Medicinal Solution for Oral Administration	248, Footnote to Aphorism 248	**Preparation**:- • In a clean 4 oz vial with a cork, add distilled water unto 3/4th of vial. • Add 15-20 drops of alcohol for preservation. • Put 7 equal marks on it. Add only one No.10 globule of selected potency crushing it with sugar of milk in the vial.
		Direction for use:- • Before use, succuss the above vial 8, 10 or 12 times as necessary. • Then take one dose in a clean glass & again put one oz of pure drinking water in it & stir it well with a teaspoon. • Take one dose (or several tea-spoonfuls) out of it. Throw away remaining. All subsequent doses are to be taken in this way.
	272	Dry form of medicine-can be administered only in "moderate recent cases of illness"
Repetition of medicine when administered Orally	248	(i) In very urgent cases very hour or oftener. (ii) In general acute cases- after every 2-6 hours (iii) In long lasting diseases, i.e. chronic diseases-daily or every second day.

Preparation of Medicinal Solution for Olfaction	248	**Preparation:-** • Put one No.10 globule of selected medicine in a new vial of 1 oz, add a drop of distilled water to dissolve it. • Fill 3/4th of vial with alcohol. • Succuss the vial 8/10/12 times as necessary before smelling.
		Direction for use:- • After the necessary succussions, open the vial & put it near one nostril of the patient for a second or so. • Then close the vial again with the cork. • The process of succussions will have to be repeated & smell for about a second before every subsequent application. • Olfaction may be done with mouth if the nose is for any reason closed.
Repetition of Medicine when administered through Olfaction	248	For chronic cases, repeat after every 2, 3 or 4 days. For acute, may be repeated as in oral application.
2nd Prescription	248	Select another, more homoeopathic medicine if any important new ailments appear & the sympotms of the disease are altered. Newly selected medicine also is to be started from 'the lowest degrees of dynamization'.

For how long the treatment be continued	280	Continue gradually heightened doses of the most serviceable medicine which produces no new troublesome symptoms until the patient, with general improvement begins to suffer a homoeopathic aggravation.
	248-249	**ii) <u>Dissimilar aggravation-</u>** This means the first prescription was wrong. • If < is unbearable & violent, an antidote is to be applied followed by proper selection of medicine. • If < is tolerable, another medicine is to be selected & administered without delay.
Advantages	Footnote to Aphorism 246	50 Millesimal potencies can be repeated with a heightening of each dose. Cures of Chronic disease can be achieved more rapidly, using gradually increased potencies of 50 millesimal potencies.

Homoeopathic Aggravation with 50 Millesimal Potency & necessary intervention	282 281, Footnote to 248 161 157, 158	**Causes & intervention:-** **i) Similar aggravation- In Chronic Diseases:** • Largeness of Dose=Stop medicine for 2-3 days, < will disappear gradually. • Over-Sensitivity of the patient, put a tea-spoonful of the prepared medicinal solution in a 2nd/3rd or 4th glass of water depending upon the sensitivity of the patient, each such glass must be prepared fresh daily. • Over dosage of the medicine to a patient at the end of treatment when the cure is almost or quite finished=diminish the dose & frequency of the medicine, or stop it for several days. **In Acute Diseases:** • There may be slight homoeopathic aggravation (good sign) during the first hours after administration of the medicine. Don't' repeat another dose immediately.

Materials & Methods

For the Cases

A) MATERIALS:

1) Sources of Data:

• Project site: Aarihant homoeopathic medical college & RI. The cases were included from patients attending the OPD and from patients attending the OPD of the above said college hospital..

2) The Material utilized for the study:

- Specially designed case format for the study.
- Computerized Homoeopathic Software, RADAR.

3) Procuring of Medicines:

The medicines were procured from dispensary attached to Aarihant homoeopathic medical college & RI Ahmedabad Homoeopathic Medical College.

B) METHOD OF COLLECTION OF DATA:

1) Method of Sampling: Simple Random Sampling Method.

2) Number of Samples: 10 cases.

3) Selection of Cases: 10 Cases were selected based on Inclusion and Exclusion Criteria.

Inclusion Criteria:

- Both Sexes & all age groups.
- All the Socio-Economic classes.
- Both acute & chronic cases.

Exclusion Criteria:

- Patients with immune-compromised status & those on steroid therapy.
- Terminally ill patients or complicated cases with advanced & irreversible pathological conditions.
- Those presenting emergency management.
- Cases with Surgical Intervention.
- Unconscious patient.

6) Case-Taking was done according to the guidelines mentioned by Dr. Hahnemann in Organon of Medicine (Aphorism 83-104) and specially designed format for the study. Data was collected from patient, patient's attendant, physician's observation & recorded in a standardized case record.

7) Physical Examination.

8) Laboratory Investigation.

(Individualization of the case was done on the basis of the case history & clinical findings & when required, necessary investigations were carried out.)

9) Selection of Medicines:

Medicines were selected on the basis of totality of symptoms using Repertorial as well as Non-Repertorial approach, depending upon the case. For Repertorial approach Computerized Homoeopathic Software- RADAR was used.

10) Selection of Potency, Dose and Repetition:

As per the presentation of the case, potency and doses were selected (starting from 0/1) and repeated as per instructions given in 6th edition of Organon of Medicine.

11) Preparation of Medicine:

Single poppy size globule of desired 50 Millesimal Potency is to be added in 100 ml water in a glass bottle in a way that 1/4th of the bottle remains empty. This solution is called the mother solution. Each time before taking the medicine the glass bottle is succussed for 8/10/12 times as per need. Then 1-2 tsp of water is taken from the mother solution & is mixed in 30 ml of water in a glass & stirred well. 1 tablespoon of the water is to be administered to the patient & the remaining is thrown away.

12) Route of Administration of Medicine:

All the medicines were administered through Oral route.

13) Follow Up and Monitoring:

Follow up of each case was taken at interval of 3-5 days for acute cases and 7-15 days or as per the requirement depending upon the severity in chronic cases.

14) Assessment of Effectiveness:

Effectiveness of the treatment was assessed on the basis of clinical improvement, disappearance or relief of symptoms, improvement in general health and reduction in frequency of complains.

15) Results:

The result criteria were:-

- **Significantly Improved**- Disappearance of all signs and symptoms with no recurrence.
- **Moderately Improved:** Decrease in intensity and/or frequency of presenting complains with a feeling of wellbeing.
- **Not Improved:** Neither increase or decrease in the symptoms of the patient.

17) Conclusion:

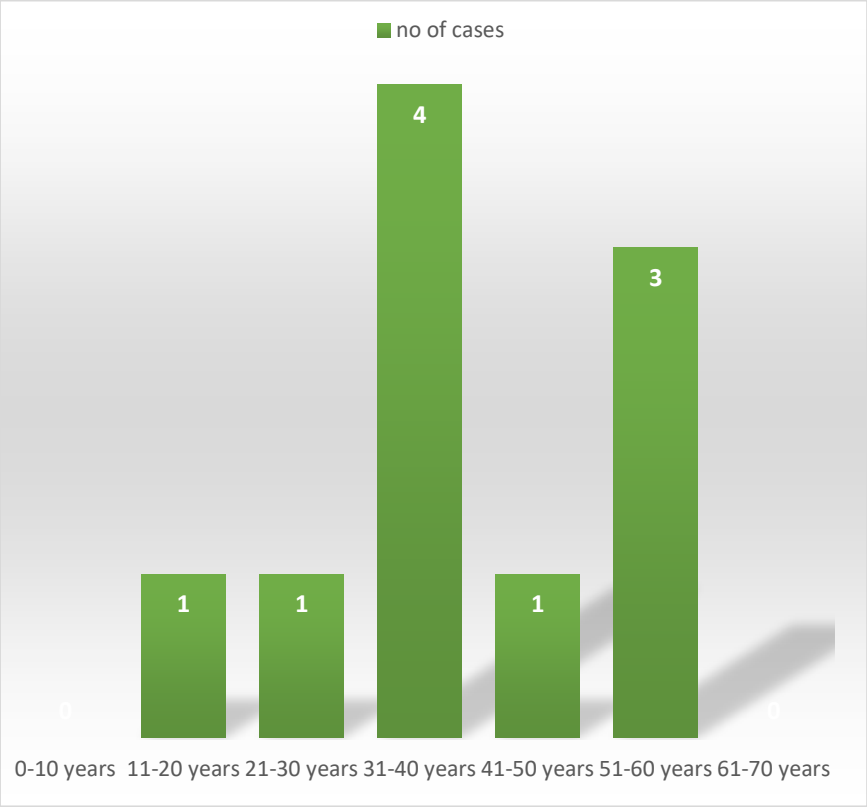
It is based on outcome of result on the basis of materials and methods.

OBSERVATION & RSULT

Table-1

Distribution of Age Group of cases related with 50 Millesimal Potencies.

Age Group in years	No. of Cases	Percentage
0-10	0	0%
11-20	01	10%
21-30	01	10%
31-40	04	40%
41-50	01	10%
51-60	03	30%
61-70	00	00%
Total	10	100%

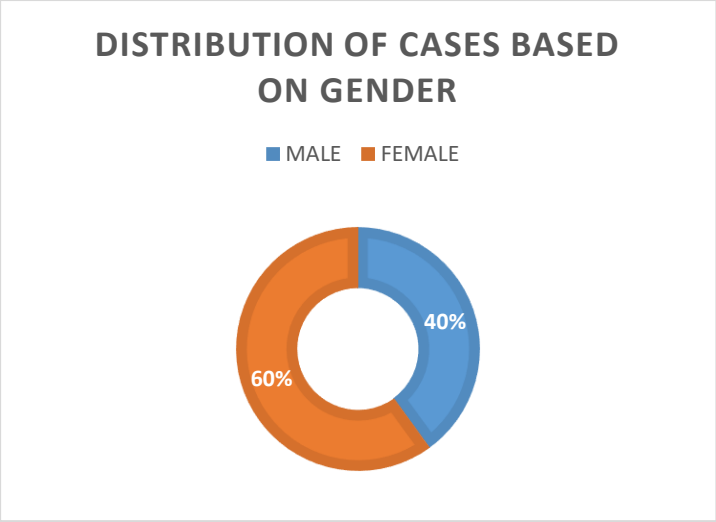


Observation: In this study, 10 cases were selected from different age groups randomly. From which, 0 cases were from age group 0-10 ; 1 from 11-20. 1 case from 21-30 age group, 4 cases from 31-40 age group, 1 from 41-50 age group, 3 from 51-60 age group and none from 61 to 70 age group.

Table-2

Gender wise distribution of Cases.

Gender	Number of Cases	Percentage
Male	04	40%
Female	06	60%
Total	10	100%



Observation: In this study, 10 cases were selected randomly. Of which 04were male & 06 were female.

Out of 04 males, 03 had significantly improved, 1 had moderately improved.

Out of 06 females, 05 females improved significantly, 01 female

Improved moderately.

Table-3

Medicines Used

Sr. no.	Medicine	No. of cases
1	Carcinosin	1
2	Calcarea Carb	1
3	Lycopodium	1
4	Natrum Mur	1
5	Arsenicum Album	3
6	Sulphur	1
7	Gelsemium	1
8	Sangunaria Can	1

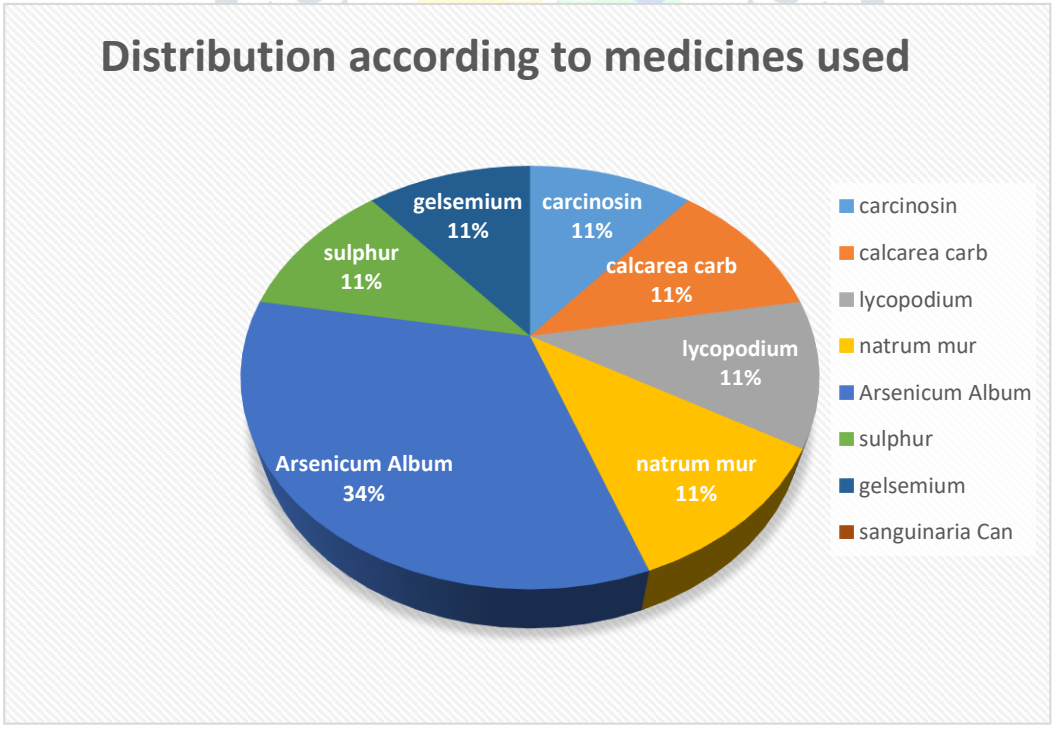
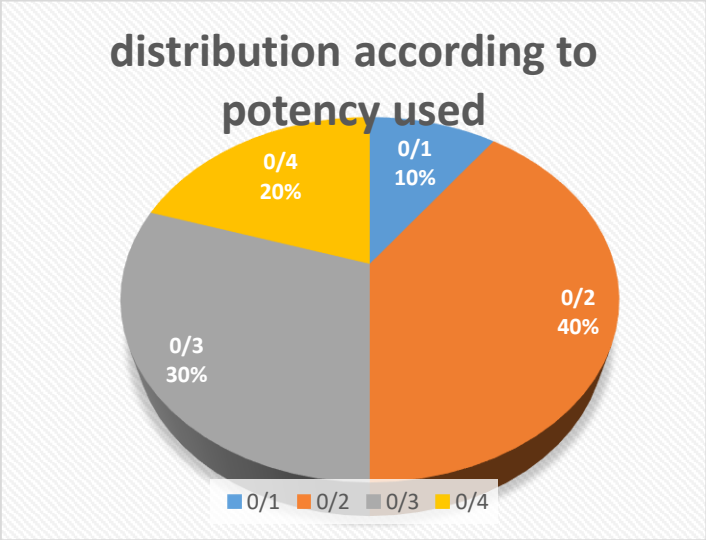


Table-4

Potencies Used:

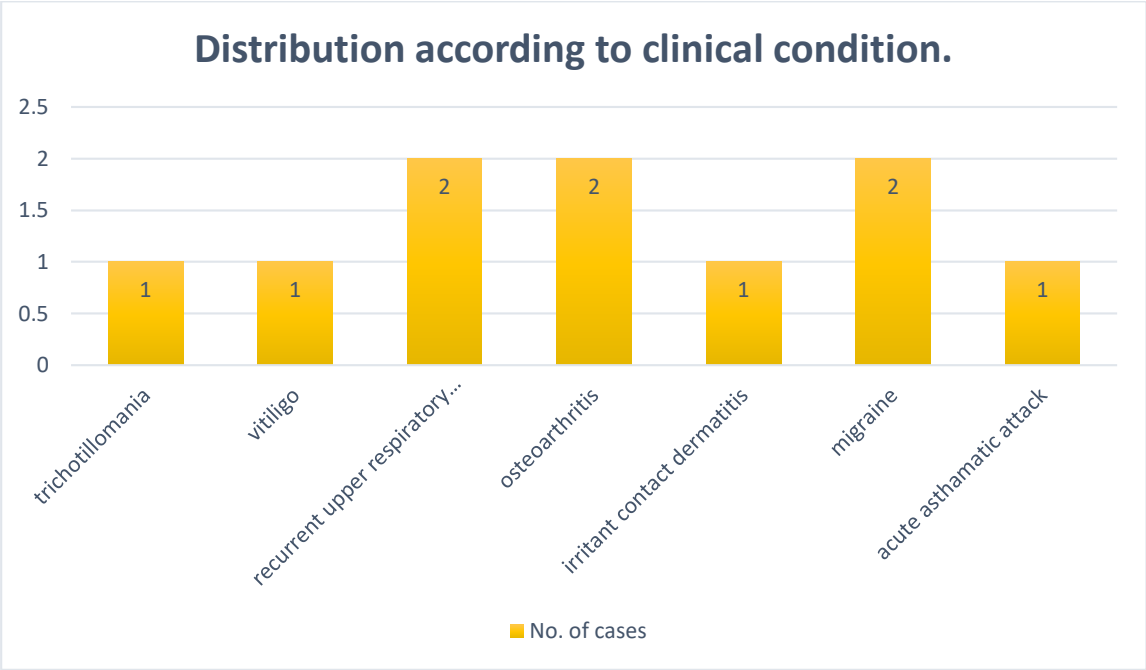


Potencies used	Number of cases
0/1	01
0/2	04
0/3	03
0/4	02

Table-5

Clinical condition based distribution

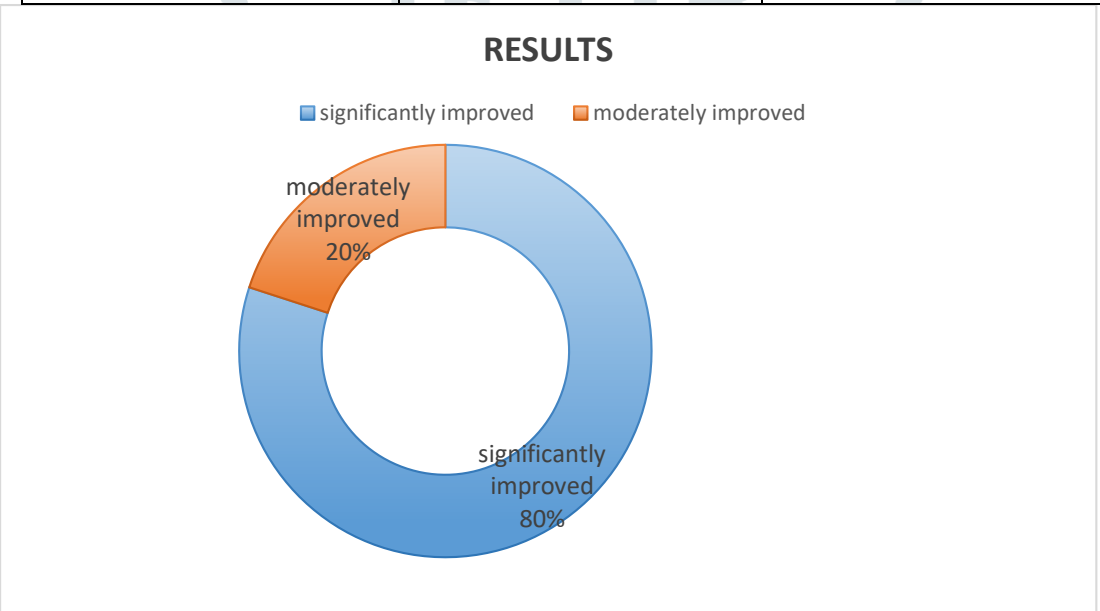
Clinical Condition	No of cases
Trichotillomania	1
Vitiligo	1
Recurrent Upper Respiratory Tract Infection	2
Osteoarthritis	2
Irritant Contact Dermatitis	1
Migraine	2
Acute Asthmatic Attack	1



Out of 10 cases– 1 case was of trichotillomania; 1 of vitiligo; 2 were of recurrent upper respiratory infection; 2 of osteoarthritis; 1 of contact dermatitis; 2 of migraine and 1 of acute asthmatic attack.

Results

	No. of Cases	Percentage
Significantly Improved	08	80%
Moderately Improved	02	20%
Not Improved	00	00%
Total	10	100%



Discussion

Cases:

The study was conducted at Aarihant Homoeopathic Medical College & RI. To understand 50 Millesimal scale potency and its current practice, total of 10 cases were selected. All selected cases were from different age groups irrespective of gender. The cases were diagnosed based on clinical presentation, investigations and follow ups were taken as per the requirement of the case. Cases were analyzed based on the age-based distribution of the results, gender-based distribution, clinical condition-based distribution, remedy distribution, potency distribution & results.

- **AGE INCIDENCE:**

In this study of 10 cases, the maximum number of cases i.e. 6 (60%), were recorded in the age group 31-40 years & the minimum number of cases i.e. 1 each (10%) were recorded in the group of 41-50 and 51-60 years respectively.

- **GENDER INCIDENCE:**

In this study, 10 cases were selected randomly. Of which 04 (40%) were male & 06 (60%) were female.

- **NUMBER OF MEDICINES USED:**

A total of 8 medicines were used based on the totality of symptoms available. They were Carcinosin, Calcarea carb, lycopodium, Natrum muriaticum, Arsenicum album, Sulphur, Gelsemium, and Sangunaria can. Amongst them Ars Alb. Ws used in more number of cases compared to the other remedies.

- **RANGE OF 50 MILLESIMAL POTENCY INCIDENCE:**

Of all the potencies, the incidence of 0/1 was 10%, 0/2 was 40%, 0/3 was 30% and 0/4 was 20%. In all the cases treatment was started with 0/1 as per Master's instructions to begin treatment with lowest degree of dynamization.

- **RESPONSE TO TREATMENT:**

-Out of 04 males, 03 had significantly improved, 1 had moderately improved.

-Out of 06 females, 05 females improved significantly, 01 female improved moderately.

- **REPETITION OF MEDICINES:**

Repetition of medicines was done as per Master's instructions.

-In Chronic cases, initially the medicines were repeated on alternate days & then once daily.

-In Acute cases, the medicines were repeated twice or thrice a day, depending upon the need of the case.

Medicines were not administered in Dry form or by Olfaction.

- **INCIDENCE OF RESULT:**

Out of 10 cases,

- 08 cases (80%) showed Significant Improvement,

- 02cases (20%) showed Moderate Improvement.

SUMMARY & CONCLUSION

To understand the 50 Millesimal Scale Potencies, I have tried to understand the journey of Master Hahnemann with his usage of crude medicinal substances from the early years of his practice to his later years where he discovered the ultra-dilutions- The 50 Millesimal Scale Potency which is a valuable part of the whole spectrum of tools to practice homoeopathy. Also, I have tried to study that if these ultra-dilutions are indeed superior, how are they been practiced today by the homoeopaths.

The journey of evolution of potencies from 'crude toxic doses of medicines' to 'ultra dilution' reflects Dr. Hahnemann's quest for the perfectly attenuated medicine, the medicine which would act as gently, as permanently, as quickly and as harmlessly as possible to cure the patient.

Dr. Hahnemann had finally released spirit from matter or energy from mass, as we would now say, achieved the transmutation which had been the goal of alchemists and chemists for thousands of years. The medicinal substance that seems to us in its crude state to be only matter, sometimes even non-medical matter, is at last completely transformed and refined by these progressive dynamization. This medicinal force by itself is no longer perceptible to the senses, but the medicated globule acts as its carrier and demonstrates its curative power in the sick organism.

10 cases, comprising both acute and chronic were studied by using 50 millesimal potency. The cases were selected randomly. Case taking and case processing was done according to the Master's instructions. The selected medicines were administered in lowest dynamization at the beginning of treatment. Repetition was done according to the ascending scale.

No aggravation had been reported in the cases which were under study. About 80% showed significant improvement, 20% showed moderate improvement.

So it can be concluded based on the above study and results that 50 millesimal Potency gives effective results and does not cause any unnecessary aggravation. But this potency it's not as extensively used in current practice as it should be, partially due to the limited knowledge regarding usage of this scale and partially due to the difficulties faced while using this scale of potency.

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