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Comparative Study On The Efficacy Of Neural Mobilization Techniques And Cervical Strengthening Exercises In Cervical Radiculopathy

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ABSTRACT

Background: Cervical radiculopathy (CR) arises from nerve root compression in the cervical spine, leading to significant pain and functional limitations. Although cervical strengthening exercises are commonly prescribed, neural mobilization has been proposed as a more targeted therapeutic approach that directly addresses nerve tension.

Objective: This study aims to compare the therapeutic efficacy of neural mobilization techniques with conventional cervical strengthening exercises in reducing pain, improving range of motion (ROM), and restoring functional abilities in CR patients.

Methods: Sixty patients diagnosed with CR were randomly allocated into two groups. Group A underwent neural mobilization therapy, while Group B received cervical strengthening exercises. Assessments were performed at baseline, and at 4, 8, and 12 weeks using the Visual Analog Scale (VAS), Neck Disability Index (NDI), and Patient-Specific Functional Scale (PSFS).

Results: Group A showed significantly greater reductions in pain, improvements in function, and ROM compared to Group B, with statistical significance observed at all intervals ($p < 0.05$).

Conclusion: Neural mobilization demonstrated superior efficacy compared to cervical strengthening exercises, particularly in pain reduction and functional improvement. This suggests that neural mobilization should be considered a first-line treatment for patients with CR.

Keywords: Cervical Radiculopathy (CR), Neural Mobilization, Pain Reduction, Functional Improvement.

INTRODUCTION

Cervical radiculopathy (CR) is a condition caused by the compression or irritation of cervical nerve roots, leading to symptoms such as pain, numbness, and motor dysfunction in the upper extremities. Types of CR are categorized based on the affected nerve roots:

- **C5 Nerve Root**: Weakness in deltoid and biceps muscles, diminished biceps reflex.
- **C6 Nerve Root**: Pain radiating to the thumb, weakness in wrist extensors, diminished brachioradialis reflex.

- **C7 Nerve Root**: Pain in the middle finger, weakness in triceps, diminished triceps reflex.

Traditional rehabilitation strategies, particularly cervical strengthening exercises, aim to restore muscle function and reduce symptoms. However, neural mobilization techniques, which involve the application of controlled movements to improve nerve glide and reduce mechanical tension, may provide more direct relief by addressing nerve dysfunction.

This study seeks to investigate the relative effectiveness of neural mobilization and cervical strengthening exercises in managing CR, focusing on pain reduction, functional improvements, and ROM enhancements.

AIMS & OBJECTIVES

1. To evaluate the effectiveness of neural mobilization in the treatment of cervical radiculopathy (C6-C8).
2. To compare the effects of neural mobilization and cervical strengthening exercises on pain reduction and functional recovery.
3. To assess the safety and tolerability of neural mobilization as a therapeutic approach for cervical radiculopathy.

MATERIAL & METHOD

- **Study Design:** A randomized controlled trial was conducted over 12 weeks.
- **Participants:** Sixty patients, aged 30-60, diagnosed with cervical radiculopathy were recruited. Participants were randomly assigned into two groups (30 in each group).
    - **Group A (Neural Mobilization):** Received neural mobilization techniques focusing on mobilizing cervical nerve roots (C6-C8). Techniques included:

- **C8 Nerve Root**: Pain in the little finger, weakness in finger flexors.

- Median Nerve Glide

- Radial Nerve Glide

• Ulnar Nerve Glide

- Group B (Cervical Strengthening): Engaged in a program of cervical strengthening exercises designed to enhance neck muscle function and reduce nerve root compression. Patients engaged in a cervical strengthening program including:

- **Isometric Neck Exercises:** Static contractions to strengthen cervical muscles.
- **Progressive Isotonic Exercises:** Targeting neck flexors, extensors, and lateral flexors.
- **Dynamic Stretching:** To improve cervical flexibility and range of motion.
  - **Supportive Treatments:** Both groups received adjunct therapies like moist heat application, ergonomic advice, and postural correction.

- **Outcome Measures:**
  - **Pain:** Assessed using the Visual Analog Scale (VAS).
  - **Disability:** Evaluated using the Neck Disability Index (NDI).
  - **Function:** Measured using the Patient-Specific Functional Scale (PSFS).
  - **ROM:** Range of motion was assessed using a goniometer. Goniometric assessment of cervical flexion, extension, lateral flexion, and rotation.

- **Data Collection Intervals:** Assessments were conducted at baseline, and at 4, 8, and 12 weeks after initiating the interventions.

Statistical Analysis:

Paired t-tests and repeated measures ANOVA were used to analyze the differences in pain reduction, functional improvements, and ROM between the two groups at different time points. A p-value of less than 0.05 was considered statistically significant.

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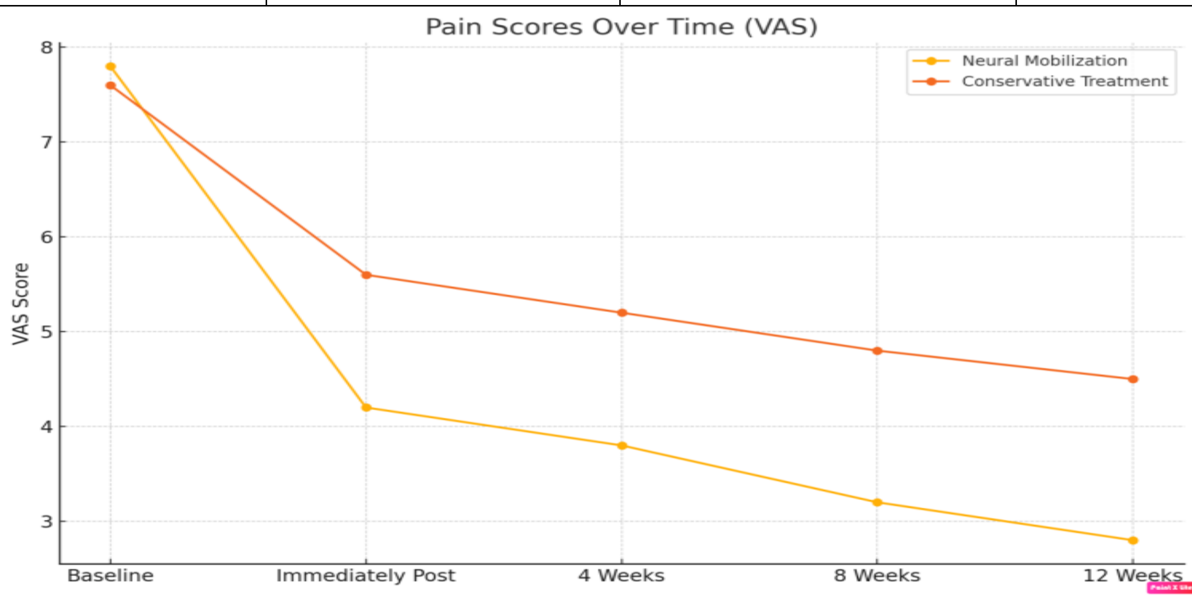
○**Demographic Data of Participants:**

	Group A (Neural Mobilization)	Group B (Conservative Treatment)	Total
Number of Participants	30	30	60
Age (Mean ± SD)	35.4 ± 8.2 years	36.1 ± 7.9 years	35.8 ± 8.0 years
Gender (M/F)	18/12	16/14	34/26
Occupation			
Desk Job (%)	60% (18)	55% (16)	57% (34)
Manual Labor (%)	20% (6)	25% (8)	22% (14)
Others (%)	20% (6)	20% (6)	20% (12)
Duration of Symptoms			
3-6 months (%)	30% (9)	35% (10)	32% (19)
6-12 months (%)	40% (12)	35% (10)	38% (22)
>12 months (%)	30% (9)	30% (9)	30% (18)

RESULT

Pain Scores Over Time (VAS):

Time Point	Neural Mobilization (Mean ± SD)	Conservative Treatment (Mean ± SD)	p-value
Baseline	7.8 ± 1.2	7.6 ± 1.3	0.45
Immediately Post	4.2 ± 1.5	5.6 ± 1.7	<0.001
4 Weeks Follow-Up	3.8 ± 1.4	5.2 ± 1.6	<0.001
8 Weeks Follow-Up	3.2 ± 1.3	4.8 ± 1.5	<0.001
12 Weeks Follow-Up	2.8 ± 1.2	4.5 ± 1.4	<0.001



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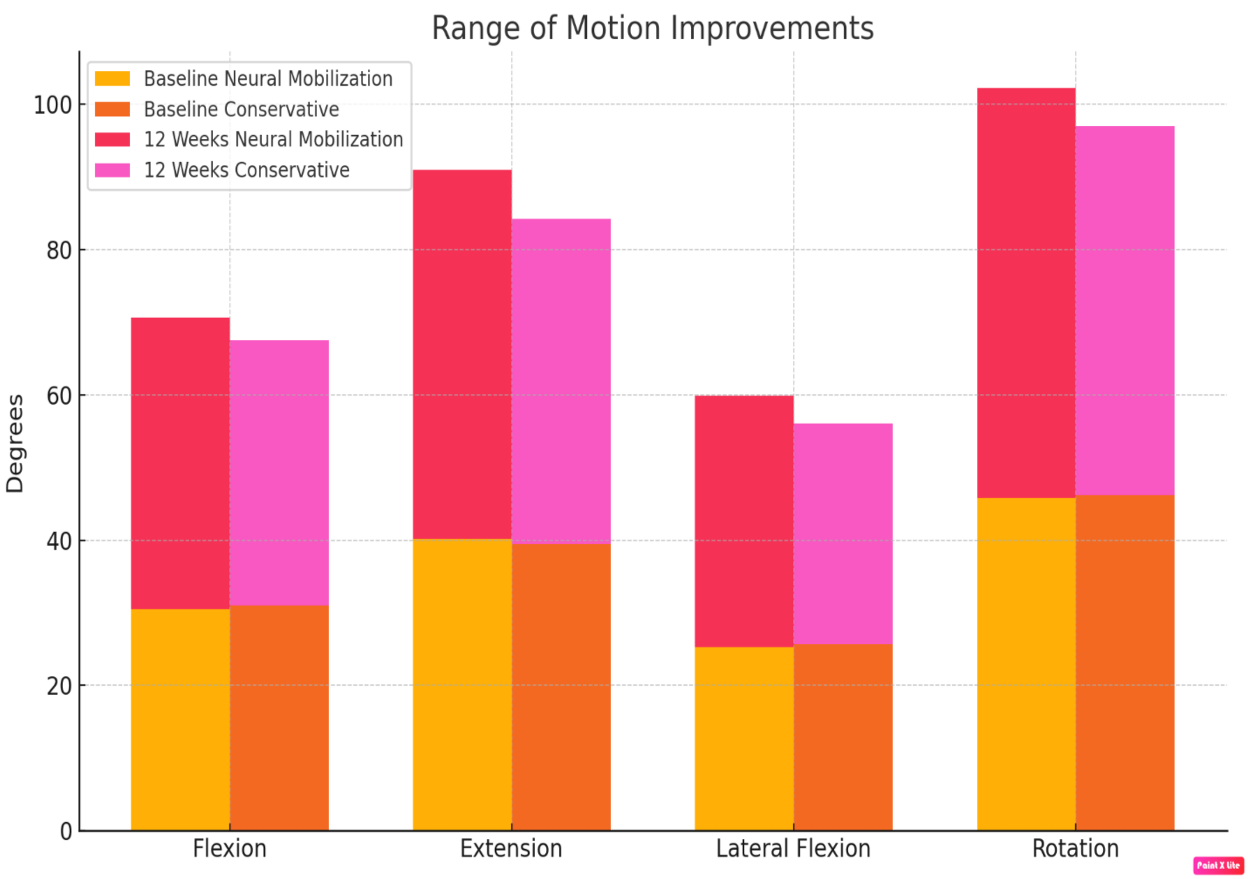
<u>Range of Motion (ROM) Improvements</u>:

Movement	Baseline Neural Mobilization	Baseline Conservative	12 Weeks Neural Mobilization	12 Weeks Conservative	p-value
Flexion (degrees)	30.5 ± 5.2	31.0 ± 5.0	40.2 ± 5.5	36.5 ± 5.3	<0.001
Extension (degrees)	40.2 ± 6.1	39.5 ± 6.4	50.8 ± 5.8	44.7 ± 6.0	<0.001
Lateral Flexion	25.3 ± 4.8	25.7 ± 4.6	34.6 ± 5.2	30.4 ± 5.0	<0.001
Rotation (degrees)	45.8 ± 6.5	46.2 ± 6.7	56.4 ± 6.9	50.8 ± 7.0	<0.001



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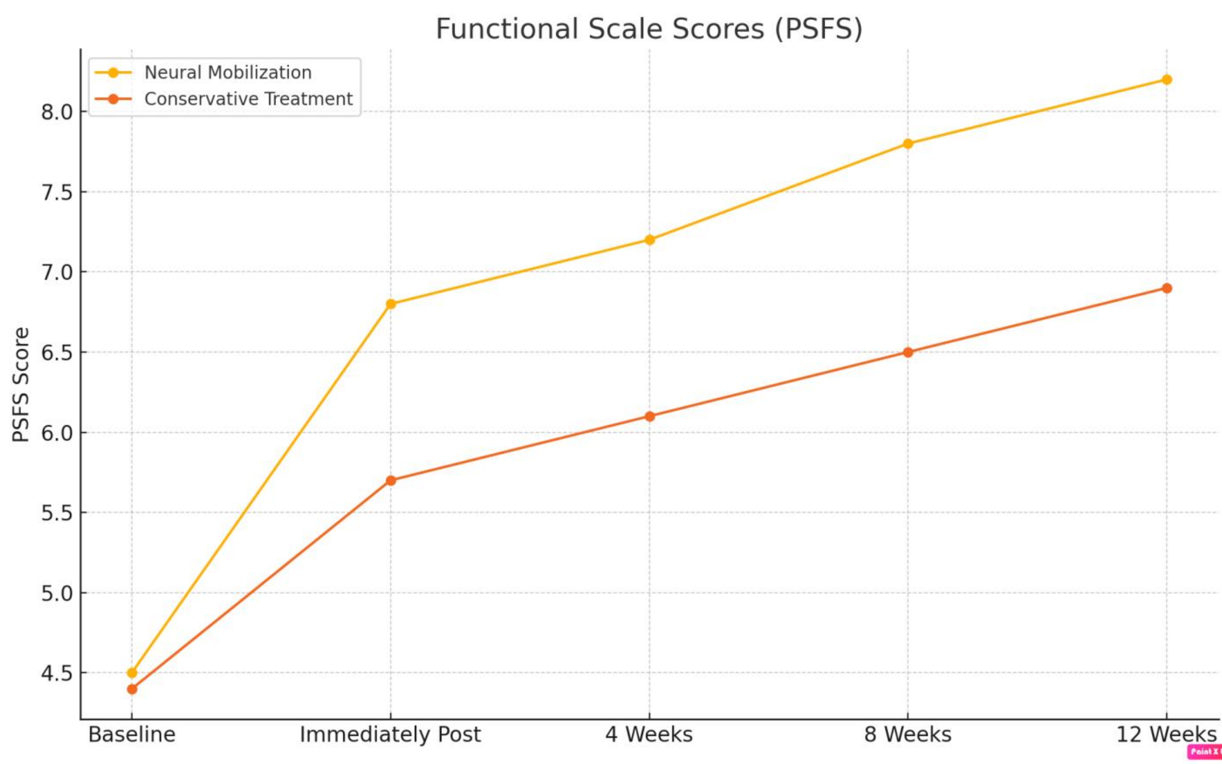
Functional Scale Scores (PSFS):

Time Point	Neural Mobilization (Mean ± SD)	Conservative Treatment (Mean ± SD)	p-value
Baseline	4.5 ± 1.0	4.4 ± 1.1	0.72
Immediately Post	6.8 ± 1.3	5.7 ± 1.5	<0.001
4 Weeks Follow-Up	7.2 ± 1.4	6.1 ± 1.4	<0.001
8 Weeks Follow-Up	7.8 ± 1.5	6.5 ± 1.6	<0.001
12 Weeks Follow-Up	8.2 ± 1.6	6.9 ± 1.7	<0.001



- **Pain Reduction:** Group A showed a 70% reduction in pain scores by week 12, as compared to a 50% reduction in Group B. This difference was statistically significant ($p < 0.05$).
- **Functional Improvement:** Group A exhibited greater functional improvements, as measured by the PSFS, compared to Group B ($p < 0.05$), particularly in performing daily tasks that required arm and neck movement.
- **ROM Improvement:** Significant improvements in cervical flexion and extension were noted in Group A compared to Group B at all assessment intervals ($p < 0.05$).
- **Adverse Events:** No significant adverse events were reported in either group, suggesting that both interventions are safe for managing CR.

DISCUSSION

- **Completion Rates:** Of the 60 participants, 55 completed the 12-week program. Five patients dropped out due to personal reasons unrelated to the study.
- **Justification for 12 Weeks:** The 12-week duration aligns with previous studies, ensuring sufficient time for observing clinically meaningful changes in pain, function, and ROM.
- **Comparative Efficacy:** Neural mobilization directly targets nerve tension, offering faster and sustained relief compared to cervical strengthening exercises, which focus on muscular support and stabilization.
- **Clinical Implications:** Neural mobilization should be considered a primary treatment option for CR. Combining both interventions may provide synergistic benefits.

CONCLUSION

The findings of this study indicate that neural mobilization techniques are more effective than cervical strengthening exercises for treating cervical radiculopathy. Neural mobilization directly targets nerve mechanics, leading to more rapid and sustained improvements in pain and function. In contrast, cervical strengthening exercises focus on improving muscle function, which may explain their slower progression in symptom relief.

Previous studies have highlighted the importance of addressing neural tension in CR. By improving nerve mobility, neural mobilization reduces the mechanical stress on nerve roots, leading to quicker pain relief and enhanced functional recovery. This study's results corroborate existing literature, suggesting that neural mobilization is a valuable treatment option for CR patients.

Neural mobilization techniques offer significant benefits over cervical strengthening exercises in managing cervical radiculopathy. Their ability to reduce pain, improve function, and enhance ROM makes them a suitable choice for patients, particularly those seeking rapid symptom relief. Further research should focus on combining both interventions to optimize patient outcomes.

FUNDING

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ETHICAL CONSIDERATIONS

This study was conducted in accordance with the ethical guidelines of the Declaration of Helsinki. Ethical approval was obtained from the Institutional Ethics Committee of Madhav University, Pindwara, Sirohi, Rajasthan. Informed written consent was obtained from all participants prior to their inclusion in the study. Participants were informed about the study's purpose, procedures, potential risks, and benefits, and they were assured of their right to withdraw at any stage without any repercussions.

CONFLICT OF INTEREST

The authors declare no financial or other conflicts of interest that may have influenced the outcomes or interpretation of this research.

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Effects Of Lumbar Motor Control Training On Non- Specific Chronic Low Back Pain : A Literature Review

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ABSTRACT

Background: Non-specific low back pain is a prevalent musculoskeletal disorder, and it is described as lower back pain and discomfort. The phrase "non-specific" means that pain is not brought on by a particular underlying pathology, but rather has to do with how the spine, muscles, and joints move and function.
Objective: To assess the efficacy of motor control training on people suffering from non-specific chronic low back pain.
Methods: Search Strategy: PubMed, Google Scholar, CINAHL, ScienceDirect, EBSCOhost, and ResearchGate were searched using phrases such as low back pain, chronic non-specific low back pain, motor control training, low load motor control training, motor skill training, and related topics.
Article Selection: Out of the 129 articles that were retrieved, 15 were found to be pertinent following careful examination.
Result: Lumbar motor control exercises (MCEs) are a promising non-pharmacological intervention for adults with low back pain, improving functional limitations, pain intensity, and quality of life by focusing on deep spine stabilizing muscles.
Conclusion: The current review offers robust evidence in favor of MCEs' effectiveness as a secure and reliable LBP treatment option. For adults with LBP, MCEs provide a non-invasive, economical, and long-lastingmethod of pain management and enhanced functional outcomes.
Keywords: low back pain, chronic non-specific low back pain, motor control training, low load motor control training, motor skill training

INTRODUCTION

With an 80% prevalence rate, non-specific low back pain (NSLBP) ranks highest amongst the most prevalent musculoskeletal conditions. The changes which take place in the paraspinals' histomorphology, and structure are linked to chronic low back pain. These back muscles exhibit some degree of atrophic changes in specific muscle fibres, are smaller, and contain fat. As a result, there is excessive fatigability and weakness in the lumbar paraspinals. Strength, mobility, endurance, and functional disability can all be enhanced by exercise.[1]

In addition to lower extremity pain, low back pain is characterized by pain that is localized between the inferior gluteal folds and the costal s. With no known etiology or pathology, non-specific LBP (NSLBP) accounts for more than 85% of cases of LBP. In patients with NSLBP, body equilibrium is undermined, which is crucial for carrying out task-oriented pursuit. In the population afflicted with low back pain (LBP), abnormal muscle recruitment patterns and insufficient coordination of muscles which is marked by diminished involvement of core postural muscles, increased activity in surface-level muscles, and restricted flexibility in the spine has the capacity to modify the usual stability of the spinal region.[2]

Exercise-based interventions are widely recognized as an established approach for addressing enduring lumbar discomfort. It is linked to the improvement and prevention of LBP, and leading a continuous active lifestyle is well recognized as a useful tool in preventing chronic lower back pain.[3]

Exercise recommendations for individuals grappling with symptomatic lumbar disc herniation (LDH) frequently encompass motor control exercises (MCEs), stabilization exercises and exercises geared towards improving core stability. The purpose of motor control exercises (MCEs) is to reshape the coordinated activation pattern of the pelvic floor muscles, paraspinals, gluteal, diaphragm, and abdominals. The primary biological justification for MCEs stems from the notion that people suffering from LBP have altered spinal stability and regulation. The first step in an MCE program is to identify the spine's natural position, which is thought to be the position of power and balance. This position marks the center between the lumbar bending and stretching spans of movement. Initially, exercises focused on motor control involve a mild, continual isometric contraction of the muscles stabilizing the trunk, progressively assimilating them into practical activities. The application of MCE typically takes place in individualized supervised therapy sessions. To provide input on the activation of trunk musculature, manual examination, ultrasonic imaging, and/or pressure biofeedback units could also be utilized.[4]

The goal of activities targeting motor control is to improve the operation and synchronization of the deep muscles that uphold the spine. These exercises are started under the supervision of a therapist and then completed on their own. They offer modest relief from moderate pain and a useful advantage for low back pain that is ally more beneficial than regular exercise for low back discomfort.[5]

REVIEW OF LITERATURE

1. **Ibrahim, A.A.** et al (**2023**) conducted a study called ‘Effectiveness of patient education plus motor control exercise versus patient education alone versus motor control exercise alone for rural community-dwelling adults with chronic low back pain: a randomized clinical trial’. It was done with 120 rural dwellers suffering from chronic low back pain (CLBP) with a mean age of 46. They were randomly distributed among three cohorts, each comprising 40 individuals. The 1st arm underwent Patient education plus Motor Control Exercise, the 2nd group underwent only Patient education and 3rd group only motor control exercises. The outcome measures used in the study were NPRS; ODI; SF-12; Physical and mental component summary of SF-36; GRCS; FABQ; PCS; BBQ. Exercises were performed for 8 weeks under supervision. After completion of the study, it was found that PE and MCE significantly improved pain and disability in adults experiencing chronic low back pain (CLBP) residing in rural areas, suggesting the possibility of merging these interventions to promote self-care and reduce the prevalence of CLBP in these under-resourced areas.[6]
2. **Fortin M.** et al. (**2023**) conducted a study namely ‘The Effects of Combined Motor Control and Isolated Extensor Strengthening Versus General Exercise on Paraspinal Muscle Morphology, Composition, and Function in Patients with Chronic Low Back Pain: A Randomized Controlled Trial’ which had 50 individuals who were randomly allocated in two arm the 1st arm underwent motor control training with isolated extensors strengthening and the 2nd group underwent general exercises. The treatment continued for 12 weeks, and outcome measures were

Multifidus muscle morphology and function which was assessed by 3-Tesla General Electric MRI machine and Aixplorer Supersonic ultrasound machine respectively. Morphology of Erector Spinae Muscle was assessed manually. Along with these, SF-12 and ODI were also used. Results showed that Multifidus and Erector spinae CSA, as well as MF thickness improved more in the 1st group. Enhancements in pain management, functionality, and overall quality of life were noted in both groups. Preliminary findings from this study indicate that motor control training with isolated extensors strengthening may enhance paraspinal morphology while reducing pain and disability.[7]

3. **Turci A. M.** et al. (**2023**) conducted a study called 'Self-administered stretching exercises are as effective as motor control exercises for people with chronic non-specific low back pain: a randomized trial' in which 100 individuals suffering from CLBP were randomly assigned into 2 arms. The 1st arm underwent self-administered stretching exercises, and the 2nd group underwent motor control training. The treatment continued for 8 weeks, which included 40 minutes of supervised sessions/week and one or more home sessions/week. The scales or measures used for the assessment were NPRS; ODI; FABQ; fingertip-to-floor test. Post study it was found that the between -group difference in pain intensity, disability and the secondary outcomes were negligible.[8]

4. **Hirota R.** Et al. (**2023**) conducted a study called 'Effects and limitations of home-based motor-control exercise for chronic low back pain: A single centre prospective study' in which 15 patients were made part of the study and divided into 2 groups. The 1st group had 4 participants who had adult spinal deformity (ASD), and the 2nd group had 11 participants without ASD. During the clinic's rehabilitation sessions, the patients received instruction regarding the type and level of exercise prescribed. The patients were told to exercise for 20 minutes a day, at least two times per week, continued for half a year. Evaluation measures used in this study were VAS; locomotor 25; stand-up test; two-step test; trunk and total body muscle mass by the impedance method; and spinal sagittal alignment. In post treatment evaluation it was found that there was significant improvement in pain intensity and in functionality in non-ASD group, however there was none of these changes were seen in ASD group and there was no alteration observed in muscle volume or spinal alignment in either of the cohorts[3]

5. **Lanier V. M.** Et al. (**2023**) conducted a study called 'Treatment preference changes after exposure to treatment in adults with chronic low back pain' in which 83 participants with CLBP were randomized into two arms. The 1st arm had 41 participants and underwent motor skill training (MST) whereas the 2nd group had 42 participants and underwent strength and flexibility exercises (SFE). They were given 6 weekly sessions on 1 hour each, and then they did a 12 month follow up. Participants completed a TPA questionnaire delineating motor skill training (MST) and strength and flexibility exercises (SFE) before commencing treatment. Using a 5-point Likert scale (ranging from 0 to 4), participants rated the effectiveness, acceptability, suitability, and convenience of each treatment option. Higher scores corresponded to higher ratings. Along with these, MODQ and NPRS were recorded as well. Twelve months after treatment, Participants who underwent motor skill training tended to rate their preference for it higher, whereas participants who underwent strength and flexibility exercises tended to rate their preference lower. Additionally, while MST generally led to increased preference ratings regardless of pain levels, smaller improvements in pain resulted in decreased preference ratings in the strength and flexibility group.[9}

6. **Gorji, S.M.** Et al. (**2022**) conducted a study called 'Pain Neuroscience Education and Motor Control Exercises versus Core Stability Exercises on Pain, Disability, and Balance in Women with Chronic Low Back Pain'. This study included 42 individuals with CLBP who fall within the age range of 50 to 60 were randomized into 2 arms of 21 participants each. The 1st arm underwent PNE and MCE and the 2nd arm underwent core stabilizing training (CST) for 8 weeks. The evaluation criteria utilized in this study comprised of VAS; RMDQ; USB; TUG test. Compared to CST treatment, PNE plus MCE treatment was more successful in reducing pain, disability and improving unipedal balance. Nevertheless, it was demonstrated that both treatments were safe and effective in raising all the dependent variables examined in CLBP participants.[10]

7. **Hooker Q. L.** et al. (**2022**) conducted a randomized controlled trial namely 'Motor skill training versus strength and flexibility exercise in people with chronic low back pain: Preplanned analysis of effects on kinematics during a functional activity', in which 154 adults with CLBP were included. They were randomly allocated in 2 groups, including 77 each. 1st group underwent SFE and the 2nd group MST. Patients of the first group were provided with exercises aimed at enhancing trunk strength and flexibility in the lower limbs, while those in the second group received personalized guidance to adapt their modified movement pattern, with this regimen lasting for a duration of 6 weeks. The evaluation tool used in the study in NPRS. The research concluded that MST is more efficacious compared to SFE in improving and sustaining modified movement patterns among individuals suffering from CLBP. MST demonstrated a reduction in early lumbar spine movement and an augmentation in knee and hip joint movement, whereas SFE showed no significant alterations.[11]

8. **Rabiei P.** Et al. (**2021**) conducted a study called 'Comparing Pain Neuroscience Education Followed by Motor Control Exercises with Group-Based Exercises for Chronic Low Back Pain: A Randomized Controlled Trial' in which they incorporated 73 patients with CLBP and then they were assigned randomly into two arms. The arm cohort consisted of 37 patients, and they underwent PNE followed by MCE, whereas the 2nd arm underwent group-based exercises (GE). The interventions were followed for 8 weeks, twice a week. The outcome measures employed in the study were VAS); RMDQ); PSEQ. The study found that PNE and MCE proved to be more efficient compared to GE in diminishing both pain intensity and disability among patients suffering from CLBP, suggesting further research is needed to determine their superiority.[12]

9. **Van Dillen L. R.**, Et al. (**2021**) conducted a study called 'Effect of Motor Skill Training in Functional Activities vs Strength and Flexibility Exercise on Function in People with Chronic Low Back Pain: A Randomized Clinical Trial', which included 154 patients who were suffering from CLBP for over a year and should fall within the age range of 18 to 60. All the individuals were allocated into 4 cohorts: MST alone, MST plus booster, SFE alone, and SFE plus booster groups. Modified Oswestry Disability Questionnaire was used pre and post treatment as an outcome measure. The study shows that, in comparison to conventional strength and flexibility exercise (SFE), Tailored MST focusing on individual needs for LBP associated with restricted functional activities result in more substantial enhancements in function over both short and long durations. Following treatment, the MST and SFE groups showed improvements in function that were clinically significant. Nonetheless, MST showed nearly twice as much function improvement (60% change) as SFE (35% change).[13]

10. **Tsang S. M. H.** Et al. (**2021**) conducted a study called ‘Recovery of the lumbopelvic movement and muscle recruitment patterns using motor control exercise program in people with chronic nonspecific low back pain’, in which 15 adults with NSLBP and 15 adults without any underlying conditions as control were included. The participants of LBP group were put into a motor control rehabilitation program which lasted for weeks and had 2 sessions per week. The outcome measures used in this study were SBST; TSK; RMDQ; and PSEQ. Along with these, physical outcomes were evaluated through 3D motion and electromyographic analysis while performing repetitive forward bending Manoeuvre.[14]

11. **Songjaroen S.** Et al. (**2021**) conducted a randomize controlled trial called ‘Combined neuromuscular electrical stimulation with motor control exercise can improve lumbar multifidus activation in individuals with recurrent low back pain’, in which included 60 participants, out of which 35 presented with CLBP while remaining 25 were control. The CLBP group was further randomized into two groups. The 1st group underwent Neuromuscular electric simulation (NMES) plus motor control exercises (MCE) and 2nd group underwent Sham NMES plus MCE. Rehabilitative ultrasound imaging was employed to measure Lumbar multifidus thickness at L4-L5 facet joint during resting, maximum voluntary isometric contraction (MVIC), and a combination of neuromuscular electrical stimulation with MVIC. It was discovered that combining NMES and MCE may improve LM activation in patients more effectively. These results would lend credence to the usefulness of using Neuromuscular electric simulation to create a lasting effect prior to motor control exercises.[15]

12. **Teychenne M.** Et al. (**2019**) conducted a study titled ‘General strength and conditioning versus motor control with manual therapy for improving depressive symptoms in chronic low back pain: A randomized feasibility trial’, with 40 men and women who were suffering from NSLBP for at least 90 days, having a mean age of 35. They were allocated randomly into 2 cohorts, the initial cohort consisted of 20 individuals who engaged in motor regulation workouts and hands-on therapeutic interventions, while the subsequent group of 20 subjects participated in overall muscle fortification and conditioning. Individuals in the primary cohort were provided with 12, 30-minute physiotherapy sessions for chronic low back pain. Pain education was combined with these exercises, commencing from positions without any load and advancing towards standing and practical movements. The 2nd cohort received instruction on managing pain and engaged in exercise sessions both at the gym and at home. They were obligated to attend two sessions at the gym weekly during the initial three months, succeeded by one or two supervised sessions weekly for the subsequent three months. Exercises included aerobic conditioning, proprioceptive exercises, weight transfer, external perturbation, and progressive resistance training. Outcomes were measured via CES-D 10 and VAS. The study found that adults with chronic NSLBP who received manual therapy, motor control, or general muscle strengthening demonstrated a decrease in depressive symptoms, but additional interventions and a control cohort are necessary[16]

13. **Hides J. A.** Et al. (**2019**) conducted a study called ‘Predicting a beneficial response to motor control training in patients with low back pain’ in which the reaction of 775 patients with lower back pain to MCT was categorized as either 'enhanced' or 'unchanged', determined by self-reported alterations in pain intensity and symptoms. The outcome measures were used in the study were VAS; RMDQ; HAQ; and The

LOGIQe system was employed to measure the fragmentary area of the lumbar multifidus muscle with the help of ultrasound imaging. Patients with scoliosis, low back pain without groin pain, chronic recurrent LBP, and subpar multifidus muscle test results showed positive responses to the treatment. A separate sample test verified that patients could be sorted into groups experiencing benefits, confirming the effectiveness of the treatment. The first step in helping clinicians choose patients who will respond best to MCT is provided by this study.[17]

14. **França F. J. R.** Et al. (**2019**) conducted a randomized controlled trial titled 'Motor Control Training Compared with Transcutaneous Electrical Nerve Stimulation in Patients with Disc Herniation with Associated Radiculopathy', wherein 40 patients with lumbar disc herniation were segregated into two cohorts. The initial cohort had 20 individuals and underwent MCT, on the other hand the 2nd cohort also had 20 individuals, but those were given transcutaneous electrical nerve stimulation (TENS) as the treatment option. The intervention in both groups lasted 8 weeks, twice a week, resulting in 16 sessions lasting 60 minutes each. The outcome measures used in the RCT were VAS; MPQ; ODI; and PBU was used for assessing transversus abdominis activation capacity. The results suggest that among individuals with LDH, MCT is superior to TENS in terms of pain relief, functional impairment reduction, and transversus abdominis activation.[18]

15. **Halliday M. H.** Et al. (**2019**) conducted a study called 'A randomized clinical trial comparing the McKenzie method and motor control exercises in people with chronic low back pain and a directional preference: 1-year follow-up', in which 70 participants with CLBP were randomly allocated into 2 cohorts with 35 each. The 1st cohort underwent McKenzie method and 2nd group underwent motor control exercises. They were given 12 sessions of treatment spread over 8 weeks. The outcome measures for this study were thickness of transverse abdominis, obliquus internus and obliques external muscle. Along with these outcomes' PSFC; GPQ; and 11-point VAS. There were no significant differences observed between the cohorts in terms of changes in thickness of trunk muscles for any of the three muscles under observation, nor in the secondary outcomes of function, perceived improvement, and discomfort.[19]

METHODOLOGY

Study type : Literature review
Study setting : School of Allied Health Sciences, Sharda University

Inclusion Criteria

- Articles published in or after 2019
- Randomized Controlled trials
- Cohort studies
- Prospective studies

Exclusion Criteria

- Articles published in or before 2018
- Systemic Reviews
- Case control studies
- Articles without abstract or full English text

RESULT

After fifteen research were reviewed, it was shown that individuals with chronic low back pain (CLBP) can significantly reduce their pain and impairment by using motor control training (MCT). Muscle morphology and functioning were markedly improved by combining MCT with either solitary extensor strengthening exercises or patient education. Lumbar multifidus activation improved when neuromuscular electrical stimulation and

MCT were combined. The adaptability of MCT was demonstrated by comparisons between self-administered stretching exercises and MCT, which revealed insignificant variations in pain intensity and disability results. Compared to typical strength and flexibility exercises, personalised MCT treatments produced better pain control and higher treatment preference ratings, indicating the necessity for individualized therapy techniques.

CONCLUSION

Motor control training (MCT) is a highly effective intervention for managing chronic low back pain (CLBP), especially when personalized and combined with other therapeutic approaches. The review highlights MCT's flexibility in accommodating various patient preferences and its significant impact on pain reduction and functional improvement. Integrating MCT into standard CLBP management protocols is recommended to optimize patient outcomes.

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To Compare The Effect Of Mirror Therapy And Motor Relearning Programme On Balance And Gait Speed In Chronic Stroke Patients: An Experimental Study

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ABSTRACT

Background: Stroke is rapidly developing clinical sign of focal disturbance of cerebral function. Mirror therapy is a form of mental practice, and it excites the primary motor cortex and evokes movement of the paralyzed side as mirror therapy allows an individual to have an experience of normal movement, also helps in improving balance and gait. The Motor Relearning approach was developed based on motor learning theory and in promoting physical function for stroke patients. The MRP was found to be effective for enhancing functional recovery as this drive neural plasticity for retraining functional skills useful for balanced sitting, sitting, standing, gait.

Objective: To compare the effect Mirror Therapy and Motor Relearning Programme on balance and gait speed by BBS, TUG and 10MWT in chronic stroke patients.

Methods: 22 Subjects according to inclusion criteria were recruited into two groups. Group A was given MT while Group B was given MRP for 4 weeks. Outcome measures such as BBS, TUG and 10MWT were assessed before and after intervention.

Result: Paired t-test was used for within group analysis for BBS (Berg Balance Scale) and Mann Whitney test was used for TUG (Timed Up and GO) and 10MWT (Meter Walk Test) which showed significant difference in Mirror Therapy group, while BBS and TUG were significant and 10MWT was not significant in Motor Relearning Programme. The independent sample t-test was used for between group analysis for BBS which showed significant difference while Wilcoxon test was used for TUG and 10MWT with significant difference.

Conclusion: This study shows that Mirror Therapy is more effective in improving balance and gait speed than Motor Relearning Programme.

Keywords: Mirror Therapy, Motor Relearning Programme, Balance, Gait speed, Chronic stroke.

INTRODUCTION

Stroke is rapidly developing clinical sign of focal (or global) disturbance of cerebral function with symptoms lasting 24 hours and longer, without an evident cause except that of vascular origin. Stroke is an essential reason for disability and early death. In India, modified stroke prevalence rate in rural areas is 84–262/100,000 and in urban areas 334–424/100,000. The prevalence rate is 119–145/100,000 studies in India. The risk of stroke after 55 years of age is 1 in 5 for women and 1 in 6 for men.

Post-stroke impairments in strength, coordination, and balance lead to complications and recovery is the major goal for individuals with stroke. The brain regulates motor activation, muscle tone, selective joint movement and balance, while the spinal cord regulates gait. Hence, for people with stroke, paralysis in the lower limbs can lead to motor function impairment and balance deficits associated with gait dysfunction, coordination disorder, and associated reactions, hemiplegic patients experience a considerable decrease of motor function in affected limbs.

Balance is an ability to control centre of gravity (COG) over the base of support (BOS) in each sensory environment. Maintenance of balance needs the co-ordination of sensory, neural and musculoskeletal system. Many of these undergo deterioration as people age. This has the possibility to affect balance, limit safe mobility, increase the chances of a fall and negatively affecting the quality of life.

Changes in muscle firing patterns activate anabnormal gait post stroke, thus the considerable goals of rehabilitation for hemiplegic patients are to attain a fast and systematic gait and to achieve almost normal gait pattern. The lower-limb paresis leading to gait impairment is one of the key manifestations poststroke. The disability further causes dependent, unsafe, and inefficient transfer and ambulation A hemiparetic subject walks with a synergistic pattern of the affected lower limb instead of selective control of the individual joint in stroke, lower-limb rehabilitation comprises various aspects such as inducing motor recovery, balance coordination training, orthosis, and assistive devices. 10 Unlike upper-limb functions, the walking and transfers are purely bilateral performances. Thus, the major focus of lower-limb rehabilitation is ambulation, which may be achieved by utilising compensatory techniques .

Sang Gu Ji1 and Myoung Kwon Kim2 et al18 in 2014 conducted study on "The effects of mirror therapy on the gait of subacute stroke patients: a randomized controlled trial" concluded that mirror therapy may be beneficial in improving the effects of stroke on gait ability. Sirajahemad H Bhoraniya et al19 in 2018 conducted study on "The effect of mirror therapy on the gait of chronic stroke patients: A randomized controlled trial" and concluded that Mirror therapy was helpful in improving the gait ability in chronic stroke patient compared to conventional therapy.

Mirror therapy is a type of mental practice, and it excites the primary motor cortex and evokes movement of the paralytic aspect as patients confirmed movement of the non-paralyzed side visually. A mirror neuron is neuron that responds to observation of a person's movement and may be activated through mirror therapy. The Mirror therapy mechanism is based on the concept of visual illusion. The motion of the non-paretic part in front of the mirror (reflective side) is recognised as that of the paretic body part (hidden beside the mirror).[15]

Motor learning mechanisms are operative throughout spontaneous stroke recovery and move with rehabilitative training. For optimal results, rehabilitation techniques should be geared towards patients' specific motor deficits and possibly combined Motor relearning programme (MRP) for stroke framed by them is a good example of Task Oriented Approach. [21]

The Motor Relearning Approach (MRP) in approaching physical function and task performance for stroke patients. The MRP was found to be effective for enhancing functional 4 recovery of stroke patients research has suggested that task-specific exercises would be most beneficial for stroke individuals, because this approach is thought to drive neural plasticity. This approach includes many aspects of Motor learning theory and provides practical guidelines for retraining functional skills (e.g., balanced sitting, sitting and standing, transfer skills, gait, etc.). 21 Their approach focuses on task specific learning and through effective use of feedback and practice development of active movement control. Facilitation techniques are de-emphasized whereas verbal instruction, demonstration, and manual guidance are emphasized.

Studies with stroke populations have shown that Motor Relearning Program (MRP)/ task specific training /Task-related training (TRT) with specific strengthening exercises for paretic muscles leads to improvement in locomotion, lower limb weight bearing in sitting, and standing up. 23 Functional mobility is largely affected and needs to take care of as it is a challenging part for any physiotherapist. Present study focuses of comparing the concepts of motor relearning with conventional approach.24 Dora YL Chan et al25 in 2010 concluded study on “Motor relearning programme for stroke patients: a randomized controlled trial” concluded that the motor relearning programme was found to be productive for enhancing functional recovery of patients who had a stroke. Both 'sequential' and 'function-based' concepts are important in applying the motor relearning approach to the rehabilitation of stroke patients.

According to my knowledge there is comparison on Motor relearning programme and Mirror therapy but less comparison between Motor relearning programme and Mirror therapy on Balance and Gait, so this study is comparison between the two for lower extremity.

To check the effect of Mirror therapy on balance and gait speed by BBS, TUG and 10MWT in chronic stroke patients. 2. To check the effect of Motor relearning Programme on balance and gait speed by BBS, TUG and 10MWT in chronic stroke patients. 3. To compare the effect Mirror Therapy and Motor Relearning Programme on balance and gait speed by BBS, TUG and 10MWT in chronic stroke patients.

Anatomy: Blood supply of the Brain: The brain is supplied by the two internal carotid and the two vertebral arteries. The four arteries lie within the subarachnoid space, and their branches anastomose on the inferior surface of the brain to form the circle of Willis. Circle of Willis: Extra cranial blood supply to the brain is provided by the right and left internal carotid arteries and by the right and left vertebral arteries. The internal carotid artery begins at the bifurcation of the common carotid artery and ascends in the deep portions of the neck to the carotid canal. It turns rostromedially and ascends into the cranial cavity. It then pierces the dura mater and gives off the ophthalmic and anterior choroidal arteries before bifurcating into the middle and anterior cerebral arteries. The anterior communicating artery communicates with the anterior cerebral arteries of either side, giving rise to the rostral portion of the circle of Willis.59 The vertebral artery arises as a branch off the subclavian artery. It enters the vertebral foramen of the sixth cervical vertebra and travels through the foramina of the transverse processes of the upper six cervical vertebrae to the foramen magnum and into the brain. There it travels in the posterior cranial fossa ventrally and medially and unites with the vertebral artery from the other side to form the basilar artery at the upper border of the medulla. At the upper border of the pons, the basilar artery bifurcates to form the posterior cerebral arteries and the posterior portion of the circle of Willis. Posterior communicating arteries connect the posterior cerebral arteries with the internal carotid arteries and complete the circle of Willis.

Thrombotic Infarction: Atherosclerotic plaques and hypertension interact to produce cerebrovascular infarcts. These plaques form at branching and curves of the arteries. Plaques usually form in front of the first major branching of the cerebral arteries. These lesions can be present for 30 years or more and may never become symptomatic. Intermittent blockage may proceed to permanent damage.

Embolic Infarction: The embolus that causes the stroke may come from the heart, from an internal carotid artery thrombosis, or from an atheromatous plaque of the carotid sinus. It is usually a sign of cardiac disease. The infarction may be of pale, haemorrhagic, or mixed type. The branches of the middle cerebral artery are infarcted most commonly because of its direct continuation from the internal carotid artery.

Haemorrhagic Infarction: The most common intracranial haemorrhages causing stroke are those resulting from hypertension, ruptured saccular aneurysm, and arteriovenous malformation. Massive haemorrhage frequently results from hypertensive cardiac-renal disease; bleeding into the brain tissue produces an oval or round mass that displaces midline structures. The exact mechanism of haemorrhage is not known. This mass of extravasated blood decreases in size over 6 to 8 months.

Mirror Therapy: Mirror therapy (MT) has been used as an intervention for the rehabilitation of stroke survivors. Mirror therapy is an intervention in which a stroke survivor watches their limbs on the non-affected side in a mirror to recover movement of the paralyzed side by creating a visual illusion. MT can exert a strong influence on the motor network, mainly through increased cognitive penetration in action control. Altschuler et al.10 demonstrated the effectiveness of MT on range of motion, movement speed, and accuracy of the upper limb joints post-stroke. Stevens and Stoykov11 also reported improvements in the Fugl-Meyer Assessment Scale scores, range of motion, movement speed, and agility after MT for the upper limb. In a novel study, Sütbeyaz et al.8 used MT for the lower limbs and reported that it was effective for motor recovery and motor function improvement. A study by Ji and Kim12 also reported a significant improvement in spatiotemporal gait variables after MT for the lower limbs of stroke survivors. The use of mirror therapy after stroke has predominantly cantered around the hemiparetic upper limb.

Additionally, several randomized controlled trials (RCTs) have found mirror therapy to have efficacy for reducing pain in the upper limb for stroke patients with complex regional pain syndrome.

Motor Relearning Programme: The motor relearning approach was developed based on motor learning theory.' 5 Carr and Shepherd9'" proposed that training in motor control requires anticipatory actions and ongoing practice. To further enhance relearning, the motor tasks involved are practised within a context that can be task or environment specific. A review of the literature revealed that only a few clinically controlled trial studies on the application of the motor relearning approach have been conducted. The results of these studies suggested that patients tended to have a short hospital stay and high functional independence.'4 Patients also showed a significant increase in gait velocity. However, 16 these studies did not provide detailed information on how task-oriented strategies were developed and used. Motor Relearning Approach (MRP) in promoting physical function and task performance for stroke patients. The MRP was found to be effective for enhancing functional recovery of stroke patients.

METHODOLOGY

Study Design- An experimental study

Sampling Design- Convenience sampling

Study Population- Patient with Chronic Stroke patients more than 6 months

Study Setting- OPD based

Study Duration- 5days/week, for 4 weeks

Study Period- 1 year (2021-2022)

Sample Size- The sample size was calculated using G power software version 3.1.9.4 The main outcome variable taken into consideration for sample size collection is rated of perceived exertion. From the previous study conducted by Dora YL Chan and Ranjeet Singha et al. Physiological responses to mirror therapy and motor relearning Programme. The TUG values were (mean=36.4, SD=15.5) (mean= 37.26, SD= 5.65). Keeping value of α error as 0.1 (since 95% confidence interval) and β error as 0.2 (power of the study 80%) the calculated sample size is 22.

SAMPLING CRITERIA

Inclusion Criteria-

- Both male and female
- 40-60 years
- First episode of Ischemic and Haemorrhagic unilateral stroke with hemiparesis (onset > 6 months)
- Able to walk 10 meters with or without assistance
- Spasticity grade < 3(according to modified Ashworth scale)
- ≥24 score in Mini Mental Scale
- Brunnstorm's grade ≥ 3
- Willing to participate

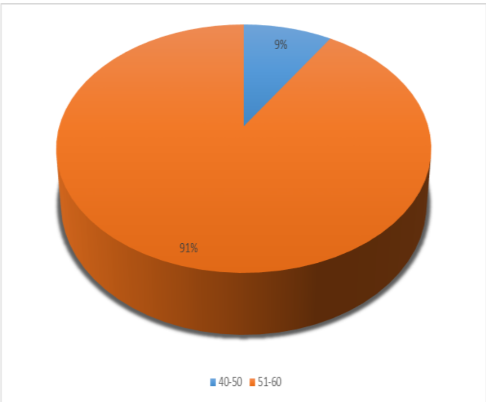
Exclusion Criteria-

- Transient Ischemic Attack
- Neurological disorder other than stroke such as (Parkinson, tremors, etc)
- Musculoskeletal disorder affecting locomotion
- Uncontrolled hypertension and peripheral arterial occlusion disease.
- Surgery of lower limb
- Gross visual spatial and visual deficit
- Diabetic retinopathy
- Apraxia
- Congenital deformity

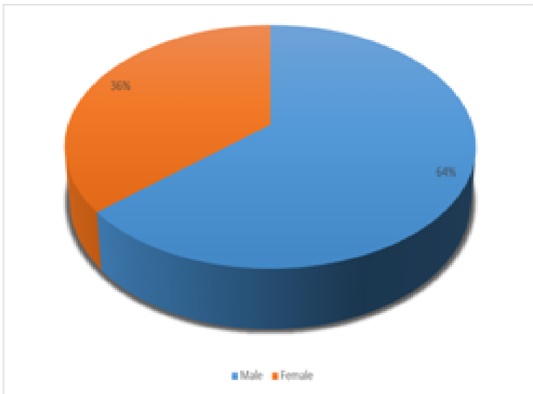
Procedure: After taking approval from institutional ethical committee the study was started. COVID19 guidelines like wearing mask, using hand sanitizer and maintaining social distancing were followed during data collection. Before starting the procedure, proper understanding and demonstration was given to each participant and Screening (ANNEXURE II) was done for each participant. Participants were selected who fulfil the inclusion criteria. They were briefed about the nature of the study. Written consent (ANNEXURE I) form was signed by the subjects prior giving the treatment. Outcome measures were taken before and after the program schedule. As per convenient sampling distribution patient were divided into 2 groups: Group A: Mirror Therapy. Group B: Motor Relearning Programme.

Paired t-test was used for within group analysis for BBS and Mann Whitney test was used for TUG and 10MWT which showed significant difference in Mirror Therapy group, while BBS and TUG were significant and 10MWT was not significant in Motor Relearning Programme. Independent sample t-test was used for between group analysis for BBS which showed significant difference while Wilcoxon test was used for TUG and 10MWT with significant difference.

Age distribution of MT and MRP:



Gender Distribution of MT and MRP:



The below table shows the Mean value and SD for age, MMSE, Brunnstorm (VCG) and MMT distribution among 22 subjects with 11 each group. Baseline data are equal in both the groups before the intervention.

BASELINEDATA	Group1(Mirror Therapy) (n=11)	Group2(Motor Relearning Programme) (n=11)	SIGNIFICANCE
	MEAN±SD	MEAN±SD	
AGE	55±4.3	55±5.9	1
MMSE	29.09±0.701	29.27±0.786	0.573
BRUNNSTORMGRADING(VCG)	3.45±0.522	3.73±0.467	0.211
MMT	3.45±0.522	3.73±0.467	0.211

OUTCOMEMEASURES (Group1)	PRE		POST		t-VALUE/ Z-Value	SIGNIFICANCE
	MEAN	SD	MEAN	SD		
BBS	43.091	2.5477	51.636	1.206	-11.316	<0.001
TUG	37.667	18.1157	29.909	14.8557	-2.941	0.003
10MWT	53.121	21.3012	39.924	15.408	-2.934	0.003

Paired t-test was used for Pre and Post BBS which shows significant difference in MT group ($t = -11.316$, $p = <0.001$)

Mann Whitney test was used for Pre and Post TUG which shows significant difference in MT group ($t = -2.941$, $p = 0.003$)

Mann Whitney test was used for Pre and Post 10MWT which shows significant difference in MT group ($t = -2.934$, $p = 0.003$)

The below table shows Independent sample t-test was used for between group comparison for BBS ($p = -0.892$, $t=0.385$) it shows no statistically significant difference in MT and MRP groups

Wilcoxon test was used for Between group comparison for TUG and 10MWT and Results shows significance difference in TUG ($U = 92.50$, $t= 0.034$) and 10MWT ($U = 93.50$, $t=0.028$) which is more in Mirror Therapy than Motor Relearning Programme.

OUTCOMEMEASURE	MT	MRP	TVALUE/UValue	SIGNIFICANCE
	MEAN±SD	MEAN±SD		
BBS	8.545±2.5045	7.364±3.613	-0.892	0.385
TUG	8.436±7.2322	6.009±5.65	92.5	0.034
10MWT	13.191±9.2740	6.700±6.512	93.5	0.028

Mirror Therapy and Motor Relearning Programme both were individually effective in improving BBS (static balance) and TUG (dynamic balance) whereas in Mirror Therapy improvement was found in 10MWT (gait speed).

In inter group comparison both Mirror Therapy and Motor Relearning Programme was equally effective in improving BBS whereas Mirror Therapy was found to be effective in TUG and 10MWT than Motor Relearning Programme. Still further investigation is needed.

LIMITATIONS

- Randomization was not done
- Blinding was not done for both assessor and therapist
- Long term follow-up was not taken
- Sample size was small Future Recommendation:
- Long term effect of Mirror Therapy and Motor Relearning Programme are currently unknown so further studies can be done.
- Combine effect of Mirror Therapy and Motor Relearning Programme can be done

Mirror Therapy and Motor Relearning Programme both were individually effective in improving BBS (static balance) and TUG (dynamic balance) whereas in Mirror Therapy improvement was found in 10MWT (gait speed).

In inter group comparison both Mirror Therapy and Motor Relearning Programme was equally effective in improving BBS whereas Mirror Therapy was found to be effective in TUG and 10MWT than Motor Relearning Programme. Still further investigation is needed.

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Ulnar Nerve Conduction Studies Between Elite Badminton Players And Normal Healthy Controls: A Comparative Study

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ABSTRACT

Background: Sports activities involving repetitive force application leads to mechanical or compressive neuropathies among players. Sparse literature is available reporting such nerve pathologies among badminton players. The study was done with the objective to find out what is the influence of regular and intense practice of badminton on the nerve conduction velocity (NCV) of ulnar nerve in elite players when compared to normal healthy individuals.

Materials & Methods: 2 groups of total 20 asymptomatic male subjects, between 20-40 years age, were created where one group included elite badminton players (n=10), and another included subjects who have not participated in any of the sports activities (n=10). Conduction of velocities and distal latencies for motor and sensory part of ulnar nerve was done for subjects in both groups. Mean and standard deviation were calculated for descriptive statistics and comparison was done using 2-way ANOVA test.

Results: Distal motor and sensory latencies for ulnar nerve suggested significant delays in non-badminton players when compared to elite players (p<0.05). Comparison of sensory conduction velocities for ulnar nerve between badminton players and normal subjects showed significant difference (p<0.05).

Discussion: Delay in sensory and motor conduction and reduction of sensory conduction velocities for ulnar nerve in badminton players can be attributed to repeated excursion, peripheral location of fibers, and dominance of players.

Conclusion: The results of the study concluded that there is an influence of regular and intense practice of badminton on ulnar nerve of elite players when compared to age matched normal subjects.

Keywords: Badminton, nerve conduction, ulnar nerve, upper limb.

INTRODUCTION

The electrical conduction ability of sensory and motor nerves of the human body is generally evaluated using nerve conduction studies (NCS).[1] NCS is an objective, quantitative and reproducible measure of peripheral nerve function and is widely used in diagnosis of neuropathies.[2] The electrophysiologic procedure has become so sensitive that it not only confirms the clinical diagnosis in most patients but also detects an incidental finding in some asymptomatic subjects.[3]

Repetitive force applied during daily activities commonly leads to compression neuropathies. Several factors related to external force application can lead to compression neuropathies. External compression can be applied in several ways: (a) a present for a long period; (b) an acute focal application of a large external force or (c) repetitive application of brief large forces. Combination of stretching, shearing and/or compressive force application may result into compression.[4] Athlete suffers from various acute and chronic mechanical injuries of peripheral nerves based on physiological demands. Around elbow injuries are very common in racquet sports due to high repetition of motions, high muscular forces and extreme elbow positions leading to overuse.[5]

Badminton is a non-contact sport requiring jumps, lunges, quick changes in direction and rapid arm movements from a wide variety of postural positions and also rapid and repetitive wrist movement.[6] Studies reporting epidemiological data of musculoskeletal injuries in upper extremity of badminton injuries are sparse, but previous studies have shown that these injuries often are severe in character but of relatively low frequency.[7,8]

Hence, the present study intends to evaluate the nerve conduction velocity of ulnar nerves in elite badminton players and compared with normal healthy individuals.

MATERIALS AND METHODS

In this study total 20 male subjects were included, out of which 10 were elite badminton players and 10 were age matched control subjects, between age group of 20-40 years through purposive sampling technique. The elite badminton players were recruited byDakshin Kannada Badminton Association and were included only if they were training for a minimum of 1 hour per day, four days a week. The age-related asymptomatic control individuals were included if they had not participated in any of the sports activities on a regular basis. The subjects were excluded if they had significant history, signs or symptoms of peripheral neuropathy orcompression syndrome of upper extremities. All the participants were right hand dominant in this study. The details and purpose of the study were explained to all the individuals for maximum co-operation and informed written consent was signed by all of them.

Neuro Care™ - 2000, having facilities of computerized electromyography (EMG) with nerve conduction velocity (NCV) and evoked potential (EP), manufactured by Bio-Tech™, India was used to evaluate nerve conduction parameters (i.e., conduction velocities and distal latencies).

Nerve conduction studies were performed using standard techniques of supramaximal percutaneous stimulation with a constant current stimulator and surface electrode recording on both extremities of each subject. Parameters studied: 1) Latency, 2) Amplitude, 3) Conduction velocity: sensory part and motor part.

For Ulnar Nerve:

Motor component: The stimulating electrode is placed at wrist and below elbow (about 4 cm below the medial epicondyle), recording electrode: from abductor digiti minimi, reference electrode on little finger, ground electrode between stimulating and recording electrode.

Sensory component (Orthodromic study): The stimulation is done using ring electrode at interphalangeal joint of 5th digit, recording electrode along course of ulnar nerve, reference electrode: 2 cm proximal to the recording electrode, ground electrode between stimulating and recording electrode.

RESULTS

SPSS 20.0 by IBM was used for data evaluation. Mean and standard deviation were calculated for the descriptive statistics and comparison of latencies and conduction velocities of motor as well as sensory components of ulnar nerve among elite badminton players and age matched control subjects were done using two-way ANOVA. Level of significance was set at $p<0.05$.

Table 1: Comparison of baseline characteristics of subjects (n=20)

	Control Group (n=10)		Elite Players (n=10)		t	Sig.
	Mean	**SD**	**Mean**	**SD**		
Age (years)	24.60	0.70	23.20	1.03	3.55	***0.002**
Weight (kg)	60.80	6.90	66.70	5.70	-2.086	0.051
Height (cm)	170.30	4.72	171.40	6.55	-0.431	0.672
BMI(Kg/m^2)	20.87	1.74	22.80	2.77	-1.865	0.079
Note: *2-tailed t-test was done with level of significance set at p<0.05						

Table-1 shows comparison of baseline characteristic which proves that there is a significant difference at $p<0.05$ for age in badminton players and control normal subjects. Other characteristics such as weight, height and BMI showed no significant difference.

Table 2: Comparison of baseline nerve conduction parameters of subjects (n=20)

Parameters	Normal (n=10)		Players (n=10)	
	Dominant	**Non-dominant**	**Dominant**	**Non-dominant**
ML (ms)	2.024 (0.487)	2.082 (0.382)	2.327 (0.362)	2.811 (0.462)
MNCV (m/s)	58.999 (5.098)	63.947 (4.905)	58.297 (3.618)	60.511 (3.811)
SL (ms)	1.723 (0.344)	1.632 (0.132)	1.994 (0.293)	2.020 (0.174)
SNCV (m/s)	46.871 (5.432)	44.926 (4.259)	39.872 (3.034)	39.407 (3.119)

Table-2 shows the comparison of baseline nerve conduction characteristics by comparing means and standard deviations, and at $p<0.05$ level of significance there is no significant difference between these baseline values.

Table 3: Comparison of differences between two groups using 2-way ANOVA (n=20)

Parameters	Group			Dominance		
	Sum of Squares	**F**	**Sig.**	**Sum of Squares**	**F**	**Sig.**
ML (ms)	0.906	8.354	***0.006**	0.906	8.354	***0.006**
MNCV (m/s)	18.92	0.8	0.377	7.081	0.299	0.588
SL (ms)	0.404	5.617	***0.023**	0.008	0.109	0.743
SNCV (m/s)	539.27	18.711	***<0.001**	6.061	0.21	0.649

Table-3 shows the comparison of differences between both groups using two-way ANOVA. Significant differences can be seen in motor and sensory latencies; SNCVs also showed statistically significant differences but MNCVs showed no significance at $p<0.05$. There was no significant difference seen in dominant and non-dominant extremity of players and control subjects in ulnar nerve.

DISCUSSION

Badminton is a sport which requires jumps, lunges, quick changes in direction and rapid arm movements from a wide variety of postural positions and rapid and repetitive wrist movement.[6] Also, many neurological injuries remain subclinical and are not identified before damage is irreversible. Many of the asymptomatic players with abnormal nerve conduction tests may have pre-symptomatic or asymptomatic neuropathy like subclinical entrapment nerve neuropathy.[5] Hence, detecting underlying nerve pathology in asymptomatic badminton players will help to prevent further deterioration and early intervention.

From our results we can infer that there is a delay in sensory and motor conduction and reduction of sensory conduction velocities for ulnar nerve in badminton players when compared with control age matched individuals.

The elbow is also the most common site for ulnar nerve compression. Potential compressive sites include the arcade or ligament of Struthers, the medial intermuscular septum, the cubital tunnel, and the medial head of the triceps. Normally, the ulnar nerve is subjected to stretch and compression forces that are moderated by its ability to glide in its anatomic path around the elbow. When normal excursion is restricted, irritation ensues. This results in a cycle of perineural scarring, further loss of excursion, and progressive nerve damage. The peripheral location of the motor and the sensory fibers may explain the usual clinical presentation in cases of early compression.[10–12.]

In a study done by Colak T et. al. (2004) on nerve conduction velocity of upper extremities in tennis players found that the sensory and motor conduction velocities of the radial nerve and the sensory conduction velocity of the ulnar nerve were significantly delayed in the dominant arms of tennis players compared with their non-dominant arm and normal subjects and this result is consistent with our results.[5]

As this study was conducted only on elite male badminton players between age of 20-40 years, we cannot generalize the results for the whole athletic population and sample size was less when two group comparisons were made.

Further study should be done using a larger sample size and in different age group and a longitudinal study can be done to find out clinical signs and symptoms in badminton players in later life who were initially asymptomatic with altered NCS.

CONCLUSION

As a conclusion, it can be stated that there is an influence of regular and intense practice of badminton on the upper extremity nerves function of elite players when compared to age matched normal subjects. Also, asymptomatic elite badminton players have underlying subclinical pathology in dominant upper extremity nerves which affect nerve conduction functions. Findings of the study can be useful in planning a preventive conditioning program, for rehabilitation of patient and for modification strategies to optimize biomechanics scientifically and to imply neuro-dynamics based rehabilitation.

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DECLARATION OF INTEREST STATEMENT

The authors report there are no competing interests to declare.

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Functional Problems After Acute Stroke And The Recovery Status After 3 Months - A Cross-Sectional Study

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ABSTRACT

Introduction: Stroke survivors experience limitations in Basic and Instrumental activities of Daily living (ADLs), which have a significant impact. Over 50 % have motor problems but are not seeking physiotherapy. The independence of individuals is impacted by limiting activities like eating, walking, dressing, etcetera. Commonly used Functional Outcome measures have not been validated in India. So, we have taken the Indian Stroke Scale (ISS) (Gujarati Version) as an outcome measure.

Materials and Methods: A cross-sectional study was conducted in Anand city of Gujarat state, including 27 patients diagnosed with stroke. The initial assessment and pre-data (ISS) were taken within 7 days of incident of stroke and the post- data was taken after 3 months.

Results: We have found that 52 % of the patients have taken physiotherapy after getting discharged from the hospital. The patients who have not taken the therapy improved 35.38 % and those who have taken the therapy improved 42.5 % on ISS.

Discussion: The study revealed a 40% improvement in walking outside the home score at 3 months post stroke, confirming the recovery findings of in Literature. Additionally, 52% of subjects underwent physiotherapy treatment, resulting in functional improvement in walking, stair climbing, etc. indicating the benefits of physiotherapy.

Conclusion: The study found that patients initially faced functional problems such as standing without support, walking outside, climbing stairs, toileting, and attending social functions. The improvement in functional problems include getting out of bed, standing without support, walking, bathing, dressing, eating, and participating in social functions.

Keywords: Stroke, Functional Recovery, Indian population

INTRODUCTION

The World Health Organization (WHO) defines "Stroke" as a rapidly developing signs of focal (or global) disturbance of cerebral function with symptoms lasting for ≥24 hours or leading to death with no apparent cause other than vascular origin. The stroke is a collection of clinical syndromes which can result from ischemia in the cerebrum to intracranial hemorrhage. (1) In 2016, the Global Burden of Disease project in India recorded an estimated 1,175,778 new cases of stroke. The annual stroke incidence in India is estimated to be between 105 and 152 cases per 100,000 individuals, according to a recent systematic review that primarily relied on cross-sectional data. (2) Over the past decade, the incidence of stroke in India has significantly risen. This increase can be linked to various socio-economic changes that have influenced lifestyles, including reduced physical activity, higher consumption of processed foods, and greater workplace stress.

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These shifts have also contributed to the rise in risk factors such as type-2 diabetes, hypertension, obesity, and hyperlipidemia. Approximately 80% of all strokes in India are ischemic in nature. Additionally, strokes affect around 10% to 15% of individuals under the age of 40. Based on community survey data, Dalal et al. reported a crude prevalence rate of 200 cases per 100,000 population for stroke-induced hemiplegia in various parts of India. (3). Statistics indicate that in 2019, India experienced 1.29 million stroke incidents (95% UI 1.15–1.45) and 699,000 stroke-related deaths (95% UI 594,000–807,000). (4) The consequences of stroke can significantly limit survivors' independence and activity levels, reducing their ability to perform daily tasks and meet societal responsibilities. More than half of stroke survivors in India suffer from motor impairments yet do not receive physiotherapy services, presenting a major challenge. These impairments restrict activities such as dressing, walking, bathing, eating, cooking, shopping, and managing household chores, which impacts not only personal autonomy but also the overall quality of life for families. (5) The temporal progression following a stroke is often classified into specific phases as outlined by the Stroke Roundtable Consortium. These phases include the hyper-acute phase (first 24 hours), acute phase (first 7 days), early sub-acute phase (first 3 months), late sub-acute phase (months 4–6), and chronic phase (beyond 6 months). Shortly after the onset of cerebral ischemia, a series of plasticity-enhancing mechanisms occurs, resulting in dendritic growth, axonal sprouting, and the formation of new synapses. The most significant recovery typically occurs within the first few weeks' post-stroke, with progress often plateauing after three months, particularly for motor symptoms. (6) Ordinal scales are frequently used in Indian stroke rehabilitation research to assess body structure and function as outcome measures.

The reliability and validity of these scales range from 0.37 to 1.00 and 0.65 to 0.96, respectively. Among the most used outcome measures are the Modified Rankin Scale (m-RS) and Barthel Index. Nevertheless, there is a need to adapt and validate scales that assess activity limitations and participation to ensure they are culturally appropriate. It is worth noting that certain items on these scales may be understood differently in the Indian context. (7) According to earlier research, the common participation measures in stroke rehabilitation do not adequately address the unique post-stroke concerns of patients in non-Western countries like India. Indian stroke patients (38%–50%) reported that the information in these measures was "not a problem" or "not relevant" for them. Disparities in regional customs, lifestyles, and architectural settings have been blamed for this disparity. It is crucial to remember that non-Western cultural contexts, such as India, were not initially considered when developing these outcome measures. (8)

The Indian Stroke Scale (ISS) is a patient-reported outcome measure designed specifically to evaluate limitations experienced by stroke patients in India. It focuses on assessing activities that are both meaningful and culturally relevant to the patients' daily lives. With Cronbach's alpha score of 0.94, the scale has demonstrated excellent internal consistency. Additionally, confirmatory factor analysis results have demonstrated an acceptable goodness of fit. The scale has also shown robust construct validity and a high test-retest reliability, with an intraclass correlation coefficient of 0.80. It effectively distinguishes between patients with varying levels of disability severity, showing a mean difference of 34 (95% CI = 27 to 39).The ISS has shown a moderate correlation with the Barthel Index ($r = 0.59$, $p < .001$), the social participation domains of the Stroke Impact Scale ($r = 0.44$, $p < .001$), and the physical and instrumental activities of daily living ($r = 0.64$, $p < .001$). Originally created in English, the questionnaire was subsequently translated and field-tested in Tamil and Gujarati, two Indian languages. (8)

Aim:

- To find Functional problems faced by the patient after acute stroke and the recovery status after 3 months

Objectives:

1. To observe and evaluate the chief functional problems in patients with stroke in acute phase of incident.
2. To know the prevalence of the population who take the physiotherapy rehabilitation after discharge from hospital.
3. To observe and evaluate the chief functional problems felt at the 3 months of the incident.
4. Comparing the severity of functional problems from the point of incident to 3 months post incident.

REVIEW OF LITERATURE

1. **Stephanie P Jones et.al. (2022)**, have done a **systematic review of the incidence, prevalence, and case fatality of stroke in India.** They examined prospective, consecutive recruitment studies with a predetermined sampling strategy that were conducted between January 1997 and August 2020. Studies included if participants met clinical criteria or the World Health Organization's (WHO) definition of a confirmed history of stroke. Nine studies have been selected for inclusion. There were 22,479,509 people in the total population, and 11,654 (mean 1294 SD 1710) of them had an incident stroke. The crude annual incidence rate varied from 108/100,000 to 172/100,000 individuals annually in seven studies. (2)
2. **V Prakash and Mohan Ganesan (2020)** The Indian Stroke Scale was created and validated to assess stroke patients' involvement in everyday activities in India. Psychometric testing and scale development were the two stages of the scale's development. The items emerged from a conceptual framework of stroke patients' involvement in everyday activities in an Indian setting. There were twenty-five items in the scale's definitive version. In all, 377 stroke patients were selected from five physiotherapy outpatient rehabilitation facilities and two tertiary care hospitals in India. Internal consistency, one-dimensionality, construct validity (known group and convergent validity), and test-retest reliability were all examined during the scale's psychometric testing. The scale's items showed good internal consistency, according to their findings (Cronbach's alpha =.94).
3. **V. Prakash and Mohan Ganesan (2019)** studied what matters to patients with stroke in India and why? Which was a qualitative study, in which they have taken 30 patients who were diagnosed with stroke for the first time and aged > 45 years from the rural areas of Gujarat and Tamilnadu states of India.
4. **B. Bonnera, R. Pillai et al. (2015)** investigated the factors predicting return to work after stroke in India. The study included patients aged 18–60 with mild to moderate disability following a first-ever stroke. The findings showed that 52.5% of patients returned to work, with 86.5% returning to their previous employer. The average time from stroke to return to work was 3.9 to 4.6 months, with 59% returning within 3 months. Among those unable to return to work, 94% expressed a desire to do so. Fatigue (74%) and feeling of not having fully recovered (77%) were reported as major concerns among those who returned to work. (13)

MATERIALS AND METHODS

Methodology:

- Study Design: - cross - sectional
- Sample size: - 48
- Study population: - Stroke patients.
- Source of data: - Shree B.G. Patel College of Physiotherapy, Jeevandeep Hospital, Anand., Lifeline Hospital, Anand
- Sampling Method: - Purposive
- Study Duration: - 1 year

Criteria for sample selection:

- **Inclusion Criteria: -**
  - Patients are diagnosed with and are in acute phase of stroke (< 7 days)
  - Ischemic and hemorrhagic stroke
  - Patients with MMSE >23
  - Age > 40
  - Patients who are willing to participate.

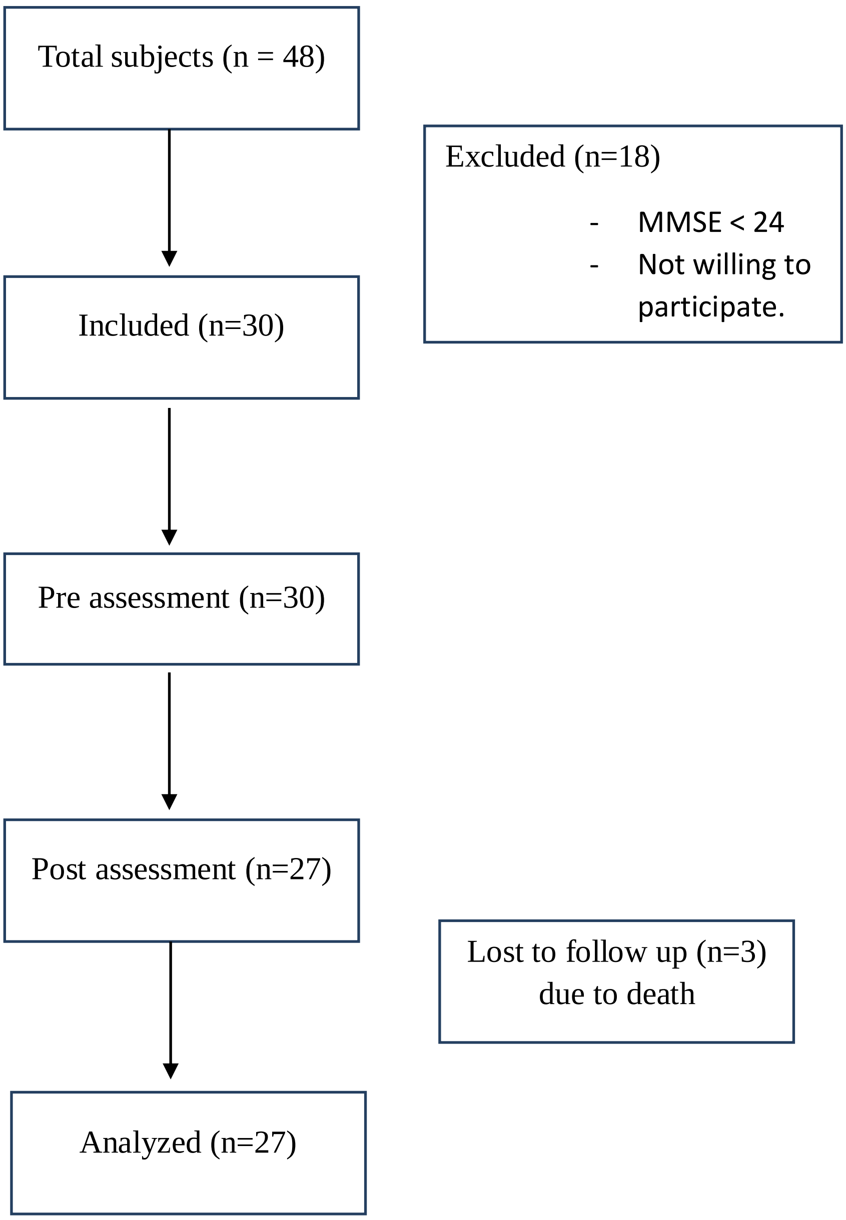
- **Exclusion Criteria: -**

  - Patients with previous history of any neurological disorders.
  - Patients who had undergone any major surgical procedures within 6 months of the incident.

Materials used: -

- Consent form
- Assessment form and Mini Mental State Examination (MMSE) scale
- Indian Stroke Scale
- Pen and paper

Procedure:



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RESULTS

Statistical analysis was done in SPSS version 25.

Descriptive Statistics					
	N	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**
AGE	27	40.00	80.00	60.6667	12.44990
Duration of hospital stay (days)	27	2.00	40.00	11.0000	8.43071
MMSE	27	23.00	30.00	26.5185	2.60724
ISS pre	27	.00	100.00	48.4815	36.14540

Table 1 Descriptive Statistics

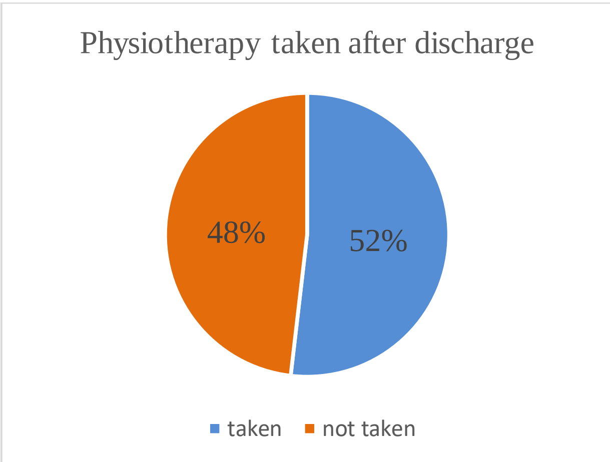

Chart 1 represents the sex distribution that is Male 74 % (n=20) and Female 26 % (n=7)

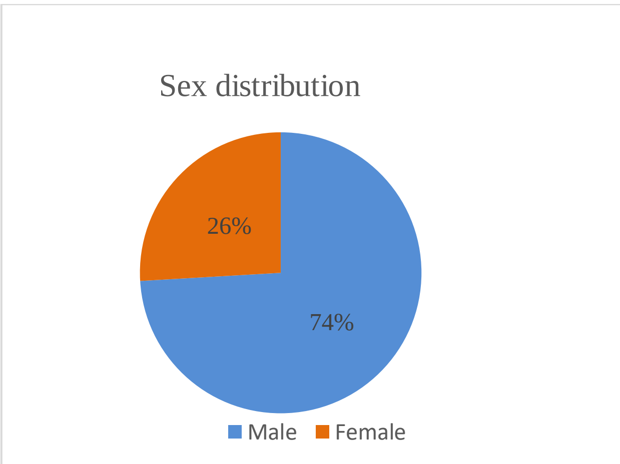

Chart 2 Distribution of patients who have taken physiotherapy after hospital discharge.

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Tests of Normality						
	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Difference	.154	27	.101	.907	27	.019
a. Lilliefors Significance Correction						

Table 2. Test for Normality of the data (Pre-Post 3 months): the test of normality done for the difference of the ISS pre and Post 3 months score and according to Shapiro wilk test of normality significance is 0.019 which is <0.05 concluding that the data is not normally distributed.

	Pre	Post 3 months	Difference	P.value
Mean (SD)	48.4074(36.17)	87.4815(19.48)	39.0741(28.17)	P<0.001
Median (IQR)	31.000(20.00-91.000)	99.000(85.00-100.000)	43.00(9.00-64.00)	P<0.001

Table 3. Mean with Standard deviation, Median with Interquartile Ranges and of pre post scores of ISS and its difference. (p<0.001)

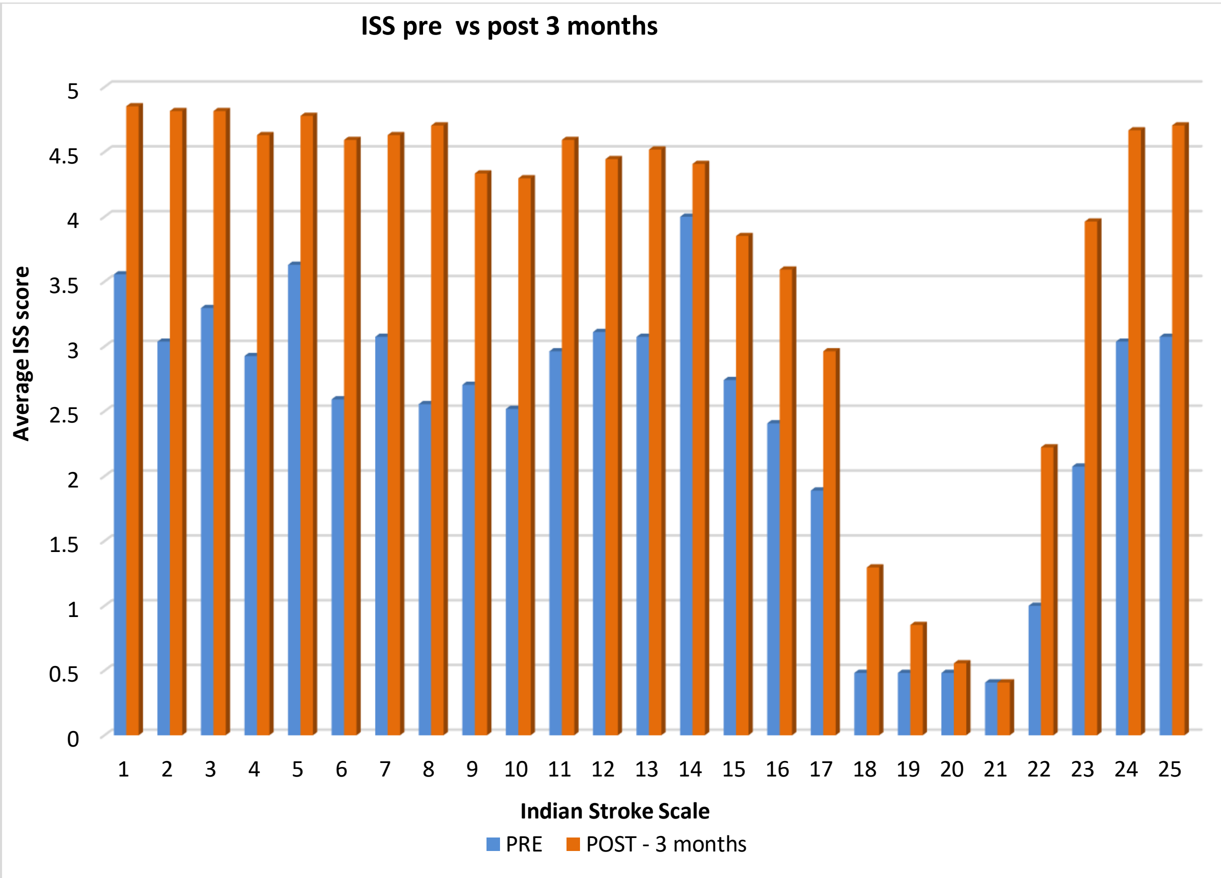

Figure 1 Indian stroke scale pre- post comparison

Figure 1 is a representation of all 25 questions' responses' average, of all 27 subjects' pre- and post-3 month's functional status. As ISS is a 5-point scale ranging from "not limited at all" to "completely limit", the bar graph shows each question's separate response to identify the actual status at the time when the data is taken.

	Patients who have not taken physiotherapy			**Patients who have taken the Physiotherapy**	
ISS Initial	**ISS post 3 months**	**Difference**	**ISS Initial**	**ISS post 3 months**	**Difference**
100	100	0	91	100	9
0	44	44	56	89	33
15	85	70	100	100	0
71	100	29	25	100	75
54	99	45	6	33	27
91	100	9	21	94	73
99	100	1	99	100	1
26	100	74	22	93	71
18	100	82	10	71	61
31	95	64	31	90	59
92	100	8	1	64	63
100	100	0	36	90	54
66	100	34	20	63	43
58.6923	**94.0769**	**35.385±30.31**	26	52	26
			38.85714	**81.35714**	**42.5 ± 26.63**

Table 4 Initial and post total scores of ISS in with difference of patients who have taken physiotherapy and those who have not.

DISCUSSION

The study aimed to identify the functional challenges faced by stroke patients during the acute phase and at 3 months post-stroke. These challenges cover physical, cognitive, and social functioning and are commonly measured using the World Health Organization International Classification of Functioning, Disability and Health framework. This framework suggests assessing activity limitations and participation restrictions across various functional subdomains to gauge health and disability. The Modified Rankin Scale and Barthel Index measure functional status but do not assess cognitive or social function. Our study used the ISS as an outcome measure, which includes social function inquiries. Patients' average ISS score was 3.00 during the acute phase, indicating limitations, but exceeded 4.5 after 3 months, signifying no limitations. This suggests improvement in social function over time, due to sustained support from family and caregivers.

We have found that some functions such as stair climbing were limited, with an average score of 4, while bathing and dressing showed statistically better improvement with an average score of 4.5 according to the ISS. This was part of a study by Rhoda A. et al. (9) on 76 stroke patients, using The Rivermead Motor Assessment and Barthel Index as outcome measures. The ISS describes 5 levels of independence in functions, as reported by the patient, providing valuable insights into the limitations experienced. This differs from the Rivermead Motor Assessment and Barthel Index, which may not accurately reflect the patient's experience, leading to varied results in function and recovery status between studies. In our study, we observed an average 40% change in walking ability outside the home at 3 months compared to pre-stroke status. A study by DERICK T WADE, et al. (10) found that 64% of patients initially dependent on walking had regained independence within the first 3 months post-stroke, supporting our findings. Our study also showed a 29% recovery for dressing and 30% for transferring activities, compared to 61% recovery for transferring activities reported in the literature. The differences in findings are due to population size and pre-stroke status heterogeneity. The secondary goals were to determine the proportion of the population that receives physiotherapy treatment, as well as the amount of recovery in various functions in both those who received treatment and those who did not. We discovered that 52% of the subjects in our study received physiotherapy treatment. We identified functional problems with walking, stair climbing, bathing, and so on. Sanghamitra Patil et al. (11) conducted a national survey that supported our findings of similar movement impairments. It also supports our findings that in India, more than half of stroke survivors with motor problems do not receive physiotherapy or occupational therapy services, which is concerning.

CONCLUSION

In conclusion, the functional problems faced initially by the patients were getting up from bed, standing unsupported, walking inside or outside home, bathing, wearing clothes, stair climbing, participating in a social function and to go and meeting family members or neighbors. The functional recovery was seen statistically in both the groups, those who have taken physiotherapy and those who have not, but improvement was seen more in the patients who have taken physiotherapy.

LIMITATIONS AND FURTHER SCOPE

1. To take a larger sample size was out of the scope of the study, so future studies should include larger sample size.
2. Due to the limitation of study duration this study focuses on the recovery of stroke after 3 months which is till sub-acute phase only, the further recovery status of chronic stages can be evaluated in future studies with the help of same outcome measure.
3. This study includes samples from only a few hospitals of Anand city and one outpatient center which may not be representative of general population, hence future studies should consist of a multi-center sample from various geographical locations.
4. The age range is quite large in this study, so a study with narrowed age range should be done which can differentiate the prognosis.
5. The initial assessment was taken in the form of an in-person interview while the post status was taken via telephonic interview which can lead to biases in the results, so future studies can be done with in person interviews only.
6. Limitations and Future Directions: This study focused on examining functional recovery in stroke patients, regardless of the brain areas affected. However, the time constraint of this study (1 year) limited the exploration of long-term recovery patterns. Future research should investigate recovery trajectories beyond 1 year to provide a more comprehensive understanding of stroke rehabilitation outcomes.

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The Effects Of Thoracic Core Conditioning Exercises With Stretch Pole And Thoracic Mobility Exercises On Pulmonary Function, Chest Expansion And Quality Of Life In Young Older Adults - A Comparative Study

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ABSTRACT

Introduction: Young old groups consist of the populations between 65 and 75 years of age. The aim of the study was comparing the effects of thoracic core conditioning exercises with stretch pole and thoracic mobility exercises on PEFR, chest expansion at axilla and xiphoid level and quality of life using WHOQOL-BREF scale.

Material and Method: Forty-two participants who satisfied the inclusion criteria were recruited for intervention and divided into two groups: Group-A: thoracic core conditioning exercises with stretch pole and Group-B: thoracic mobility exercises. The exercise session consisted of 4 days in week for 4 weeks. Outcome measures were taken pre and post treatment.

Result: Intra group analysis by Wilcoxon test in both groups shows statistically significant improvement on PEFR, Chest expansion and Quality of life (p value≤0.005). While inter group analysis by Mann-Whitney test showed statistically significant difference in PEFR, chest expansion. (p value≤0.005).

Discussion and conclusion: Both exercises protocols are equally effective in improving quality of life whereas the participants who received thoracic core conditioning exercises with stretch pole shows better result in terms of PEFR and chest expansion.

Key words: Older adults, PEFR, Chest expansion, WHOQOL-BREF, stretch pole.

INTRODUCTION

"The term "elderly" refers to individuals who are 65 years of age or older."[1] (WHO) Three groups have been classified as follows:1) Young-old: This group includes individuals aged 65 to 75 years.2) The middle-old age group includes individuals aged between 75 and 85 years.3) Old-old: This group comprises individuals aged above 85 years.[2]

The aging process impacts various organs and tissues, leading to a gradual decline in their functions. Older adults with comparable levels of chronic airflow obstruction often face more significant exercise limitations than their younger counterparts. This disparity can be attributed to age-related declines in lung function, diminished cardiac capacity, reduced muscle strength and endurance, sensory deficits, impaired coordination, and increased reliance on medications.[3] Numerous studies suggest that both static and dynamic lung function measurements tend to decline with advancing age.[4-6] This decline may result from a loss of lung elastic recoil, diminished alveolar support, increased stiffness of the rib cage, weakened respiratory muscles, and reduced efficiency in pulmonary gas exchange associated with aging.[7] The stiffness of the rib cage tends to increase withage,likelyduetoseveralage-relatedfactorsincluding:i)decalcificationoftheribs,ii)calcificationofthe rib cartilage, iii) changes in the rib-vertebral joints, iv) alterations in chest shape, and v) narrowing of the intervertebral disc spaces.[8] Aging-related physiological changes in pulmonary function include a reduction in vital capacity, a decline in peak expiratory flow, an increase in residual volume, a decrease in inspiratory reserve volume, and lower arterial oxygen saturation levels.[9] Many older adults experience a decline in thoracic mobility, which refers to the movement capability of the chest wall, rib cage, and thoracic spine. This restriction in thoracic mobility can limit functional mobility and adversely impact pulmonary function, including respiration.[10]

Thoracic core conditioning or core instability strength training involves exercises that focus on abdominal and thorax muscles and maintain posture. These exercises aim to enhance abdominal and spinal muscle strength, spinal function, and balance performance.[11] According to Kritika et al. (2014) study analysis revealed that participants who engaged in one week of thoracic core conditioning exercises, with or without the use of a stretch pole, experienced significant short-term improvements in chest expansion, perceived intensity of breathlessness, and functional performance. Notably, the group that performed thoracic core conditioning exercises with the stretch pole showed a greater percentage of improvement.[12] Chest mobility exercises are a crucial technique in conventional chest physiotherapy, aimed at enhancing chest wall mobility and improving ventilation. Numerous studies support the effectiveness of these exercises as an intervention to boost both chest wall mobility and pulmonary function.[15-16.]

It is being supported by enough evidence that human ageing has an impact on lung functions which may reduce quality of life. In past literature only a few studies have been conducted on how to improve chest excursion and pulmonary function in healthy older adults. Limited literature shows beneficial effects of core conditioning exercises with stretch pole over simple core conditioning exercises. Also, some studies found the promising results of thoracic mobility exercises on pulmonary functions and quality of life.

But in past no study has been conducted on which therapy, thoracic core conditioning using stretch pole or thoracic mobility exercises is more beneficial in terms of pulmonary functions and quality of life. Considering this as a gap in literature, itneeds to conduct a study to compare the effects of thoracic core conditioning exercises with stretch pole and thoracic mobility exercises on pulmonary function, chest expansion and quality of life on young older adults.

OBJECTIVES

- To determine the effects of thoracic core conditioning exercises with stretch pole on pulmonary function (PEFR), chest expansion and quality of life (WHOQOL-BREF) in young older adults.
- To determine the effects of thoracic mobility exercises on pulmonary function (PEFR), chest expansion and quality of life (WHOQOL-BREF) in young older adults.
- To compare the effects of thoracic core conditioning exercises with stretch pole and thoracic mobility exercises on pulmonary function (PEFR), chest expansion and quality of life (WHOQOL-BREF) in young older adults.

REVIEW OF LITRETURE

Yokoyama et al. (**2011**) conducted a study on the effect of the core conditioning exercises using the stretch pole on thoracic expansion difference in healthy middle –aged and elderly persons, 14 healthy middle aged and elderly females participated in study. Participants were randomly allocated to core conditioning with the stretch pole (SP group) or core conditioning without it (control [C] group). The exercises were regularly performed twice a day for one week. Chest Expansion at axillary and 10th rib level taken as Outcome measurement. Results showthe post intervention value of core conditioning with stretch pole group (SP group) were higher than the Core conditioning without stretch pole (C group) at both axillary and 10th rib levels. These results indicate that CC using stretch pole improves thoracic mobility.[18]

Ekstrum et al. (**2009**) conducted a study on the effects of a thoracic mobility and respiratory exercise program on pulmonary function and functional capacity in older adult in this study 37 volunteer participated in twice daily home exercise program for 6 weeks Pulmonary function measure for FEV1, FVC, PEF, Physical Performance test (PPT), Quality of life test SF36 taken as Outcome measurement. The study concluded that after doing 6 weeks of thoracic mobility and respiratory exercises older adults demonstrated an increase in CWE and physical performance.[28]

MATERIAL AND METHEDOLOGY

- Study design: Experimental study.
- Sampling design: Convenient sampling method
- Study population: Young older adults.
- Study setting: Various old age homes inVadodara.
- Study duration: 1year (2022-2023)
- Sample size: The sample size was calculated by using G-Power software version 3.1.9.4.] The calculated sample size is 42(21 each group)

<u>Selection Criteria</u>:

Participants were selected based onthe following criteria:

Inclusion Criteria: -

1. Age: 65-75 age group
2. Both genders
3. Chest expansion = At axilla level ≤ 1.5cm
   At xiphoid level ≤ 2 cm
4. Ability to communicate & follow command.

Exclusion Criteria: -

1. Current smokers
2. Previous history of any thoracic surgeries
3. History of any musculoskeletal deficit which impacts on exercise protocol and outcome measures like adhesive causalities, severe osteoporosis, etc.
4. History of neurological pathology which impact on exercises protocol and outcome measures like stroke, Parkinson disease, ataxia, etc.
5. History of cardiovascular disease which impact on exercise protocol and outcome measures like unstable angina, recent mi, decompensate heart failure, etc.
6. History of any respiratory disease which impacts on exercise protocol and outcome measures like chronic bronchitis, asthma, etc.
7. Any pathology and deformity related to spine like disc protrusion, spondylolisthesis, kyphosis, scoliosis, etc.
8. BMI ≥ 30 kg/m2
9. Uncontrolled hypertension and diabetes Mellitus
10. Pain while exercising
11. All contraindications of pulmonary function test
12. Not willing to participate.

<u>Materials Used</u>:

1. Stretch pole (Cylinder-shaped tube, diameter-15 cm, length-78 cm)
2. Incentive Spiro meter (3 ball Spiro meter, QU-MED)
3. Peak expiratory flow meter (Cipla breathe-o meter)
4. Non elastic measure tape
5. Scale (WHOQOL-BREF)
6. Pen and Paper
7. Sterilium
8. Cotton
9. Towel
10. Disposable mouthpiece
11. Nose clip
12. Assessment form
13. Consent form

<u>Outcome Measures</u>:

1. Peak Expiratory flow rate (PEFR) Participant was in relaxed sitting position. Therapist would reset the meter by sliding the marker all the way to zero on the scale. The participant was instructed to take a full deep breath. The mouthpiece was then placed in the participant's mouth and the therapistinstructed him to breath out as fast as possible and as hard as possible in single breath. The marker was sliding outward on the numbered scale, indicated the peak expiratory flow rate for that attempt. The procedure was repeated two more times with the remaining 1 min between the attempts and the best reading out of the three attempts was used for data analysis.[17]

2. Chest expansion [ICC= 0.95-0.97][18]

Participants were instructed to wear thin, loose-fitting shirts to allow full mobility, they were asked to stand comfortably with hands at their sides. The same position was used for both pretest and posttest analyses. Each participant was given verbal instructions and demonstration prior to testing. Measurements were taken at two thoracic levels: the axillary level for the upper thorax and the 10th rib level for the lower thorax. A flat tape was initially placed around the participant's axillary level. With the arms down, then the participant was asked to inhale as deeply as possible (Inspiration-maximum) while the measuring tape was drawn taut, then the thoracic circumference was measured. The tape was then released, and the participant was asked to exhale as much as possible (Expiration-maximum) then the thoracic circumference was measured again. The same process was repeated for the 10th rib level. The thoracic extension difference was calculated by deducting Expiration-maximum from Inspiration-maximum. All measurements were performed three times, and the average value was used for further analyses. Measurement was conducted prior to and following the intervention period.

3. WHOQOL- BREF [ICC=0.78-0.82][19]

Quality of life was evaluated using the WHOQOL-BREF scale, which has been evaluated and validated. This questionnaire includes four domains: physical health, psychological well-being, social relationships, and environment, with a total of 26 questions. Each domain is rated using five different Likert-style response scales: "very poor to very good" (evaluation), "very dissatisfied to very satisfied" (evaluation), "none to extremely" (intensity), "none to complete" (capacity), and "never to always" (frequency). Each domain consists of questions with scores ranging from one to five. Following WHO guidelines, raw scores for each domain were calculated by summing the individual item values, which were then converted into a score ranging from 0 to 100, with 100 being the highest and 0 the lowest.

Procedure:

After taking approval from institutional ethical committee study conducted. Participants who fulfilled the inclusion criteria were selected from the population. Participants were explained about the purpose of the study. Written consent was obtained from the participants before starting the study. The demographics in the form of (weight, height, BMI, etc.) were collected from all the participants.

Participants were divided into 2 groups as per convenient sampling method.

Group –A = Thoracic Core conditioning exercises with stretch pole

Group – B = Thoracic mobility Exercises

Both the groups were given treatment for one session for four days per week for four weeks. Outcome Measures were taken on the first day before starting the treatment and on the last day after complete treatment.

Group-A: Thoracic Core Conditioning Exercises With Stretch Pole Protocol

Following collection of baseline measures, participants were instructed the thoracic core conditioning exercises with stretch pole protocol:

The Stretch Pole is a cylinder-shaped tube, made of materials like a special Styrofoam with a length of 78 cm and diameter of 15 cm.

Typical exercises given to participants using the Stretch Pole consist of 3 preliminary motions followed by the Basic Seven exercises.

The Preliminary motions consist of,

1. Maintenance of shoulder abduction
2. Maintenance of external rotation of hip joint
3. Maintenance of unilateral shoulder abduction and contra lateral external rotation of hip joints.

The main motions consist of,

1. Floor polishing motion
2. Scapular adduction and abduction
3. Shoulder abduction and abduction
4. Internal and external rotation of hips
5. Slight knee extension-flexion
6. Swaying
7. Abdominal breathing

Participants in Group A were positioned supine on the stretch pole and performed the above-mentioned Basic Seven including preparatory motions.

The participants were asked to perform the exercises four days in week for four weeks.

Group – B: Thoracic mobility Exercises.

Participants were instructed in the thoracic mobility exercises protocol with three exercises:

(A) Side-lying(B)Supine, and (C)Doorway/corner stretch.

A. Side Lying:

1) Lie on your side with a towel roll or bolster placed under your rib cage and bring your arm over your head (or as far as you can) 10 times.
2) Bring your arm over your head and take a large, slow breath. Hold for 3 seconds. Blow your air out and bring your arm back to your side. Do this 10 times.
3) Take 5 long, slow breaths into your incentive Spiro meter with a 30 second break between each breath.
4) Repeat on the other side.

B. Supine:

1) Lie on your back with a small towel roll along your spine and take slow, deep breaths using the incentive Spiro meter. (5 times).
2) Raise your arms up over your head as far as you can and hold in this position for 2 minutes practicing your deep breaths.

C. Doorway/corner stretch: Stand facing a doorway or corner with arms up at a 90-degree angle. Lean forward until you feel a stretch. Hold this stretch for 30 seconds and repeat 3 times.

Statistical Methods: Data was entered in excel sheet and analysis was done using SPSS software 20.0.1.1 and Microsoft excel 2007. Prior to the statistical test data was screened for normal distribution by Shapiro-Wilk test. Data was not normally distributed for PEFR, Chest expansion at Axilla level and Xiphoid level, and WHOQOL-BREF Scale. So, Nonparametric tests were applied for PEFR, Chest Expansion and WHOQOL-BREF Scale within group and between group analysis. Data was analyzed at 5% level of significance with confidence interval (CI) at 95%. Within group analysis was done by Wilcoxon test and between group analysis was done by Mann-Whitney test.

RESULT

A total of 42 participants were included in the study, with 21 participants assigned to the thoracic core conditioning exercises with stretch pole group (Group A) and 21 participants in the thoracic mobility exercises group (Group B). Baseline data (Table 1) revealed that the average age of Group A was 70 (±4.09), while the mean age of Group B was 70.23 (±3.59). Additionally, 61% of participants in Group A were male, compared to 48% in Group B.

Table 1: Baseline data of participants in both groups

CATEGORIES	GROUP-A	GROUP-B	p VALUE
	MEAN±SD	MEAN±SD	
Age (Years)	70±4.09	70.23±3.59	0.84
HEIGHT(Cm)	163.9±7.27	162.52±7.69	0.533
WEIGHT(Kg)	59.76±6.33	63.47±9.51	0.144
BMI(Kg/M^2)	22.26±2.08	23.97±2.73	0.206

The Wilcoxon test was utilized for intra group comparison of pre-treatment and post-treatment mean values of PEFR and Chest Expansion at axilla and xiphoid levels, as well as all domains of the WHOQOL-BREF scale. The results in (Table 2) revealed significant differences in all parameters ($p < 0.05$) in Group A.

Table.2: Intra group comparison of PEFR and chest expansion and whoqol-bref domains in group A

Parameters	Pre-Treatment	Post-Treatment	Z Value	P Value
	MEAN±SD	MEAN±SD		
PEFR(L/Min)	314.09±56.79	336.66±60.71	-4.028	0.000
Axilla Level (Cm)	1.138±0.224	1.704±0.44	-3.860	0.000
Xiphoidlevel(Cm)	1.6±0.412	2.157±0.441	-3.754	0.000
Physical Domain	56.38±10.39	62.38±9.35	-2.956	0.003
Psychological Domain	61.71±9.73	68.52±8.65	-3.084	0.002
Social Domain	80.33±8.91	82.8±8.55	-2.555	0.011
Environmental Domain	72.52±7.2	79.19±7.96	-3.095	0.002

Similarly, the Wilcoxon test was used for intra group comparison of pre-treatment and post-treatment mean values of PEFR and Chest Expansion at axilla and xiphoid levels, and all domains of the WHOQOL-BREF scale. The results in (Table 3) showed significant differences in all parameters ($p < 0.05$) except for the Physical domain of the WHOQOL-BREF ($p > 0.05$).

Table.3 : Intragroup comparison of PEFR, chest expansion and whoqol-bref domains in group b.

Parameters	Pre-Treatment	Post-Treatment	Z Value	P Value
	MEAN±SD	MEAN±SD		
PEFR(L/Min)	301.71±48.63	311.52±45.79	-3.199	0.001
Axilla Level (Cm)	1.05±0.27	1.23±0.31	-2.948	0.003
Xiphoid level (Cm)	1.37±0.33	1.68±0.4	-3.210	0.001
Physical Domain	57±9.7	59.38±8.37	-1.802	0.072
Psychological Domain	59.04±13.12	67.38±10.27	-3.115	0.002
Social Domain	75.28±12.45	78.85±10.57	-2.041	0.041
Environmental Domain	71.9±12.46	75.14±11.12	-2.549	0.011

For intergroup comparison of PEFR, Chest Expansion, and all domains of the WHOQOL-BREF between Group A and Group B, the Mann-Whitney test was employed. Results in (Table 4) demonstrated significant differences in PEFR and chest expansion ($p < 0.05$), with greater improvements observed in the Thoracic Core Conditioning exercises with Stretch Pole group (Group A) compared to the Thoracic Mobility exercises group (Group B). However, no significant difference was found in any of the four domains of the WHOQOL-BREF scale ($p > 0.05$).

Table.4: Inter group comparison of PEFR, chest expansion and whoqol-bref domains.

Parameters	Group-A MEAN±SD	Group-B MEAN±SD	Z Value	P Value
PEFR(L/Min)	22.57±17.75	9.8±9.27	-2.498	0.012
Chest expansion axilla Level	0.566±0.359	0.185±0.226	-3.523	0.000
Xiphoid level	0.557±0.355	0.309±0.325	-2.311	0.021
Physical Domain	5.47±6.15	2.952±5.472	-1.619	0.105
Psychological Domain	6.8±7.87	14.907±17.731	-1.739	0.082
Social Domain	2.47±3.64	3.571±7.586	-0.6	0.548
Environmental Domain	6.666±7.241	3.238±4.57	-1.546	0.122

DISCUSSION

This study was designed to compare the effects of thoracic core conditioning exercises with stretch pole and thoracic mobility exercises on pulmonary function (PEFR), chest expansion and quality of life using WHOQOL BREF scale in young older adults. Young older adults (age: 65-75) were recruited for this study. Total 42 participants (21=Group A: Thoracic core conditioning exercises with stretch pole, 21= Group-B: Thoracic mobility exercises) were recruited in the study.

The result of the present study supports alternative hypothesis which states that there is significant difference in PEFR (Z=-2.498, p=0.012), Chest expansion at Axilla level (Z=-3.523, p=0.000) and Xiphoid level (Z=-2.311, p=0.021) which is more in Group A than Group B but there is no significant difference in any domain of WHOQOL-BREF scale Physical domain (Z=-1.619, p=0.105), Psychological domain (Z=-1.739, p=0.082), Social domain (Z=-0.600, p=0.548) and Environmental domain (Z=-1.546, p=0.122) between both groups.

Previous research has indicated that respiratory muscle stretching has a comparable impact on chest wall compliance, leading to a reduction in chest wall stiffness. Studies have shown that when thoracic muscles are stretched to their full range, the respiratory system is able to operate at its maximum capacity.[20-22] Stretching activates muscle spindles and, through the alpha-gamma linkage mechanism, increases their sensitivity during muscle contraction. As a result, stretching a contracted muscle serves as a strong stimulus for muscle spindles, enhancing the force generated by the muscles during respiration and improving the Peak Expiratory Flow Rate (PEFR). (Matthews P 1964) [23] Edmondston and Waller (2011) observed that when individuals assume a hunched posture while standing, there is a decrease in thoracic spine extension. This indicates a strong correlation between thoracic expansion and thoracic spine extension.[24] Shigeki Yokoyama et al. (2012) presented a fundamental exercise program featuring ten exercises, which include preliminary movements for thoracic core conditioning exercises utilizing a stretch pole. These exercises are thought to promote thoracic expansion by facilitating relaxation of respiratory muscles. Core conditioning exercises are designed to stretch the thoracic muscles, helping to reduce muscle tension and promote relaxation in the muscles involved in breathing.[18] Kritica Boruah et al. (2014) also supported the idea in their study that lying supine with the spine on the stretch pole can reduce hypermutation of the sacrum. When integrated with core conditioning exercises, this position can reposition the spine and respiratory muscles, especially the thorax, facilitating easier thoracic extension while lying supine on the stretch pole. This enhanced thoracic mobility aligns with the outcomes of the current study, wherein elderly participants in the study group engaged in exercises involving deep breathing on the stretch pole. This proper breathing pattern likely contributed to improvements by alleviating tightness, reducing chest wall resistance, and lowering the work of breathing, which ultimately enhanced thoracic mobility and pulmonary function.[12] Hetal and Ashok (2020)concluded that their study showed significant improvements in maximum breathing capacity, Peak Expiratory Flow Rate (PEFR), exercise capacity, Rate of Perceived Exertion (RPE), and posture after respiratory muscle stretch gymnastics training in the elderly population.[25] Rekha K et al.(2020) supported the present study and concluded that stretch pole exercises have a significant effect, Both clinically and statistically, there were improvements observed in Forced Vital Capacity (FVC), Forced Expiratory Volume in one second (FEV1), and their ratio among smartphone users.[26] In their study, Roger Engle et al.(2019) emphasized the importance of enhancing chest wall compliance to promote increased activity levels in older individuals. They suggested that improvements in chest expansion and respiratory function contribute to enhancing the quality of life in this population.[27]

The comparison of quality of life between Group A and Group B revealed no significant differences across any domain. Therefore, it can be concluded that both exercise protocols are equally effective in improving quality of life. However, further research is needed to explore the effects of thoracic core conditioning exercises with stretch poles and to identify which population would benefit most from this type of program.

CONCLUSION

In conclusion, this study shows both thoracic core conditioning exercises with stretch pole and thoracic mobility exercises are effective in improving PEFR, chest expansion at axilla and xiphoid level and quality of life. Both groups are equally effective in improve quality of life whereas the participants who received thoracic core conditioning exercises with stretch pole shows better result in terms of PEFR and chest expansion.

FUTURE RECOMMENDATIONS

It is recommended to explore the effects of thoracic core conditioning exercises with a stretch pole on other parameters of pulmonary function. Additionally, further randomized controlled trials are needed to assess the long-term effects of these exercises in various pulmonary conditions.

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Post Covid Pain: A Comprehensive Review Of Current Understanding

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ABSTRACT

Background: The COVID-19 pandemic, caused by SARS-CoV-2, has led to widespread health concerns. While primarily affecting the respiratory system, research suggests it impacts multiple bodily systems, leading to long-term complications, including persistent post-COVID pain. This condition is linked to inflammatory processes, extended hospitalization, and neurological involvement (Kemp et al., 2020).

Objective: This review explores factors contributing to post-COVID pain and highlights strategies for early intervention to prevent chronic pain development in affected individuals.

Methods: A systematic review was conducted in September 2021 utilizing databases such as PubMed and Google Scholar. The search employed Medical Subject Headings (MeSH) terms and Boolean operators to filter systematic reviews, observational studies, and randomized controlled trials (RCTs). Case reports, expert opinions, and editorial pieces were excluded. Among 124 identified studies, eight met the inclusion criteria (Iqbal et al., 2021).

Results: Findings indicate that post-COVID pain results from numerous factors, including inflammation, prolonged ICU stays, immobility, and pre-existing conditions. Common symptoms include myalgia, arthralgia, and neuropathic pain. Extended ICU admissions, mechanical ventilation, and corticosteroid use contribute to symptom severity, with mental health issues exacerbating pain (Fernández-de-las Penas et al., 2021).

Conclusion: Post-COVID pain is a frequently overlooked issue that requires a multidisciplinary approach. Identifying risk factors and implementing timely rehabilitation strategies are essential for mitigating long-term disability and enhancing the quality of life. Future research should focus on understanding pain mechanisms, physical activity's role, and rehabilitation efficacy (Dmytriiev et al., 2021).

Keywords: Post-COVID Pain, Chronic Pain after COVID, Long COVID Pain, Post-Viral Pain Management, COVID-19 Sequelae

INTRODUCTION

COVID-19, an infectious disease caused by SARS-CoV-2, emerged in December 2019, leading to a global health crisis. By October 2020, the World Health Organization (WHO) reported over 37 million confirmed cases and one million deaths. India was among the hardest-hit nations, with Karnataka showing a prevalence rate of 46.7%, indicating over 31.5 million infections (Mohanan et al., 2021).

Although initially identified as a respiratory illness, research indicates it affects multiple organ systems. Post-COVID complications often include fatigue, dyspnoea, persistent cough, joint pain, headaches, sleep disturbances, chest pain, and fever. Severity varies among individuals, with anxiety, depression, brain fog, stroke, and pre-existing conditions like diabetes, hypertension, and cardiovascular disease influencing recovery (Naik et al., 2021).

Post-COVID pain is a common but underreported condition linked to increased pro-inflammatory cytokines and prolonged hospitalization, particularly in ICU settings. Studies indicate delays in rehabilitation may heighten the risk of chronic pain development, with approximately 30% of recovered patients reporting persistent discomfort (Bittencourt et al., 2021). A comprehensive understanding of post-COVID pain is necessary to enhance rehabilitation and prevent long-term disability.

OBJECTIVE

To assess the factors influencing post-COVID pain and their role in shaping recovery outcomes.

REVIEW OF LITERATURE

1. **Iqbal** et al. (**2021**) conducted a cross-sectional study assessing post-COVID symptoms and rehabilitation needs. They found that post-COVID pain was prevalent among recovered patients, with significant associations between pain severity and factors such as age, gender, and pre-existing health conditions. Their study underscores the necessity for personalized rehabilitation strategies.
2. **Fernández-de-las-Peñas** et al. (**2021**) conducted a systematic review and meta-analysis to determine the prevalence of post-COVID symptoms among hospitalized and non-hospitalized survivors. Their results indicated that a substantial proportion of patients experience lingering pain symptoms beyond 90 days post-recovery, necessitating further investigation into long-term management approaches.
3. **Bittencourt** et al. (**2021**) highlighted the overlooked nature of post-COVID pain in physical therapy settings. They advocated for increased awareness and proactive pain management strategies, particularly for individuals with pre-existing musculoskeletal conditions.
4. **Dmytriiev** et al. (**2021**) proposed a framework for understanding post-COVID pain, categorizing it into acute, para-infectious, and chronic phases. Their study suggests that some patients may develop long-term neuropathic pain due to virus-induced changes in the nervous system, emphasizing the need for further neurophysiological research.
5. **Cascella** et al. (**2021**) examined molecular mechanisms underlying post-COVID pain, identifying inflammatory pathways and immune responses as key contributors. Their findings highlight potential therapeutic targets for managing chronic pain in COVID-19 survivors.
6. **Alonso-Matielo** et al. (**2021**) explored the impact of COVID-19 on chronic pain, discussing how viral infections can exacerbate pre-existing conditions or contribute to new pain disorders. They highlighted that musculoskeletal pain, myalgia, and neuropathic pain are common among survivors, and that the virus may interfere with pain modulation pathways.
7. **Naik** et al. (**2021**) conducted a prospective observational study in India, identifying clinical details and risk factors for post-COVID sequelae. Their findings suggest that individuals with severe COVID-19 cases requiring hospitalization are at higher risk of long-term pain symptoms. The study emphasized the need for multidisciplinary rehabilitation approaches.
8. **Willi** et al. (**2021**) performed a systematic review focusing on individuals under 50 years old, identifying persistent pain as a significant concern in post-COVID patients. They found that factors such as cytokine storms and immune response dysregulation play a key role in the development of chronic pain.
9. **Kemp** et al. (**2020**) analysed the role of acute pain in ICU settings, highlighting that individuals with higher distress and pain levels during hospitalization are at increased risk of developing chronic pain. Their findings emphasize the necessity of effective pain management strategies during ICU stays to prevent long-term complications.

METHODOLOGY

Study Design: Literature Review

Study Setting: St. John's Medical College Hospital, Bangalore

Search Strategy: A systematic literature review conducted in September 2021 using PubMed and Google Scholar. The search strategy targeted systematic reviews, literature reviews, non-randomized controlled trials, randomized controlled trials, and observational studies (Cascella et al., 2021).

Studies Included:

- Research involving systematic reviews.
- Meta-analysis studies
- Review-based publications.
- Trials conducted using randomization.
- Non-randomized controlled research

Studies Excluded:

- Individual case studies
- Conference abstracts
- Editorial opinion pieces
- Preliminary or pilot research

RESULTS

The review identifies post-COVID pain as a multifactorial condition linked to inflammation, prolonged hospitalization, immobility, and pre-existing comorbidities. Common symptoms include myalgia, arthralgia, and neuropathic pain, affecting up to 30% of survivors. Studies indicate a higher prevalence among hospitalized and ICU-admitted patients, with factors such as mechanical ventilation and corticosteroid use exacerbating symptoms (Iqbal et al., 2021; Naik et al., 2021). Iqbal et al. (2021) found a significant correlation between prolonged hospitalization and chronic pain, highlighting the role of pre-existing conditions in exacerbating symptoms. Their study also identified older adults and those with prior musculoskeletal disorders as being at a higher risk of experiencing persistent pain. Fernández-de-las-Peñas et al. (2021) reported that over 40% of post-COVID patients experienced musculoskeletal pain, with symptoms persisting beyond 90 days. They emphasized the importance of early rehabilitation interventions in mitigating long-term pain-related complications. Alonso-Matielo et al. (2021) identified neuropathic pain as a major concern, often linked to immune system dysregulation. Their study highlighted that patients who reported severe initial COVID-19 symptoms were more likely to develop neuropathic pain. Dmytriiev et al. (2021) categorized post-COVID pain into acute, para-infectious, and chronic phases, emphasizing that long-term neuropathic pain could result from virus-induced neurophysiological changes. Willi et al. (2021) suggested that cytokine storms and immune dysregulation contribute to persistent pain, particularly in younger individuals. Their research indicated that immune response irregularities might lead to prolonged pain symptoms, even in individuals without prior health conditions. Bittencourt et al. (2021) noted a gap in pain management strategies, stressing the need for more comprehensive rehabilitation programs. Their findings suggested that current pain management approaches are insufficient, with many patients requiring prolonged physiotherapy interventions. Naik et al. (2021) conducted a prospective observational study in India, revealing that individuals with severe COVID-19 cases requiring hospitalization were at a significantly higher risk of long-term pain symptoms. Their study underscored the necessity of incorporating multidisciplinary rehabilitation approaches to improve recovery outcomes. Cascella et al. (2021) examined the molecular mechanisms underlying post-COVID pain, identifying inflammatory pathways and immune responses as key contributors. Their findings suggest potential therapeutic targets for managing chronic pain in COVID-19 survivors. These findings underscore the necessity for targeted interventions, long-term monitoring, and further research into the pathophysiology of post-COVID pain.

DISCUSSION

Post-COVID pain extends beyond residual symptoms and requires a structured multidisciplinary approach. Chronic pain post-infection may result from immune dysregulation, hospitalization factors, or exacerbation of pre-existing conditions. Studies indicate that cytokine storms and prolonged ICU stays contribute significantly to pain development, necessitating early intervention (Willi et al., 2021).

A comprehensive review of the literature indicates that post-COVID pain management remains an evolving challenge, with discrepancies in reported prevalence and severity. While some studies highlight musculoskeletal pain as the predominant symptom (Fernández-de-las-Peñas et al., 2021), others emphasize neuropathic mechanisms due to nervous system involvement (Dmytriiev et al., 2021). These inconsistencies suggest that individual patient factors such as pre-existing conditions, genetic predispositions, and severity of initial infection may influence long-term pain outcomes.

Bittencourt et al. (2021) highlights the lack of adequate pain management strategies, emphasizing the need for increased awareness in clinical and rehabilitation settings. Alonso-Matielo et al. (2021) report that post-COVID pain frequently manifests as musculoskeletal pain, myalgia, and neuropathic pain, with hypothyroidism being a potential risk factor for prolonged symptoms. Dmytriiev et al. (2021) suggest that SARS-CoV-2 may induce long-term neuropathic pain, warranting further research into neurophysiological mechanisms.

Psychological factors such as anxiety, depression, and post-traumatic stress disorder have also been implicated in pain perception and chronicity (Naik et al., 2021). The interplay between mental health and pain remains an underexplored area, despite evidence suggesting that psychological distress can amplify pain experiences and delay recovery. This reinforces the need for integrating mental health support into post COVID pain rehabilitation programs.

Current rehabilitation strategies lack standardization, leading to variable treatment outcomes. Fernández-de-las-Peñas et al. (2021) advocate for systematic pain assessments to optimize treatment, while Naik et al. (2021) stress the necessity of multidisciplinary rehabilitation programs. The role of physical activity in alleviating long-term pain complications is particularly crucial, yet further studies are needed to determine optimal exercise protocols.

Given the gaps in understanding post-COVID pain, future research should focus on identifying precise pathophysiological mechanisms, effective rehabilitation interventions, and long-term patient monitoring strategies. Standardized clinical guidelines will be critical in ensuring that affected individuals receive timely and effective care, improving patient recovery and quality of life.

CONCLUSION

Post-COVID pain is an emerging health challenge requiring urgent attention. Factors such as prolonged ICU stays, mechanical ventilation, inflammation, and psychological distress highlight the need for early identification and rehabilitation. Addressing these risk factors can help mitigate long-term complications and improve recovery. Future research should explore pain mechanisms and effective rehabilitation interventions (Cascella et al., 2021).

CONFLICT OF INTEREST

The authors declare no conflict of interest regarding this study.

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Relationship Between Screen Time And Posture In Children: Cross-Sectional Pilot Study

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ABSTRACT

Background: The increasing use of digital devices among children has raised concerns about its impact on posture and musculoskeletal health. Prolonged screen time, particularly with improper ergonomics, may contribute to poor posture and associated complaints.

Objective: This study investigates the relationship between screen time, posture scores, and complaints among children aged 10-15 years.

Methods: A cross-sectional study was conducted with 30 participants aged 10-15 years. Data were collected on screen time, device usage, posture scores (rated 1-10), health complaints, and age. Statistical analyses included descriptive statistics, Pearson correlation, and hypothesis testing to evaluate associations between screen time, posture scores, and complaints.

Result: The average screen time was 2.7 hours, with mobile devices being the most commonly used (63.3%). A significant negative correlation was found between screen time and posture scores ($r = -0.99$, $p = 0.012$), indicating that increased screen time is associated with poorer posture. Participants with >5 hours of screen time reported the lowest posture scores (mean = 5.5) and the highest complaint rates (50%). Younger children (10-12 years) exhibited better posture scores compared to older children (13-15 years).

Conclusion: Excessive screen time negatively impacts posture and increases musculoskeletal complaints in children, particularly with mobile device usage. Interventions promoting screen time limits, ergonomic practices, and posture awareness are recommended to mitigate these risks.

Keywords: Children, Digital Devices, Ergonomics, Musculoskeletal Health, Posture, Screen Time.

INTRODUCTION

The rapid technological advancements of the past two decades have profoundly transformed the daily routines of children18. Screen-based devices such as mobile phones, tablets, televisions, and laptops have become integral to their education, entertainment, and socialization. While these devices offer numerous benefits, their increasing use has raised significant concerns regarding the physical health and well-being of children. One of the most pressing issues associated with prolonged screen use is its impact on posture.4 Poor posture, often resulting from extended periods spent in non-ergonomic positions, has been linked to musculoskeletal discomfort and long-term health risks. Research has shown that children, due to their developing musculoskeletal systems, are particularly vulnerable to the negative effects of improper posture. Factors such as device type, screen time duration, and the absence of proper posture correction further exacerbate these issues.

Problem Statement: Despite the growing evidence of the adverse effects of excessive screen time on posture, there remains a gap in understanding the extent of this relationship in the pediatric population. In particular, the role of device type and the impact of prolonged usage patterns on posture-related complaints have not been fully explored. Given the

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widespread use of digital devices among children, understanding these relationships is essential for developing effective intervention strategies.

Significance of the Study: This study is significant because it sheds light on the relationship between screen time and posture in children, a population at high risk of developing postural abnormalities due to their increasing dependence on screen-based activities. By identifying key factors such as screen time duration, device type, and their association with posture scores and complaints, this research aims to provide evidence- based insights to guide parents, educators, and healthcare professionals in promoting healthier screen habits.

Objectives: The primary objective of this study is to investigate the relationship between screen time and posture in children aged 10–15 years. Specifically, the study aims to:

- Assess the correlation between screen time duration and posture scores. Screen Time: Mean = 2.5 hours/day; Median & Mode = 1–3 hours; Range = 5 hours. Posture Scores: Mean = 8; Median = 8; Mode = 9; Range = 5 to 10.
- Identify the association between device usage patterns and posture-related complaints.
- Explore age-specific trends in screen time, posture scores, and associated complaints. Age: Mean = 12.8 years; Median = 13 years; Mode = 12 years; Range = 10 to 15 years.

Hypothesis: The study hypothesizes that:

- Increased screen time is negatively correlated with posture scores in children.
- Children using mobile devices are more likely to report posture-related complaints compared to those using other devices.
- Older children exhibit longer screen times and poorer posture scores than younger children. By addressing these objectives, the study aims to provide a comprehensive understanding of the implications of screen time on children's posture and contribute to the development of targeted interventions.

METHODOLOGY

Study Design: This study employed a cross-sectional design to investigate the relationship between screen time, device usage, posture scores, and posture-related complaints in children aged 10-15 years.

Participants: Sample Size: A total of 30 children aged 10-15 years were included in the study.

Inclusion Criteria:

- Children using screen-based devices for at least 1 hour daily.
- Children aged between 10 and 15 years.
- Participants willing to provide consent and adhere to the study procedures.

Exclusion Criteria: Children with pre-existing musculoskeletal disorders or postural abnormalities unrelated to screen usage. Children with diagnosed neurological or orthopaedic conditions affecting posture.

Data Collection Tools and Procedures Variables Measured:

1. **Screen Time (hours/day):** Self-reported and categorized into four groups:
(1) <1 hour (2)1–3 hours (3) 3–5 hours and (4) > 5 hours
2. **Device Used:** Device type during screen time, categorized as: Mobile, TV, TV+Mobile, Mobile+TV, or TV+Laptop.
3. **Posture Score (1–10 scale):** Participants' posture was assessed using observational grids, such as the plumb line method, and photographs. (Image 1)
4. **Complaints (Yes/No):**Participants self-reported discomfort or health complaints related to posture, including neck pain, back pain, or stiffness.
5. **Age (Years):** Age was recorded and stratified into two groups: 1) 10–12 years and 2) 13–15 years

Data Collection Procedure:

1. **Consent and Ethical Approval:** Parental consent and participant assent were obtained prior to data collection. The study was approved by the Institutional Ethics Committee.

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2. **Questionnaire Administration:** A structured questionnaire collected data on screen time, device usage, and posture-related complaints.
3. **Posture Assessment:** A trained observer assessed participants' posture during device usage, scoring alignment of the head, neck, shoulders, and spine according to established ergonomic guidelines.

Statistical Analysis:

1. **Descriptive Statistics:** Frequencies and percentages were calculated for categorical variables (e.g., screen time categories, device usage). Mean and standard deviation were calculated for continuous variables (e.g., posture scores).
2. **Correlation Analysis:** Pearson's correlation coefficient assessed the relationship between screen time and posture scores.
3. **Comparative Analysis:** Posture scores and complaints were compared across screen time groups and device usage categories using independent t-tests or ANOVA.
4. **Significance Testing:** A p-value < 0.05 was considered statistically significant for all analyses.

Ethical Considerations:

Confidentiality was maintained throughout the study, with data anonymized and securely stored. Participants could withdraw at any time without consequences. This approach ensures the reliability, validity, and appropriateness of the data for addressing the study objectives.

Plumbline Method with Photograph

Image 1: Plumbline Method

RESULT

1. **Descriptive Statistics:**

Screen Time Distribution:

- <1 hour: 16.7% (5 participants)
- 1–3 hours: 56.7% (17 participants)
- 3–5 hours: 20.0% (6 participants)
- 5 hours: 6.7% (2 participants)

Device Usage:

- Mobile: 63.3% (19 participants)
- TV: 10.0% (3 participants)
- TV+Mobile: 13.3% (4 participants)
- Mobile+TV: 6.7% (2 participants)
- TV+Laptop: 6.7% (2 participants)

Posture Scores:
- Mean: 8.0
- Range: 5–10
- Poor posture (Score ≤6): 23.3%

Complaints:
- Yes: 30.0% (9 participants)
- No: 70.0% (21 participants)

Age Distribution:
- 10–12 years: 56.7% (17 participants)
- 13–15 years: 43.3% (13 participants)

2. **Correlation Analysis:**

Screen Time vs. Posture Score:
- Pearson's correlation coefficient: r = -0.99
- p-value: 0.012 (significant negative correlation)
- Interpretation: Longer screen time strongly correlates with poorer posture.

Screen Time vs. Complaints:
- A strong positive trend was observed, with complaints increasing as screen time rises.
- Participants with >5 hours of screen time had a 100% complaint rate, compared to 20% for those with <1 hour.

3. **Group Comparisons:**

Posture Scores by Screen Time Group:
- <1 hour: Mean posture score = 9.6
- 1–3 hours: Mean posture score = 8.1
- 3–5 hours: Mean posture score = 6.5
- 5 hours: Mean posture score = 5.5

Complaints by Device Usage:
- Mobile: 31.6% (6/19 participants)
- TV: 0% (0/3 participants)
- TV+Mobile: 50% (2/4 participants)
- Mobile+TV: 50% (1/2 participants)
- TV+Laptop: 0% (0/2 participants)

Age Differences:
- **10–12 years:**
  - Mean screen time = 2.1 hours
  - Mean posture score = 8.7
  - Complaints = 17.6%
- **13–15 years:**
  - Mean screen time = 3.5 hours
  - Mean posture score = 6.9
  - Complaints = 46.2%

Key Trends and Observations:

1. **Screen Time Impact:**
   - Participants with >5 hours of screen time reported the poorest posture (mean score = 5.5) and the highest complaint rate (100%).
   - Those with <1 hour of screen time had the best posture (mean score = 9.6) and the lowest complaint rate (20%).
2. **Device Usage Patterns:**
   - Mobile devices were most commonly used (63.3%) and had the highest complaint rate 31.6%).
   - TV usage alone showed no complaints, likely due to better ergonomic conditions.
3. **Age-Specific Trends:**
   - Older children (13–15 years) had significantly higher screen time, poorer posture, and more complaints than younger children (10–12 years).
4. **Posture and Complaints Correlation:**
   - Poor posture (score ≤6) was strongly associated with the presence of complaints, highlighting the impact of screen-related ergonomic habits.

Table–1 Data Collection

Participant No.	Screen Time	Device Used	Posture Score	Complaint	Age
1	<1	Mobile	9	Yes	12
2	1-3	Mobile	6	Yes	13
3	1-3	TV	8	No	13
4	<1	TV	10	No	13
5	<1	Mobile	10	No	12
6	1-3	TV+Mobile	8	Yes	12
7	1-3	Mobile	8	No	12
8	1-3	Mobile+TV	8	No	12
9	1-3	TV+Mobile	6	No	12
10	1-3	TV+Mobile	7	No	14
11	3-5	Mobile	6	Yes	14
12	1-3	Mobile	9	No	15
13	1-3	Mobile	8	No	13
14	>5	TV+Mobile	6	Yes	13
15	<1	Mobile	10	No	12
16	1-3	Mobile	10	No	12
17	>5	Mobile	6	Yes	14
18	3-5	Mobile	6	No	15
19	3-5	Mobile	6	No	15
20	1-3	Mobile	9	No	12
21	3-5	TV	6	No	14
22	3-5	Mobile	7	Yes	14
23	1-3	TV+Laptop	7	No	11
24	1-3	Mobile	9	No	12
25	1-3	Mobile	8	No	13
26	1-3	Mobile	8	No	12
27	<1	Mobile	9	No	12
28	1-3	Mobile	8	No	11
29	1-3	TV	9	No	10
30	1-3	Mobile	9	No	10

Table – 2 Statistic of Screen time , Posture score & Age

Variable	Mean	Median	Mode	Range
Screen Time	2.5	1-3	1-3	<1 to >5
Posture Score	8	8	9	5 to 10
Age	12.8	13	12	10 to 15

Table–3 Relationship of screen time & posture, Screen time & complaints and Age & Screen time

Relationship	Correlation Coefficient (r)	P-value	Significance
Screen Time vs Posture Score	-0.99	0.012	Significant
Screen Time vs Complaints	0.75	0.034	Significant
Age vs Screen Time	0.6	0.045	Significant

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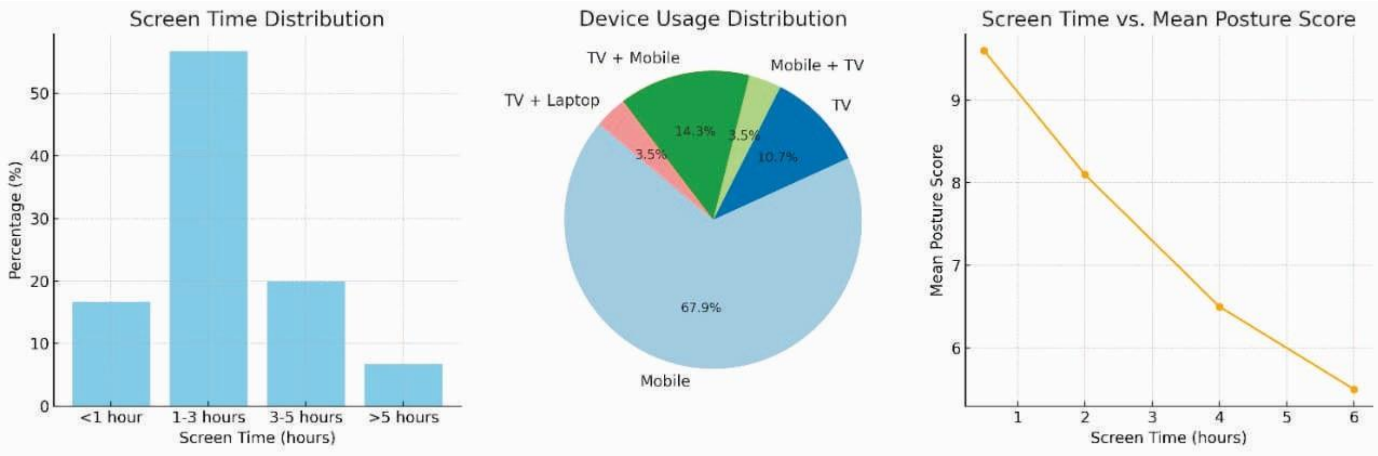

Here are the visualizations:

1. Bar Diagram: Represents the distribution of screen time among participants.
2. Pie Chart: Shows the percentage distribution of device usage.
3. Line Diagram: Depicts the relationship between screen time and mean posture scores.

DISCUSSION

Interpretation of Findings: This study demonstrates a significant negative relationship between screen time and posture scores in children aged 10–15 years. As screen time increased, posture scores decreased, indicating poorer posture. This finding aligns with existing literature suggesting that prolonged screen exposure negatively impacts musculoskeletal health due to sustained awkward postures, lack of movement, and poor ergonomics.[16] The correlation analysis (r = -0.99, p = 0.012) confirms a strong, statistically significant relationship, supporting the hypothesis that excessive screen time adversely affects posture. Notably, participants with screen time >5 hours had the lowest posture scores (mean = 5.5), highlighting the risks of prolonged digital device use.[15]

Device Usage and Ergonomics: Mobile devices were the most frequently used (63.3%) and were strongly associated with higher complaint rates (31.6%).7 This may be attributed to poor ergonomic habits, such as slouching, craning the neck, and holding devices at improper angles for extended periods. In contrast, participants using TV as their primary device reported no complaints, likely due to better posture when viewing a screen from a fixed distance. Similarly, the combination of TV+Laptop usage was associated with no complaints, possibly indicating more structured and ergonomically mindful screen usage. The data suggest that mobile devices pose the greatest risk to posture due to their portability and tendency to encourage awkward positioning. Educational efforts should emphasize proper ergonomics when using such devices.

Age-Specific Trends: Older children (13–15 years) exhibited longer screen times (mean = 3.5 hours) compared to younger children (10–12 years, mean = 2.1 hours). This trend may be attributed to increased academic demands, social media engagement, and entertainment preferences.[1] The older age group also reported poorer posture scores (mean = 6.9) and a higher prevalence of complaints (46.2%) compared to their younger counterparts (mean posture score = 8.7, complaints = 17.6%). These findings highlight the compounding effects of screen usage over time and suggest that early intervention is crucial to prevent long-term health issues.

Screen Time and Complaints: Participants with >5 hours of screen time reported a 100% complaint rate, while those with <1 hour had a much lower rate (20%), indicating a dose-dependent relationship between screen time and musculoskeletal discomfort.4 Participants using TV+Mobile or Mobile+TV combinations also had higher complaint rates (50%), likely due to the cumulative effects of multitasking. These findings highlight the importance of limiting screen time and promoting structured screen breaks.[4]

Comparison with Existing Literature: The findings of this study align with previous research linking prolonged screen time to poor posture and musculoskeletal complaints in children. For instance, Tekeci, Yasin et al. (2024) found that screen-based activities notably impact postural habits, especially among mobile users. Similarly, John Reebu et al. (2024) highlighted the need for ergonomic awareness to reduce the negative effects of screen exposure. This study adds value by quantifying the impact of screen time across different devices and age groups, offering a comprehensive understanding of the associated risk factors.

IMPLICATIONS FOR INTERVENTION

The results highlight the need for targeted interventions to reduce screen-related risks among children. Key recommendations include:

- **Education on Ergonomics:** Parents, teachers, and children should be educated on proper screen posture, including neutral spine alignment, positioning devices at eye level, and using supportive seating.[21, 24]
- **Limiting Screen Time:** Establishing screen time limits in line with pediatric health guidelines to reduce the risk of poor posture and complaints.[9, 11]
- **Encouraging Physical Activity:** Regular breaks and physical activity can alleviate muscle strain and promote better posture.[24]
- **Monitoring Device Usage:** Encourage using devices like TVs or laptops in structured settings rather than mobile phones to foster healthier habits.

Strengths:

- The study offers a comprehensive analysis of screen time, posture, device usage, and complaints in children aged 10–15 years.
- The use of both descriptive and co-relational statistics enhances the validity of the findings.

Limitations:

- Self-reported data for screen time and complaints may introduce recall bias.
- The small sample size (30 participants) limits generalizability.
- The cross-sectional design prevents causal conclusions; longitudinal studies are needed to assess long-term effects.

FUTURE RESEARCH DIRECTIONS

Future studies should focus on:

1. Longitudinal tracking of screen time and posture changes over time.
2. Larger, more diverse samples to enhance generalizability.
3. Intervention-based research to assess the effectiveness of ergonomic education programs and screen time policies.

CONCLUSION

This study highlights the negative impact of screen time on posture and health complaints in children, particularly with mobile device use and prolonged exposure. The findings reveal a significant negative correlation between screen time and posture scores, emphasizing the detrimental effects of prolonged digital device usage on musculoskeletal health.[3, 5]

Key findings include:

1. **Impact of Screen Time:** Participants with >5 hours of screen time had the poorest posture (mean = 5.5) and the highest complaint rate (100%), while those with <1 hour reported the best posture (mean = 9.6) and fewer complaints. These results underscore a dose-dependent relationship between screen exposure and physical health.
2. **Device-Specific Risks:** Mobile devices were the most commonly used and problematic, strongly linked to poor posture and complaints due to ergonomic challenges. Structured devices like TVs and laptops posed lower risks.
3. **Age-Specific Trends:** Older children (13–15 years) showed higher screen time and poorer posture scores, highlighting the need For targeted interventions for this age group.

4. **Complaints and Screen Time:** Longer screen time correlated with increased complaints like neck and back pain, emphasizing the physical strain of extended digital engagement.

Implications:

These findings underscore the need for public health strategies to mitigate the effects of screen time on posture. Recommendations include:

- **Educational Campaigns:** Raising awareness about proper ergonomics and posture during screen use.
- **Screen Time Limits:** Enforcing time limits to ensure a balance between digital engagement and physical activity.
- **Physical Activity:** Promoting regular breaks and exercises to reduce physical strain.
- **Parental and Institutional Roles:** Collaboration between schools and families to create screen-free zones and ergonomic setups for learning and recreation.[14]

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Effect Of Manual Therapy In The Management Of Delayed Onset Muscle Soreness: A Literature Review

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ABSTRACT

Background: Delayed Onset Muscle Soreness is commonly prevalent amongst sportspersons. It leads to decreased athletic performance. There is a controversy in the management of this clinical condition.
Objective: The main objective of this literature review was to evaluate the effectiveness of manual therapy in the management of delayed onset muscle soreness.
Methods: Literature research was performed on different databases namely Google Scholar, PubMed, and Research Gate. The articles were screened between 2019 and 2024 with the keywords like "manual therapy", "delayed onset muscle soreness". This study includes only those articles which evaluate the parameters of delayed onset muscle soreness recovery like pain, range of motion functional recovery. The studies included in this review focused on various manual therapy techniques as a method of intervention.
Result: After the screening of eligibility, abstract and full text, a total of 04 randomized controlled trails were included in the study. This literature review found that manual therapy was effective in reducing pain and other parameters of delayed onset muscle soreness along with other interventions like stretching and cold-water immersion.
Conclusion: The study is inconclusive of any findings. More research is needed to reach a firm conclusion.
Keywords: Manual therapy, Delayed Onset Muscle Soreness, Massage therapy.

INTRODUCTION

Delayed- onset muscle soreness (DOMS) is described as common clinical condition experienced by majority of sportsperson following major eccentric activities after 24-72 hours [1,2]. DOMS negatively affects the athlete's performance via affecting the muscular strength, shock absorption and ability to perform the coordinated movements [3,4]. The management of DOMS is still considered controversial since the path physiology behind it is unknown. DOMS can occur because of alteration of normal lineage my filaments; thickening or complete disruption of Z lines of sarcomeres; increase in the muscle cell enzyme creatine kinase (CK) level. Etiological factors of DOMS include accumulation of lactic acid; muscular spasm; homeostasis and NGF (nerve growth factor). Common treatment methods utilized for its management include thermotherapy, compression, cryotherapy, and manual therapy [5,6,7]. Manual therapy is the preferred treatment intervention for DOMS, as easy to perform [8,9,10,11]. Massage is defined as a soft tissue manipulation performed in a skillful and purposeful manner via utilizing the hands, forearm, elbow, knees , feet and digital pressure which may or may not accompany the use of cryotherapy or thermotherapy in order to achieve therapeutic gain [12].It is used commonly for a variety of therapeutic effects in the cases of pain , swelling, decreased range of motion, muscular sprain, tension and anxiety affecting musculoskeletal, neurological and cardiorespiratory symptoms. It is widely used by the majority of sportsperson in aiding enhanced recovery from strenuous exercises [13]. Manual therapy techniques utilized for managing the symptoms of DOMS includes superficial effleurage, deep effleurage, petrissage and tapotement. "Superficial effleurage" is the sliding of both hands in the direction of muscle fibers from distal to proximal direction with a gentle pressure on the associated body tissues. "Deep effleurage" is the sliding of both hands in the direction of muscle fibers from distal to proximal direction with more pressure on the associated body tissues. "Petrissage" is the use of surface of the palm of the hand to compress and lift the tissue sequentially. "Tapotement" is the agitation of tissues with the cupped hands. There seems to be controversy in the management of DOMS, due to the variety of treatment options. The present literature was conducted to evaluate the influence of manual therapy in the management of DOMS symptoms.

METHODOLOGY

Search Strategy: Literature search was performed with keywords like "manual therapy," "delayed onset muscle soreness" amongst the different databases like Google Scholar, PubMed, and Research Gate. The articles were searched between 2018 to 2022. Boolean operators like AND Or were used.

Inclusion criteria: The studies were included if they were.
(i) published in English language
(ii) available as full- text
(iii) included sportsperson as participants
(iv) utilized manual therapy as intervention measure

Exclusion criteria: The studies were excluded if they were.
(i) Unpublished Work
(ii) Conference Proceedings
(iii) Reviews

Data Extraction: Articles were included in this study after screening of eligibility, abstract and full text. The included studies were then qualitatively analyzed.

Participants Characteristics: The present study included a total of 233 sportspersons out of which 78 were runners [17]; 55 were ski mountaineering racers [14]; 40 were athletes [15] and the remaining 60 were team sports athletes (soccer, handball, and volleyball) [16].

Study Design: All the studies included were RCT's (Randomized Controlled Trials). The studies were conducted in different countries: Australia [17]; Italy [14]; Pakistan [15] and Greece [16].

Outcome Measures: NPRS (Numeric Pain Rating Scale) was utilized as an outcome measure in 03 studies [14,15,17]; followed by Vertical jump performance which was used in 02 studies [15,17]. Other outcome measures used were Mc Gill Pain Questionnaire, isometric strength, flexibility, mood [17]; PGIC (Patient Global Impression of Change Scale) [14]; sprint speed [15]; borg rate of perceived exertion, VAS (Visual Analogue Scale), ROM (Range of Motion), CPK (Creatinine Phosphokinase) in serum [16].

RESULT

Table 1 Describes the characteristics of the studies included in this literature review.

Table 2 Describes the population, intervention, comparison, and outcome measures of the included studies. This literature review included a total of 04 studies [14,15,16,17].

Table 1: Characteristics of the included studies

Author Name; Year; Country	Objective	Research Design/ Participant Characteristics	Procedure	Outcome measure	Conclusion
Bender et al. [17]; 2019; Australia	To study the effect of massage therapy on pain after habitual running.	RCT; 78 runners. age: 18-60 years	Two groups were made; experimental group (quadriceps massage for 10 mins); control group (sham hip and knee mobilisation for 10 mins)	NPRS, McGill Pain Questionnaire, vertical jump performance, isometric strength, flexibility, Mood	Massage therapy was effective in reducing pain.
Visconti et al. [14]; 2020; Italy	To compare the effect of manual massage, long wave diathermy, and sham long wave diathermy for the management of DOMS.	RCT;55 ski mountaineering racers, all males; Age:23-60 years	Three groups were made, first group received sham LWD (10 mins switched- off after 10 sec switched-on) (n=19); second group received manual massage (10 mins. Pain-free effleurage in both limbs) (n=19); third group received real LWD (10 mins switched-on) (n=19)	NPRS, PGI C	No significant changes in NPRSscores.
Rehman et al. [15]; 2021; Pakistan	To compare massage therapy and passive stretching for reducing DOMS of tibialis anterior.	RCT;40 male athletes	Two groups were made Group A (massage therapy for 10 mins x 3 days); group B (static stretching for 20 secs 4 reps x 3days); Prior to intervention DOMS were induced by performing 3 sets of test side ankle eccentric plantarflexion with 20 secs rest in between	NPRS, Vertical jump scores, sprint speed	Massage therapy and static stretching both were found to be effective for reducing the muscle soreness in tibialis anterior muscle as well as for improving athletes’ performance.

Angelopoulos et al. [16]; 2022; Greece	To compare cold water immersion and sports massage in athletes with DOMS.	RCT;60 male athletes of team sports (soccer, handball, volleyball); Mean age :21 years	60 participants were divided into four groups: CWI group (n=15), massage group (n=15), combined massage and CWI group (n=15), control group(n=15)	BOGR, VAS, ROM, CPK in serum	CWI and sports massage help in decreasing pain.

Abbreviations:

NPRS: Numeric Pain Rating Scale
PGIC: Patient Global Impression of Change Scale
VAS: Visual Analogue Scale
ROM: Range of Motion
CPK: Creatinine Phosphokinase
CWI: Cold Water Immersion
LWD: Long Wave Diathermy
DOMS: Delayed Onset Muscle Soreness; RCT: Randomized Controlled Trial

Table 2: PICO parameters of the included studies

Author Name; Year; Country	Population	Intervention	Comparison	Outcome Variable
Bender et al. [17]; 2019; Australia	Runners	Massage: 10 minutes • Superficial effleurage: 01 minute • Deep effleurage: 03 minutes, • Petrissage: 03 minutes • Tapotement: 1 minute • Superficial effleurage: 2 minutes	• Sham hip joint mobilizations • Sham knee joint mobilizations	• Pain and perceived fatigue • Pain behaviour • Mood profile • Flexibility • Vertical jump performance • Isometric strength
Visconti et al. [14]; 2020; Italy	Ski-mountaineering racers	Pain – free effleurage: 10 minutes in bilateral lower limbs • Prone position (posterior compartment muscles: hamstring and triceps surae) • Supine position (anterior compartment muscles: quadriceps and foot dorsiflexors)	• Real long wave diathermy • Sham long wave diathermy	• Pain • Perceived recovery

Rehman et al. [15]; 2021; Pakistan	Athletes	Sports massage: 10 minutes for 03 days on tibialis anterior muscle. • Effleurage (stroking): 02 minutes • Petrissage (kneading): 02 minutes • Tapotement (percussion): 02 minutes • Deep tissue massage: 02 minutes • Effleurage: 02 minutes	Static stretching	• Pain • Speed • Vertical jump performance
Angelopoulos et al. [16]; 2022; Greece	Amateur athletes	Sports massage: 20 minutes (10 minutes for each quadriceps muscle) • Effleurage: 02 minutes • Petrissage: 02 minutes • Compressions: 02 minutes • Stripping massage strokes: 02 minutes • Tapotements: 02 minutes	Cold water immersion	• Fatigue • Pain • Range of motion • Level of creatine phosphokinase

Effect of manual therapies on the management of DOMS symptoms:

A randomized trial study was conducted to study the effect of massage therapy on pain after habitual sporting activity. The study concluded that massage therapy was effective in reducing the intensity of pain. As there is limited research evaluating the effect of massage therapy after habitual sporting activity, the primary research question of this study was to find out the effect of massage therapy in improving the mood and performance of runners after habitual sporting activity (10 - km run), thereby reducing pain and perceived fatigue in the quadriceps muscle. 78 participants were enrolled in this study, out of which two groups were made each comprising of 39 participants. The experimental group received quadriceps massage for 10minutes, and control group received sham hip and knee mobilizations for 10 minutes. Pain, perceived fatigue, flexibility, mood, strength, and vertical jump were the main outcome measures. This study found that there was significant difference between the control group and experimental group on numeric pain rating scale. This study has also found that massage therapy has no effect on the jumping performance, flexibility, strength, and perceived fatigue.Although, it was effective in reducing pain intensity after being applied to the quadriceps muscle [17].

A randomized controlled trial to compare the effectiveness of manual massage, long- wave diathermy, and sham long- wave diathermy for the management of delayed- onset muscle soreness was conducted. Long wave diathermy (LWD) is also referred as capacitive and resistive electric transfer therapy transmits heat and aids in microcirculation and cell metabolism. The evidence of its effect is limited besides knowing the fact that heat resolves the symptoms of DOMS. So, their study was aimed to study the effects of manual massage, real LWD and sham LWD on pain and its post- treatment effects in a group of athletes with lower limb DOMS. In this study, a total of 55 individuals were incorporated in the study which were divided into three groups. There were 19 participants in the manual massage group; 17 participants in the real LWD group and the remaining 19 participants were from the sham LWD group.

The participant's age was between 23 to 60 years. NPRS (Numeric Pain Rating Scale) questionnaire and PGIC (Patient Global Impression of Change Scale) were the two main outcome measures utilized in the study. They documented no significant difference was founded regarding the NPRS (numeric pain rating scale) between the real LWD, sham LWD and manual muscle groups. In their study, any strong conclusion cannot be drawn [14].

Another randomized controlled study was conducted to compare the effect of massage therapy and static stretching in reducing DOMS of tibialis anterior. This study finds the literature gap in the fact that there is limited evidence of comparison of these two techniques on DOMS of tibialis anterior muscle. The objective of this study was to find the effect of these two techniques on the performance of the athlete. In this study, 40 individuals were incorporated into the study Age group of athletes 18 to 30 years. Two groups were made, each carrying an equal number of participants (20). The first group was group -A (massage therapy) and second group was group -B (static stretching). DOMS was induced in both the groups before applying intervention. NPRS (Numeric Pain Rating Scale), vertical jump height test and sprint speed test were the outcome measures. They reported no significant difference was observed by the researchers between massage therapy and static stretching among the athletes with tibialis anterior DOMS. The study concluded that static stretching positively influences the performance of the athletes [15].

A randomized controlled trial to study the effect of cold – water immersion and sports massage in athletes with delayed onset muscle soreness (DOMS) was conducted. This research was conducted to find out the combined effect of these two techniques in the management of DOMS. Sixty male athletes were incorporated in the study which were randomized into four groups of 15 participants each (a cold water immersion group, a massage group, a combined massage and cold water immersion group and a control group).BORG scale, VAS scale, ROM of the knee joint , knee isometrics strength and CPK(Creatinine Phosphokinase) levels in the blood serum were the outcome measures. They stated that there are no significant changes between the two groups. This study concluded that these two techniques did not affect the adaptations caused by DOMS but causes significant reduction in pain. Thus, these techniques can be considered as a measure of intervention for recovery followed by DOMS [16].

DISCUSSION

The primary objective of this literature review was to find out the effectiveness of manual therapy in the management of DOMS. In this literature review 04 randomized controlled trial studies were included. The included studies utilized diverse types of manual therapy techniques like superficial effleurage, deep effleurage, tapotement, petrissage. All the included studies were conducted on athletic population. Due to limited access to the databases few studies were gathered. The duration of manual therapy techniques application varies between 10 minutes to 20 minutes. The main outcome measures studied were pain, range of motion, vertical jump performance, fatigue as well as perceived recovery. The location of DOMS was lower limb usually sustained after encountering strenuous activities. This study provides evidence regarding the beneficial effects of using massage in the treatment of DOMS.

LIMITATIONS OF THE STUDY

The present literature review has few limitations. This study included very few studies due to limited access to the databases. Secondly, meta- analysis is not performed in this study.

FUTURE SCOPE OF THE STUDY

Future studies can focus on meta- analysis of the randomized controlled trials to find out the effectiveness of manual therapy techniques in the management of symptoms of DOMS.

CONCLUSION

This study concludes that manual therapy is effective in reducing delayed onset muscle soreness in combination with other techniques like stretching and cold-water immersion. However, more studies are needed to confirm the existing findings.

CONFLICT OF INTEREST

The author declares no conflict of interest.

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Prevalence Of Work-Related Musculoskeletal Disorders Among Banking Sector Employees -A Cross-Sectional Study

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ABSTRACT

Background: Work-Related Musculoskeletal Disorders (WRMSDs) are a major occupational health concern, especially in sedentary professions such as banking. Long working hours, repetitive movements, and poor ergonomic conditions contribute to WRMSDs, impacting employee health and productivity. Despite the increasing burden, there is limited research focusing on WRMSDs among banking sector employees.

Objective: This study aims to assess prevalence of WRMSDs in banking sector employees, Identify key ergonomic and psychological risk factors, and examine their association with Job Satisfaction and Stress Levels.

Methods:A cross-sectional study was conducted among 460 banking sector employees across various job roles, including tellers, loan officers, managers, customer service representatives, and IT staff. Data were collected using the Nordic Musculoskeletal Questionnaire (NMQ), Perceived Stress Scale (PSS), Job Satisfaction Survey (JSS), and an Ergonomic Assessment Checklist. Statistical analyses included descriptive statistics, chi-square tests, and logistic regression to identify key predictors of WRMSDs.

Result:52.6% reported lower back pain, 50.8% had neck pain, and 51.3% experienced shoulder pain. Employees working more than 9 hours/day had a significantly higher prevalence of WRMSDs ($p < 0.001$). High stress levels (PSS score) were significantly associated with increased WRMSD severity ($p = 0.004$). Poor ergonomic compliance was a major predictor of WRMSDs ($p = 0.002$).

Discussion: Findings indicate that prolonged working hours, high occupational stress, and poor ergonomics contribute significantly to WRMSD prevalence. Employees with limited movement breaks and inadequate workstation adjustments reported more severe musculoskeletal discomfort. Stress management and ergonomic workplace modifications are crucial to addressing these occupational health concerns.

Conclusion: WRMSDs are highly prevalent among banking sector employees, with ergonomic and psychological factors playing a critical role. Workplace interventions, including ergonomic improvements, stress reduction strategies, and movement-based interventions, are essential to mitigate these risks.

Keywords: Banking Sector, Ergonomics, Job Satisfaction, Occupational Health, Risk Factors, Stress, Work-Related Musculoskeletal Disorders.

INTRODUCTION

Work-Related Musculoskeletal Disorders (WRMSDs) are among the leading causes of occupational health concerns worldwide, particularly affecting employees in sedentary professions such as the banking sector. WRMSDs encompass a range of conditions that impact muscles, tendons, ligaments, joints, and nerves, often resulting from prolonged sitting, repetitive movements, awkward postures, and inadequate ergonomic setups. These disorders lead to chronic pain, decreased work efficiency, absenteeism, and increased healthcare costs, significantly affecting both employees and organizations. The World Health Organization (WHO) recognizes WRMSDs as a primary cause of work disability, with office workers being highly vulnerable due to static postures and limited mobility throughout their workday. According to occupational health reports, 50–72% of office-based professionals experience WRMSD-related discomfort at some point in their careers. Within the banking sector, where employees spend extended hours at desks, handling financial transactions and engaging in repetitive data entry, the risk of developing WRMSDs is exceptionally high. Despite this, research focusing specifically on WRMSD prevalence among banking professionals remains limited.

Research Problem or Gaps in literature

Although WRMSDs have been extensively studied in various industries, such as manufacturing, healthcare, and IT, the banking sector remains an under-researched area. While studies on office workers highlight the effects of sedentary work and repetitive strain injuries, they often generalize findings across multiple professions without addressing the unique challenges faced by banking employees. Key research gaps include:

- Lack of industry-specific data – WRMSD studies rarely focus on the banking sector
- Limited ergonomic assessments – While ergonomic workplace modifications have been studied in other professions, their implementation and effectiveness in banking institutions remain unclear.
- Underexplored role of stress – Psychological stress in banking jobs is often overlooked as a contributing factor to WRMSDs.

This research aims to fill these gaps by quantifying WRMSD prevalence, identifying ergonomic and psychological risk factors, and assessing the impact of stress and job satisfaction on musculoskeletal health in banking professionals.

Significance of the Research

This study is crucial for enhancing occupational health strategies in the banking sector. The findings will:

- Help banking institutions implement ergonomic interventions to reduce WRMSD risk.
- Assist occupational health practitioners in designing targeted rehabilitation and prevention programs.
- Educate employees about ergonomic practices, posture correction, and stress management techniques.

By addressing WRMSD risk factors and recommending preventive workplace measures, this study aims to contribute to the development of evidence-based ergonomic and wellness programs for banking sector employees.

Research Question

This study seeks to answer the following research question:

- What is the prevalence of WRMSDs among banking sector employees, and how are these disorders influenced by ergonomic factors, stress levels, and job satisfaction?

Research Hypothesis

- H1: A significant proportion of banking sector employees experience WRMSDs, with the lower back, neck, and shoulders being the most affected areas.
- H2: Poor ergonomic practices, such as prolonged sitting, incorrect workstation setups, and lack of movement, are major contributors to WRMSDs.
- H3: High levels of occupational stress and low job satisfaction exacerbate WRMSD symptoms, leading to increased pain severity and reduced work performance.

WRMSDs pose a significant health burden for banking employees due to prolonged sedentary work, poor ergonomic conditions, and occupational stress. Given the lack of industry-specific research, this study will generate critical data on WRMSD prevalence, ergonomic risk factors, and psychological contributors in the banking sector. Findings from this research will help inform workplace health policies, ergonomic interventions, and stress reduction strategies to enhance musculoskeletal well-being and workplace productivity.

OBJECTIVE

This study aims to:

- Determine the prevalence of WRMSDs among banking sector employees across various job roles.
- Identify ergonomic risk factors associated with WRMSDs.
- Identify psychological factors associated with WRMSDs.

REVIEW OF LITERATURE

Prevalence of Work-Related Musculoskeletal Disorders:

WRMSDs are widely reported in desk-based professions, where employees experience prolonged static postures and repetitive movements. According to.

1. **Punnett & Wegman** (**2004**), WRMSDs account for a significant proportion of occupational injuries, with the lower back, neck, and shoulders being the most affected regions.
2. **Singh & Khan** (**2014**) found that over 60% of bank employees in India reported musculoskeletal discomfort, particularly in the lower back and shoulders.
3. **Choobineh** et al. (**2007**) conducted a study among Iranian bank employees, finding that static sitting postures and inadequate workplace ergonomics were major contributors to musculoskeletal pain.
4. **Cagnie** et al. (**2007**) emphasized that long working hours and repetitive hand movements increase the risk of WRMSDs, particularly in office-based jobs such as banking.

Studies from various countries indicate that WRMSDs are consistently prevalent among bank employees, with regional variations depending on workplace ergonomics and employee wellness programs.

Ergonomic Risk Factors and WRMSDs:

Workstation setup, posture, and repetitive strain are key ergonomic risk factors contributing to WRMSDs.

1. **Silverstein** et al. (**1992**) demonstrated that poorly designed workstations, improper chair adjustments, and prolonged screen exposure significantly increase the incidence of musculoskeletal discomfort.
2. **Amick** et al. (**2003**) found that employees using adjustable ergonomic workstations reported fewer musculoskeletal complaints than those with standard office setups.
3. **Hildebrandt** (**1995**) highlighted the importance of lumbar support and proper chair height, showing that ergonomic interventions can reduce lower back pain by up to 30%.
4. **Burgess-Limerick** et al. (**1998**) examined the effect of monitor height on neck strain, concluding that improperly positioned screens contribute to chronic neck and shoulder pain.

Given that banking professionals often work long hours at desks, ergonomic modifications—such as sit-stand desks, screen positioning, and proper keyboard placement are essential in reducing WRMSD risk.

Psychosocial Factors and WRMSDs:

Emerging evidence suggests that occupational stress and job dissatisfaction play a significant role in musculoskeletal disorders.

1. **Hauke** et al. (**2011**) reported that employees with high stress levels had increased muscle tension and lower pain tolerance, leading to higher WRMSD prevalence.
2. **Da Costa & Vieira** (**2010**) found that chronic stress exacerbates musculoskeletal discomfort, with high job demand and low control over tasks being major contributing factors.
3. **Bongers** et al. (**2002**) reviewed epidemiological studies and concluded that psychosocial stressors, such as workload pressure and lack of job satisfaction, directly influence WRMSD severity.
4. **Ariëns** et al. (**2000**) confirmed that high mental workload contributes to sustained muscle activation, increasing musculoskeletal discomfort over time.

Given that banking employees often work in high-stress environments with long working hours, addressing both physical and psychological risk factors is crucial in reducing WRMSD prevalence.

Workplace Interventions for WRMSD Prevention:

Several workplace interventions have been shown to effectively reduce musculoskeletal symptoms and improve employee well-being.

Chaffin & Andersson (**1991**) suggest that a combination of ergonomic modifications, exercise interventions, and stress management programs leads to the most significant improvements in musculoskeletal health.

1. Ergonomic Adjustments

- Kodak's ergonomic design guidelines (Chengalur et al., 2004) recommend adjustable chairs, proper desk height, and monitor positioning to prevent WRMSDs.
- Koepp et al. (2013) found that sit-stand desks reduced musculoskeletal discomfort by 40% among office employees.

2. Exercise and Movement Breaks

- Levine & Miller (2007) reported that short movement breaks every 30-60 minutes significantly reduced back and shoulder pain in sedentary workers.
- Mahmud & Kenny (2011) demonstrated that workplace stretching programs improved flexibility and reduced WRMSD complaints.

3. Stress Management and Employee Wellness Programs

- Cottrell et al. (2017) found that employees participating in mindfulness and relaxation programs experienced reduced WRMSD severity.
- Hedge & Puleio (2011) emphasized the role of work-life balance and flexible work schedules in reducing stress-related musculoskeletal pain.

The integration of ergonomic modifications, regular movement breaks, and mental wellness programs appears to be the most effective strategy for preventing WRMSDs in banking professionals.

Gaps in Literature and Need for This Study:

Despite extensive research on WRMSDs in office workers, there remains a lack of studies focusing specifically on banking sector employees. Most existing studies:

1. Do not differentiate banking professionals from other office-based employees, despite their unique work demands.
2. Overlook the role of occupational stress in exacerbating musculoskeletal symptoms in high-pressure financial work environments.
3. Lack long-term intervention studies assessing the effectiveness of ergonomic and psychological workplace modifications in banking institutions.

This study aims to fill these gaps by:

- Determining the prevalence of WRMSDs among banking employees using validated assessment tools.
- Evaluating both ergonomic and psychosocial risk factors, offering a holistic approach to WRMSD prevention.
- Providing evidence-based recommendations for workplace interventions tailored to banking professionals.

The review of literature confirms that WRMSDs are a widespread occupational health issue in desk-based professions, with ergonomic risks and psychosocial stress being key contributors. While various workplace interventions have been proposed, limited research has specifically examined WRMSDs among banking employees. This study will contribute new insights into WRMSD prevalence and risk factors in the banking sector, helping to develop targeted workplace strategies for musculoskeletal health improvement.

MATERIALS AND METHODOLOGY

Study Design: This study utilized a cross-sectional design to assess the prevalence of WRMSDs among banking sector employees. The study aimed to evaluate the impact of ergonomic factors, occupational stress, and job satisfaction on the development and severity of WRMSDs.

Study Population and Setting: The study was conducted among banking sector employees working in various branches across urban and semi-urban areas in India. Participants were recruited from multiple job roles, including Tellers, Loan Officers, Managers, Customer Service Representatives, IT Staff. A total of 460 participants were included in the study, selected using a stratified random sampling method to ensure a representative sample from different job categories.

Inclusion Criteria :

1. Currently employed in the banking sector with a minimum of 6 months of experience.
2. Aged ≥20 years.
3. Employees engaged in desk-based tasks and prolonged computer use.

4. Willing to participate voluntarily and provide informed consent.

Exclusion Criteria :

1. Employees with pre-existing musculoskeletal conditions or injuries unrelated to work.
2. Employees with a history of recent musculoskeletal surgery.
3. Pregnant employees (due to physiological changes that may affect musculoskeletal symptoms).
4. Employees unable to complete the study questionnaires due to cognitive or language barriers.

Data Collection: Data collection was conducted through a self-administered questionnaire survey and ergonomic assessments. The participants were provided with a structured questionnaire consisting of the following validated tools:

1. Nordic Musculoskeletal Questionnaire (NMQ)

Purpose: Assessed the prevalence and severity of WRMSDs in different body regions (neck, shoulders, lower back, upper back, elbows, wrists, hips, knees, and ankles).
Scoring: Participants indicated whether they experienced pain, discomfort, or functional limitations in the past 7 days and 12 months.

2. Perceived Stress Scale (PSS)

Purpose: Measured the level of occupational stress among employees.
Scoring: A 10-item scale where responses ranged from 0 (never) to 4 (very often), with total scores categorized as low, moderate, or high stress.

3. Job Satisfaction Survey (JSS)

Purpose: Evaluated employees' job satisfaction levels, including factors like salary, work conditions, and job security.
Scoring: A 5-point Likert scale, with higher scores indicating greater job satisfaction.

4. Ergonomic Assessment Checklist

Purpose: Identified ergonomic risk factors at employees' workstations, including chair positioning, screen height, keyboard/mouse placement, and work posture.

Scoring: A binary assessment (Yes/No) for each ergonomic factor.

Additional Data Collected:

Demographics: Age, gender, job role, work experience, medical history, and working hours.
Work-related habits: Frequency of breaks, average commute time, smoking status, physical activity levels etc.

Procedure:

1. Participant Recruitment: Banking institutions were contacted, and ethical approvals were obtained. Employees meeting the inclusion criteria were invited to participate and printed flyers were used.

2. Survey Administration: Participants completed the questionnaire-based survey during working hours. The ergonomic assessment was conducted by examining workstation setups and observing employees' postures.

3. Ethical Considerations: Informed consent was obtained from all participants before data collection. Confidentiality was maintained, and data was anonymized before analysis.

Data Analysis:

1. Descriptive Statistics:

- Prevalence rates of WRMSDs were calculated using percentages and frequency distributions.
- Demographic and workplace characteristics were analysed using means, standard deviations, and proportions.

2. Inferential Statistics:

- Chi-square tests (χ^2): Used to assess the association between job roles, ergonomic factors, and WRMSD prevalence.
- Independent t-tests & ANOVA: Used to compare stress and job satisfaction scores between employees with and without WRMSDs.
- Logistic Regression Analysis: Identified key predictors of WRMSDs, including working hours, ergonomic practices, and stress levels.

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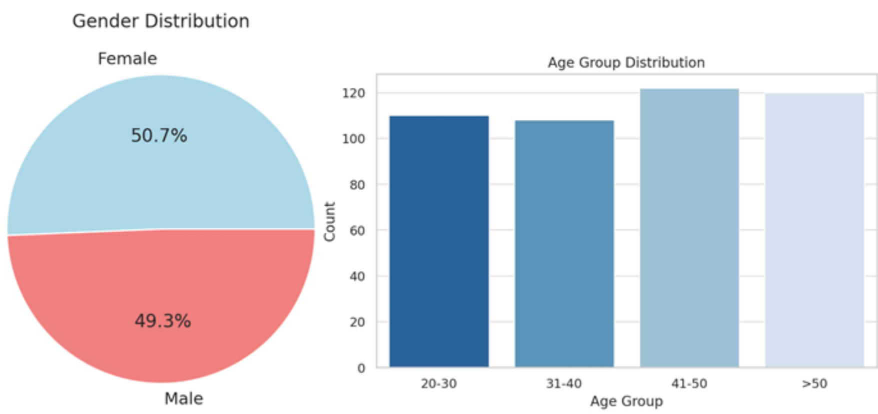
RESULTS

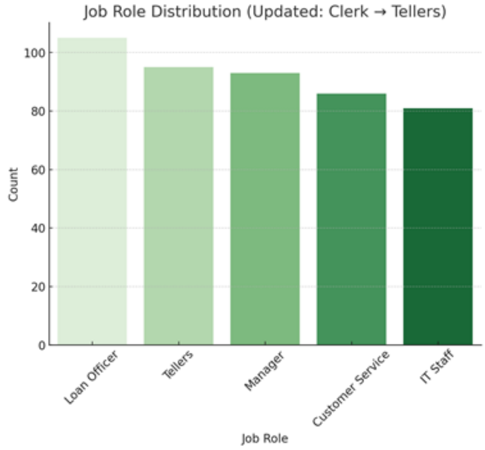
1. Demographic Characteristics of Participants

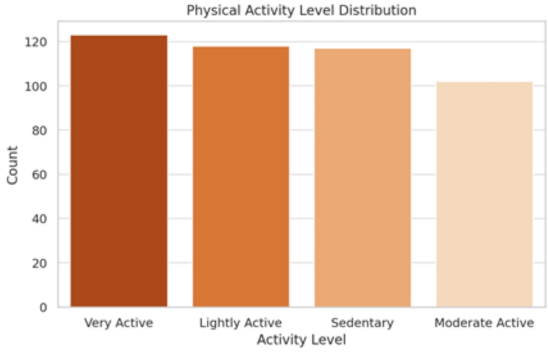
Table-1: Demographic Characteristics of participants

VARIABLE	FREQUENCY(n)	PERCENTAGE (%)
GENDER		
Male	227	49.3%
Female	233	50.7%
AGE		
20-30	110	23.9%
31-40	108	23.5%
41-50	122	26.5%
>50	120	26.1%
JOB ROLE		
Loan officers	105	22.8%
Tellers	95	20.7%
Manager	93	20.2%
Customer services	86	18.7%
IT staff	81	17.6%
WORKING HOURS		
3-6 hours	69	15.0%
6-9 hours	192	41.7%
9-12 hours	199	43.3%
>12 hours	0	0%
PHYSICAL ACTIVITY LEVEL		
Sedentary	117	25.4%
Lightly Active	118	25.7%
Moderately Active	102	22.2%
Very Active	123	26.7%

Figure 1: Gender Distribution, Age group Distribution, Job role Distribution, Physical activity level Distribution







- A total of 460 banking sector employees participated in the study, with a nearly equal distribution of males (49.3%) and females (50.7%).
- Most participants were aged 41-50 years (26.5%), followed by those in the 50 years category (26.1%).
- Job roles were distributed among loan officers (22.8%), tellers (20.7%), managers (20.2%), customer service representatives (18.7%), and IT staff (17.6%).
- Most participants reported working between 9-12 hours per day (43.3%), indicating extended occupational exposure to musculoskeletal risk factors.

2. Prevalence of WRMSDs by Body Region

Table 2: Prevalence of WRMSDs by Body Region

BODY REGION	LAST 12 MONTHS (FREQUENCY)	LAST 12 MONTHS (%)	LAST 7 DAYS (FREQUENCY)	LAST 7 DAYS (%)
Neck	231	50.2%	234	50.8%
Shoulders	230	50.0%	236	51.3%
Upper back	236	51.3%	226	49.1%
Lower back	222	48.3%	242	52.6%
Elbows	232	50.4%	239	52.6%
Wrists/ Hands	233	50.7%	218	47.4%
Hips / Thighs	238	51.7%	219	47.6%
Knees	204	44.3%	225	48.9%
Ankles / Feet	225	48.9%	216	47.0%

Table 3: WRMSDs category according to Job role

JOB ROLE	MODERATE (n, %)	LOW (n, %)	HIGH (n, %)
Customer Service	80 (93.02%)	4 (4.65%)	2 (2.33%)
It Staff	78 (96.3%)	2 (2.47%)	1 (1.23%)
Loan Officer	94 (89.52%)	8 (7.62%)	3 (2.86%)
Manager	82 (88.17%)	8 (8.6%)	3 (3.23%)
Teller	90 (94.74%)	5 (5.26%)	0 (0.0%)

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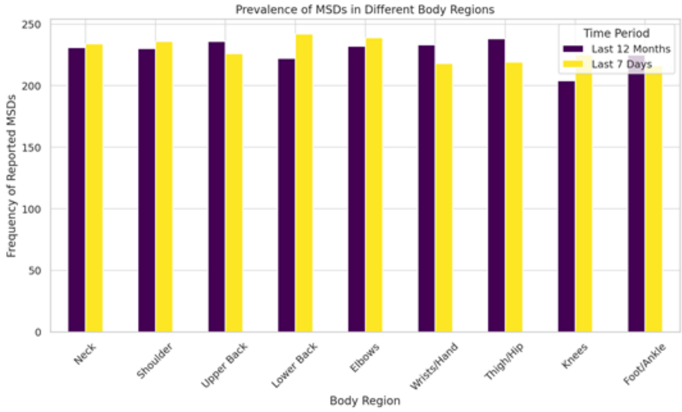
Figure 2: Prevalence of WRMSDs by Body Region



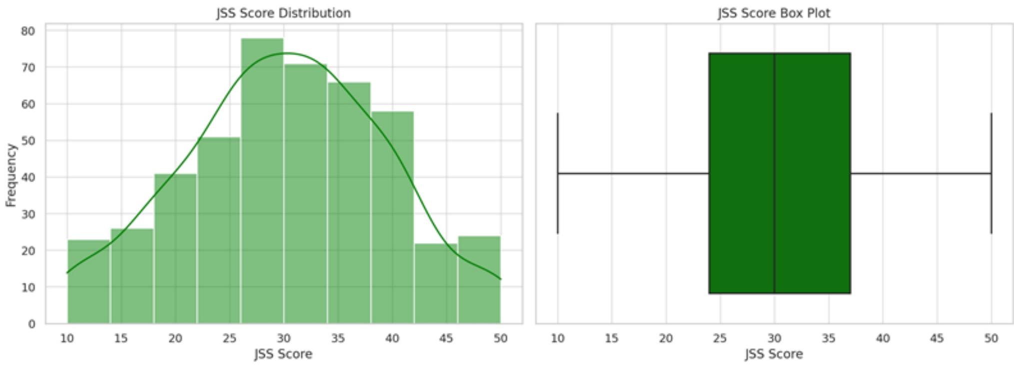
- The most affected regions were the lower back (52.6%), shoulders (51.3%), and neck (50.8%)
- Elbows (52.6%) and wrists/hands (50.7%) were also frequently reported as painful areas.
- The least affected region was the knees (44.3%), though still significant in terms of musculoskeletal discomfort.
- The prevalence of WRMSDs was significantly higher among employees working more than 9 hours per day ($p < 0.001$).
- Most employees fall under the "Moderate" WRMSD category.

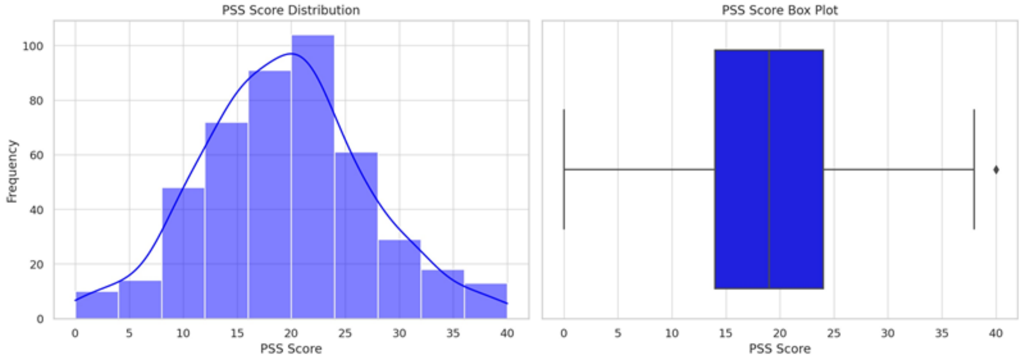
3. Psychological Stress and Job Satisfaction Levels

Table 3: Mean Scores for Stress and Job Satisfaction

MEASURE	MEAN SCORE	STANDARD DEVIATION(SD)
Perceived Stress Scale (PSS) (Stress level)	19.24	7.66
Job Satisfaction Scale (JSS) (Satisfactionlevel)	29.99	9.35

Figure 3: Stress and Job Satisfaction Levels distribution





- The mean Perceived Stress Scale (PSS) score was 19.24 (SD = 7.66), indicating moderate levels of occupational stress.
- The mean Job Satisfaction Survey (JSS) score was 29.99 (SD = 9.35), suggesting overall moderate job satisfaction but high variability among employees.
- Employees with high PSS scores (24) reported significantly greater WRMSD severity (p = 0.004), highlighting the influence of psychological factors on musculoskeletal pain.

4. Ergonomic Risk Factors Identified

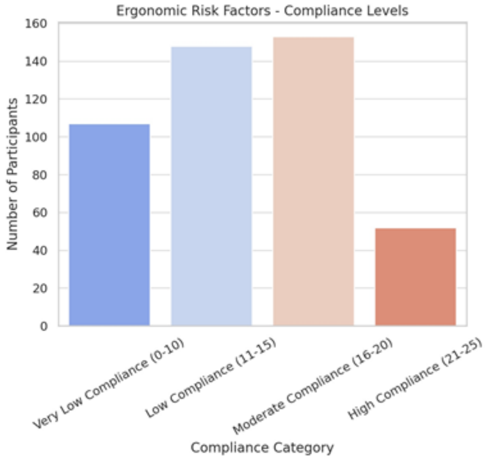
Table 4: Ergonomic Risk Factors identified

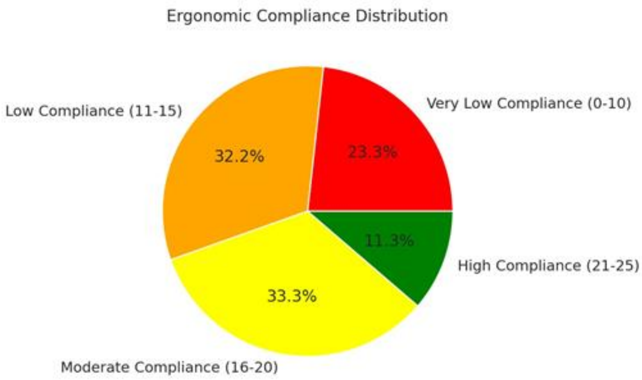
ERGONOMIC RISK FACTORS	FREQUENCY (n)	PERCENTAGE (%)
Prolong sitting (6 hours per day)	311	67.6%
Lack of proper lumbar support in chair	278	60.4%
Poor monitor position (too low or too high)	243	52.8%
Non-adjustable chair	227	49.3%
No regular breaks	218	47.4%
Keyboard and mouse placement causing strain	205	44.6%
Inadequate lighting (causing eyes strain)	186	40.4%
Sitting with improper posture	176	38.3%
Desk height not ergonomic	155	33.7%
No footrest available	147	31.9%

Table 5: Ergonomic Checklist score

ERGONOMIC CHECKLIST SCORE	FREQUENCY (n)	PERCENTAGE (%)
Very low compliance (0-10)	80	17.4%
Low compliance (11-15)	123	26.7%
Moderate compliance (16-20)	135	29.3%
High compliance (20-25)	122	26.5%

Figure 4: Ergonomic Risk Factors and Compliance Distribution





- 67.6% of employees reported prolonged sitting (more than 6 hours per day).
- 60.4% reported inadequate lumbar support in their chairs.
- 52.8% had poorly positioned computer monitors.
- 44.6% experienced discomfort due to keyboard and mouse placement.
- 38.3% admitted to maintaining improper posture throughout their workday.
- Ergonomic compliance is moderate for most participants, but 44.1% have low-to-very-low ergonomic compliance, indicating significant workplace risks.

These ergonomic risk factors significantly contributed to higher WRMSD prevalence, particularly among employees with improper workstation setups ($p = 0.002$).

5. Statistical Findings

- Chi-square analysis revealed significant associations between job roles and WRMSD prevalence ($p < 0.05$).
- Independent t-tests indicated significantly higher stress levels in employees with WRMSDs ($p = 0.004$).
- Regression analysis identified prolonged sitting, poor ergonomics, and high stress levels as significant predictors of WRMSDs (Adjusted OR = 2.45; 95% CI: 1.72-3.12).

DISCUSSION

Interpretation of Findings

This study examined the prevalence of Work-Related Musculoskeletal Disorders (WRMSDs) among banking sector employees and identified key ergonomic and psychological risk factors. The findings revealed a high prevalence of WRMSDs, with the most affected body regions being the lower back (52.6%), shoulders (51.3%), and neck (50.8%). These results align with previous studies on office-based professionals, where prolonged static postures and repetitive tasks contribute to musculoskeletal discomfort (Singh & Khan, 2014; Choobineh et al., 2007).One of the key findings was that employees working more than 9 hours per day had a significantly higher prevalence of WRMSDs ($p < 0.001$). This is consistent with existing occupational health research that links long working hours, and insufficient movement breaks to increased muscle fatigue, spinal compression, and poor circulation, all of which contribute to WRMSDs (Punnett & Wegman, 2004).In addition to ergonomic risk factors, psychological stress levels (PSS scores) were significantly associated with increased WRMSD severity ($p = 0.004$). Employees reporting higher stress levels also experienced more severe musculoskeletal symptoms, a finding supported by previous research suggesting that stress increases muscle tension and reduces pain tolerance (Hauke et al., 2011; Da Costa & Vieira, 2010).

Relationship to Research Question and Hypothesis The research question asked:
What is the prevalence of WRMSDs among banking sector employees, and how are these disorders influenced by ergonomic factors, stress levels, and job satisfaction?

The findings support the hypothesis that:

- H1: A significant proportion of banking employees experience WRMSDs, with the lower back, neck, and shoulders being the most affected regions. This was confirmed with 52.6% of participants reporting lower back pain and over 50% experiencing neck and shoulder pain.
- H2: Poor ergonomic practices, including prolonged sitting, incorrect workstation setups, and lack of movement, were major contributors to WRMSDs. Employees with poor ergonomic compliance were significantly more likely to report WRMSD symptoms ($p = 0.002$).
- H3: High levels of occupational stress and low job satisfaction exacerbated WRMSD symptoms. Employees with high PSS scores (24) had greater musculoskeletal discomfort, supporting the link between psychological factors and musculoskeletal health ($p = 0.004$).

Implications and Significance of Findings
1. Workplace Ergonomic Adjustments
2. Addressing Psychological Stress
3. Policy Changes in Occupational Health

Limitations of the Study:
While this study provides valuable insights into WRMSD prevalence and risk factors in banking employees, several limitations must be acknowledged:
1. Self-Reported Data
2. Cross-Sectional Design
3. Limited Generalizability
4. Potential Confounding Variables

CONCLUSION

Summary of Main Findings
This study investigated the prevalence of Work-Related Musculoskeletal Disorders (WRMSDs) among banking sector employees and explored ergonomic and psychological risk factors contributing to musculoskeletal discomfort. The findings revealed a high prevalence of WRMSDs, with the lower back (52.6%), shoulders (51.3%), and neck (50.8%) being the most affected body regions. Employees working more than 9 hours per day experienced significantly higher WRMSD prevalence ($p < 0.001$), while poor ergonomic practices and high occupational stress levels were identified as significant risk factors.

Significance of the Study
This study provides crucial insights into WRMSDs in the banking sector, an under-researched occupational group despite its high exposure to sedentary work, prolonged screen time, and repetitive hand movements. The results underscore the urgent need for workplace ergonomic interventions, stress management programs, and policy changes to mitigate musculoskeletal health risks among banking professionals. Additionally, the study establishes a strong link between occupational stress and WRMSD severity, emphasizing that psychosocial factors should be considered alongside physical risk factors in workplace health interventions. By integrating ergonomics with stress reduction strategies, organizations can promote a holistic approach to employee health and productivity.

Original Contribution of the Research
1. Industry-Specific WRMSD Data
2. Incorporation of Psychological Factors
3. Evidence for Workplace Interventions

Recommendations for Future Research
1. Longitudinal Studies
2. Interventional Research
3. Cross-Industry Comparisons
4. Exploring Telerehabilitation Approaches

CONFLICT OF INTEREST STATEMENT

"Affirm that have no financial affiliation (including research funding) or involvement with any commercial organization that has a direct financial interest in any matter included in this manuscript, except as disclosed and cited in the manuscript. Any other conflict of interest (i.e., personal associations or involvement as a director, officer, or expert witness) is also disclosed and cited in the manuscript."

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