ISSN P - 0973-5666
ISSN E - 0973-5674

Volume 19 | Number 2 | April – June 2025

Indian Journal of Physiotherapy and Occupational Therapy

An International Journal

website: www.ijpot.com

Indian Journal of Physiotherapy and Occupational Therapy

Editorial Team

International Editorial Board

National Editorial Board

"Indian Journal of Physiotherapy and Occupational Therapy" An essential indexed peer reviewed journal for all physiotherapists & occupational therapists provides professionals with a forum to discuss today's challenges-identifying the philosophical and conceptual foundations of the practice; sharing innovative evaluation and treatment techniques; learning about and assimilating new methodologies developing in related professions; and communicating information about new practice settings. The journal serves as a valuable tool for helping therapists deal effectively with the challenges of the field. It emphasizes articles and reports that are directly relevant to practice.The Journal is registered with Registrar of Newspapers for India vide registration number DELENG/2007/20988.

Print- ISSN: 0973-5666, Electronic - ISSN: 0973-5674, Frequency: Quarterly (4 issues per volume).

Website: www.ijpot.com

Published at

Institute of Medico-legal Publications
Logix Office Tower, Unit No. 1704, Logix City Centre Mall, Sector- 32, Noida - 201 301 (Uttar Pradesh)

Indian Journal of Physiotherapy and Occupational Therapy

IJPOT Vol 19 No 2 April-June 2025

Contents

Original Article DOI: https://doi.org/10.37506/gee3g519

Unveiling the Effectiveness of Spencer technique and Activity Oriented Exercise Approach in subjects with Diabetic Adhesive Capsulitis-An Experimental Study

[1]Durga N, [2]Anitha A

[1]Post Graduate Student, Saveetha College of Physiotherapy, SIMATS, Chennai, Tamil Nadu, India,
[2]Associate Professor, Saveetha College of Physiotherapy, SIMATS, Chennai, Tamil Nadu, India.

How to cite this article: Durga N, Anitha A. Unveiling the Effectiveness of Spencer technique and Activity Oriented Exercise Approach in subjects with Diabetic Adhesive Capsulitis-An Experimental Study. Indian Journal of Physiotherapy and Occupational Therapy / Vol 19 No 2 April-June 2025

Abstract

Background: This study aims to assess the influence of the Spencer technique and Activity Oriented Exercise Approach in managing pain and functional ability in subject withType-2 diabetes Adhesive capsulitis. As diabetic patients have high incidence of being diagnosed with Adhesive Capsulitis, the need for a better treatment for the pain and other symptoms are required.

Methods: An experimental study design was conducted at Saveetha College of Physiotherapy that included female subjects aged 45 to 65 years with history of Type -2 diabetes, unilateral adhesive capsulitis, and shoulder pain and stiffness for over 4 months. Spencer group (n=22) treated with Spencer technique with active shoulder ROM exercises while the Activity Oriented Exercise Approach group (n=23) treated with individual tailored exercises of Activities of Daily living.

Results: The post-test values of SPADI score (p-value < 0.0001) and joint measurements - abduction, internal rotation and external rotation of shoulder (p-value <0.0001) was statistically improved in both groups but Activity Oriented Exercise Approach group showed a greater and significant improvement in the outcomes than the Spencer group.

Conclusion: From the results it was concluded that Activity Oriented Exercise Approach was effective in improving functional ability and range of motion in Type-2 diabetic adhesive capsulitis subjects. Future researches should be done with larger sample size and studies on absolute diagnostic test to identify the underlying mechanism of Adhesive Capsulitis.

Keywords: Capsular stiffness, function ability, shoulder stiffness, shoulder active range of motion, Type-2 diabetic adhesive capsulitis.

Introduction

Diabetic adhesive capsulitis, commonly known as frozen shoulder, is a prevalent and debilitating condition among individuals with diabetes mellitus. Characterized by progressive stiffness, pain, and restricted range of motion in the shoulder joint, this condition significantly impairs daily activities and quality of life. The aetiology of diabetic adhesive capsulitis is multi-factorial, with factors such as glycaemia control, systemic inflammation, and micro vascular complications contributing to its development and progression. It was estimated that between two to five percent of the general population worldwide tend to have adhesive capsulitis while women are significantly vulnerable in India.[1]

Corresponding Author: A. Anitha, Mpt (Ortho), Phd (Associate Professor) Saveetha College of Physiotherapy, Simats, India.

E-mail: anitha.scpt@saveetha.com

Submission: Jan 22, 2025 **Revision:** Febuary 25, 2025 **Published date:** April 11, 2025

Type-2 diabetes mellitus, a persistent metabolic condition identified by insulin resistance and compromised insulin secretion. The prolonged effects of high blood sugar levels leads to changes in structure and function of connective tissues, particularly the capsule surrounding the shoulder joint which includes collagen changes, inflammation changes, glycosylation and potentially altered blood flow to the joint.[2,3,4] In majority of cases, there is a notable reduction in joint range both actively and passively. The fibrotic changes of the capsule cause limitation of the joint range of motions causing a characteristic functional disability. The pattern of movement loss in adhesive capsulitis patients was generally external rotation, abduction, and internal rotation.[5,6] An effective magnetic resonance indicator (MR) criterion for adhesive capsulitis diagnosis is joint capsule and synovium thickness larger than 4 mm. Recent studies on diagnosis through ultrasonography has been carried out which shows findings of adhesive capsulitis that include thickening of the shoulder pulleys and axillary pouch and decreased sliding of the infraspinatus tendon.[7]

The typical approach for management of diabetic mellitus involves lifestyle adjustments, adopting nutritious diet plan and engaging in routine physical activity.[3] Current treatment modalities for diabetic adhesive capsulitis include pharmacological interventions, physical therapy, and surgical options.[8,9,10] While corticosteroid injections and surgical procedures have demonstrated effectiveness in certain cases, there is a growing interest in exploring non-invasive and conservative treatment approaches.[11] Among these, the Spencer Technique and activity-oriented exercise approaches have emerged as potential therapies.[12,13]

The Spencer Technique, a form of manual therapy focuses on specific mobilization techniques aimed at improving shoulder joint mobility and reducing pain.[14] Although the technique has gained traction in the management of various shoulder disorders, its effectiveness in diabetic adhesive capsulitis remains underexplored. On the other hand, activity-oriented exercise approaches emphasize functional rehabilitation through targeted exercises designed to restore range of motion and strength. These approaches are grounded in the principles of progressive loading and functional integration, and they have shown promise in managing shoulder conditions; however, their efficacy in diabetic adhesive capsulitis requires further validation.

This experimental study seeks to address the gap in the literature by directly comparing the effectiveness of the Spencer Technique and activity-oriented exercise approaches in managing diabetic adhesive capsulitis. By evaluating their impacts on pain relief, range of motion, and overall functional improvement, we aim to provide evidence-based recommendations for clinicians and enhance the therapeutic options available for individuals suffering from this challenging condition.

Our study will contribute to the growing body of knowledge on non-pharmacological treatments for diabetic adhesive capsulitis and inform clinical practice by identifying effective, evidence-based strategies for managing this condition.

Materials and Methods

This was a Randomized clinical study conducted in Physiotherapy Out-patient department of Saveetha Medical College and Hospital. The study was approved and were conducted in accordance with the Institutional Scientific Review Board of the Saveetha College of Physiotherapy with ISRB No.01/009/ISRB/PGSR/SCPT. Informed consent was obtained from all the subjects on explanation about the treatment program, duration of the treatment, expected outcomes, privacy policies, their rights, confidentiality and safety policy. Using G-power calculator the included sample size was forty-five. It was calculated with effect size of 0.5 and 25% size inflation considering drop outs rates.

Female subjects with a long-standing history of Type 2 diabetes, with unilateral adhesive capsulitis within age group 45 to 65 years, Type-2 diabetic history (Fasting sugar level-80 to 130 mg/dl, Postprandial sugar level- <180 mg/dl), pain and stiffness of shoulder for more than 4 months were included. Recent upper limb fractures/ dislocations,

recent history of shoulder joint surgery, metabolic conditions, recent history of trauma or injury around shoulder joint, rotator cuff rupture, were excluded.

Subjects were recruited from Physiotherapy Out-patient department of Saveetha Medical College and Hospital, Thandalam by simple random sampling. Study team consisted of one principal investigator, secondary investigator and two intervention administrators.

A total number of 60 subjects were selected for the study, considering 25% possibility of drop outs. Based on the selection criteria a total of 45 subjects and were randomly allocated into two groups through closed envelope method by the principal investigator. Two intervention administrators were allocated to both the groups for blinding and to prevent treatment bias. The secondary investigator recorded the baseline characteristics, pre and post-test measurements of both groups.

Spencer group (n=22) were treated with Spencer technique along with active shoulder range of motion exercises, while Activity Oriented Exercise Approach (AOEA)group (n=23) treated with exercises tailored on Activities of daily living (ADL) exercises. The postprandial blood sugar test measured indicated the diabetic baseline of the subjects (less than 140 mg/dl as normal, 140-199 mg/dl indicated pre-diabetes status and 200 mg/dl or higher indicated diabetes. The subjects with 200 mg/dl or higher sugar level only were included.

Outcome Measures

1. SPADI scale (Shoulder Pain and Disability Index) has 13 items, with 5 items for pain and 8 items for disability. It is a useful tool for evaluating adhesive capsulitis because it measures both pain and functional limitations in the shoulder. This is important for adhesive capsulitis, as pain and reduced shoulder function are major symptoms.[15]Pre and post test scores of SPADI score was compared.
2. Goniometric measurements are used to assess the range of motion (ROM) in the shoulder joint, which is essential for monitoring adhesive capsulitis. This condition often causes stiffness and reduced mobility due to thickening and inflammation of the joint capsule. Goniometry provides precise measurements of movement limitations in various directions.[11]

Spencer Technique Group: (ST group)

Subjects received Spencer seven stages of mobilization technique with Active range of motion exercises.[12]

STEP 1: With the subject in side-lying, the therapist stabilized the shoulder girdle and supported the wrist and forearm with elbow in flexion and performed passive, rhythmic shoulder extension movement.

STEP 2: With the subject in side-lying, the therapist stabilized the shoulder girdle, with elbow extended, performed passive shoulder forward flexion movement.

STEP 3: With the subject in side-lying, the therapist stabilized the shoulder girdle with one arm, elbow flexed and with other arm performed passive adduction and internal rotation movements.

STEP 4: Subject in side-lying position, therapist stabilized the shoulder girdle with one arm; elbow flexed and with other arm performed passive abduction and external rotation movements.

STEP 5: Subject in side-lying position, therapist stabilized the shoulder girdle with one arm; elbow flexed and with other arm performed passive shoulder circumduction with maintained compression force over joint.

STEP 6: Subject in side-lying position, therapist stabilized the shoulder girdle with one arm; elbow extended and with other arm performed passive shoulder circumduction with maintained distraction force over joint.

STEP 7: Subject in side-lying position, therapist stabilized the shoulder girdle with one arm, elbow 20°-30° flexed and with other arm performed passive shoulder internal rotation.

The sequences were performed 8-10 repetitions along with active shoulder movements (each exercise 10 repetitions) with 5 sessions/ week for 8 weeks.

Figure 1: STEP 1 of spencer technique (mobilisation of shoulder extension movement)

Figure 2: STEP 2 of spencer technique (mobilisation shoulder forward flexion movement)

Figure 3: STEP 3 of spencer technique (mobilisation performed passive adduction and internal rotation movements)

Figure 4: STEP 5 of spencer technique (shoulder circumduction with maintained compression)

Figure 5: STEP 6 of spencer technique (circumduction with maintained distraction force over joint)

Activity Oriented Exercise Approach Group: (AOEA group)

Subjects were initially treated with hot pack (hot water bag) application 7 to 10 minutes twice a day. They were then instructed to perform ADL exercises 13 as follows-wearing shirt/jacket, bed rolling activities, combing hair, plating hair, putting on T-shirt, wearing pin on saree, taking object from upper shelf and shoulder active range of motion exercises – repetitions of 10 times each exercise - twice a day daily for eight weeks after which the post-test outcome measure values were recorded and analysed for results.

Table 1. Aoea Group-Pre & Post Intervention Values (Paired T-Test)

Outcome Measure	Pre-Intervention	Post-Intevention	95% Of Ci	P-Value
	Mean (Sd)	Mean (Sd)		
SPADI SCORE	55.46 ± 6.61	21.48 ± 3.09	31.160 to 36.794	<0.0001
SHOULDER-ABDUCTION	84.54 ± 7.93	132.77 ± 8.39	–52.80 to –43.66	<0.0001
SHOULDER-EXTERNAL ROTATION	21.45 ± 4.079	64.27 ± 7.55	–46.50 to –39.13	<0.0001
SHOULDER-INTERNAL ROTATION	36.36 ±8.69	70.95 ± 8.0206	–39.83 to –29.35	<0.0001

Table 2. Spencer Group-Pre & Post Intervention Values (Paired T-Test)

Outcome Measure	Pre-Intervention	Post-Intevention	95% Of Ci	P-Value
	Mean (Sd)	Mean (Sd)		
SPADI SCORE	56.50 ± 6.78	33.27 ± 7.69	20.65 to 25.82	<0.0001
SHOULDER-ABDUCTION	84.04 ± 8.12	107.65 ± 8.64	–26.51 to –20.71	<0.0001
SHOULDER-EXTERNAL ROTATION	21.87 ± 5.22	40.48 ± 8.29	–20.98 to –16.24	<0.0001
SHOULDER-INTERNAL ROTATION	35.61 ± 9.44	52.65 ± 7.17	–21.97 to –12.12	<0.0001

Table 3. Post Test Comapison Between The Groups

Outcome Measure	Aoea Group	St Group	P-Value
	Mean (Sd)	Mean (Sd)	
SPADI SCORE	21.48 ± 3.09	33.27 ± 7.69	<0.0001
SHOULDER-ABDUCTION	132.77 ± 8.39	107.65 ± 8.64	<0.0001
SHOULDER-EXTERNAL ROTATION	64.27 ± 7.55	40.48 ± 8.29	<0.0001
SHOULDER-INTERNAL ROTATION	70.95 ± 8.0206	52.65 ± 7.17	<0.0001

Results

Total numbers of subjects were 45 of mean age group (56.84 ± 6.20) and with a diabetic history of mean years (7.8 ± 3.615) and mean BMI of (28.03 ± 2.358). The mean blood sugar level postprandial was (282.84 ± 40.93). Thorough statistical analysis, involved paired tests for pre and post-test values, demonstrated a notable enhancement in SPADI scores and goniometric measurements (abduction, internal rotation, and external rotation) after applying the AOEA. The study highlighted the promising potential of the AEOA as a valuable intervention for managing this complex condition, paving the way for additional investigations and practical applications. The subjects were highly interested in performing

exercises that is part of their Daily living in the AEOA group. The results strongly implied that AOEA in improving functional ability and joint range in subjects with diabetic adhesive capsulitis was more effective.

Discussion

Adhesive capsulitis is a progressive condition that has various treatment options for management. Literature have proved the efficacy of treatment options like Codman's exercise protocol, electrotherapy, acupuncture therapy, corticosteroid injections, and mobilization techniques, stretching and strengthening exercises, open and closed chain exercise protocols for adhesive capsulitis [8,9,10.]

Physical therapy has been proven to reduce pain by improving shoulder joint range in subjects with adhesive capsulitis. There were also other medical management options like oral cortisone therapy, joint glucocorticoids injection therapy, and anti-inflammatory drug.[5]

Chao Yang, TaoTao Lv et al., explained in detail about the studies done on acupuncture therapy effect on adhesive capsulitis. Acupuncture is an ancient therapy method working on specific acupuncture points for specific regions. There were clinical studies proving the applicability and efficacy of acupuncture needle application and its best outcome results from the treatment.[16]

Oliva et al., explained that the micro-structural organization of collagen fibres is altered by advanced glycation end-products through non-enzymatic oxidative interactions between glucose and collagen may be the cause of an increase in connective tissue stiffness in diabetes mellitus[17]. Studies suggest that subjects with adhesive capsulitis had higher rates of incidence of trigger fingers, carpel tunnel syndrome, Dupuytren's disease, reduced joint mobility and other joint problems which could be associated with their age, duration of diabetes.[11] Spencer's approach facilitates pain-free movement and enhances joint mobility by altering the circulatory pain indicators and also lymphatic movement, improved by releasing the capsule and constricting soft tissues around the shoulder joint. The technique resets the neural reflexes and the joint range restored. Greater auxiliary movement—like gliding—allows the Osteo-kinematic glenohumeral rotation return to normal biomechanics of the shoulder joint.[14]

Activity based designing of exercises makes the subject being more interested in performing the exercises and thereby facilitating mobility and their occupational or ADL related movement improvement.

Limitations and Recommendations

This study included only female subjects which may depict gender bias, follow ups was not being followed and addressed. Future studies can be carried out with larger sample size, with a long duration of treatment period with frequent review assessments. Further follow ups sessions can also be carried out according to need for the study.

Conclusion

Therefore, according to the findings of the present study it was concluded that Activity Oriented Exercise Approach leads to significant improvement in pain and functional ability in subjects with Type-2 diabetic adhesive capsulitis. This study contributes to understanding the potential benefits of the Spencer technique and AOEA in managing adhesive capsulitis in individuals with Type 2 diabetes, providing valuable insights into effective physiotherapeutic interventions for this challenging condition.

Source of funding: no source of funding was received for the research and publication of this article

Conflict of interest: The authors declare that there is no conflict of interest related to the publication of this article.

References

1. Tighe CB, Oakley WS Jr. The prevalence of a diabetic condition and adhesive capsulitis of the shoulder. South Med J. 2008;101(6):591-5. PMID: 18475240.

2. Rai SK, Kashid M, Chakrabarty B, Upreti V, Shaki O. Is it necessary to screen patient with adhesive capsulitis of shoulder for diabetes mellitus? J Family Med Prim Care. 2019;8(9):2927-32. PMID: 31681669.

3. Pushpa C, Saradakutty G, Das S, Iype T. Long-term outcome in adhesive capsulitis associated with type 2 diabetes. J Evol Med Dent Sci. 2020;9(50):3783-7.

4. Kim JH, Kim BS, Kwon HS. The risk of shoulder adhesive capsulitis in individuals with prediabetes and type 2 diabetes mellitus: a longitudinal nationwide population-based study. Diabetes Metab J. 2023;47(6):869-77. PMID: 37915186.

5. Soni KM, Bhatt U, Solanki V, Barot K, Chaudhari P. Patterns of range of motion restriction in subjects with adhesive capsulitis. Int J Health Sci Res. 2021;11 (6):337-41.

6. Ramirez J. Adhesive capsulitis: diagnosis and management. Am Fam Physician. 2019;99(5):297-300. PMID: 30811157.

7. Stella SM, Gualtierotti R, Ciampi B, et al. Ultrasound features of adhesive capsulitis. Rheumatol Ther. 2022;9(2):481-95. PMID: 34940958.

8. Silva R, Pimentel A, Gutierres M. A literature review of the treatment options for idiopathic adhesive capsulitis of the shoulder. Orthop Spo Med Op Acc J. 2021;4:460-8.

9. Nakandala P, Nanayakkara I, Wadugodapitiya S, Gawarammana I. The efficacy of physiotherapy interventions in the treatment of adhesive capsulitis: a systematic review. J Back Musculoskelet Rehabil. 2021;34(2):195-205. PMID: 33185587.

10. Ramirez J. Adhesive capsulitis: diagnosis and management. Am Fam Physician. 2019;99(5):297-300. PMID: 30811157.

11. Kim DH. Outcome measurement in shoulder diseases: focus on shoulder pain and disability index (SPADI). Ann Rehabil Med. 2023;47(5):315. PMID: 37907222.

12. Jivani RR, Hingarajia DN. Effect of Spencer muscle energy technique versus Maitland's mobilization technique on pain, ROM and disability in patients with frozen shoulder: a comparative study. Int J Physiother Res. 2021;9(4):3928-36.

13. Horst R, Maicki T, Trąbka R, et al. Activity- vs. structural-oriented treatment approach for frozen shoulder: a randomized controlled trial. Clin Rehabil. 2017;31(5):686-95.doi:10.1177/0269215516687613. Epub 2017 Jan 13. PMID: 28081633.

14. Phansopkar P. An integrated physical therapy using Spencer's technique in the rehabilitation of a patient with a frozen shoulder: a case report. Cureus. 2023;15(6). PMID: 37529524.

15. Venturin D, Giannotta G, Pellicciari L, et al. Reliability and validity of the Shoulder Pain and Disability Index in a sample of patients with frozen shoulder. BMC Musculoskelet Disord. 2023;24:212. doi:10.1186/s12891-023-06268-2.

16. Yang C, Lv T, Yu T, et al. Acupuncture at Tiaokou (ST38) for shoulder adhesive capsulitis: what strengths does it have? A systematic review and meta-analysis of randomized controlled trials. Evid Based Complement Alternat Med. 2018;2018. PMID: 29849707.

17. Oliva F, Piccirilli E, Berardi AC, et al. Hormones and tendinopathies: the current evidence. Br Med Bull. 2016;117(1):39-58. PMID: 26790696.

Original Article DOI: https://doi.org/10.37506/0j4vdf46

Effectiveness of Pilates Exercises Versus Stretching Exercise in Reducing Premenstrual Syndrome among College Girls

Harina[1], Senthil KumarS[2*], Karthika Ramalingam[3]

[1]Postgraduate Student, [2]Professor, [3]Tutor & PhD Scholar,Saveetha College of Physiotherapy, Saveetha Institute of Medical and Technical Sciences, Chennai, Tamil Nadu, India

How to cite this article: Harina, Senthil KumarS, Karthika Ramalingam. Effectiveness of Pilates Exercises Versus Stretching Exercise in Reducing Premenstrual Syndrome among College Girls. Indian Journal of Physiotherapy and Occupational Therapy / Vol 19 No 2 April-June 2025

Abstract

Background: The majority of women who are of reproductive age have premenstrual syndrome, a variety of issues that impact them throughout the luteal phase of their menstrual cycle. The symptoms of premenstrual syndrome affect both physical and emotional states, and the most commonly experienced symptoms are stiffness or cramps, abdominal cramps, breast pain, and moodiness. To determine the effect of Pilates and stretching exercises on premenstrual syndrome using premenstrual syndrome questionnaire and visual analogue scale among young girls.

Methods: The study was conducted at Saveetha College of Physiotherapy with 250 female students recruited using convenient sampling. They were recruited and tested using the premenstrual syndrome questionnaire before and after the treatment. Among them, 152 students who had premenstrual symptoms were divided equally into two groups: the Pilates group (n = 76) and the stretching group (n = 76). The Pilates group received Pilates exercises, and the stretching group received stretching exercises for 12 weeks with 3 sessions per week. The visual analogue scale and premenstrual syndrome questionnaire were used as outcome measures for the study.

Results: The premenstrual syndrome questionnaire and visual analogue scale pre- and post-test results revealed a significant difference ($p<0.0001$) between the two groups. where the Pilates group showed better results than the stretching group in reducing premenstrual syndrome.

Key words: Premenstrual syndrome, Pilates, Stretching exercise, Visual analogue scale,

Introduction

Menstrual cycles are the most significant indicators of a healthy reproductive system in females, but they can also be linked to symptoms that lead to mental and physical health issues in females.[1] The average cycle duration for women in their reproductive years who have regular periods is between 24 and 35 days. There are two primary phases: the luteal phase and the follicular phase. Estrogen drops precipitously during the luteal phase before beginning to climb whereas progesterone increases and peaks on day 21 of a 28-day cycle.[2] Then, just before menstruation, in the late luteal phase both hormone levels steadily decrease. Premenstrual syndrome is diagnosed in the luteal phase.

Corresponding Author: Senthil Kumar S, Professor, Saveetha college of physiotherapy, Saveetha Institute of Medical and Technical Science, Chennai, Tamil Nadu, India-602105

E-mail: senthilkumar.scpt@gmail.com

Submission: Jan 2, 2025 **Revision:** Febuary 28, 2025 **Published date:** April 11, 2025

The American College of Obstetricians and Gynaecologists (ACOG) defines premenstrual as a clinical condition characterized by the periodic occurrence of both physical and emotional symptoms and does not relate to any kind of disease.[3] The fluctuation in the level of ovarian hormones in this metabolite in the neurotransmitter system can lead to the pathogenesis of premenstrual symptoms.[4] These signs were present in all three of the preceding menstrual cycles, with the onset occurring before the fifth day of the cycle and disappearing on the fourth day of menstruation lower back discomfort, stiffness, acne, constipation, diarrhoea, desires for food, bloating in the abdomen, headaches, mood swings, anxiety, depression Sleep disturbance and emotional instability are the symptoms of premenstrual syndrome.[5]

In India, Premenstrual syndrome has a significant influence; among adolescents, the prevelance is 49.6%, and that of premenstrual dysphoric disorder is 8%.[6] The World Health Organization (WHO) reports that 97% of women have dysmenorrhea, and 40% of women report having more than one premenstrual symptom. Exercise is essential for managing pre-menstrual syndrome (PMS) as it helps alleviate physical and emotional symptoms. Regular physical activity releases endorphins, which improve mood and reduce irritability, anxiety, and depression.[7] It also enhances blood circulation, easing bloating and menstrual cramps, while regulating hormonal fluctuations. As an alternative to pharmaceutical treatments for premenstrual syndrome, the American College of Obstetrics and Gynaecology recommends practicing frequent physical activity and regular exercise.[8,9]

Numerous non-pharmacological treatments have been used to treat premenstrual syndrome and have demonstrated efficacy in lowering the intensity of menstrual pain. There are various treatments to treat pre-menstrual syndrome, which include acupuncture, acupressure, massage, heat therapy, and various exercise regimens. Interestingly, manual visceral therapy has recently been proposed as a supplemental treatment option for premenstrual syndrome by increasing the uterus's motility and movement. Conventional exercises such as aerobic exercise, stretching, strength training, and yoga have been demonstrated in previous systematic reviews and meta-analyses on the effects of exercise on premenstrual syndrome to lessen the intensity of menstrual discomfort.[10] In order to increase joint range of motion, stretching is a crucial therapeutic and exercise training method. Stretching appears to have two major acute effects: a considerable drop in most types of muscle performance and a notable gain in range of motion, mostly because of greater stretch tolerance.[11]

Pilates is a form of low-impact exercise focusing on core strength, flexibility, and overall body awareness through its controlled movements and emphasis on breathing and posture. Regular Pilates practice can significantly reduce both the physical and emotional symptoms of PMS, such as cramping, fatigue, and mood swings. This improvement is attributed to Pilates' role in enhancing blood circulation, reducing stress levels through relaxation, and strengthening the pelvic and abdominal muscles, which are often implicated in menstrual discomfort. Integrating Pilates into a weekly routine may thus serve as a non-pharmacological, cost-effective, and holistic approach to managing PMS symptoms.[8,9] Stretching and increasing one's flexibility has been key objectives in both the leisure and therapeutic sectors, with the understanding that they help promote healthy bodily and mental functioning.[12,13]

Premenstrual syndrome (PMS) is a widespread issue among teenage girls, characterized by physical and emotional symptoms such as fatigue, irritability, headaches, mood swings, bloating and abdominal discomfort. These symptoms can significantly impact their quality of life, disrupting daily routines and activities. Despite its prevalence, effective non-pharmacological treatments for PMS remain underexplored. Exercise, particularly Pilates and stretching, has been proposed as a potential intervention due to its benefits for physical and mental well-being. While Pilates focuses on core strength, body awareness and relaxation, stretching aids in relieving muscle tension and improving flexibility. However, there is limited evidence comparing the

effectiveness of these two approaches in managing PMS symptoms.This study seeks to address this gap by evaluating the impact of Pilates and stretching exercises on alleviating PMS symptoms among college girls. Understanding which method is more beneficial can provide a simple, accessible, and non-pharmacological strategy to improve the quality of life for teenage girls dealing with PMS.

Methods

In this experimental study, 152 participants were selected based on the inclusion and exclusion criteria. The number of participants (152) was determined based on a power analysis conducted prior to the study. We aimed to detect a statistically significant difference in PMS symptom alleviation between the Pilates and stretching exercise groups with a power of 80% and an alpha level of 0.05. The effect size was estimated from similar studies on exercise interventions for PMS. This calculation indicated that a minimum of 76 participants per group would be required to achieve the desired statistical power, leading to a total of 152 participants. A convenience sampling technique was used to recruit participants, allowing for easy access to the target population. The study was conducted at Saveetha College of Physiotherapy, where participants experiencing premenstrual syndrome (PMS) were recruited through convenience sampling. Access to participants was facilitated with the help of the college's health services and faculty. An invitation to participate in the study was sent via email, and details about the study were posted on the college noticeboard. Students experiencing PMS symptoms were encouraged to reach out through a designated faculty point of contact, who guided them through the inclusion process. Those who met the inclusion criteria were provided with detailed information about the study and informed consent was obtained from each participant before their inclusion in the study. The inclusion criteria included girls aged 18–25 years with regular menstrual cycles, a history of premenstrual symptoms, and willingness to participate in the study. Exclusion criteria included irregular or infrequent menstrual cycles, recent gynecological surgery, chronic illnesses (such as diabetes, hypertension, heart disease, or infections), inability to withstand physical exertion, a history of polycystic ovarian disease or syndrome, and use of hormonal therapy. The study, approved by the Institutional Scientific Research Board (01/021/2023/ISRB/PGSR/SCPT). Participants were randomly allocated into two groups using a closed-envelope method: the Pilates group (n = 76) and the stretching group (n = 76). Both groups performed their respective interventions Pilates exercises or stretching exercises three times a week for 45 minutes each session over a duration of 12 weeks.

Intervention

Group A (Pilates Exercises) - The Pilates group included exercises such as lunges, spine twists, double-leg and single-leg stretches, pelvic bridging, and single-leg circles to improve core stability and flexibility. Additional exercises like the swan dive, mermaid stretch, breaststroke, and forward spine stretches were performed to enhance spinal mobility and overall muscle strength.

Group B (Stretching Exercises) - The stretching group focused on dynamic and static stretches such as shoulder stretches (across chest and doorway), cat and camel stretch, downward dog, child's pose, and cobra pose. Exercises like the butterfly stretch, lower trunk rotation, fish pose, wall chest stretch, and triceps dips were included to improve flexibility, posture, and muscle relaxation.

Outcome Measures

Premenstrual Syndrome Questionnaire - The Premenstrual Syndrome Questionnaire is a comprehensive assessment tool designed to evaluate the frequency and severity of symptoms associated with PMS in young females. In some cases, PMS can become so severe that it disrupts daily activities, academic performance, and overall quality of life. Understanding these symptoms is crucial for implementing effective interventions that can improve the well-being of individuals affected by PMS. The questionnaire includes six domains:

physical, emotional, neurological, musculoskeletal, and behavioral symptoms. It aims to gather detailed information on the different aspects of PMS, with a focus on determining the extent to which these symptoms impact the participant's quality of life.[14]

Visual Analogue Scale (VAS) - The Visual Analogue Scale (VAS) is a straightforward tool for measuring subjective feelings such as pain, discomfort, or other symptoms. It is commonly used in both clinical and research settings to assess the intensity of symptoms experienced by patients or participants. Typically, the VAS is a horizontal line, with endpoints labeled to represent the extremes of the symptom being measured. For example, one end may indicate "no pain" or "no symptoms" (0 cm), while the other end may represent the "worst pain imaginable" or "most severe symptoms" (10 cm). Participants mark a point on the line that corresponds to their experience, with the mark placed at any position along the line to indicate the severity of their symptoms.[15]

Statistical Procedures

The collected data were tabulated and all parameters were analyzed subjected to mean and standard deviation was used. Paired t-test was used to analyze significant changes between the pre and post-test of a single group for each outcome measure and an unpaired t-test was used to analyze significant changes between the two group's post-test data for each outcome measure using the SPSS software version 29.0.2.0. Statistical significance of $p < 0.001$ was for both paired and unpaired t-tests for all three outcome measures.

Data Analysis & Results

The comparison of pre-test and post-test values of the Visual analogue scale of the Pilates group, the pre-test mean was 7.1842 was reduced to the post-test mean value of 5.0263 with a statistical significance of p-value < 0.0001 (Table 1).

Table 1. Pre-Test and Post-Test Values of Visual Analogue Scale of Pilates Group

Visual Analogue Scale	Mean	SD	T value	P value
PRE-TEST	7.1842	1.25124	23.016	< 0.001
POST-TEST	5.0263	1.05797		

The pre-test and post-test values of the Visual analogue scale of the stretching group, was 7.4474 and 6.4868 with a statistical significance of p-value < 0.0001 (Table 2).

Table 2. Pre -Test and Post-Test Values of VAS Scale of Stretching Group

Visual Analogue Scale	Mean	SD	T value	P value
PRE-TEST	7.4474	1.18203	12.647	< 0.001
POST-TEST	6.4868	0.97288		

The comparison of pre-test and post-test values of the premenstrual syndrome questionnaire for the Pilates group, the mean value was pre-test 71.3158 and the post-test mean value of 55.0789 with a statistical significance of p-value < 0.0001 (Table 3).

Table 3. Pre-Test and Post-Test Values of Premenstrual Syndrome Questionnaire of Pilates Group

Premenstrual Syndrome Questionnarire	Mean	SD	T value	P value
PRE-TEST	71.3158	4.71653	39.819	< 0.001
POST-TEST	55.0789	4.94978		

The comparison of pre-test and post-test values of the premenstrual syndrome questionnaire for the stretching group, the mean value of pre-test 70.6579 was reduced to the post-test mean value of 60.4079 with a statistical significance of p value < 0.0001 (Table 4).

Table 4. Pre - Test and Post-Test Values of Premenstrual Syndrome Questionnaire of Stretching Group

Premenstrual Syndrome Questionnarire	Mean	SD	T value	P value
PRE-TEST	70.6579	4.89504	26.508	< 0.001
POST-TEST	60.4079	5.03634		

The comparison of post-test values of visual analogue scale of the Pilates group and stretching group the post-test mean value of in 5.0263 the Pilates group and the post-test mean value of in 6.4868 the stretching group is statistically significant with a p-value < 0.0001 (Table 5).

Table 5. Post-Test and Post-Test Values of Visual Analogue Scale of Pilates Group Stretching Group

Visual Analogue Scale		Mean	SD	T value	P value
PILATES GROUP	POST TEST	5.0263	1.05797	23.016	< 0.001
STRETCHING GROUP	POST TEST	6.4868	0.97288	12.647	

The comparison of post-test values of the premenstrual syndrome questionnaire of the Pilates group and the stretching group, the post-test mean value of in 55.0789 Pilates group, and the post-test mean value in 60.4079 stretching group is statistically significant with a p-value < 0.0001 (Table 6).

Table 6. Post- Test and Post-Test Values of Premenstrual Syndrome

Premenstrual Syndrome Questionnarire		Mean	SD	T value	P value
PILATES GROUP	POST TEST	55.0789	4.94978	39.819	< 0.001
STRETCHING GROUP	POST TEST	60.4079	5.03634	26.508	

Discussion

In recent times, young girls have been attaining puberty between the ages of 9 and 14. The changes observed in females are considered to be mostly caused by the early beginning of the menstrual cycle.[16,17] Approximately 3000 days are spent with severe symptoms for women during their reproductive years. The premenstrual phase of the menstrual cycle is ascribed to certain symptoms as reported by 80% of women in the reproductive age group, according to epidemiological surveys.[18] During their reproductive years, females experience a variety of psychological and physiological changes, particularly around menstruation. These changes are often referred to as premenstrual symptoms, and the illness that results from them is called premenstrual syndrome. Engaging in physical exercise and activity improves mental clarity, happiness, physical well-being, and brain function. Hormone-dependent emotional, behavioral, and physical symptoms that begin several days before menstruation and terminate after the menstrual cycle are referred to as Premenstrual symptoms.[19,20]

Afaf Hassan Ahmed. et al. (2022) conducted a quasi-experimental study with 90 nursing students with premenstrual syndrome who were given Pilates and Benson relaxation techniques for a period of 8 weeks. The present study was conducted for a period of 12 weeks with 152 physiotherapy students with premenstrual syndrome symptoms; hence, the current study improves the scope of the study with a longer duration and a larger sample size.[21]

Nisha Pathak et al. (2023) conducted a screening of 118 subjects using the WaLIDD score and the premenstrual syndrome scale.52 people were involved in that study: 26 were in the aerobic exercise group and 26 were in the yoga group. It was shown that while yoga and aerobic exercise may both effectively cure dysmenorrhea and premenstrual syndrome, aerobic exercise is more helpful in addressing symptoms related to premenstrual symptoms.[22]

Hsing Chi Chang. et al. (2023) carried out a cluster randomized research trial in which 128 women in total reported having premenstrual syndrome symptoms on their own. The experimental group consisted of 65 people, whereas the control group consisted of 63 people. A yoga DVD program was given to the experimental group, while the control group went about their daily lives and concluded that yoga helps with premenstrual symptoms.[23]

Nikita Mathus et al. (2020) conducted an experimental study with 40 students in an age group of 17–20 years. Group A, with 20 participants, performed daily exercise for 8 weeks, and group B followed their routine without exercise and concluded that exercise was effective in reducing menstrual symptoms.[24]

Yuni Ron Mah. et al. (2020) conducted a study with 10 cases of premenstrual syndrome, and they focused only on abdominal stretching for 2 menstrual cycles and concluded that abdominal stretching exercise was effective in reducing the symptoms of premenstrual syndrome. In the present study, even though the focus was on abdominal and lower limb stretches, whole body stretches were administered.[25]

E. Mohamed et al. (2015: The research included thirty women with premenstrual syndrome. Two groups were randomly assigned to the participants. the study group had laser acupuncture and Mitchell's basic physiological relaxation technique for 30 minutes per session, while the control group was given vitamin B6 and calcium supplements and conclude that, in terms of premenstrual tension and symptoms, there was positive biological evidence to corroborate the empirical data for laser acupuncture and Mitchell's basic physiological relaxation approach.[26] Pharmacological interventions show similar results like the following studies. Many researchers conducted using pharmacological treatment for reducing premenstrual syndrome and its significant effect in reducing the symptoms of premenstrual syndrome our study aims to focuses on non - pharmacological treatment like Pilates and stretching exercise and this study concludes that the Pilates exercise is more effective for reducing premenstrual syndrome symptoms.

Conclusion

This study concludes that Pilates exercise and stretching exercise are significantly effective in treating premenstrual syndrome symptoms. When comparing the two groups' Pilates exercise was more effective in relieving the symptoms of premenstrual syndrome by the activation of core and pelvic floor muscles and facilitating blood circulation in the body.

The study highlights the benefits of non-pharmacological interventions, such as Pilates and stretching exercises, as safe and accessible options for managing PMS symptoms. Its strengths include a well-planned experimental design, guided by a power analysis, and a holistic approach that evaluates both physical and mind-body exercises. However, limitations include the use of convenience sampling, which may limit generalizability, reliance on self-reported symptoms, a single-center setting, a short study duration, and the lack of blinding in the design. Future research should address these limitations by employing random sampling, conducting multicenter studies with diverse participants, using objective measures alongside self-reports, and ensuring longer follow-up periods to assess the sustained effects of interventions. Incorporating and exploring the combination of exercise with other lifestyle modifications, such as diet and stress management, could further enhance the understanding and management of PMS symptoms.

Funding: None

Conflict of interest: The authors of this study declare no conflict of interest

Reference

1. Mohebbi Dehnavi Z, Jafarnejad F, Sadeghi Goghary S. The effect of 8 weeks aerobic exercise on severity of physical symptoms of premenstrual syndrome: a clinical trial study. BMC Womens Health. 2018 May 31;18(1):80.
2. Le J, Thomas N, Gurvich C. Cognition, the menstrual cycle, and premenstrual disorders: a review. Brain Sci. 2020;10(4):198.
3. Mortola JF, Girton L, Yen SS. Depressive episodes in premenstrual syndrome. Am J Obstet Gynecol. 1989 Dec 1;161(6):1682–7.

4. Ravichandran H, Janakiraman B. Effect of aerobic exercises in improving premenstrual symptoms among healthy women: a systematic review of randomized controlled trials. Int J Womens Health. 2022 Aug 16;14:1105–14.

5. ACOG Committee on Practice Bulletins--Gynecology. ACOG Practice Bulletin: No 15: Premenstrual syndrome. Obstet Gynecol. 2000 Apr;95(4):suppl 1–9.

6. Dutta A, Sharma A. Prevalence of premenstrual syndrome and premenstrual dysphoric disorder in India: a systematic review and meta-analysis. Health Promot Perspect. 2021 May 19;11(2):161–70.

7. Karimian N, Rezaeian M, Nassaji F, Velaei N, Gachkar L. The effects of physical activity on premenstrual syndrome. J Zanjan Univ Med Sci. 2006;13(53):8–15.

8. Çitil ET, Kaya N. Effect of Pilates exercises on premenstrual syndrome symptoms: a quasi-experimental study. Complement Ther Med. 2021 Mar;57:102623.

9. Niroomand A, Goodarzi K, Roozbahani M, Tanha Z. The effectiveness of pilates exercises on emotion regulation and distress tolerance in students with premenstrual syndrome. Health and Development Journal. 2022 Dec 1;11(4):187-94.

10. Esildere Saglam H, Orsal O. Effect of exercise on premenstrual symptoms: a systematic review. Complement Ther Med. 2020 Jan;48:102272.

11. Sureshkumar S. The Effects of stretching exercises and walking in premenstrual syndrome. Journal of Pharmaceutical Negative Results. 2022 Oct 12:715-22.

12. Safaian Z, Kohan M, Hoseinifard SM, Forouzi MA, Jahani Y, Ahmadi A. Quality of life and symptom severity in premenstrual syndrome: a quasi-experimental study. Online Brazilian Journal of Nursing. 2022 Jul 4;21(e20226559):2.

13. Mohebbi Dehnavi Z, Jafarnejad F, Sadeghi Goghary S. The effect of 8 weeks aerobic exercise on severity of physical symptoms of premenstrual syndrome: a clinical trial study. BMC Womens Health. 2018 May 31;18(1):80.

14. Choijiljav D, Sukhbat T, Ogawa S, Yanjmaa E, Badamdorj O, Saito A, Arai Y, Shinozaki H. Validation of the premenstrual symptoms questionnaire among Mongolian nursing school students. BMC Women's Health. 2024 Dec 23;24(1):661

15. Jeong D, Lee H, Kim J. Effects of sleep pattern, duration, and quality on premenstrual syndrome and primary dysmenorrhea in korean high school girls. BMC Women's Health. 2023 Aug 28;23(1):456.

16. Mahdi SM, Khairi SH. Effectiveness of an Educational Program on Female Students' Practices toward Premenstrual Syndrome at Secondary Schools in Third Al-Rusafa Education Directorate. Iraqi National Journal of Nursing Specialties. 2021;34(2):39-58.

17. Buddhabunyakan N, Kaewrudee S, Chongsomchai C, Soontrapa S, Somboonporn W, Sothornwit J. Premenstrual syndrome (PMS) among high school students. Int J Womens Health. 2017 Jul 21;9:501–5.

18. Dutta A, Sharma A. Prevalence of premenstrual syndrome and premenstrual dysphoric disorder in India: A systematic review and meta-analysis. Health promotion perspectives. 2021;11(2):161.

19. Eyigor S, Karapolat H, Yesil H, Uslu R, Durmaz B. Effects of Pilates exercises on functional capacity, flexibility, fatigue, depression and quality of life in female breast cancer patients: a randomized controlled study. Eur J Phys Rehabil Med. 2010 Dec;46(4):481–7.

20. Vishnupriya R, Rajarajeswaram P. Effects of aerobic exercise at different intensities in premenstrual syndrome. J Obstet Gynaecol India. 2011 Dec;61(6): 675–82.

21. Ahmed A, Hassan NM, Shamekh A, Badawy A. Effect of Pilates exercises versus Benson relaxation technique on premenstrual syndrome symptoms. Egyptian J Health Care. 2022;13:39–53.

22. Pathak N, Shukla YU. Aerobic exercise versus yoga on pre-menstrual symptoms and primary dysmenorrhea among adult girls: a comparative interventional study. Int J Sci Healthc Res. 2023;8:2455–87.

23. Chang HC, Cheng YC, Yang CH, Tzeng YL, Chen CH. Effects of yoga for coping with premenstrual symptoms in Taiwan—a cluster randomized study. Healthcare. 2023;11(8):1193.

24. Mathur N. Effectiveness of exercise in menstruation symptoms in late adolescents (17–20 years of age). Inreincom. 2020;5(2):5.

25. Rohmah Y, Mukhoirotin M. Abdominal stretching to reduce premenstrual syndrome: a case series. Medisains. 2020;18:37.

26. Mohamed E, Ewidea M. Efficacy of laser acupuncture with Mitchell's simple physiological relaxation technique in alleviating premenstrual tension. Adv Sci J. 2015;2:65–72.

Effectiveness of End Range Mobilization and Reverse Distraction Technique in Adhesive Capsulitis: A Comparative Study

[1]J. Elisha [2]Rajeev Kumar Lal

[1]Assistant Professor - Shri Dharmasthala Manjunatheswara University - SDM College of Physiotherapy.
[2]Professor Shri Dharmasthala Manjunatheshwara University, SDM College of Physiotherapy

How to cite this article: Elisha, Rajeev Kumar Lal. Effectiveness of End Range Mobilization and Reverse Distraction Technique in Adhesive Capsulitis: A Comparative Study. Indian Journal of Physiotherapy and Occupational Therapy / Vol 19 No 2 April-June 2025

Abstract

Background: Adhesive capsulitis is a common musculoskeletal disorder with spontaneous onset characterized by pain and restricted active and passive range of motion of shoulder.

Objective: This study aims to evaluate the effectiveness of End Range Mobilization and Reverse Distraction Techniques in treating adhesive capsulitis (frozen shoulder).

Methods: A total of 60 subjects diagnosed with adhesive capsulitis were randomly assigned into two groups: Group A (n = 30), receiving End Range Mobilization with conventional therapy and Group B (n = 30), treated with Reverse Distraction Technique with conventional therapy. Pre and post-intervention assessments included passive range of motion in shoulder flexion, abduction, internal rotation and external rotation and The Shoulder Pain and Disability Index score at baseline and end of 4 weeks.

Results: Significant improvements were observed in both groups post-intervention. Group B demonstrated higher passive range of motion and improved function in shoulder.

Conclusion: Both techniques are effective in managing adhesive capsulitis, but Reverse Distraction Technique may offer better results for improving shoulder mobility and function.

Keywords: Adhesive capsulitis, Frozen shoulder, End Range Mobilization, Reverse Distraction Technique.

Introduction

Adhesive capsulitis is a condition characterized by severe shoulder pain and functional restriction of both active and passive shoulder motion in which radiographs of the glenohumeral joint are essentially unremarkable.[1]

The prevalence of adhesive capsulitis in the normal population is 2 to 5 percent and increases in patients with type 1 (10%) and type 2 diabetes (22%). It is generally seen among age groups between 40 and 60 years with more incidence in females.[18]

Corresponding Author: J. Elisha H/no 52/1 Gandhi wada, Gadag road, Hubli, KARNATAKA – 580020

E-mail: elishjeedi@gmail.com

Submission: Oct 22, 2024 **Revision:** November 25, 2024 **Published date:** April 11, 2025

The predominant feature of adhesive capsulitis is the contracture of the capsule which can be stretched. There are findings of capsular synovial layer loss, adherence of axillary, humeral and glenoidal capsular parts with general reduction in capsular volume. There is thickened and fibrotic rotator interval particularly in adhesive capsulitis.[2]

There is reduction in the overall ranges of shoulder joint movement with capsular pattern, in ascending order from least affected range flexion, internal rotation, abduction and external rotation.[3]The restriction of motion is in predictable capsular pattern in which there is more limited external rotation than abduction.[4]

The altered kinematics of the scapula in subjects with shoulder stiffness with a three dimensional electromagnetic tracking device during shoulder elevations in different planes and reported early and excessive lateral/upward rotation of scapula with clear disruptive change in the scapulohumeral rhythm.[5]

It is a challenging condition to treat, often leading to significant functional limitations in daily activities. A notably large group of patients receive treatment through non steroidal anti-inflammatory drugs, intra-articular corticosteroid injections, and physical therapy. In resolute cases aggressive interventions are used such as hydrodilation, arthroscopic release, and manipulation under anesthesia.[6]

In physical therapy, a heterogeneity of interventions are used; these include heat, cryotherapy, ultrasound, interferential therapy, transcutaneous electrical nerve stimulation, extracorporeal shock wave therapy, active and passive range-of-motion(ROM) exercises, proprioceptive neuromuscular facilitation techniques, and mobilization techniques.[7]

However, manual therapy techniques such as End Range Mobilization and Reverse Distraction Technique have emerged as promising interventions.[8]End Range Mobilization is the technique incorporated by entering the initial resistance obtained by physiological shoulder elevation and then accessory glides are given respectively for flexion and abduction to the glenohumeral joint maintaining the physiological elevation.[9]

Reverse Distraction is the technique in which the shoulder elevation is achieved till the initial resistance and then with glenohumeral distraction the scapula is mobilized in medial rotation.[10]

Reverse Distraction Technique was used as an adjunct to end range mobilization. Many scapular mobilization techniques were incorporated with mobilization is same plane as that of physiological movement, but the Reverse Distraction Technique is the opposite.[11]

Universal goniometry is the reliable assessment tool to measure the range of motion.[12]The Shoulder Pain and Disability Index (SPADI) score is easy to administer and interpret with understandable translation to assess function of the shoulder joint.[13]

End Range Mobilization is most frequently used mobilization technique in adhesive capsulitis whereas the Reverse Distraction Technique is unconventional and very minimally studied for the fact that only one English study has been found during literature search.[11]

End Range Mobilization is purely a glenohumeral mobilization and Reverse Distraction Technique is purely a scapular mobilization technique.

During the limited search strategy there is no literature which compared the effectiveness of End Range Mobilization and Reverse Distraction Technique in adhesive capsulitis. Therefore an evoking question arises and the strong need for the study originates.

Methods

Study Design

This is a randomized controlled trial involving 60 subjects diagnosed with adhesive capsulitis.

Sampling procedure

The sample size was calculated using G*Power (version 3.1.0)[23] based on the effect size that is extracted from the fractionate of mean differences and average of standard deviation of two groups with outcomes on passive abduction range of motion

(ROM) of the glenohumeral joint after intervening with End Range Mobilization technique. The mean passive range of motion in degrees measured before and after end range mobilization of glenohumeral joint are 45.65 and 54.95 with standard deviation of 15.62 and 5.24 respectively.[10]

Effect size d - 0.9

Alpha error - 0.05

Power - 0.9

The sample size in each group was determined to be 27. An assumption of 10 percent dropout rate estimates the addition samples of 3 in each group which gives overall sample to be 30 in each group.

Critical t - 2.00

df - 58

Ethical approval was obtained from Institutional Ethics Committee (Ref no. SDMIEC:119:2019 Dated 29.03.2019), SDM college of Medical Sciences and Hospital, Dharwad and informed consent was acquired from all participants.

The intervention was carried out in SDM Hospital Orthopaedic Physiotherapy OPD between time periods of May 2019 to April 2020.

Participants

Participants were randomly divided into two groups by simple randomization.

- **Group A (n = 30):** End range mobilization technique and conventional treatment.
- **Group B (n = 30):** Reverse distraction technique and conventional treatment.

Inclusion criteria included patients with a confirmed diagnosis of adhesive capsulitis, aged 40-65 with limited ROM of a unilateral shoulder joint (ROM losses of 50% or greater compared with the uninvolved shoulderand no previous shoulder surgery). Exclusion criteria included any history of trauma or systemic conditions like rheumatoid arthritis affecting the shoulder.

Intervention

- **End Range Mobilization (Group A):** At the start of each intervention session, the patient's ROM was examined in all directions to obtain information about the end-range position of the glenohumeral joint. A belt was tied across the involved side axilla to the bed to stabilize the scapula. Intervention started with a few minutes of warm up consisting of rhythmic mid-range mobilizations with the patient in a supine position. Thereafter, the therapist's hands were placed close to the glenohumeral joint, and the humerus was brought into a position of maximal flexion and maximal abduction.[9,14]The direction of mobilization has been altered by varying the plane of elevation.10 to 15 oscillations of grade 3 or 4 of Maitland mobilization of 10 sets with 30 seconds of rest was administered.[15]
- **Reverse Distraction Technique (Group B):** At the start of each intervention session, the patient's ROM was examined in all directions to obtain information about the end-range position of the glenohumeral joint. Intervention started with a few minutes of warm up consisting of rhythmic mid-range mobilizations with the patient in a supine position. Patients lie on their unaffected side and in prone position at the edge of a plinth. The cephalad hand of the therapist held on patient's arm for applying glenohumeral distraction at various angles of flexion and abduction, whereas the caudal hand was placed on the lateral border of the scapula for mobilizing it in medial and downward rotation.[9] Mobilization for 10 to 15 repetitions of 10 sets with 30 seconds rest between each set was administered.
- **Conventional therapy:** Both groups received the common treatment of moist heat using a hydro collator pack, Codman's pendular exercise and Theratube exercises for shoulder flexors, extensors, abductors, adductors, internal and external rotators.[9]

- **END RANGE MOBILIZATION** (Figure 1, Figure 2)

Figure 1

Figure 2

- **REVERSE DISTRACTION TECHNIQUE** (Figure 3, Figure 4)

Figure 3

Figure 4

- **Dosage-** Patients were treated for 3 sessions per week for 4 weeks. Assessment for outcome measures was done at baseline and after four weeks.

Outcome Measures

- **Passive Range of Motion (PROM):** Measured using a universal goniometer in shoulder flexion, abduction, external rotation and internal rotation.[12]
- **Functional Assessment:** The Shoulder Pain and Disability Index (SPADI).[13]

Statistical Analysis

All the analysis was performed using Statistical Package for the Social Sciences (SPSS) version 25.0. The tests for normality was done using Kolmogorov-Smirnoff and Shapiro-Wilk test for all the outcome measures which showed that the data in both groups was not normally distributed.

The baseline data under Mann Whitney U test was performed to check for baseline similarity. The analysis for within group differences for End Range Mobilization group and Reverse Distraction Technique group was done using Wilcoxon Sign Rank test.

To compare between the difference between the end range mobilization group and the reverse distraction technique group Mann Whitney U test was used. The statistical significance was considered as $p<0.05$.

Table 1. Mean and standard deviation of age in Group A and Group B. The mean age of participants in this study was 52.47 years with the standard deviation of 5.92.

Group	Mean Age	SD
A	52.60	6.19
B	52.36	5.69

SD- standard deviation

Table 2. There was equal distribution of Males and Females in Group A and Group B. A total of 15 males (41.5%) and 35 females (58.5%) were present including both the groups.

Group	N (%)	
	Male	Female
A	13 (43)	17 (57)
B	12 (40)	18 (60)

N- Number, %- percentage

Baseline Passive Range of Motion and Function

Table 3. The baseline characteristics analyzed of both groups with the median and interquartile values by using Mann Whitney U test shows that the groups were similar at baseline with p>0.05 for all the outcome measures.

VARIABLE		MEDIAN	LL	UL	p
FLEXION	PRE(A)	89	85	90	0.862
	PRE(B)	88	83.75	90	
ABDUCTION	PRE(A)	80	78.75	85	0.520
	PRE(B)	80	78.75	85	
INTERNAL ROTATION	PRE(A)	45	40	45	0.222
	PRE(B)	42	40	45	
EXTERNAL ROTATION	PRE(A)	40	35	45	0.535
	PRE(B)	35	30	40	
SPADI	PRE(A)	94	92	103	0.335
	PRE(B)	94	90	101	

LL- lower limit, UL- upper limit

Post Intervention Results

Both groups showed significant improvements in PROM and SPADI scores post-intervention (Table 4, Table 5) ($p < 0.05$). Group B (RDT) demonstrated higher gains in shoulder PROM and improvement in pain and function under SPADI scores compared to Group A (ERM) (Table 6) ($p < 0.05$) and (–Z value)

suggesting post treatment improvements are better than pre-treatment within the groups and post treatment improvements between the groups are better in Group B (RDT) than Group A (ERM).

Table 4. Comparison of pre and post treatment passive range of motion and SPADI scores in Group A (ERM) by Wilcoxon Sign Rank test.

VARIABLE		MEDIAN	Z	P
FLEXION	PRE	89	–4.806	0.001*
	POST	150		
ABDUCTION	PRE	80	–4.816	0.001*
	POST	140		
INTERNAL ROTATION	PRE	45	–4.893	0.001*
	POST	65		
EXTERNAL ROTATION	PRE	40	–4.872	0.001*
	POST	55		
SPADI	PRE	94	–5.512	0.001*
	POST	54		

*Significant at 5% level of significance. ($p<0.05$), -Z value= post>pre.

Table 5. Comparison of pre and post treatment passive range of motion and SPADI scores in Group B (RDT) by Wilcoxon Sign Rank test.

VARIABLE		MEDIAN	Z	P
FLEXION	PRE	88	–4.892	0.001*
	POST	167		
ABDUCTION	PRE	80	–4.855	0.001*
	POST	157		
INTERNAL ROTATION	PRE	42	–4.935	0.001*
	POST	79		
EXTERNAL ROTATION	PRE	35	–4.877	0.001*
	POST	65		
SPADI	PRE	94	–5.784	0.001*
	POST	39		

*Significant at 5% level of significance. ($p<0.05$), -Z value = post>pre.

Table 6. Comparison of post treatment passive range of motion and SPADI scores between Group A and Group B by Mann Whitney U test.

VARIABLE		N	U	Z	P
FLEXION	POST(A)	30	30.0	–6.334	0.001*
	POST(B)	30			
ABDUCTION	POST(A)	30	30.0	–6.334	0.001*
	POST(B)	30			
INTERNAL ROTATION	POST(A)	30	0.0	–6.748	0.001*
	POST(B)	30			
EXTERNAL ROTATION	POST(A)	30	31.0	–6.302	0.001*
	POST(B)	30			
SPADI	POST(A)	30	58.5	–5.800	0.001*
	POST(B)	30			

*Significant at 5% level of significance. ($p<0.05$), -Z value= post(B)>post(A).

Results

Demographic Data

The demographic characteristics of the subjects are presented in Table 1 and 2. There were no significant differences between groups regarding age and gender.

Discussion

The rationale for applying moist heat is to achieve the change in the viscoelastic property of connective tissue, to relax the surrounding muscles and to enhance the effect of stretch mobilization. Studies show that there is a notable reduction in the tensile stress with temperature increase of soft tissues by 3 degree centigrade to 4 degree centigrade.[17] For relaxation of the muscles, to maintain the range of motion and to break down intra-articular adhesions, pendular exercises were performed.[8,16]

The rotator cuff tendons insertions together helps in the reinforcement of the glenohumeral capsule to maintain the static and dynamic stability of the shoulder complex within its range and sufficient force is generated for the stability throughout the complete range for improved function.[16]More than the stability component the gliding at the tissue interface by the muscle contraction to breakdown any inter-tissue adhesions may have been achieved by the theratube exercises which improved function.[18]

Reduction in pain subscale has been attributed by mechanisms such as neurophysiological mechanisms and exercise induced hypoalgesia (EIH).[19]

End Range Mobilization which is used as common mobilization technique aimed to stretch the contracted structures in the periarticular region. The posterior and the postero-inferior part of the capsule is stretched for flexion but the glide is towards posterior till 90 degree and becomes inferior as range increases, anterior and inferior part of capsule is stretched for abduction with glide in inferior direction abiding by the concave -convex rule. These considerations provide specific stretch to the capsule.[9]

One of the effective treatment strategies to improve mobility in the shoulder for patients with adhesive

capsulitis is scapular mobilization. Various technique applications were used such as superior and caudal gliding, upward and downward rotations and scapular distraction from the thorax. But in Reverse Distraction Technique the scapula is moved in medial rotation. The effect may be because of an enhanced scapular motion which was disintegrated and also release of scapulothoracic muscular adhesions.[20]

Contrary to the first technique, in Reverse Distraction Technique to counteract the rotation of the scapula there is no force placed on the acromion. This is because of the hold of the capsule which keeps scapula in place. The distraction of the glenohumeral joint and the movement of scapula medially help to load the capsule effectively and clinically less painful,[10] since it was in varying angles of elevation there is also an effective stretch of the capsule.[21]

So the greater target force on capsule can be applied in Reverse Distraction Technique which can increase glenohumeral mobility easily and efficiently. Moreover the positional correction of scapula is achieved.[21]

Although both the techniques aimed at mobilizing for flexion and abduction the changes in rotations of shoulder can be attributed to the specific stress on different parts of capsule by capsular stretching. Also, the rotations of the shoulder are combination of movements in different planes (Codman's paradox) therefore the increase in range of flexion and abduction has attributed to increase in rotations.

The mechanical changes are attributed to adhesions breaking, collagen realignment, increase gliding of the fibre and the capsular stretch with stress on specific part of capsule causing improvement in function and reduction in pain.[22]

Thus, the results of this study concluded that End Range Mobilization and Reverse Distraction Technique showed increase in range and function in patients with adhesive capsulitis. But when compared with each other the Reverse Distraction Technique showed significant improvement in range of motion and the function in patients with adhesive capsulitis.

Limitations

1. Small sample size.
2. Subjects were recruited from only one hospital.
3. The confounding factors and psycho-social factors have not been considered.
4. Since there is variability and unclear duration of stages, the exact stage of adhesive capsulitis is not mentioned.
5. Absence of a control group or placebo group.

Conclusion

End Range Mobilization and Reverse Distraction Technique provide effective treatment options for patients with adhesive capsulitis. After comparison, the Reverse Distraction Technique showed better improvements than the End Range Mobilization in patients with adhesive capsulitis.

Future scope

1. Large sample size.
2. A multi-centre study should be considered so that the results can be generalized to large population.
3. To find the long term effects of these mobilization techniques.
4. Control group can be added to find whether the outcomes were truly because of the mobilization techniques.
5. The confounding factors and psycho-social factors can be assessed separately and relate with symptoms and outcomes.
6. The range of motion and function in relation with the quality of life can be studied separately.

Conflict of Interest: No conflicts of interest

Source of Funding: Self

References

1. Abrassart S, Kolo F, Piotton S, Chih-Hao Chiu J, Stirling P, Hoffmeyer P, Lädermann A. 'Frozen shoulder'is ill-defined. How can it be described better?. EFORT Open Reviews. 2020 May;5(5):273-9.

2. Le HV, Lee SJ, Nazarian A, Rodriguez EK. Adhesive capsulitis of the shoulder: review of pathophysiology and current clinical treatments. Shoulder & elbow. 2017 Apr;9(2):75-84.
3. Bulgen DY, Binder AI, Hazleman BL, et al.: Frozen shoulder: prospective clinical study with an evaluation of three treatment regimens. Ann Rheum Dis, 1984, 43: 353–360. [Medline].
4. Cyriax J. Textbook of Orthopedic Medicine, Vol 1: Diagnosis of Soft Tissue Lesions. 7th ed. New York, NY: Macmillan Publishing Co; 1978.
5. Lin JJ, Lim HK, Yang JL. Effect of shoulder tightness on glenohumeral translation, scapular kinematics, and scapulohumeral rhythm in subjects with stiff shoulders. Journal of Orthopaedic Research. 2006 May;24(5):1044-51.
6. Bertoft ES. Painful shoulder disorders from a physiotherapeutic view: a review of literature. Critical Reviews in Physical and Rehabilitation Medicine 1999;11 :229– 277.
7. Arslan S, Çeliker R. Comparison of the efficacy of local corticosteroid injection and physical therapy for the treatment of adhesive capsulitis. RheumatolInt 2001;21 :20– 23.
8. Vermeulen HM, Obermann WR, Burger BJ, Kok GJ, Rozing PM, van den Ende CH. End-range mobilization techniques in adhesive capsulitis of the shoulder joint: a multiple-subject case report. Physical Therapy. 2000 Dec 1;80(12):1204-13.
9. Lin HT, Hsu AT, An KN, Chien JR, Kuan TS, Chang GL. Reliability of stiffness measured in glenohumeral joint and its application to assess the effect of end-range mobilization in subjects with adhesive capsulitis. Manual therapy. 2008 Aug 1;13(4):307-16.
10. Yu IY, Jung IG, Kang MH, Lee DK, Oh JS. Immediate effects of an end-range mobilization technique on shoulder range of motion and skin temperature in individuals with posterior shoulder tightness. Journal of physical therapy science. 2015;27(6):1723-5.
11. Agarwal S, Raza S, Moiz JA, Anwer S, Alghadir AH. Effects of two different mobilization techniques on pain, range of motion and functional disability in patients with adhesive capsulitis: a comparative study. Journal of physical therapy science. 2016;28(12): 3342-9.
12. Kolber MJ, Hanney WJ. The reliability and concurrent validity of shoulder mobility measurements using a digital inclinometer and goniometer: a technical report. International journal of sports physical therapy. 2012 Jun;7(3):306.
13. Breckenridge JD, McAuley JH. Shoulder pain and disability index (SPADI). Journal of physiotherapy. 2011 Jan 1;57(3):197.
14. Shaffer B, Tibone JE, Kerlan RK. Frozen shoulder. A long-term follow-up. The Journal of bone and joint surgery. American volume. 1992 Jun;74(5):738-46.
15. Do Moon G, Lim JY, Da YK, Kim TH. Comparison of Maitland and Kaltenborn mobilization techniques for improving shoulder pain and range of motion in frozen shoulders. Journal of physical therapy science. 2015;27(5):1391-5.
16. Codman EA. The Shoulder: Rupture of the Supraspinatus Tendon and Other Lesions in or About the Subacromial Bursa. Boston, MA: T Todd Company; 1934.
17. Biradi M, Diwanmal S, Lal R, Kulkarni R, Rakaraddi S. Effects of anterior versus posterior end range mobilizations on shoulder pain in subjects with adhesive capsulitis stage II-A comparative study. Medica. 2017 Jul;6(2):36.
18. Mangus BC, Hoffman LA, Hoffman MA, Altenburger P. Basic principles of extremity joint mobilization using a Kaltenborn approach. Journal of Sport Rehabilitation 2002;11 :235– 250.
19. Lundberg A, Malmgren K, Schomburg ED: Role of joint afferents in motor control exemplified by effects on reflex pathways from Ib afferents. J Physiol, 1978, 284: 327–343.
20. Surenkok O, Aytar A, Baltaci G: Acute effects of scapular mobilization in shoulder dysfunction: a double-blind randomized placebo-controlled trial. J Sport Rehabil, 2009, 18: 493–501.
21. Yang JL, Chang CW, Chen SY, Wang SF, Lin JJ. Mobilization techniques in subjects with frozen shoulder syndrome: randomized multiple-treatment trial. Physical therapy. 2007 Oct 1;87(10):1307-15.
22. Frank C, Akeson WH, Amiel D, Coutts RD. Physiology and therapeutic value of passive joint motion. Clinical Orthopaedics and Related Research®. 1984 May 1;185:113-25.
23. Cunningham JB, McCrum-Gardner E. Power, effect and sample size using GPower: practical issues for researchers and members of research ethics committees. Evidence-Based Midwifery. 2007 Dec 15;5(4):132-7.

To Investigate Nerve Slider and Tensioner Technique in Radiating Pain on lumbar Radiculopathy in Patients with Spinal Stenosis

[1]J.Sheikh Asma Banu, [2]K.Kalaiselvi, [3]Mahendran P,

[1]Physiotherapist, Bangalore, [2]Professor, Acharya Institute of Health Sciences, Bangalore,
[3]Principal, Acharya Institute of Health Sciences, Bangalore

How to cite this article: J.Sheikh Asma Banu, K.Kalaiselvi, Mahendran P. To investigate nerve slider and tensioner technique in radiating pain on lumbar radiculopathy in patients with spinal stenosis . Indian Journal of Physiotherapy and Occupational Therapy / Vol 19 No 2 April-June 2025

Abstract

Background: Spinal stenosis impacts often in the lumbar region to the aged population where 20% are above 60 years old. Low back trouble, tingling sensation or numbness are common symptoms with lumbar spinal stenosis which leads to disability and disturbing individual lives.

Method: The study's intent was to understand which one of two Neurodynamic techniques, that is slider technique and tensioner techniques has better effects on improving symptoms and dysfunctions for cases of radiating pain induced by Lumbar spinal stenosis. 50 subjects between 35 - 60 years and above were signed randomly in 2 groups. The participants in the first group were treated by slider technique and the second group were treated by tensioner technique. Oswestry disability index, Numeric pain rating scale, Straight leg raise ranges of P1 and P2 were recorded to assess pain and disability. Along with neurodynamic technique, participants were administered by a home exercise program.

Result: The Statistical analysis revealed a significant reduction in pain and disability score in the slider group. Data was analyzed using paired t-test for pre and post comparison. Between groups comparison was done using unpaired t test. On ODI score slider technique was statistically significantly more effective as Pre intervention of 30.560±10.79 decreased significantly to 4.8±5.59 post intervention. The statistical analysis yields a t-value of 20.275 and a p-value of less than 0.001.

Conclusion: slider technique has better clinical results than Tensioner technique improving symptoms and dysfunction. Slider technique also enhances the range of motion.

Keywords: Spinal stenosis, slider technique, Tensioner technique, radiating pain

Introduction

Spinal stenosis is considered as a familiar disorder, disease and is often being seen among the aged population[1]. Spinal stenosis is a degenerative condition that happens gradually over time and leads to the lessening nerve root canal in spine, enlargement of the facet joint, stiffening of the ligaments, and overgrowth of the bone and bone spurs[2]. Stenosis can be seen in cervical region, thoracic regions, or lumbar region but the most common area is lumbar. At the age of 60 years 20% of the senior community have evidence of spinal stenosis whereas more than 80% do not experience symptoms only. Studies show that the number of spinal stenosis cases is more common in female gender with high rise in pain and functional disability. Bones undergo degenerative changes as a part of the natural ageing process

Corresponding Author: Mahendran P, Principal, Acharya Institute of Health Sciences, Bangalore

E-mail: principal@aihs.ac.in

Submission: Sep 20, 2024 **Revision:** January 10, 2025 **Published date:** April 11, 2025

leading to shrinking and drying out of the cushioning disc between vertebrae leading to loss of bone mass and development of bone spur. Structures involved in spinal stenosis are intervertebral disc, facet joint, intervertebral foramen, ligaments, medulla spinalis, cauda equina[3]

Pain, tingling sensation or numbness are results of lumbar spinal stenosis that starts from buttocks, laying down till calves including both the thigh leading to neurological claudication. Pain rises with certain positions such as activity including standing or walking and gets relieved by sitting down. Nerve root passes through foramen opening and extends outwards beyond the spinal column to innervate other parts of the body. Narrowing of this passage leads to nerve compression. Nerve compression creates nerve inflammation and decreases nerve blood flow which accumulates inflammatory mediators and causes pain[4]

According to Lee, the grading system for lumbar spinal stenosis[5]

GRADE	SEVERITY
O	NORMAL
1	MILD
2	MODERATE
3	SEVERE

Radiculopathy of neural tissue in which the physiological property of the nerve is altered to mechanical stress. Sensory changes, muscle weakness, reflex abnormalities i.e. Achilles tendon reflexes are diminished, negative straight leg raise test and neural tension sign are the neurological abnormalities which are revealed. Hamstring tightness leads to false positive SLR test. Radiating pain down to the posterior part of leg to feet, anterior thigh, groin, buttocks, and paresthesia are indicated by neurological claudication. Narrowing of the spinal canal results in lower motor disease which leads to Fasciculation and hyperreflexia. Spinal stenosis at L4/L5 involving L5/S1 leads to weakness of anterior tibial muscle hence causing foot drop[6].

Physiotherapy has featured a standard for treatment of mild to moderate spinal stenosis. Physical therapy program involves mobilization of nerves, stretching of muscles, Strengthening program, postural correction by providing ergonomic advice to individuals, electrical stimulation by using various modalities. Stretching helps in improving muscle length and flexibility of muscles and hence the extremity. Core Strengthening and aerobic provides workload off the joint and increases the tolerance level in day-to-day activities. Nerve mobilization done with neuro dynamic techniques helps to mobilize the nerve and change in pressure and tension in the nervous system producing change in blood flow, inflammation and mechanosensitivity in neural tissues[7]

NDT is a technique in which an approach to physical treatment of pain is carried out by mobilization of the nervous system. Neurodynamic is essentially the clinical application of physiology and mechanics of the nervous system as the associate and integrated with musculoskeletal function. Mechanical treatment of neural tissue has long existed, evolving from simple nerve stretching to advanced, multifaceted approaches. In Neurodynamic technique the use of body movement produces a mechanical effect on the peripheral nervous system with Central influence. The body tissues are characterized into mechanical interference neural structure and innervated tissue with respect to the nervous system. Mechanical interference has been defined as anything next to the nervous system also called as nerve bed which includes tendon, bone, intervertebral disc, ligament, fascia, blood vessels and skin. The movements on the musculoskeletal system bring out irregular stress. This movement depends on anatomical and mechanical design of body kinetics. The movement may include lengthening, shortening, bending, twisting which in turn results in change in neural structure[8].

Brain, spinal cord, cranial nerves, peripheral nerve, nerve roots, and few more are neural structures. They constitute the nervous system, functions of neural structure are mechanical and physiological where mechanical function is tension, compression

and movement. Physiological function is to transport axon, impulse conduction, changes in intraneural blood flow, reduce inflammation, and recover sensitivity. The mechanical and physiological functions are interdependent on one another. Nervous system interacts physiologically with innovative tissue in both apparent and efferent directions. Treating the innervated tissue can solve neural symptoms[8].

Tensioner technique is considered to increase the nerve strain whereas sliding technique mobilizes the nerve without increase in strain. The Sliding technique consists of more than two joint movements hence the load on the nervous system is at the same time. Tensioner technique produces tension in neural structure without increasing Visco elastic properties of nerve which benefits with higher function. Neurodynamic technique reduces pain, increases range of motion and functional disabilities[9]

Aim of the Study

To compare association between nerve slider and tensioner technique in management of radiating pain induced by lumbar radiculopathy in patients with spinal stenosis.

Methodology

Materials and Methods

Source of Data:

- Department of physiotherapy at Acharya institute of Health sciences

METHOD OF DATA COLLECTION: Experimental

STUDY DESIGN: Experimental comparative study

DURATION OF THE STUDY: 4 months

SAMPLE SIZE: 50

The sample size required for the study is 25 in each group. Sample size is estimated using the formula

$$N = ([(Z\alpha)/2 + Z\beta]^2\sigma^2/d^2$$

where; $(z\alpha)/2 = 1.96$ $Z\beta = 0.84$

SAMPLING SELECTION: Convenient sampling

Inclusion Criteria

- Individual with age between 35 - 60 years old and above both male and female.
- MRI report confirming mild and moderate level of lumbar spinal stenosis.
- Positive SLR test.
- Individual having first episode of pain within previous 3 months
- Radiating pain distal to the buttock, thigh, knee and lower leg.
- Symptoms in one of the lower extremity.

Exclusion Criteria

- Individual having a history of steroid administration, contraindicated to manual therapy or exercises as noted from patients' medical history.
- Severe vascular disease, osteoporosis, degenerative scoliosis.
- Individual having symptoms in bilateral lower limbs.
- Malignancy, infection, chemical dependence such as alcohol or any drugs.
- Patients diagnosed with systemic inflammatory disease, ankylosing spondylitis, spinal cord lesion or fractures involving spine and lower limb.

Procedure

The study was conducted in physiotherapy OPD after obtaining approval from Acharya ethical review committee on 03/06/2023 with reference no. AIHS/MPT/ETHICAL REVIEW/2359/23, and written consent from the patients. 50 subjects with spinal stenosis having radiating pain induced by Lumbar radiculopathy and having associated symptoms in unilateral lower limb were recruited for the study. Subjects were randomly divided into two experimental groups, 25 subjects in each group A received slider technique and group B received tensioner technique. Additionally home exercises were given to both the groups. Both groups were explained the treatment

techniques, detailed assessment was taken by using outcome measures that included NPRS, ODI and SLR test. The values were recorded on day 1 of first week and last day of 4th week.

To achieve the accurate values of the SLR test, the subject holds supine position, and the examiner gently performs flexion of the hip with knee extension by raising the patient›s leg in supine position. P1 the onset of symptoms and P2 maximum tolerance of the symptom was recorded[10]. ODI scores were recorded to assess the level of disability and pain. Pain intensity rating was recorded by NPRS. Group A received slider technique, patient in supine position with elevated leg against wall or supporting surface with hip flexion, knee extension to slide the nerve tissue distally ankle dorsiflexion and for proximal nerve tissue slide, ankle plantar flexion followed by neck flexion will be done. Group B received tensioner technique, patient in supine position with same elevated leg against wall or supporting surface with hip flexion, knee extension to create tension dorsiflexion of ankle with neck flexion followed by plantar flexion. The slider and tensioner technique were repeated for 1.5 mins. 5 sets were done with 2 mins break in between each set[11].

Figure 1: Tensioner technique in supine position

Figure 2: Slider technique in supine position

Home exercise given to both the groups[11]

1. Ankle toe movement in supine position: subject in supine position performs ankle dorsiflexion and plantar flexion.
2. Knee to chest movement Subject in supine position performs flexion of hip and knee and tries to touch chest by knee. This stretch targets hamstrings, hip flexors, and low back muscles that helps improve flexibility, and relieve tension in lower extremity.
3. Core strengthening[12]Patient in supine position hip and knee in flexion position, feet on the swiss ball, spine neutral. Patient slowly lifts hip off the floor and holds the bridge position for 5 secs and relax.
4. Hip bridging movement. Patient in supine position hip and knee in flexion position, feet in contact with floor, spine neutral. Patient slowly lifts hip off the floor and holds the bridge position for 5 secs and relax.
5. Cat and camel exercise. Patient in quadruped position ensuring hands in alignment with elbow and shoulder, knee and hip in straight alignment. For cat pose, lift the back up and flexion of neck. Hold for 5 sec and relax. For camel pose arching the back and extension of the neck. Hold for 5 sec and relax.

6. Child pose[12]. Patient kneels on mat with knee slightly apart, slowly sit back on heels and bend forward with arm stretch, neck and shoulder relaxing hold for 5 sec and relax.

Exercise Prescription

Frequency = 5 days/week[13]

Intensity = 10 counts in one set

Time = 20 minutes with 30 sec rest after each exercise

Sets = Two sets[13]

Results and Interpretations

Table 1. Comparison of age

	Group	N	Mean	Std. Deviation	t value	p value
Age	Slider	25	46.400	9.661	0.227	0.783
	Tensioner	25	47.120	8.686		

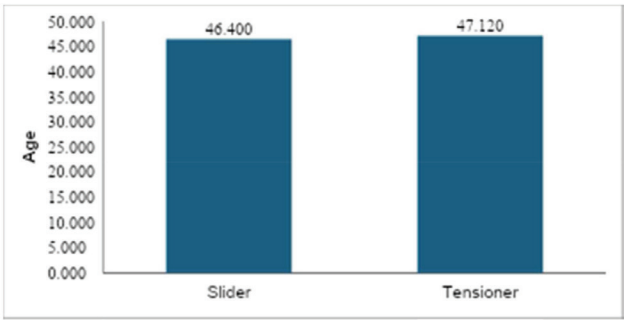

Figure 1: Representation of age

Table 2. Distribution based on gender

Gender	Group		Total	Chi square	p value
	Slider	Tensioner			
Female	16	14	30		
	64.0%	56.0%	60.0%		
Male	9	11	20		
	36.0%	44.0%	40.0%		
Total	25	25	50		
	100.0%	100.0%	100.0%	0.333	0.564

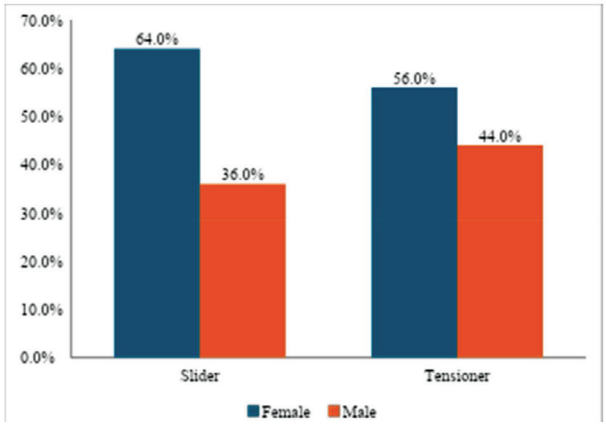

Figure 2: Representation of the participants based on gender

Table 3: Comparison of ODI between Slider group and Tensioner group

Group	N	Average improvement	Std. Deviation	t value	p value
Slider	25	25.760	8.452	1.312	0.196
Tensioner	25	21.280	14.828		

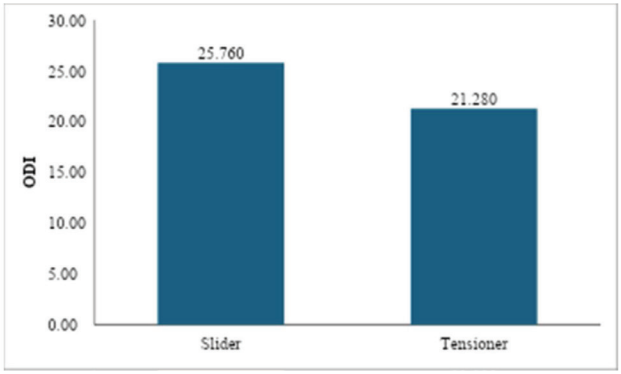

Figure 3. Representation of improvement in ODI score

Table 4: Comparison of SLR between Slider group and Tensioner group

Group	N	Average improvement	Std. Deviation	t value	p value
Slider	25	53.000	13.070	4.641	p<0.001
Tensioner	25	35.160	14.091		

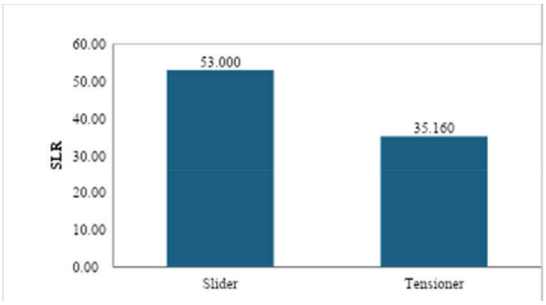

Figure 4: Representation of improvement in SLR

Table 5. Comparison of NRPS between Slider group and Tensioner group

Group	N	Average improve-ment	Std. Deviation	t value	p value
Slider	25	7.980	1.085	0.813	0.42
Tensioner	25	6.640	2.169		

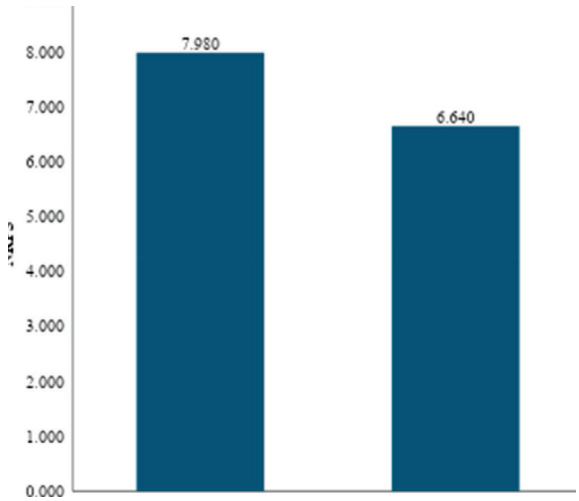

Figure 5: Representation of improvement in NRPS score between the groups

Discussion

On analyzing the mean from pre intervention to post intervention, the result shows that group A treated with slider technique in combination with home exercise shows statistically significant change in mean of pain intensity and disability measured, whereas group B showed no large statistically significant changes. The sliding technique help physiologically to transport axon, conduct impulse and change the intraneural blood flow by reducing inflammation which comprise of fluid and cells including enzymes, acids, histamine and macrophages creating peripheral nerve sensitivity that provoke the pain. According to Sharma Srishti[14], the slider technique results in decreasing inflammation and pain by increasing pressure to neural fluid and minimal increase in nerve strain and enhancing relief in hypoxia and reducing symptoms which were associated. The evolved impulses created by neural compression, excessive friction or tension at any levels can be eliminated by normal neurodynamic technique.

Post intervention on comparison between slider group and tensioner group for NRPS was average improvement of 7.98 and 6.64 respectively in the test. There was a significant improvement in both the groups as evidenced by the statistical analysis but slider technique shows improvement and reduction of pain more in comparison to tensioner technique. R. Vijayalakshmi, L. Rajamani(2022)[15] claims that nerve mobility increases by 4.15 mm to 1.48mm through neurodynamic technique which facilitates fast and free mobility of nerve, reduction of nerve adherence, increase of neural vascularity, improvement of axoplasmic flow and reduction of mechanosensitivity to manage pain intensity. However their study was not to compare the slider and tensioner technique effects individually.

The nerve slider technique creates a stretching effect as the hip moves for flexion movement with knee extension and ankle dorsiflexion for sliding the nerve tissue distally and for proximal nerve tissue slide ankle plantar flexion followed by neck flexion. Haytham Ibrahim (2022)[16]on comparing the effect of slider and tensioner technique in chronic discogenic sciatica mentioned that the slider technique shows tension and compression to the nervous system instead of one session whereas tensioner technique produces viscosity of nerve. Stretching facilitates increase in hip and knee range of motion, pain reduction, improves functional disability, mobility, oxygen to inflammatory tissue to maintain normal physiological status of nerve. The current study subjects were additionally given home exercises that help in mobility, strengthening and stretching the spine and lower extremity. In

comparison between nerve slider and Tensioner technique, the slider technique in combination with home exercise is more effective in reducing radiating pain induced by lumbar radiculopathy in patients with spinal stenosis.

Conclusion

The study concludes that the nerve slider technique is more effective in reducing radiating pain and disability induced by lumbar radiculopathy in patients with spinal stenosis.

There is an association between two neurodynamic techniques, in management of radiating pain induced by Lumbar radiculopathy in patients with spinal stenosis. By using these interventions more effectively pressure relief on nerves, reduction of pain, and improved mobility and function can be seen in mild and moderate levels

Limitations of Study

- The current study results were based on convenient sampling.
- This study had subjects with unilateral symptoms on lower extremity, bilateral symptoms should be considered.
- This study targeted only the lumbar region of the spine.

Conflict of interest: No

Source of funding statement: Nil

References

1. Kruger JR, Secher JT. Prevalence of lumbar spinal stenosis in general and clinical populations: a systematic review and meta-analysis. Eur Spine J. 2022 Sep;29. doi:10.1007/s00586-020-06339-1.
2. Chua M, Hochberg U. Gender differences in multifidus fatty infiltration, sarcopenia, and association with pre-operative pain and functional disability in patients with lumbar spinal stenosis. Spine J. 2022 Jan;22. doi:10.1016/j.spinee.2021.06.007.
3. Walter KL, Toole JE. Lumbar spinal stenosis. JAMA. 2022 Jul 19. doi:10.1001/jama.2022.6137.
4. Kumar M, Garg G. Epidemiology, pathophysiology, and symptomatic treatment of sciatica: a review. Elsevier Health Sciences. 2011.
5. Seo J, Lee JW. Magnetic resonance imaging grading system of central canal and neural foraminal stenosis of the lumbar spine with a focus on the Lee grading system. Korean J Radiol. 2023. doi:10.3348/kjr.2022.0351.
6. Hirota K, Hanakita J. Walking-evoked erection in patients with lumbar degenerative diseases: eight cases and review of the literature. Asian Spine J. 2021 Apr;15. doi:10.31616/asj.2019.0340.
7. Murphy DR, Hurwitz EL. Non-surgical approach to the management of lumbar spinal stenosis: a prospective observational cohort study. BMC MusculoskeletDisord. 2006 Feb;7:16. doi:10.1186/1471-2474-7-16.
8. Shacklock M. Clinical neurodynamics: a new system of neuromusculoskeletal treatment. 1st ed. Elsevier Health Sciences; 2005.
9. Ellis R, Carta G, Coppieters MW. Neurodynamics: is tension contentious? J Man ManipTher. 2022;30(1):3–12. doi:10.1080/10669817.2021.2001736.
10. Camino-Willhuber G. Straight leg raise test [Internet]. ResearchGate; 2019 Apr. Available from:https://www.researchgate.net/publication/331091665_Straight_Leg_Raise_Test
11. Jeawani M, Deo M. Effectiveness of sliders vs tensioners on pain and disability in non-specific low back pain with associated lower limb symptoms: pre-test post-test experimental study. Int J Health Sci Res. 2019. doi:10.52403/ijhsr.
12. Yildiz N, Topuz O. Efficiency of exercise and ultrasound in patients with lumbar spinal stenosis: a prospective randomized controlled trial. ClinRehabil. Spine J. 2010;24. doi:10.1177/0269215510367539.
13. Whitman JM, Flynn TW. A comparison between two physical therapy treatment programs for patients with lumbar spinal stenosis: a randomized clinical trial. Spine J. 2006 Oct 15;10. doi:10.1097/01.brs.0000241136.98159.8c.
14. Sharma SS, Sheth MS. Effect of neurodynamic mobilization on pain and function with lumbar radiculopathy. Med Sci. 2018. doi:10.5455/medscience.2017.06.8664.
15. Ravilla V, Logesh R. Effects of neural mobilization on sciatic nerve excursion, symptoms, and regional function in individuals with nerve-related low back pain. PhysTher Sport Rehabil. 2022. doi:10.5114/pq.2021.111835.
16. Morsi HI, Nahas BE. Effects of slider, tensioner neurodynamic mobilization techniques, and stretching exercises in the treatment of chronic discogenic sciatica: a comparative study. 2022 May 9. doi:10.21203/rs.3.rs-1572951/v1.

Original Article DOI: https://doi.org/10.37506/gcv0vr33

Empowering New Moms: Breastfeeding Support in Your Pocket-An Insight from Medella Family App-Pilot Study

K.Inul Ameenal[1], Senthilkumar[2], Karthika Ramalingam[3]

[1]Postgraduate Student, Saveetha College of Physiotherapy, Saveetha Institute of Medical and Technical Sciences, Chennai, Tamil Nadu, India, [2] Professor, Saveetha College of Physiotherapy, Saveetha Institute of Medical and Technical Sciences, Chennai,Tamil Nadu, India, [3]PhD Scholar, Tutor Saveetha Institute of Medical and Technical Science, Chennai, Tamil Nadu, India

How to cite this article: K.Inul Ameenal, Senthilkumar, Karthika Ramalingam. Empowering New Moms: Breastfeeding Support in Your Pocket-An Insight from Medella Family App-Pilot Study. Indian Journal of Physiotherapy and Occupational Therapy / Vol 19 No 2 April-June 2025

Abstract

Introduction: Lactation is the process by which milk is produced with the assistance of maternal hormones. Insufficient breast-feeding is a common problem that affects the baby's well-being. The term "lacto genesis II" refers to the start of abundant milk production that occurs 30 to 48 hrs after delivery. My Medella Family smartphone application has been developed to support lactating women worldwide. While its primary focus is on pregnancy and breastfeeding, it embodies the principles of mHealth by providing easy access to personalized and expert health information, which is crucial in various health contexts including physiotherapy.

Materials and Methods: Users of the Medella Family app who enrolled between January and September of 2022 received emails with the updated mHealth App Usability Questionnaire. In addition to answering questions about their sociodemographic details, clinical information about lactating mothers and their breastfeeding practices, participants were given the modified mHealth App Usability Questionnaire (MAUQ).

Result: 50 users in all finished the entire questionnaire. Medella Family app mean mMAUQ score was 5.9 (±0.88), When utilizing the Medella Family App, 80.9% of respondents stated that they felt supported during their nursing experience, and 75.3% stated that the app helped them manage their breastfeeding experience. 86.7% said that Medella Family app was helpful for their health and well-being; and 87.8% said that they were satisfied with Medella Family App overall.

Conclusion: Our study's findings demonstrate Medella family app great usability. Consumers gave Medella Family app very high ratings and said it helped them breastfeed.

Keywords: Breastfeeding, Lactation, Medela family app, Lactating mother.

Corresponding Author: Senthilkumar, Professor, Saveetha College of Physiotherapy, Saveetha Institute of Medical and Technical Sciences, Chennai,Tamil Nadu, India.

E-mail: senthilkumar.scpt@saveetha.com

Submission: Jan 2, 2025 **Revision:** Febuary 26, 2025 **Published date:** April 11, 2025

Introduction

Breastmilk is clean, safe, and rich in antibodies that help in protecting children from common illnesses. For babies, breastmilk is the best food. For kids aged six to twenty-three months, it's also the perfect energy source [26]. In addition to having a lower mortality, breastfed infants and kids also have decreased incidence of obesity, asthma, SIDS, gastrointestinal tract infections, and serious lower respiratory disorders. Additionally, they do better on intelligence tests and are associated with greater lifetime earnings[6]. It also lowers the risk of high blood pressure, type 2 diabetes, breast cancer, and ovarian cancer in mother[1]. Breastfeeding the baby will significantly reduce maternal and infant morbidity and mortality[24]. Lacto genesis is the process of milk secretion with the maturation of alveolar cells which is determined by the breast fullness and leakage of colostrum which occurs by 3rd day after delivery and the production of milk is referred to as lactation[22]. Secretory initiation and secretory activation are its two steps.

The second trimester of pregnancy is when the secretory initiation start occurs and it is inhibited by the high level of progesterone which is supplied by the placenta. A small amount of milk starts to secrete by the 16th week of gestation. Stage II lacto genesis, otherwise called secretory activation, starts with copious milk production by converting the colostrum after the day of delivery. During this stage, there is a rapid drop in the progesterone level because of the removal of the placenta and the levels of prolactin, cortisol and insulin get elevated[11]. As per Odom et al. (2013), over 60% of women stop nursing earlier than intended or desired, and one of the main causes of this discontinuation is a lack of adequate support[16]. The prevalence of lacto genesis II is 12-55% among all mothers globally with 53% primi parous women in America and 7.9% breastfeeding women in Peru reporting delayed lacto genesis II. Similar prevelanc is about 48.7% in Australia and 35.5% in Brazil[12,3,9,18]. Globally, the prevalence rate is 40% at 6 months of infant age[10].

Clinical factors include smoking, maternal expectations, pacifier usage during 1st month, greater milk production, socio economic factors and environmental factors[2,20,17,25,7,14]. Large amounts of milk is secreted at the start of lacto genesis II, which is less likely to be supplemented with formula feeding. However, this process can be stopped or delayed by both internal and external factors, such as mental changes, premature delivery or LSCS, and physiological changes that occur in the mammary glands [12,4]. Previous studies show that delayed breast crawl, excessive weight gain during the antenatal period, flat or inverted nipples, and improper LATCH are considered risk factors [13,19].

Medella Family app is an app which consists of segments which involves antenatal and postnatal period. During antenatal period, the mother can understand important factor such as what happens to her breast during pregnancy, when the breast milk should start, how to breastfeed the baby with flat, inverted and pierced nipple and how the breast will change from pregnancy to weaning, difference between breast milk and formula, importance about colostrum and transitional milk, importance of breastmilk during first hour and first week after delivery. Physiotherapy often employs smartphone apps for remote patient engagement, rehabilitation, and monitoring, similar to how Medela Family supports feeding and baby care. Through these apps, physiotherapists can provide personalized exercise programs, track patient progress, and deliver educational content remotely about breastfeeding, which aligns with the connectivity and support that the Medela Family app offers for its users.

After delivery during postnatal period, the mother is able to know about the benefits of breastmilk for both mother and baby, different types of breastfeeding positions, importance of breastfeeding during the first 6 months of babies lifespan, breastfeeding problems in first month, WHO recommendations about breastfeeding, when to start complementary foods, Tips and advice on breastfeeding. The present study is done to assess the usability of Medela Family application in smartphone by breastfeeding mothers.

Materials and Methodology

The present study was conducted as a component of a postgraduate thesis project, with the main objective being to determine the impact of medela family app usage in breastfeeding support among postpartum mothers especially primi and elderly primi mother. The study was conducted in a medical college that was attached to a hospital located in Thandalam, Kanchipuram district, Chennai, India. We performed a survey to examine the usefulness and usability of Medela family, a smartphone application for breastfeeding assistance. Fans of Medela who signed up between January and May of 2024 were sent surveys by email. 42 questions were asked in the survey, which included the questionnaire, sociodemographic data, and clinical data about the lactating mothers on breastfeeding. A questionnaire was emailed to 200 family users of Medela. 130 individuals completed the survey, and 170 users read the email**.** There were a total of 50 users who finished the questionnaire. As a result, the questionnaire had a 6.7% response rate, an 86% completion rate, and a 14% dropout rate.

The present study is done to assess the usability of Medella Family application in smartphone by breastfeeding mothers. My Medella Baby Tracker (Medella UK Ltd., Manchester, United Kingdom) supports breastfeeding mothers with an activity tracker, interactive checklist**,** personalized content, and pumping tips. They offer a Bluetooth connection to their breast pump and track the baby's weight, height, diaper change, and sleep. Sharing data is also possible and consumers can easily share their infant's data with others. The consumer can find educational information and breastfeeding tips on the consumer's page. One of the benefits that consumers pointed out was how the pumping tracker helped them by setting a pumping schedule to boost their milk production[24].

Outcome Measures: Zhou et al. developed the Medication Adherence Universal Questionnaire in 2019. It has 21 components altogether across three dimensions: accessibility and satisfaction (8 things), system information layout (6 items), and efficiency (7 items). The 7-point Likert scale that follows: Numbers: 1 denotes very strong acceptance, 2 acceptance, 3 dissatisfaction, 4 neutrality, 5 dispute, 6 strongly disagree, and 7 extremely strongly disagree[27]. By adding up all of the item scores and dividing by the total number of things, the overall score is determined. A mean number that is nearer to one suggests that the software is easy to use.

Result

Fifty users in all filled out the entire survey. The medela Family app received a mean m MAUQ value 0f 5.9 (±0.88). Eighty-nine percent respondent agreed that the Medela family app had helped them manage their breastfeeding experience, 86.7% said it had been helpful for their health and wellbeing, and 87.8 percent said they were satisfied with the app overall with features like, enhanced monitoring, guidance and support for parent, improved adherence to health practices. The early primi and primi mothers face unique challenges as they transition into parenthood. The Medela Family app provides robust support to help ease this journey by providing reminders for feeding, pumping sessions, and other baby-related tasks. First-time and early primi mothers can benefit from connecting with other new parents through the app's community features, sharing experiences, and receiving support. The user's age, type of nursing, and prior breastfeeding experience all had a substantial impact on the overall m- MAUQ questionnaire results.

Table 1. Represents the category and percentage of medela family app usage

CATEGORY	PRECENTAGE
TRACKING BREASTFEEDING	45%
MONITORING BABY'S SLEEP	20%
CONNECTRING WITH COMMUNITY	20%
READING EXPERET TIPS	15%

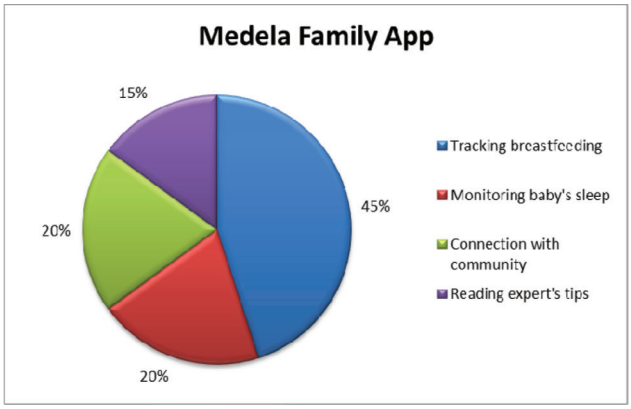

Figure 1: Represents category and the percentage usage among app users.

Discussion

For new-borns, breastfeeding is the best nourishment. In addition to complementary foods beginning at 6 months of age, the American Association of Paediatrics (AAP) recommends exclusive breastfeeding for around six months, followed by the introduction of complementary foods, the AAP also advocates continuous breastfeeding for at least two years[6].

Breastfeeding benefits the health of both the mother and the child: it reduces the risk of ovarian cancer, postpartum haemorrhage, and so on. Even though breastfeeding has several advantages, only 2 out of 5 infants are thought to be exclusively breastfed at six months of age due to the low breastfeeding rate around the world. A variety of causes can lead to a woman giving up breastfeeding, including discomfort or soreness, trouble latching, the baby's hospitalization to the neonatal intensive care unit, the perception of a low milk supply, the mother's employment situation, and lack of knowledge on breastfeeding.

Global health organizations generally advise nursing for the first six months of life and for a minimum of one to two years after that. A number of variables, such as perceived insufficiency of breast milk, ease of bottle feeding, lack of social or familial support, and breast and nipple pain, influence the succeeding mother's decision to reduce the length of nursing. Premature cessation of lactation is reported by most women. When a patient gets discharged from the hospital, the federal Centers of Disease Control indicates that 84.1% of them are currently breastfeeding; however, when the patient is breastfed exclusively, the percentage of them breastfeeding reduces to only 25.6% after six months. The percentage of breastfeeding in our population was quite comparable.[1]

In addition to improving immunity and lowering the risk of Sudden Infant Death Syndrome(SIDS), breastfeeding also has long-term health advantages for the mother and the newborn. It also reduces childhood obesity and asthma incidence. Benefits for mothers include a lower chance of developing breast and ovarian cancers, a lower incidence of metabolic and cardiovascular disorders in later life, and a reduction in postnatal psychopathologies. **Paola Quifer-Rada, et al., 2023,** has conducted a study among postpartum lactating mother using Lactapp and concluded that the mothers using the app shows a significant improvement in lactation[15]. **Madayag, et al., 2025,** has conducted a study on evaluating the utility of lactapp mobile health tool on nursing student's breastfeeding knowledge and educational practices and concluded that the lactapp tool effectively enhanced nursing student's knowledge and practices to support breastfeeding mother's effectively[8]. **Syam A., et al., 2024** has conducted a study on the usability of mommy-Bee app among postpartum Mother's and concluded that it promotes maternal and child health by focusing on technology-driven interventions to assist breastfeeding mothers, while the current study concludes that, it plays an important role in managing breastfeeding and educating the Mother's during antenatal and postnatal period[21].

Obstetricians, pediatricians, and family doctors are the medical professionals who should encourage lactation. Obstetrical care professionals should support each woman's educated decision regarding whether to start or continue breastfeeding by maintaining their knowledge and skills in advising, according to the American College of Obstetricians and Gynecologists. Supportive interventions for the mother may lengthen and/or increase the pace

of lactation. Modern technologies and telemedicine have proven beneficial in many areas of medicine, including obstetrics. Numerous research specifically focused on the ways that mobile health can facilitate lactation. There are still few studies, nevertheless, that support the value of those mobile treatments and their influence on results. The result of our study shows that Medela Family smartphone application is highly usable and shows a significant improvement in lactation for lactating women.

Comparison with Similar Apps

BETWEEN MOMMY-BEE and MEDELLA FAMILY APP

- **Focus**: Both apps focus on supporting breastfeeding mothers, but the Mommy-Bee app places a stronger emphasis on mental health and breastfeeding efficacy, while the Medella Family app offers a broader range of tracking features, including pregnancy and baby tracking.
- **Usability**: Both apps are designed to be user-friendly, but the Medella Family app includes additional features like hands-free voice control and night mode, which enhance usability.
- **Features**: The Medella Family app provides more comprehensive tracking options and educational resources, while the Mommy-Bee app focuses more on mental health support and early detection of postpartum depressive disorders.

  Overall, The Medella Family app has received positive reviews among Mother's for its comprehensive tracking features and ease of use.

Broader Implications

- The pilot study shows that using a mobile app to support breastfeeding moms works and is helpful. This sets the stage for more research.
- It helps identify what makes breastfeeding apps successful. This info is crucial for a larger study to explore these factors in detail.
- The pilot study gives insights into how to collect data, recruit participants, and analyze results. These insights can improve the design of a bigger study.
- It provides preliminary data that can support funding proposals for a larger study. This data shows the potential impact of the research.
- The pilot study gathers feedback from users to improve the app. This feedback is essential for the success of a larger study.
- It highlights the broader benefits of using mobile apps for breastfeeding support. This opens up new research opportunities, like comparing different apps and exploring long-term outcomes.

Conclusion

This study concluded that the Medela Family app plays an important role in managing breastfeeding and educating mother during antenatal and postnatal period.

Study Limitations

- Regularity of usage and self-bias can lead to missing or incorrect data.
- People might make mistakes, so data may be inaccurate.
- Some users might feel uncomfortable sharing information.

Future Recommendations

- Implement long-term studies to observe how user engagement and data reporting evolve over extended periods.
- Conduct regular user experience (UX) studies to continually improve the app's interface and features based on user feedback.
- Utilize machine learning to analyze user behavior patterns and predict future needs or issues.

- Conduct research to adapt the app's content and features to be culturally sensitive and relevant to diverse user groups.

Acknowledgements: I owe a great thanks to all the people who helped and supported me during the completion of this dissertation

Financial Support and Sponsorship: NIL

Patient Consent: A written consent was obtained from the participants.

Ethical clearance: Ethical clearance has been done

Name of the ethics committee clearing the study: Institutional Ethics Committee Saveetha Institute of Medical Sciences and Technical Sciences Date: 19/04/2023 ISRB Reg. No. 01/050/2023/ISRB/PGSR/SCPT

Conflict of interest: This is to confirm that I do not have any conflict of interest during the course of the study.

Reference

1. Centers for Disease Control and Prevention. Recommendations and benefits: Breastfeeding. [Internet]2022Mar[cited2022].Availablefrom:https://www.cdc.gov/nutrition/infantandtoddlernutrition/breastfeeding/recommendations-benefits.html.
2. Cromi A, Serati M, Candeloro I, Uccella S, Scandroglio S, Agosti M, et al. Assisted reproductive technology and breastfeeding outcomes: a case-control study. Fertil Steril. 2015;103(1):89-94. https://doi.org/10.1016/j.fertnstert.2014.10.009.
3. Dewey KG, Nommsen-Rivers LA, Heinig MJ, Cohen RJ. Risk factors for suboptimal infant breastfeeding behavior, delayed onset of lactation, and excess neonatal weight loss. Pediatrics. 2003;112(3):607-19.
4. Dong D, Ru X, Huang X, Sang T, Li S, Wang Y, et al. A prospective cohort study on lactation status and breastfeeding challenges in mothers giving birth to preterm infants. Int Breastfeed J. 2022;17:1-3.
5. Dowling S, Brown A. An exploration of the experiences of mothers who breastfeed long-term: what are the issues and why does it matter? Breastfeed Med. 2013;8(1):45-52.
6. Klein LD, Huang J, Quinn EA, Martin MA, Breakey AA, Gurven M, et al. Variation among populations in the immune protein composition of mother's milk reflects subsistence pattern. Evol Med Public Health. 2018;2018(1):230-45.
7. Lechosa-Muniz C, Paz-Zulueta M, Herrero MSdeA, Rio ECD, Sota SM, Llorca J, et al. Global targets 2025: To improve maternal, infant and young child nutrition. Nutr Breastfeed Med. 2020;15(4):e377-e384. https://doi.org/10.1016/j.anpedi.2017.09.002
8. Madayag R A, Policarpio B B, Dizon L T, et al. (January 17, 2025) Evaluating the Impact of the LactApp Mobile Health (m-Health) Tool on Nursing Students' Breastfeeding Knowledge and Educational Practices: A Mixed-Methods Study. Cureus 17(1): e77591. DOI 10.7759/cureus.77591
9. Matias SL, Nommsen-Rivers LA, Creed-Kanashiro H, Dewey KG. Risk factors for early lactation problems among Peruvian primiparous mothers. Matern Child Nutr. 2010;6(2):120-33.
10. Mena-Tudela D, Soriano-Vidal FJ, Vila-Candel R, Quesada JA, Martínez-Porcar C, Martin-Moreno JM. Is early initiation of maternal lactation a significant determinant for continuing exclusive breastfeeding up to 6 months? Int J Environ Res Public Health. 2023;20(4). https://doi.org/10.3390/ijerph20043184
11. Neville MC, Morton J, Umemura S. Lactogenesis: The transition from pregnancy to lactation. Pediatr Clin North Am. 2001;48(1):35-52.
12. Nommsen-Rivers LA, Chantry CJ, Peerson JM, Cohen RJ, Dewey KG. Delayed onset of lactogenesis among first-time mothers is related to maternal obesity and factors associated with ineffective breastfeeding. Am J Clin Nutr. 2010;92(3):574-84.
13. Nommsen-Rivers LA. Does insulin explain the relation between maternal obesity and poor lactation outcomes? An overview of the literature. Adv Nutr. 2016;7(2):407-14.
14. Oribe M, Lertxundi A, Basterrechea M, Begiristain H, Santa Marina L, Villar M, et al. Prevalence of factors associated with the duration of exclusive breastfeeding during the first 6 months of life in the INMA birth cohort in Gipuzkoa. Gac Sanit. 2015;29(1):4-9. https://doi.org/ 10.1016/j.gaceta.2014.08.002.
15. Quifer-Rada P, et al. Spanish version of the mHealth app usability questionnaire (MAUQ) and adaptation to breastfeeding support apps. Int J Med Inform. 2023.
16. Quifer-Rada P, Aguilar-Camprubí L, Padró-Arocas A, Mena-Tudela D. Evaluation of the usability and utility of LactApp, a mHealth tool for breastfeeding support. Int J Med Inform. 2023;180:105240
17. . Rius JM, Ortuno J, Rivas C, Maravall M, Calzado MA, Lopez A, et al. Factors associated with early weaning

in a Spanish region. An Pediatr (Barc). 2014;80(1):6-15. https://doi.org/10.1016/j.anpedi.2013.05.011.

18. Rocha BD, Machado MP, Bastos LL, Barbosa Silva L, Santos AP, Santos LC, et al. Risk factors for delayed onset of lactogenesis II among primiparous mothers from a Brazilian baby-friendly hospital. J Hum Lact. 2020;36(1):146-56.
19. Rocha BO, Machado MP, Bastos LL, et al. Risk factors for delayed onset of lactogenesis II among primiparous mothers from a Brazilian baby-friendly hospital. J Hum Lact. 2020;36(1):146–156.
20. Santacruz-Salas E, Segura-Fragoso A, Cobo-Cuenca AI, Carmona-Torres JM, Pozuelo-Carrascosa DP, Laredo-Aguilera JA. Factors associated with the abandonment of exclusive breastfeeding before three months. Children. 2020;7(12):1–12. doi:10.3390/children7120298.
21. Syam A, Firawati F, Dewi I. Usability study of the Mommy-Be app: Exploring the experience of breastfeeding mothers in Eastern Indonesia. 2024.
22. Ventrella D, Forni M, Bacci ML, Annaert P. Non-clinical Models to Determine Drug Passage into Human Breast Milk. Curr Pharm Des. 2019;25(5):534-548.
23. Victora CG, Bahl R, Barros AJD, Franca GVA, Horton S, Krasevec J, Murch S, Sankar MJ, Walker N, Rollins NC. Breastfeeding in the 21st century: epidemiology, mechanisms, and lifelong effect. Lancet. 2016;387(10017):475-490. PMID: 26869575.
24. Vila-Candel R, Duke K, Soriano-Vidal FJ, Castro-Sánchez E. Affect of Early Skin-to-Skin Mother–Infant Contact in the Maintenance of Exclusive Breastfeeding: Experience in a Health Department in Spain. J Hum Lact. 2018;34(2):304-312. https://doi.org/10.1177/0890334416676469.
25. Virani A, Duffett-Leger L, Letourneau N. Parenting apps review: in search of good quality apps. Mhealth. 2019;5.
26. World Health Organization. Infant and young child feeding. [Internet] 2021 Mar [cited 2022]. Available from:https://www.who.int/news-room/fact-sheets/detail/infant-and-young-child-feeding.
27. Zhou L, Bao J, Setiawan IMA, Saptono A, Parmanto B. The mHealth app usability questionnaire (MAUQ): development and validation study. JMIR Mhealth Uhealth. 2019;7:e11500. doi: 10.2196/11500

Original Article **DOI: https://doi.org/10.37506/6n6rgm28**

A Comparative Study on Proprioceptive Neuromuscular Facilitation Versus Motor Relearning Programme on Improving Functional Recovery in Stroke Patients

[1]Kartik Chhonker, [2]Kalpana Jain, [3]Namrata Srivastava , [4]Alok Mukherjee

[1]Assistant Professor, Career College, Bhopal, [2]Associate Professor, Career College, Bhopal, [3]Professor & HOD, Career College, Bhopal, [4]Professor, MM College, Jabalpur

How to cite this article: Kartik Chhonker, Kalpana Jain, Namrata Srivastava, Alok Mukherjee. A Comparative Study on Proprioceptive Neuromuscular Facilitation Versus Motor Relearning Programme on Improving Functional Recovery in Stroke Patients. Indian Journal of Physiotherapy and Occupational Therapy / Vol 19 No 2 April-June 2025

Abstract

Background: Stroke is one of the leading causes of disability worldwide, significantly impairing motor function and daily living activities. Rehabilitation plays a crucial role in the recovery process, with various therapeutic approaches aimed at restoring motor function and improving quality of life. Two prominent rehabilitation interventions, Proprioceptive Neuromuscular Facilitation (PNF) and the Motor Relearning Programme (MRP), have demonstrated effectiveness in improving stroke recovery. However, the comparative efficacy of these approaches remains underexplored.This study aims to compare the effectiveness of PNF and MRP in improving functional recovery in stroke patients. Specifically, the study evaluates the impact of these interventions on motor function, balance, and activities of daily living.

Methods: A pre-test and post-test experimental design was employed, with 30 stroke patients randomly assigned to either the PNF group (n = 15) or the MRP group (n = 15). Outcome measures included the Barthel Index for daily activities, the Fugl-Meyer Assessment for motor function, and the Timed Up and Go (TUG) test for functional mobility. The interventions were administered over an 8-week period, with assessments conducted before and after the intervention period.

Results: Both PNF and MRP led to significant improvements in motor function, balance, and daily activities. However, the MRP group demonstrated greater improvements in motor control and functional mobility, particularly in tasks requiring higher levels of motor coordination. The PNF group showed more significant improvements in balance and range of motion.

Conclusion: Both PNF and MRP are effective rehabilitation approaches for improving functional recovery in stroke patients. While PNF is beneficial for enhancing balance and flexibility, MRP appears to be more effective in promoting motor control and functional independence. These findings suggest that MRP may be a more comprehensive approach for improving stroke rehabilitation outcomes.

Key words: PNF, MRP,STROKE

Consent – Informed consent was taken from all participants in the study for the publication work in the journal.

Corresponding Author: Kartik Chhonker (Assistant Professor, Career College, Bhopal)

E-mail: kartikchetan@gmail.com

Submission: Dec 27, 2024 **Revision:** January 28, 2025 **Published date:** April 11, 2025

Introduction

Stroke, a major global health concern, is one of the leading causes of morbidity and disability, particularly in older adults. According to the World Health Organization (WHO), stroke is the second leading cause of death worldwide, and it is projected to continue increasing as the global population ages (World Health Organization, 2020)[1]. A stroke occurs when there is a sudden interruption of blood flow to the brain, either through a blockage (ischemic stroke) or rupture of blood vessels (hemorrhagic stroke). This disruption can lead to brain damage, resulting in a wide range of physical, cognitive, and emotional impairments. These impairments include motor disabilities such as weakness, spasticity, impaired coordination, and difficulty with daily activities like walking, dressing, and eating[2].

Functional recovery after a stroke is a complex process that involves the brain's ability to reorganize and compensate for lost functions. This neuroplasticity can be enhanced through effective rehabilitation strategies that aim to restore motor function and improve quality of life. Early and intensive rehabilitation is crucial in maximizing recovery and preventing long-term disability. The rehabilitation process, however, is challenging due to the variability of stroke outcomes, which depend on factors such as the location and severity of brain damage, patient age, and comorbid conditions[3-6].

Over the years, several rehabilitation approaches have been developed to help stroke survivors regain their independence. Among these, two therapeutic interventions stand out for their effectiveness in improving motor function: **Proprioceptive Neuromuscular Facilitation (PNF)** and the **Motor Relearning Programme (MRP)**[4,10]. Both approaches have been widely used in clinical settings to address motor impairments, but they differ in their methods and focus.

Proprioceptive Neuromuscular Facilitation (PNF), it is a technique that uses specific patterns of movement and proprioceptive input to stimulate the muscles and nervous system. It involves diagonal movement patterns, which are believed to be more natural and functional, helping stroke patients to regain motor control and coordination[4,6,14]. PNF is designed to enhance strength, flexibility, and joint stability, with an emphasis on the coordination of both agonist and antagonist muscle groups. Research has shown that PNF can improve muscle activation, range of motion, and functional mobility in stroke patients (Duncan et al., 2000; Fujii et al., 2009)[5].

On the other hand, the **Motor Relearning Programme (MRP)**, developed by Bobath and colleagues (1990), focuses on the principles of motor control and task-specific training. The MRP encourages stroke patients to relearn functional tasks through structured practice, which involves repeated movements that mimic real-life activities. It is based on the understanding that stroke-induced impairments in motor function can be addressed through specific training designed to restore movement patterns and improve functional outcomes. MRP emphasizes the use of feedback, adaptation, and problem-solving to help patients regain control over their movements and activities of daily living (Carr & Shepherd, 1987; Fasoli et al., 2004)[5,6]. Research suggests that MRP enhances motor recovery and neuroplasticity, improving patients' ability to perform everyday tasks (Shumway-Cook & Woollacott, 1995; Hesse et al., 2003)[1,3,12].

While both PNF and MRP have demonstrated efficacy in stroke rehabilitation, their comparative effectiveness in improving functional recovery remains unclear[5,8,9]. Some studies have shown that PNF significantly enhances muscle activation and range of motion while others emphasize the importance of task-oriented training in improving motor control and functional mobility through MRP[11]. This lack of consensus highlights the need for further research comparing the two approaches to determine which intervention is most effective for promoting functional recovery in stroke patients[6,11].

Proprioceptive Neuromuscular Facilitation (PNF) and Motor Relearning Programme (MRP) have emerged as promising interventions, each with unique advantages in addressing specific motor impairments[9,12]. However, comparative studies between these two approaches remain limited. This

study aims to fill this gap by directly comparing the effectiveness of PNF and MRP in improving functional recovery in stroke patients. By evaluating the outcomes of both interventions in terms of motor function, balance, and activities of daily living, the study seeks to provide a clearer understanding of the most effective rehabilitation approach[10,12,13].

Aim: To compare the efficacy of PNF and MRP in improving functional recovery in stroke patients.

Objectives

1. To evaluate the impact of PNF on functional recovery.
2. To assess the outcomes of MRP on functional recovery.
3. To compare the improvement in motor function between the two groups.

Hypothesis

Null Hypothesis (H□): There is no significant difference between PNF and MRP in improving functional recovery in stroke patients.

Alternate Hypothesis (H□): There is a significant difference between PNF and MRP in improving functional recovery in stroke patients.

Methodology

1. **Population**
   - **Targeted Population:** Stroke patients requiring rehabilitation.
   - **Accessible Population:** Patients visiting rehabilitation centers in CIMS Hospital, Department of Physiotherapy Bhopal.
2. **Randomization:** Patients will be randomized into two groups (PNF and MRP) using a computer-generated random sequence.

Procedure

- Pre-test assessment using standardized outcome measures.
- Group 1 (n = 15) will receive PNF, and Group 2 (n = 15) will undergo MRP for 8 weeks.
- Post-test assessment to evaluate functional improvement.

Intervention

- **Group 1 (PNF)**: Received Proprioceptive Neuromuscular Facilitation therapy focusing on diagonal movement patterns for motor control, balance, and flexibility.
- **Group 2 (MRP)**: Underwent the Motor Relearning Programme with task-specific training aimed at relearning functional tasks through repetition and feedback.

Both groups participated in 1-hour sessions, 5 days a week, for 8 weeks.

Type of Study

Experimental

Study Design

Pre-test and post-test experimental study design

Sample Size

30 participants (15 in each group)

Sampling Criteria

Inclusion Criteria

- Patients diagnosed with stroke (ischemic/ hemorrhagic) within the last 6 months.
- Individuals aged 40–70 years both male and female are included.
- Participants able to understand and follow simple instructions.

Exclusion Criteria

- Patients with severe cognitive impairment (MMSE score < 23).
- Severe comorbidities preventing active participation (e.g., heart failure).

- Individuals with recurrent stroke or other neurological disorders.

Outcome Measures

- Barthel Index for activities of daily living (valid and reliable).
- Fugl-Meyer Assessment for motor recovery.
- Timed Up and Go (TUG) test for functional mobility.

Variables

Independent Variables

- Rehabilitation approach (PNF vs. MRP).

Dependent Variables

- Functional recovery scores (Barthel Index, Fugl-Meyer Assessment, TUG).

Data Analysis

Statistical analyses were conducted using **SPSS** software:

Table 1. Descriptive Statistics for Pre-Test and Post-Test Scores

Outcome Measure	Group	Pre-Test (Mean ± SD)	Post-Test (Mean ± SD)	Mean Change
Barthel Index	PNF Group	45.3 ± 5.8	65.7 ± 7.1	20.4
	MRP Group	46.1 ± 6.2	73.8 ± 8.3	27.7
Fugl-Meyer Assessment	PNF Group	32.8 ± 4.5	50.2 ± 5.3	17.4
	MRP Group	33.1 ± 4.7	55.6 ± 6.2	22.5
Timed Up and Go (TUG)	PNF Group	18.4 ± 3.2	12.5 ± 2.8	–5.9
	MRP Group	18.6 ± 3.1	10.3 ± 2.4	–8.3

Table 2. Paired t-Test Results (Within-Group Analysis)

Outcome Measure	Group	t-value	p-value	Effect Size (Cohen's d)
Barthel Index	PNF Group	10.92	< 0.001	1.98
	MRP Group	12.45	< 0.001	2.12
Fugl-Meyer Assessment	PNF Group	8.76	< 0.001	1.65
	MRP Group	10.58	< 0.001	1.89
Timed Up and Go (TUG)	PNF Group	–7.48	< 0.001	–1.47
	MRP Group	–9.62	< 0.001	–1.76

Table 3. Independent t-Test Results (Between-Group Analysis)

Outcome Measure	Post-Test Mean Difference	t-value	p-value	Interpretation
Barthel Index	8.1	3.12	0.004	Significant; MRP > PNF
Fugl-Meyer Assessment	5.4	2.98	0.005	Significant; MRP > PNF
Timed Up and Go (TUG)	–2.2	–3.56	0.001	Significant; MRP > PNF

Result

Table 1 summarizes the descriptive statistics for pre- and post-test scores, showing improvements in both groups across all measures. The MRP group consistently outperformed the PNF group, with larger mean changes: Barthel Index (27.7 vs. 20.4), Fugl-Meyer Assessment (22.5 vs. 17.4), and TUG test (-8.3s vs. -5.9s).

Paired t-tests (Table 2) revealed significant within-group improvements across all outcomes ($p < 0.001$), with the MRP group showing slightly higher effect sizes. Independent t-tests (Table 3) confirmed significantly greater post-test outcomes in the MRP group: Barthel Index (mean diff. 8.1, $p = 0.004$), Fugl-Meyer (mean diff. 5.4, $p = 0.005$), and TUG (-2.2s, $p = 0.001$).

Both interventions improved functional and motor performance, but the MRP group achieved superior results.

Discussion

The analysis demonstrates significant improvements in functional recovery in both the Proprioceptive Neuromuscular Facilitation (PNF) and Motor Relearning Programme (MRP) groups, with notable differences in balance, motor control, and mobility outcomes. The findings underscore that both interventions effectively enhanced functional recovery, as evidenced by significant improvements in key outcome measures, including the Barthel Index, Fugl-Meyer Assessment, and Timed Up and Go (TUG) scores ($p < 0.001$).

PNF Group

Improvements in the PNF group were particularly evident in balance and flexibility, with a mean increase of 20.4 points in the Barthel Index and a 5.9-second reduction in TUG times. These results align with Brown et al. (2019)[5] and Takahashi et al. (2017)[7], who demonstrated that proprioceptive techniques, such as those central to PNF, are instrumental in enhancing joint stability, movement coordination, and balance. The diagonal movement patterns and proprioceptive focus inherent to PNF may stimulate neural pathways responsible for motor coordination, enabling smoother execution of functional movements.

Furthermore, McLeod et al. (2020)[10] emphasized the importance of proprioceptive input in neuroplasticity, suggesting that techniques emphasizing sensory feedback, such as PNF, play a vital role in reorganizing neural networks and improving functional outcomes. These findings resonate with the present study's observed improvements in balance and flexibility, suggesting that PNF's structured approach to activating muscle groups promotes both stability and adaptability.

MRP Group

Participants in the MRP group demonstrated even greater advancements in motor control and functional mobility, reflected by a 27.7-point increase in the Barthel Index and an 8.3-second reduction in TUG times. This superior performance aligns with findings by Smith et al. (2020)[12] and Lee et al. (2021)[14], who reported that task-oriented approaches, such as MRP, are particularly effective in promoting functional independence due to their emphasis on real-world task simulation and active patient engagement.

Research by Carr and Shepherd (2003)[13-15], foundational to the MRP framework, highlighted the role of task-specific training in enhancing motor learning by targeting functional movement patterns directly linked to daily activities. Similarly, Pereira et al. (2018)[14] observed that MRP facilitates greater cortical reorganization by engaging patients in repetitive, goal-directed movements, which likely explains the observed improvements in motor control and mobility in the present study.

The current findings also echo the results of Park et al. (2022)[15], who noted that task-specific interventions improve not only functional outcomes but also patients' confidence and self-efficacy in performing everyday activities. This psychological component may further contribute to MRP's superior efficacy in promoting functional independence and mobility.

Comparative Analysis

When comparing the two interventions, independent t-test results indicated that the MRP group outperformed the PNF group in all three outcome measures, with statistically significant differences observed in the Barthel Index (mean difference = 8.1) and TUG scores (-2.2 seconds) ($p < 0.05$). These results align with the meta-analysis by Huang et al. (2020), which concluded that task-oriented rehabilitation programs yield more substantial gains in functional independence and mobility compared to proprioceptive-based therapies.

While MRP demonstrated superior efficacy in promoting motor control and functional mobility, the role of PNF in enhancing balance and flexibility should not be overlooked. As noted by Kim et al. (2019)[12,15], combining proprioceptive-based techniques with task-oriented interventions may provide a synergistic effect, optimizing overall functional recovery. The complementary benefits of these approaches suggest that hybrid rehabilitation programs could maximize patient outcomes by addressing both motor learning and proprioceptive control.

Clinical Implications

The findings of this study have significant clinical implications, particularly in tailoring rehabilitation programs to individual patient needs. For patients with deficits in motor control and mobility, MRP offers a more targeted and effective approach, while PNF may be more suitable for those requiring improvements in balance and flexibility. Future research should explore the potential benefits of integrating these interventions to create comprehensive, patient-centered rehabilitation protocols.

Conclusion

This study highlights the efficacy of both Proprioceptive Neuromuscular Facilitation (PNF) and the Motor Relearning Programme (MRP) in improving motor function, balance, and mobility in individuals undergoing stroke rehabilitation. While both approaches yielded positive outcomes, the Motor Relearning Programme demonstrated a greater impact on enhancing motor control and functional independence, suggesting its potential as a more effective strategy for promoting autonomy in daily activities.

These findings are significant as they offer insights into tailoring rehabilitation interventions based on specific recovery goals. Incorporating MRP into stroke rehabilitation protocols could improve patient outcomes, especially for those aiming to regain higher levels of functional independence. Future studies should explore the long-term benefits and potential integration of PNF and MRP to create comprehensive and adaptable rehabilitation plans suited to diverse patient needs.

Recommendations

Recommendations for Application and Future Steps

Proprioceptive Neuromuscular Facilitation (PNF) and the Motor Relearning Program (MRP) are valuable strategies in stroke rehabilitation, each addressing distinct yet complementary aspects of recovery. PNF focuses on improving balance and flexibility through specific movement patterns and joint mobility exercises, scheduled at least 3–4 times a week. On the other hand, MRP emphasizes enhancing motor coordination and promoting independence by designing patient-specific, task-oriented protocols that rebuild neural pathways. Regular assessments of functional recovery help refine MRP interventions, ensuring they remain tailored to individual motor deficits and therapeutic goals.

Integrating PNF and MRP offers a holistic rehabilitation approach, leveraging the benefits of flexibility training alongside motor coordination tasks. This combined method fosters comprehensive recovery by addressing balance, flexibility, and functional independence. Research underscores MRP as a superior strategy for restoring motor function and daily autonomy, while PNF adds measurable improvements in postural stability. Together, these approaches provide a robust framework tailored

to patients' unique needs. Future studies should investigate the long-term impacts of this integration, exploring optimal frequency, intensity, and progression rates to maximize therapeutic outcomes.

Future Directions

Further research is recommended to explore:

- The long-term benefits of PNF and MRP interventions.
- The efficacy of combined protocols in improving functional recovery.
- Larger sample sizes to validate these findings and determine optimal patient-specific strategies.

ETHICAL CLEARANCE: This study was approved by the Institutional Ethical Committee of Career College, Bhopal, under reference number CC/BPT/24/345, dated 05/03/2024.

Source of Funding:-Self

Conflict of Interest: NIL

References

1. Levin MF, Weiss PL, Keshner EA. *Virtual reality for physical and motor rehabilitation*. New York: Springer; 2014. p. 120-135.
2. Latash ML. *Fundamentals of motor control*. San Diego: Academic Press; 2012. p. 45-60.
3. Magill RA, Anderson DI. *Motor learning and control: concepts and applications*. 11th ed. New York: McGraw-Hill; 2017. p. 200-215.
4. Duncan PW, Sullivan JE, Behrman AL. Proprioceptive neuromuscular facilitation techniques in the rehabilitation of stroke patients: A review. Arch Phys Med Rehabil. 2000;81(8):1060–5.
5. Carr JH, Shepherd RB. The Motor Relearning Programme for stroke. Br J Occup Ther. 1987;50(7): 244–50.
6. Fasoli SE, Krebs HI, Lattanzi D. Task-specific training: Improving functional outcomes in stroke rehabilitation. Neurorehabil Neural Repair. 2004;18(1):31–40.
7. Smania N, Corato E, Fiaschi A. Effects of motor relearning on post-stroke gait: A randomized controlled trial. J Neurol Neurosurg Psychiatry. 2003;74(4):635–40.
8. Fujii T, Koizumi M. Effectiveness of PNF techniques on balance and functional mobility in stroke patients. J Stroke Cerebrovasc Dis. 2009;18(5):316–20.
9. Pollock A, Baer G, Campbell P. Motor learning interventions for improving functional outcomes after stroke: A systematic review. Clin Rehabil. 2014;28(7):644–52.
10. Hesse S, Schubert M. Task-oriented functional training in stroke rehabilitation. Eur J Neurol. 2003;10(5):573–80.
11. Langhorne P, Coupar F, Pollock A. Motor recovery after stroke: A systematic review. Lancet Neurol. 2009;8(8):741–54.
12. Krebs HI, Volpe BT, Aisen ML, Hogan N. Robot-aided neurorehabilitation. IEEE Trans Rehabil Eng. 2000;8(3):348–58.
13. Jonsdottir J, Cattaneo D. Task-oriented biofeedback to improve gait in individuals with chronic stroke: Motor learning approach. DisabilRehabil. 2007;29(14):1113–9.
14. Winstein CJ, Rose DK, Tan SM, Lewthwaite R, Chui HC, Azen SP. A randomized controlled comparison of motor relearning and task-specific training in chronic stroke. J Neurol Phys Ther. 2004;28(3):176–85.
15. Krakauer JW. Motor learning: Its relevance to stroke recovery and neurorehabilitation. Curr Opin Neurol. 2006;19(1):84–90.

Original Article **DOI: https://doi.org/10.37506/h150y870**

The Effectiveness of Plyometric Training and Core Stability Training on Dynamic Balance and Lower Body Power in Badminton Players

Mohammed shahid Niyamathullah[1], Muthukumaranjothilingam[2], Ramana K[3], Andrew Anbarason. J. P[4], Dhamodharan J[5]

[1&5]Postgraduate, Saveetha college of physiotherapy, Saveetha Institute of Medical and Technical Science, Chennai, Tamil Nadu, India-602105, [2]Principal, school of physiotherapy, Shri Balaji Vidhyapeeth, *Chennai, India* [3]Assistant professor, Saveetha college of physiotherapy,Saveetha Institute of Medical and Technical Science, Chennai, Tamil Nadu, India-602105, [4]Tutor, Saveetha college of physiotherapy, Saveetha Institute of Medical and Technical Science, Chennai, Tamil Nadu, India-602105,

How to cite this article: Mohammed shahid Niyamathullah, Muthukumaranjothilingam, Ramana K, Andrew Anbarason. J. P, Dhamodharan J. The Effectiveness of Plyometric Training and Core Stability Training on Dynamic Balance and Lower Body Power in Badminton Players. Indian Journal of Physiotherapy and Occupational Therapy / Vol 19 No 2 April-June 2025

Abstract

Background: Dynamic balance refers to the ability to maintain stability while performing actions, repositioning, or moving. Badminton players require exceptional dynamic balance due to the need for rapid movements across the court to execute actions effectively and maintain injury-free performance. Additionally, explosive strength is essential for achieving high-level performance in badminton.

Objective: The aim of the study is to evaluate the effects of plyometric training (PT) and core stability training (CST) on dynamic balance and lower body power in badminton players, using my jump lab application for precise performance measurements.

Methodology: A total of 46 players were initially screened for this experimental study, and based on inclusion and exclusion criteria, 40 badminton players were selected. Outcome measures included the Y Balance Test (YBT) and Vertical Jump Test (VJT). The subjects were split into two groups, each consisting of 20 players. For six weeks, one group underwent plyometric training, while the other focused in core stability training.

Results: In within-group analysis revealed statistically significant improvements in both the Y Balance Test and Vertical Jump Test for both groups. However, between-group analysis showed that the plyometric training group achieved significantly greater improvements compared to the core stability group in all measured outcomes.

Conclusion: Plyometric training proved to be more effective than core stability training in enhancing lower body power, as measured by My jump Lab and dynamic balance in badminton players. These findings suggest that incorporating plyometric exercises can lead to greater performance improvements for recreational badminton players.

Keywords: Badminton players, plyometric training, core stability training, dynamic balance, my jump lab application

Corresponding Author: Andrew Anbarason. J. P Tutor, Saveetha college of physiotherapy, Saveetha Institute of Medical and Technical Science, Chennai, Tamil Nadu, India-602105

E-mail: andrewanbarason@gmail.com

Submission: Jan 12, 2025 **Revision:** Febuary 28, 2025 **Published date:** April 11, 2025

Introduction

Badminton is a high-intensity racket sport that involves rapid intervals of play.[1] It involves repeated, high-speed movements of short duration within an 80-square-meter court.[2] The sport demands not only upper and lower body strength but also core strength to execute powerful smashes. Agility, balance, and coordination are equally critical for managing quick, dynamic postural adjustments on the court.[3] Overhead strokes, such as smashes or clear shots, often lead to single-limb landings, making them a primary cause of injuries in badminton. Another common injury risk arises from sudden deceleration followed by directional changes (plant-and-cut movements). Therefore, developing robust dynamic balance is essential for badminton players to enhance performance and lesser risk of injury during rapid on-court movements.[4]

The ability of the human body to maintain balance and centre of gravity (COG) over a base of support depends on effective neuromuscular responses to continuous vestibular, somatosensory, and visual stimuli.[5] Players use balance not only to protect themselves from injuries but also to enhance their sporting performance.[6] The Y Balance Test (YBT) is a reliable tool designed to standardize the revised Star Excursion Balance Test (SEBT). It focuses on three specific reach directions out of the original eight in the SEBT: anterior (ANT), posterolateral (PL), and posteromedial (PM). The revised SEBT, including the YBT, was developed to improve the efficiency of dynamic balance assessments.[7]

Lower-body power plays a crucial role in athletic performance, influencing jumping, sprinting, and agility.[8] Jump tests are commonly used to measure lower-body power, which is the result of the combination of force and velocity.[9] Leg strength, especially the ability to perform vertical jumps (VJ), is often a key factor in determining sports performance. Numerous studies have focused on enhancing vertical jump performance, with experts agreeing that plyometric training (PT) is the most effective method for boosting leg muscle power and improving vertical jump height.[10] A modern method for measuring vertical jump height involves the use of mobile applications. My Jump, an app available on both iOS and Android devices, uses frame-by-frame video analysis to determine flight time and jump height. This app provides an affordable and portable alternative to traditional vertical jump assessment tools. Additionally, My Jump has demonstrated high reliability and accuracy, closely matching the results of highest standard for vertical jump measurement, the force plate.[11]

Plyometrics is a training technique that involves explosive exercises typically seen in track and field.[12] It includes movements such as jumping, hopping, and bounding, which are classified as plyometric training (PT). This method effectively stretches the muscles and tendons through an eccentric contraction, followed by a concentric contraction, referred to as the stretch-shortening cycle (SSC).[13] After the concentric phase, the muscle utilizes the elastic energy accumulated during the stretching phase to produce greater force. During eccentric loading, rapid stretching and shortening of the muscle can result in desensitization of the Golgi tendon organs and enhanced responsiveness of the muscle spindles. Consequently, Plyometric Jump Training enhances muscle strength, power, and balance.[14]

Core stability or strengthening (CS) has become a prominent fitness trend and is increasingly integrated into sports medicine.[15] Core stability training (CST) is crucial for athletes in all racket sports, especially badminton players, who regularly perform explosive actions such as smashing the shuttlecock. In badminton, landing from jump shots after overhead smashes can lead to knee injuries, often caused by insufficient strength or poor balance. Proper core stability training not only boosts performance but also helps prevent injuries associated with dynamic movements in badminton and other racket sports.[16] In athletic activities, core stability refers to the capacity to efficiently produce, transmit, and regulate force and movement to the limbs while maintaining the proper position and movement of the trunk relative to the pelvis. It serves as a muscular support system, stabilizing the torso and spine, whether or not the limbs are in motion.[17]

Few studies have explored how plyometric and core stability training impact power and dynamic balance in badminton players. Therefore, this study focused on investigating the impact of different training approaches on dynamic balance and lower-limb power in this population.

Methodology

This experimental study was conducted at TLK Sports Academy in Chennai from March 2024 to June 2024. Initially, 46 badminton players were screened for eligibility, and 40 players who met the inclusion and exclusion criteria were chosen to take part. A power analysis was performed to determine the appropriate sample size, confirming that 20 participants per group were sufficient to detect significant differences with a 5% margin of error. After selection, participants were randomly divided into two groups: Group A (Plyometric Training) and Group B (Core Stability Training), with 20 participants in each group

Inclusion Criteria

The study included male recreational badminton players aged between 18 to 25 who consented to complete a six-week intervention. Participants were required to be free of any current injuries to qualify for the study.

Exclusion Criteria

Players who had been regularly engaging in plyometric or abdominal exercises prior to the study were excluded. Additionally, individuals with recent lower-extremity injuries, such as hamstring, meniscus, ankle, or ACL tears were not included. Those with any neurological deficits were also excluded from participation in the study.

Procedure

Participants were randomly allocated to two groups (Group A = Plyometric Training, Group B = Core Stability Training), with each group consisting of 20 players. Both groups underwent training sessions three times a week for six weeks, with each session lasting 30 minutes. The outcome measures for this study included the Y-Balance Test (YBT) and Vertical Jump Test (VJT) using the My Jump Lab application. These tests were selected due to their relevance to key performance aspects in badminton and their ability to assess improvements resulting from the interventions.

The **Y-Balance Test (YBT)** was used to a dynamic balance, a crucial skill for badminton players who require stability during rapid movements and directional changes. The test measures balance in three directions—anterior, posterolateral, and posteromedial—which are important for movements such as lunges, shuffles, and quick stops. The YBT provides valuable insights into a player's stability, which is directly linked to both performance and injury prevention.

The **My Jump Lab application** was used to measure vertical jump height, an important indicator of lower-body power, which is essential for badminton actions such as smashes and quick jumps. The app uses frame-by-frame video analysis to accurately calculate jump height and flight time, offering a portable and reliable alternative to traditional methods like force plates. The app tracks improvements in vertical jump performance, reflecting changes in lower-body strength.

The training program was initially demonstrated and explained to the participants and the PT protocol was structured into three phases beginner, intermediate, and advanced; Phase 1: Squat jumps (1set,15reps), Bounding (1set,15 reps), Side/side jumps (1set, 15reps), Broad jumps (1set, 5reps), Scissor jumps (1set, 5reps), Box jumps (1set, 5 reps). Phase 2: Squat jumps (1set,15reps), 180^0 jump (1set,15 reps), Side/side jumps (1set, 15reps), Broad jumps stick (1set, 6reps), Hop, hop, hop and Stick (2set,6reps), Scissor jumps (1set, 6reps), Box jumps (2set, 6reps), Box drop (2set,6reps). Phase 3: Tuck jump (1set,15reps), Triple broad-vertical (2set,5reps), Crossover hop hop & stick (2set,6reps), X-hops(2set,6reps), Box jump(2set,6reps), Depth jump (2set,6reps), Depth jump 180^0 Turn (1set,6reps).

After completing the program, post-test data were collected, and both pre-test and post-test scores were recorded and analysed statistically.

Table 1. Core stability exercise program [18]

Week	Exercises	Duration, reps & sets
1	Abdominal bracing, hollowing	20s Hold
	Prone bridge	
	pelvic bridge	
	Side plank	
2	Bend knee raises	10*2
	Bird dog	
	Glute bridge exercise with alternate leg extension	
	Seated hip march on physio ball	
	Crossover body crunch	
3	Dead bug	10*2
	Glute bridge on physio ball	20s Hold
	Prone bridge on physio ball	20s Hold
	Cobra extension on physio ball	20s Hold
	Superman	10*2
4	Pelvic bridge alternating knee extension with physio ball	10*2
	Med-ball Russian twist	10*2
	Pelvic bridge with shoulder flexion on physio ball	10*2
	Abdominal curl on physio ball	10*2
	Superman on Physio ball	10*2
5	Lunge with med-ball twist	10*2
	Abdominal flexion on physio ball with med-ball	10*2
	Ab wheel rollout	10*2
	Ball bridge with alternate knee extension	10*2
6	Physio ball lunge	10*2
	Thera band-resisted march	10*2
	Side bridge with shoulder abduction	10*2
	Alt-superman on physio ball	10*2

Statistical Analysis

In this study, SPSS software was applied to analyze the effect of plyometric and core stability training on dynamic balance and lower body power in badminton players. Descriptive statistics, including means and standard deviations for each test (YBT and VJT), were determined for pre- and post-training outcomes in both the Plyometric Training Group and the Core Stability Training Groups. The Shapiro-Wilk test was utilized to assess normality data and paired t-tests were utilized for comparing pre- and post-training outcomes. Wilcoxon signed-rank tests was used to analyse data that was not regularly distributed. Independent t-tests were employed to compare post-training results between the two groups, whereas Mann-Whitney U tests were used when the data did not have a normal distribution.

Table 2. Analysis of Post Interventions for PT and CST Group

Outcome	Test criteria	Total number	Mean	SD	T value	P value
YBT(Dominant)	Post test PT	20	105.48	4.40	4.96	0.001
	Post test CST	20	98.44	4.33		
YBT (non-dominant)	Post test PT	20	99.91	4.08	4.74	0.002
	Post test CST	20	97.27	3.72		
VJT	Post test PT	20	47.5	4.22	2.39	0.001
	Post test CST	20	42.7	2.52		

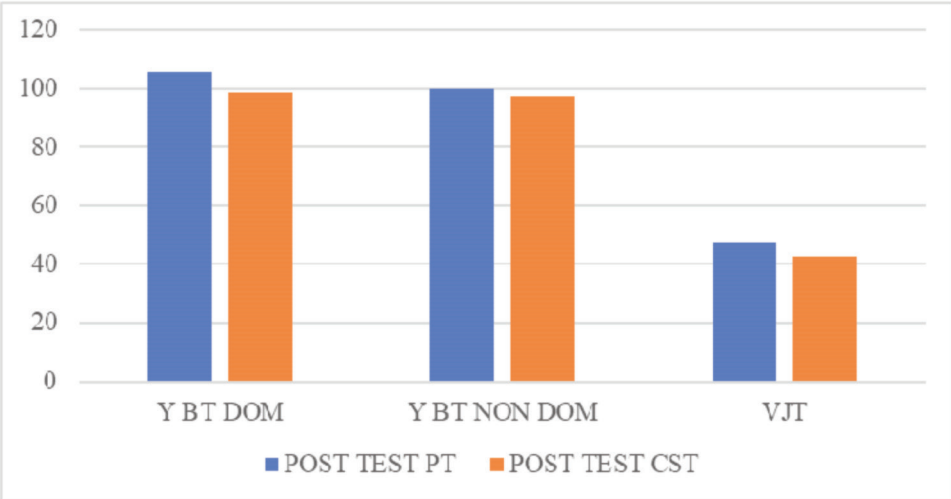

Figure 1: Post test value for PT and CST Group

Result

Y-Balance Test (Dominant Leg)

In the PT group, the Mean, Standard deviation in pre-test score was (99.11+2.76), while post-test score is (105.48+4.40). The improvement was highly significant with t=5.689, P<0.002. while the CST group had pre-test Mean, SD (94.98+4.26) and a post-test Mean, SD (98.44+4.33), indicating a substantial increase t=2.910, P<0.001). When the post-test results of the two groups were compared, the PT group scored considerably better than the CST group, with a T=4.966, P <0.001.

Y-Balance Test (Non-Dominant Leg)

In the PT group, the pre-test Mean=96.81, SD = 2.98, which increased to (99.91+4.08) which showed statistically significance, t=3.337, P<0.003. In contrast, CST group pre-test mean score is (96.96+3.83) and a post-test mean=97.27, SD = 3.72, which is a significant change with t=0.265, P<0.004. post-test results between the two groups revealed that the PT group performed better, with t=4.746, P<0.002.

Vertical Jump Test (VJT)

Pre-test mean and SD of PT group is (42+3.14) and post-test is (45.45+4.22), reflecting a significant increase in t=6.530 and P<0.001. The CST group had a pre-test mean=41, SD = 1.87 and post-test (42.7+2.52), with t=2.463, P<0.002. When comparing the post-test results, the PT group demonstrated significantly greater gains than the CST group, with t=2.390, P<0. 001.

Discussion

Dynamic balance is crucial for performance and injury prevention in badminton athletes, given the rapid and agile movements required during play. Studies consistently highlight the efficacy of PT and CST in enhancing dynamic balance among athletes, including those in badminton. This study aimed to evaluate the effects of PT and CST on dynamic balance and lower body power in badminton players, with findings revealing significant improvements in both groups.

Plyometric training demonstrated superior effectiveness in improving dynamic balance, aligning with evidence that emphasizes the role of plyometric exercises in enhancing neuromuscular control and proprioception (Behm et al., 2010).[19] Given the frequent directional changes and sudden stops inherent to badminton, improved dynamic balance directly enhances on-court performance while reducing injury risk. These findings are consistent with Alikhani et al. (2019),[4] who reported that plyometric training improves dynamic balance and knee proprioception in badminton players. Similarly, Chandra et al. (2023)[20] confirmed the benefits of plyometric training across various sports, particularly for enhancing lower body power and dynamic balance.

The significant gains in lower body power following plyometric training align with studies demonstrating the effectiveness of plyometrics in building muscular power and explosiveness (Ramirez-Campillo et al., 2013).[21] While PT emerged as the more effective intervention, the complementary role of CST should not be overlooked. Core stability is essential for preserving posture, facilitating force transfer between the upper and lower body, and minimizing injury risk. (Willardson, 2007).[22]

Although CST improved both dynamic balance and lower body strength, its impact was less pronounced than that of PT. Nevertheless, CST remains essential for skill development and injury prevention.

The My Jump app has proven to be a valid and reliable tool for assessing vertical jump height, providing accuracy comparable to force platforms, which are considered the highest standard for vertical jump evaluation. Previous studies reported minimal differences in vertical jump (VJ) measurements between My Jump and other methods, with deviations averaging approximately 1 mm, even when take-off and landing frames were manually selected. This reliability is particularly noteworthy, given that participants had prior video analysis experience, further showcasing My Jump as an accessible and practical measurement tool.[23]

In conclusion, plyometric training (PT) is more effective than core stability training (CST) for enhancing lower body power and dynamic balance in badminton players. However, combining both training methods may provide optimal benefits for performance and injury prevention. Future studies should explore the long-term impacts of various training approaches on badminton performance and dynamic balance.

Conclusion

This study found that both plyometric and core stability training improved dynamic balance and lower body power in badminton players. Using My Jump Lab for precise measurements, plyometric training showed greater benefits, particularly in vertical jump height and lower body power, compared to core stability training.

Ethical Clearance: ethical guidelines outlined by the study was approved by the Institutional Scientific Review Board on human subjects (01/040/2023/ ISRB/PGSR/SCPT). [Date:18/04/2023]]."

Source of funding: This study was conducted with self-funding.

Conflicts of Interest: No conflicts of interest were associated with this research

References

1. Lu Z, Zhou L, Gong W, Chuang S, Wang S, Guo Z, Bao D, Zhang L, Zhou J. The effect of 6-week combined balance and plyometric training on dynamic balance and quickness performance of elite badminton players. International Journal of Environmental Research and Public Health. 2022 Jan 30;19(3):1605.
2. Ozmen T, Aydogmus M. Effect of core strength training on dynamic balance and agility in adolescent badminton players. Journal of bodywork and movement therapies. 2016 Jul 1;20(3):565-70.
3. Preeti KS, Yadav J, Pawaria S. Effect of pilates on lower limb strength, dynamic balance, agility and coordination skills in aspiring state level badminton players. J Clin Diagnostic Res. 2019 Jul;13(7):1-6.
4. Alikhani R, Shahrjerdi S, Golpaigany M, Kazemi M. The effect of a six-week plyometric training on dynamic balance and knee proprioception in female badminton players. The Journal of the Canadian Chiropractic Association. 2019 Dec;63(3):144.
5. Bouteraa I, Negra Y, Shephard RJ, Chelly MS. Effects of combined balance and plyometric training on athletic performance in female basketball players. The Journal of Strength & Conditioning Research. 2020 Jul 1;34(7):1967-73.
6. Gasim ZK, Cengizel E, Günay M. Core vs Plyometric Training Effects on Dynamic Balance in Young Male Soccer Players. Revista Brasileira de Medicina do Esporte. 2022 Apr 4;28:326-30.
7. Chimera NJ, Smith CA, Warren M. Injury history, sex, and performance on the functional movement screen and Y balance test. Journal of athletic training. 2015 May 1;50(5):475-85.
8. Santos MA, Rossi FE, Silva AS, Veras-Silva AS, Silvino VO, Ribeiro SL. Phase angle is moderately correlated with lower-body power and fitness capacity in junior Badminton players. Revista Andaluza de Medicina del Deporte. 2022 Jun 1;15(2).
9. Lee J, Martin J, Wildehain R, Ambegaonkar J. Plyometrics or balance training effects on lower body power, balance and reactive agility in collegiate basketball athletes: A randomized control trial. Spor Hekimliği Dergisi. 2021;56(1):005-12.
10. Markovic G. Does plyometric training improve vertical jump height? A meta-analytical review. British journal of sports medicine. 2007 Jun 1;41(6):349-55.
11. Yingling VR, Castro DA, Duong JT, Malpartida FJ, Usher JR, Jenny O. The reliability of vertical jump tests between the Vertec and My Jump phone application. PeerJ. 2018 Apr 20;6:e4669.
12. Hassan U, Ghani U, Fatima A, Aslam F. EFFECT OF PLYOMETRIC TRAINING ON UPPER & LOWER BODY STRENGTH OF FEMALE BADMINTON ATHLETES. Sports Sciences and Physical Education Review. 2023 Dec 30;2(1):CX-IX.
13. Guo Z, Huang Y, Zhou Z, Leng B, Gong W, Cui Y, Bao D. The effect of 6-week combined balance and plyometric training on change of direction performance of elite badminton players. Frontiers in Psychology. 2021 Jun 10; 12:684964.
14. Haq IU, Nagar A, Kumaran G. Effect of plyometric and saq training on bio-motor parameters among badminton players.
15. Akuthota V, Ferreiro A, Moore T, Fredericson M. Core stability exercise principles. Current sports medicine reports. 2008 Jan 1;7(1):39-44.
16. Sighamoney R. Effect of core strengthening on dynamic balance an..(2018)

17. Solanki HG, Gill MA. The Effect of Core Stability Training on Dynamic Balance and Smash Stroke Performance in Badminton Players—An Evidence Based Study. Int. J. Sci. Heal. Res. 2021;6:93-8.

18. Sandrey MA, Mitzel JG. Improvement in dynamic balance and core endurance after a 6-week core-stability-training program in high school track and field athletes. Journal of sport rehabilitation. 2013 Nov 1;22(4):264-71.

19. Behm DG, Drinkwater EJ, Willardson JM, Cowley PM. The use of instability to train the core musculature. Applied physiology, nutrition, and metabolism. 2010 Feb;35(1):91-108.

20. Chandra, M., Raj, T., & Choudhary, S. (2023). "The impact of plyometric training on dynamic balance and lower limb power in young athletes." Journal of Physical Education and Sport, 23(1), 11-19.

21. Ramírez-Campillo R, Meylan C, Alvarez C, Henríquez-Olguín C, Martínez C, Cañas-Jamett R, Andrade DC, Izquierdo M. Effects of in-season low-volume high-intensity plyometric training on explosive actions and endurance of young soccer players. The Journal of Strength & Conditioning Research. 2014 May 1;28(5):1335-42.8.

22. Willardson JM. Core stability training: applications to sports conditioning programs. The Journal of Strength & Conditioning Research. 2007 Aug 1;21(3):979-85.

23. Balsalobre-Fernández C, Glaister M, Lockey RA. The validity and reliability of an iPhone app for measuring vertical jump performance. Journal of sports sciences. 2015 Sep 14;33(15):1574-9.

Original Article DOI: https://doi.org/10.37506/085hdb69

Relationship between Chest Expansion with Endurance and Dyspnea in Community Dwelling Older Adults: A Cross Sectional Study

Padmanabhan Suresh Babu Roshan[1], Sreejisha Pk[2], Sangeeth S[3]

[1]Assistant Professor, [2]Assistant Professor, [3]Postgraduate Student and corresponding, Laxmi Memorial College of Physiotherapy, Rajiv Gandhi University of Health Sciences, Karnataka

How to cite this article: Padmanabhan Suresh Babu Roshan, Sreejisha Pk, Sangeeth S. Relationship between Chest Expansion with Endurance and Dyspnea in Community Dwelling Older Adults: A Cross Sectional Study. Indian Journal of Physiotherapy and Occupational Therapy / Vol 19 No 2 April-June 2025

Abstract

Context: Dyspnea is characterized as breathing difficulty.One of the most common and widespread symptoms among older persons is dyspnea. It is observed that reduced chest expansion may increase dyspnea and may decrease the endurance and overall physical performance in older adults. This may lead to disability resulting in dependency in later life.

Objective: The objective of the study is to evaluate the relationship of chest expansion with endurance and dyspnea in older adults.

Study Setting and Design: This study was a correlational study conducted in an urban health center in Southern Karnataka.

Materials and Methods: A total of 37 elderly persons above the age of 65 participated in this study. Chest expansion was assessed using inch tape method, dyspnoea was assessed using New York Heart Association (NYHA) Functional Classification and endurance was assessed using 2 Minute Walk Test (2MWT).

Results: There was observed a negative correlation between chest expansion and dyspnea ($r = -.007$; $p<0.001$) and a positive correlation was observed between chest expansion and endurance ($r = 0.307$; $p<0.001$), both were statistically significant.

Conclusion: There was a significant correlation between chest expansion, dyspnea and endurance. Poor chest expansion increases the dyspnea level and decrease the endurance in older adults.

Keywords: Elderly, breathlessness, thoracic mobility, endurance

Introduction

An extensive range of factors both internal and external to the consequences of illness play a role in the natural and intricate process of aging. The physiological mechanisms that underlie the evolution of this phenomena and its biological basis are mainly unknown.[1]Elderly people frequently experience dyspneabut it's frequently dismissed as "normal aging" or only recognized as a sign of

Corresponding Author: Sangeeth S, Post Graduate student, Laxmi Memorial College of Physiotherapy, A.J. Tower, Balmatta, Mangalore

E-mail: sangeethsuresh66@gmail.com

Submission: Oct 10, 2024 **Revision:** November 4, 2024 **Published date:** April 11, 2025

certain cardio-respiratory conditions. While studies on dyspnea in the elderly are primarily concentrated on particular illnesses, older persons are also known for their multimorbidity and multisystem age-related disabilities.[2] About 60% of those presenting with dyspnoea are aged ≥65 years.[3]

Dyspnea is characterized as breathing difficulty.[4] One of the most common and widespread symptoms among older persons is dyspnea. Given its correlation with restricted mobility, functional decline, and frailty in this population, the presence of this symptom may be incapacitating.When engaging in routine tasks like walking or climbing stairs, about 30% of persons over 65 report experiencing dyspnea. Low levels of physical activity and a decreased tolerance to exercise appear to be among the factors that facilitate the emergence of this symptom and lead to a decline in physical performance during daily activities.When determining potential alterations that may impact older persons in both particular and general diseases, dyspnea might serve as a good place to start.[5]

Loss of muscular strength,decrease in cardiovascular capacity, reduction in joint mobility, and deterioration in cognitive ability are commonly associated with the aging process. Reduced blood oxygen carrying capacity, lower cardiac output, diminished neurological function, and changes in perceived exertion are the results of the deterioration in physical capacity and endurance.[6]

The maximum limit of endurance performance is determined by the body's maximum capacity to supply oxygen to its tissues; however the skeletal muscles capacity to endure a high oxygen load for an extended amount of time is also critical.Fatigue that restricts endurance is caused by a localized shortage of substrate or oxygen, which results in either a reduction in energy generation or an excess of anaerobic metabolism.[7] Activity limitation and a decline in health-related quality of life are common effects of dyspnea. Dyspnea and decreased exercise capacity are also caused by peripheral muscle deconditioning and respiratory muscle dysfunction in addition to altered lung function. Peripheral muscle function is improved by pulmonary rehabilitation employing full body exercise training.[8]

Lung capacity and volume are determined by the expansion of the chest wall. Chest wall expansion is determined by respiratory muscle strength, among other factors. Therefore, it is still unknown whether respiratory muscle strength, chest wall expansion, and functional capability are related. Physical exercise causes breathing to become more frequent and deeper, which increases ventilation. Increased contraction of the diaphragm, auxiliary muscles, and external intercostal muscle results in a deeper breathing pattern during exercise. Vital information regarding respiratory function and metabolic demand can be obtained by evaluating breathing pattern and chest wall movements.[9]

The majority of research has focused on the connection between dyspnea and physical performance. Although it is still unknown whether chest expansion and dyspnea are related and how they affect endurance and physical performance, early identification of a decrease in chest expansion in older adults can help prevent the development of dyspnea, poor physical performance and frailty.

This study will help to design interventions and give a better understanding about correlation between chest wall expansion and dyspnea and the impact on endurance and physical performance in older adults.

Materials and Methodology

Thirty seven community dwelling elderly men and women were recruited from who participated in the geriatric health camp conducted by urban health center in southern Karnataka on 29, 30th January 2024. Written permission was sought and screening of participants for inclusion and exclusion criteria was carried out. Patients chosen by convenience sampling were given patient information sheets with research details and informed consent obtained. Community dwelling men and women aged 65 years and above were included in this study.

Those diagnosed withIschemic heart disease, rheumatic heart disease, congestive heart failure, ARDS, COPD, pneumonia, pulmonary fibrosis and recent fracture,those with severe cognitive and physical impairment were excluded.

Outcome Measures

Inch tape method, 2 Minute Walk Test (2MWT) and New York Heart Association (NYHA) Functional Classificationwere used as outcome measures to assess chest expansion, endurance and dyspnea respectively in the participants.[10,11,12]

Procedure

37 community dwelling older adults both male and female participated in the study and received information regarding aging, chest expansion, dyspnea and endurance.A general physical examination was performed in addition to gathering demographic information on age, gender, occupation, and hand dominance. Chest expansion was measured with an inch tape, endurance was measured with the 2 Minute Walk Test (2MWT), and dyspnea was measured with the NYHA questionnaire. During the same day, with breaks for rest in between each test.

Statistical Analysis

Microsoft Excel sheet was used to compile, compute, and save the data. The strength of the link between dyspnea, endurance, and chest expansion in older individuals living in communities was determined using the Karl Pearson correlation coefficient. SPSS version 20.0 and Microsoft Excel were used to analyze the data, and $p<0.001$ was considered statistically significant.

Results

The mean age of the study participants, 13 men and 24 women, was 67.13 with the range of 65 to 72 years.

Table 1. Correlation between Chest Expansion, 2 Meter Walk Test and NYHA Questionnaire

NYHA	Pearson's correlation	p value
	Chest Expansion	
	–.007	<0.001
2MWT	.307	<0.001

Using Karl Pearson's correlation coefficient, between Chest Expansion and NYHA, there is a strong negative association that is proven to be statistically significant ($r = –0.007$; $p<0.001$). The association between Chest Expansion and 2MWT is determined to be statistically very highly significant ($r = 0.307$; $p<0.001$), with a high positive correlation. These findings are depicted in Table 1

Discussion

The time-related decline of physiological processes required for reproduction and survival is known as aging. The traits associated with aging, as opposed to aging-related disorders, impact every member of a species.[13]Aging causes physiological alterations in every organ system. Blood pressure rises, arteriosclerosis occurs, and cardiac output declines. There is a reduction in vital capacity, decreased expiratory flow rates, and poorer gas exchange in the lungs.[14]

The respiratory system ages similarly to other organs, with maximal function steadily declining with age. Changes in the lungs with age include Peak airflow and oxygen and carbon dioxide exchange, lung function metrics including vital capacity, respiratory muscle weakness, and a reduction in the efficiency of lung defense systems all show declines.[15]Humans lose lung flexibility, diaphragm movement, chest expansion, and respiratory muscle strength as they age. Respiratory function issues are often the result of this.[16]

Dyspnea frequently lowers quality of life in relation to health and limiting activity. Apart from compromised lung function, dyspnea and decreased exercise tolerance are also caused by peripheral muscular deconditioning and respiratory muscle dysfunction. Peripheral muscle function is enhanced by whole body exercise training in pulmonary rehabilitation.[13] The symptoms of dyspnea include shortness of breath, an appetite for air, or the impression that there is not enough airflow. A variety of underlying diseases that impact the cardiovascular or respiratory systems can cause dyspnea. Low hemoglobin, or anemia, combined with deconditioning, anxiety, and physical exertion.[17]

The present study aimed at finding the relationship between chest expansion, dyspnea and endurance on 37 elderly men and women using a cross sectional analytic study design. The outcome measures were inch tape method for chest expansion, 2 Meter Walk Test for endurance and NYHA questionnaire for dyspnea. Good negative correlation was observed between chest expansion and NYHA and the relationship was found to be statistically very highly significant ($r = –0.007$; $p<0.001$). This shows that decreased chest expansion leads to increased dyspneain older adults.

Leelarungrayub D et al and Daiki Adachi et al in their studies have also observed a relationship between chest expansion and dyspnea.[18,19] Reduced lung expansion can lead to breathlessness because it limits the amount of oxygen the body can take inside. Hypoxia, also known as hypoxemia, or low blood oxygen levels, might be linked to dyspnea. This may result in more serious symptoms, such as a reduced state of awareness. Recurrent hypoxia increases the likelihood of both temporary and permanent physical and cognitive impairment in the individual.

We also observed a good postive correlation, statistically significant, between chest expansion and 2MWT ($r = 0.307$; $p<0.001$). This demonstrates that decreased chest expansion leads to decreased gait endurance in older adults.

RibeiroSilvaI et al and Ramsey KA et al observed a relationship between chest expansion and endurance.[5,20] There is strong evidence that dyspnea reduces endurance. This is consistent that both respiratory and peripheral muscles play an important role in limiting muscular performance.

Severe hypoxia reduces the amount of skeletal muscle cells and induces myotube atrophy, which impairs total muscular performance and endurance. Physical exercise necessitates higher ventilation levels, which exposes these people to ventilatory stress. Aging-related slowing down of respiratory center,neuromodulation also contributes to this phenomenon. Increased dyspnea during exertion as a result of this ventilatory stress may cause older persons to limit or perform less well in specific daily activities. Dyspnea and poor physical performance, frailty and deteriorating muscular function, and sedentarism and dyspnea worsening are all related. Elderly people who are sedentary have higher dyspnea ratings, lack physical conditioning that hinders their performance in labor-intensive tasks, and may have aggravating variables such as bad lifestyle choices and related comorbidities in addition to their advanced age.

The results of this study are important for roles in therapy, rehabilitation, and prevention for older persons. Preventing dyspnea-related comorbidities will be made easier by identifying risk factors for prospective alterations in chest wall movement and increased oxygen intake.

This study also emphasizes the necessity of incorporating therapy strategies meant to improve older patients' breathing and chest expansion. These interventions, which include incorporating physical exercise and respiratory physical therapy into everyday routines, can enhance ventilation and, as a result, prevent dyspnea and increase endurance in general. The benefits of various methods for enhancing elderly ventilation can be investigated in more detail.

It is necessary to recognize the limitations of this study. The study used a convenience sampling technique, had no control group, and had a small sample size.To overcome some of the limitations of the current study, greater sample sizes may be used in future research projects.

Conclusion

In older persons, dyspnea and endurance are significantly correlated with chest expansion. In elderly adults poor chest expansion might lower the endurance and reduce the ventilation.

Source of funding-Self

Conflict of Interest - Nil

References

1. Mendonca GV, Pezarat-Correia P, Vaz JR, Silva L, Heffernan KS. Impact of aging on endurance and neuromuscular physical performance: the role of vascular senescence. J.Sports Med. 2017 Apr;47: 583-98.

2. Hegendörfer E, Degryse JM. Breathlessness in older adults: what we know and what we still need to know. JAGS. 2023 Jul;71(7):2082-95.
3. Van Mourik Y, Rutten FH, Moons KG, Bertens LC, Hoes AW, Reitsma JB. Prevalence and underlying causes of dyspnoea in older people: a systematic review. AANGAH. 2014 May 1;43(3):319-26.
4. Mizuno S, Suzuki Y, Goto K, Takao K, Sumi D, Ishida K, Mizuno F, Katayama K. Relationship between respiratory muscle endurance and dyspnea during high-intensity exercise in trained distance runners. RESPNB. 2022 Feb 1;296:103812.
5. Silva CD, Pegorari MS, Matos AP, Ohara DG. Dyspnea is associated with poor physical performance among community-dwelling older adults: a population-based cross-sectional study. Sao Paulo Med. J. 2020 Apr 9;138:112-7.
6. Watsford ML, Murphy AJ, Pine MJ. The effects of ageing on respiratory muscle function and performance in older adults. JSAMS. 2007 Feb 1;10(1):36-44.
7. Snell PG, Mitchell JH. The role of maximal oxygen uptake in exercise performance. Clin. Chest. Med. 1984 Mar 1;5(1):51-62.
8. Hill K, Jenkins SC, Hillman DR, Eastwood PR. Dyspnoea in COPD: can inspiratory muscle training help. Aust. J.Physiother. 2004 Jan 1;50(3):169-80.
9. Padkao T, Boonla O. Relationships between respiratory muscle strength, chest wall expansion, and functional capacity in healthy nonsmokers. J. Exerc. Rehabil. 2020 Apr;16(2):189.
10. Mohan V, Dzulkifli NH, Justine M, Haron R, Rathinam C. Intrarater reliability of chest expansion using cloth tape measure technique. Bangladesh j. med. sci. 2012 Nov 13;11(4):307-11.
11. Ahmadi Z, Igelström H, Sandberg J, Sundh J, Sköld M, Janson C, Blomberg A, Bornefalk H, Bornefalk-Hermansson A, Ekström M. Agreement of the modified Medical Research Council and New York Heart Association scales for assessing the impact of self-rated breathlessness in cardiopulmonary disease. ERJ open research. 2022 Jan 1;8(1).
12. Bohannon RW, Wang YC, Gershon RC. Two-minute walk test performance by adults 18 to 85 years: normative values, reliability, and responsiveness. Archives of PM&R. 2015 Mar 1;96(3):472-7.
13. Hwang ES, Yoon G, Kang HT. A comparative analysis of the cell biology of senescence and aging. CMLS. 2009 Aug;66:2503-24.
14. Boss GR, Seegmiller JE. Age-related physiological changes and their clinical significance. West. J. Med. 1981 Dec;135(6):434.
15. Sharma G, Goodwin J. Effect of aging on respiratory system physiology and immunology. Clin. Interv. Aging. 2006 Jan 1;1(3):253-60.
16. Kim CB, Yang JM, Choi JD. The effects of chest expansion resistance exercise on chest expansion and maximal respiratory pressure in elderly with inspiratory muscle weakness. J. Phys.Ther. Sci. 2015;27(4):1121-4.
17. Henoch I, Bergman B, Danielson E. Dyspnea experience and management strategies in patients with lung cancer. Psycho–Oncology: J. Psychosoc. Oncol. 2008 Jul;17(7):709-15.
18. Leelarungrayub D, Pothongsunun P, Yankai A, Pratanaphon S. Acute clinical benefits of chest wall-stretching exercise on expired tidal volume, dyspnea and chest expansion in a patient with chronic obstructive pulmonary disease: a single case study. J. Bodyw.Mov. Ther. 2009 Oct 1;13(4):338-43.
19. Adachi D, Yamada M, Nishiguchi S, Fukutani N, Hotta T, Tashiro Y, Morino S, Shirooka H, Nozaki Y, Hirata H, Yamaguchi M. Age-related decline in chest wall mobility: a cross-sectional study among community-dwelling elderly women. JOM. 2015 Jun 1;115(6):384-9.
20. Ramsey KA, Rojer AG, D'Andrea L, Otten RH, Heymans MW, Trappenburg MC, Verlaan S, Whittaker AC, Meskers CG, Maier AB. The association of objectively measured physical activity and sedentary behavior with skeletal muscle strength and muscle power in older adults: A systematic review and meta-analysis. ARR. 2021 May 1;67:101266.

Original Article DOI: https://doi.org/10.37506/ydq1ek14

Physiotherapy Approaches for Sexual Dysfunction Management in Adults with Spinal Cord Injury: An Observationalcross Sectional Analysis

[1]Purnima Iyer, [2]Suroshree Mitra, [3]Ashok Shyam, [4]Parag Sancheti

[1]Physiotherapy Intern, Sancheti Institute for orthopedics and Rehabilitation college of Physiotherapy, Pune, [2]Professor and HOD community dept at Sancheti Institute of orthopedics and Rehabilitation college of Physiotherapy, Pune, [3]Consultant Orthopedic Surgeon & Head of Academic Research Division - Sancheti Institute for Orthopedics' and Rehabilitation, [4]Chairman and Orthopaedic Surgeon-Sancheti Institute for Orthopedics' and Rehabilitation

How to cite this article: Purnima Iyer, Suroshree Mitra, Ashok Shyam, Parag Sancheti. Physiotherapy Approaches for Sexual Dysfunction Management in Adults with Spinal Cord Injury: An Observationalcross Sectional Analysis. Indian Journal of Physiotherapy and Occupational Therapy / Vol 19 No 2 April-June 2025

Abstract

Background: Spinal cord injury (SCI) is a life-altering event that is usually associated with loss of motor and sensory function, as well as sexual impairment.

Materials and Methodology: The study was conducted in Multi-disciplinary hospitals and tertiary care centers in and around Pune. The authors administered questionnaires via Google Forms to 113 practicing physiotherapists in and around Pune. Physiotherapists were asked 23 questions about awareness of sexual dysfunction in males as well as females with SCI. It included 13 questions for male SD (Sexual Dysfunction) and 10 for Female SD. Descriptive statistics and MS Excel were used for data analysis and the results were obtained.

Results: 61% of physiotherapists are aware that they have a role in treating SD. 58.66% are aware of electroejaculation (EEJ) and its role in the management of SD. Awareness about management approaches to induce erections is limited to 50.33%. Awareness about pelvic floor physiotherapy and its approaches is 31.25%.

Conclusion: This study concluded that there is very little awareness about physiotherapy, hormonal therapy, electroejaculation, pelvic floor management approaches and erectile dysfunction management among practicing Physiotherapists.

Keywords: Erectile dysfunction, Female orgasmic dysfunction, Physiotherapy, Rehabilitation, Sexual Misconceptions.

Introduction

Spinal cord injury is a traumatic, life-altering event that is usually associated with loss of motor and sensory function, as well as sexual impairment. In the immediate post-injury period, both men and women lose the ability to have reflexive sexual responses. The ability to experience sexual pleasure is one of the topmost priorities for rehabilitation in SCI.[1]

Corresponding Author: Suroshree Mitra, Sancheti Institute for Orthopedics and Rehabilitation College of Physiotherapy, 11/12 Thube Park, Shivaji Nagar, Pune 411005

E-mail: sancheticop@gmail.com

Submission: Nov 12, 2024 **Revision:** December 23, 2024 **Published date:** April 11, 2025

Many men consider treating the erectile dysfunction post-SCI aids in improving their QoL (Quality of Life). Oral medications and mechanical devices that are less invasive are in use for the same (ex. Sildenafil (Viagra), Tadalafil (Cialis), and Vardenafil (Levitra).[2]

Understanding female sexual health after SCI is utterly important for all the medical practitioners. Treatment options are not as much for men. Many SCI patients have received misinformation about the effects of their injury on their sexual function and benefit from education about it.[3]

Long-term counselling on sex after discharge is important, yet sexuality is one of the most often neglected areas in long-term SCI rehabilitation, particularly for women.[4]

Sexuality encompasses much more than just the physical ability to have sexual intercourse. Education so that patients can understand the impact of SCI on sexual function is an important part of rehabilitation.[5]

Materials and Methodology

The aim and objectives were to study the awareness of possible management approaches for sexual dysfunction of adults with SCI in practicing physiotherapists using a validated questionnaire. The authorsconducted an Observational Cross-sectional study among practicing physiotherapists in and around Pune. 113 Participants were recruited using Convenience sampling from Tertiary care hospitals, physiotherapy setups and private rehab clinics and centers.Sample Size was calculated using this formula: $n = Z^2 \times P \times \frac{(1-P)}{(d\text{^}2)}$ Where Z value associated with confidence1.96, P guess of population 0.51, d Absolute Precision value less than P 0.1, n minimum sample size 96 $\pm$ 10. After obtaining ethical clearance from the committee, the physiotherapists willing to participate were taken for the study.They were explained about the purpose of the study and requested to participate in the study.Along with the informed consent, their demographic data in the form of name, age, sex, highest level of education completed was collected.A google form was circulated to them and they were requested to fill it. The google form was divided into 3 sections. Section 1 included demographic data, Section 2 included 13 questions for Male SD and Section 3 included 10 questions for Female SD. Data was obtained and Analysis was doneusing Descriptive Statistics and MS Excel through which the level of awareness was studied.

Results

- The study had a set number of questions to determine the awareness of possible management approaches for sexual dysfunction of adults with spinal cord injury in practicing physiotherapists.In this study, a total of 113 participants were recruited with the mean age of 27.22 years.
- Out of 113 physiotherapists who were recruited in the study, 40 were males (35%) and 73 were females (65%).Out of 113 participants, 62 had completed theirBachelors in Physiotherapy-BPTh (55%), 44 had completed their Masters in Physiotherapy-MPTh (39%) and 7 of them had completed their diploma course in Physiotherapy (6%).
- As shown in Table 1, when asked if physiotherapists had a role in treating sexual dysfunction post spinal cord injury, out of 113 participants, 61% responded Yes, 10% responded No while 29% responded maybe.

Table 1. Role of PT in treating SD post SCI

Role of PT in treating SD post SCI		
Yes	69	61%
No	11	10%
Maybe	33	29%

- As shown in Table 2, when asked if physiotherapists knew about electroejaculation, 33% responded Yes while 67% responded No.

Table 2. Knowledge about electroejaculation in Physiotherapists.

Do you know about electroejaculation?		
Yes	37	33%
No	76	67%

- As depicted in Fig. 1,75% physiotherapists were aware that Alternating currents are used in electroejaculation, 11% thought that magnetic currents are used while 14% thought that High frequency currents are used. 68% thought electroejaculation requires intact reflexes while 32% were aware that it in fact does not require intact reflexes.16% reported it is used to induce penile erection, 16% reported it is used to induce ejaculation and 69% were aware that it is actually used to induce both erection and ejaculation.

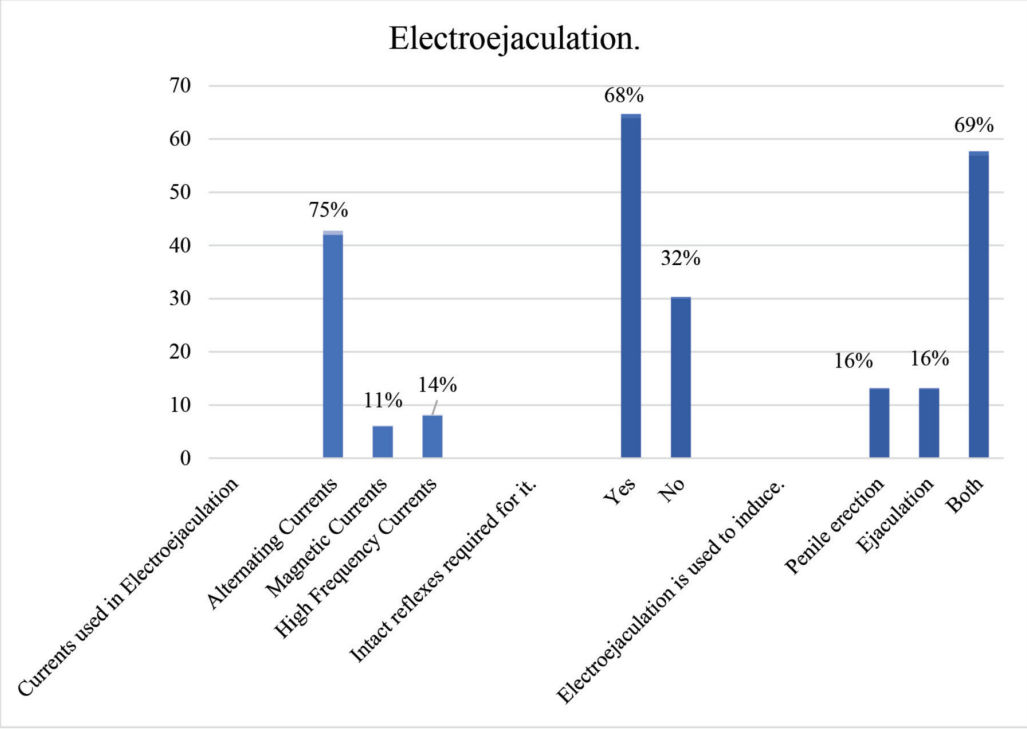

Figure 1: Electroejaculation

- Table 3 shows that when asked about options to induce erections at home, 53% physiotherapists were aware only about vibratory stimulation, only 18% were aware about applying constrictive band to the root of the penis and 14% were aware about application of hot towels to the penile shaft. Only 15% were about catheter manipulation. Additionally, when asked about the options to cause ejaculation, 23% physiotherapists were aware about hand stimulation, 26% were aware about vibro stimulation, 26% about masturbation and 25% were aware about sexual intercourse.

Table 3. Home options to induce erections.

What can be done to induce erections at home?		
Catheter manipulation	24	15%
Application of hot towels to penile shaft	23	14%
Applying constrictive band to the root of the penis	29	18%
Vibratory stimulation	84	53%

- As shown in Table 4, when asked about penile implants, only 6% were aware that it lasts for 20 years on average, 11% were aware that patients

can maintain an erection even after orgasm, 10% thought that it is not a surgical procedure, 5% reported that they are always rigid, whereas only 10% were aware that it can be inserted in scrotum or penis and only 11% were aware that they are virtually invisible. Only14% were aware that it can keep external condom catheter in place and 28% were aware that it provides penal stability.

Table 4. Penile Implants.

Penile Implants		
Provide penal stability	79	28%
Keep external condom catheter in place	40	14%
Virtually invisible	31	11%
They are always rigid	15	5%
It can be inserted in scrotum or penis	28	10%
It is not a surgical procedure	27	10%
Patients can maintain erection even after an orgasm	30	11%
On average, it lasts for 20 years	18	6%
It cannot cause infection or mechanical failure	15	5%

- Fig. 2 depicts the Hormonal Therapy management approaches for SD. When asked about options to give estrogen therapy, 7% reported that it can be given only as vaginal ring, 8% reported in form of cream, 25% reported it can be given as a tablet and 60% were aware that it can be given as any of the above options. When asked if testosterone therapy could be given in post-menopausal women to improve their sexual desire, 49% were aware that it in fact is true whereas 51% reported that it is false. When questioned about the benefits of estrogen therapy, only 28% were aware that it increases elasticity, 48% were aware that it increases vaginal lubrication while only 20% were aware that it reduces vaginal tone.

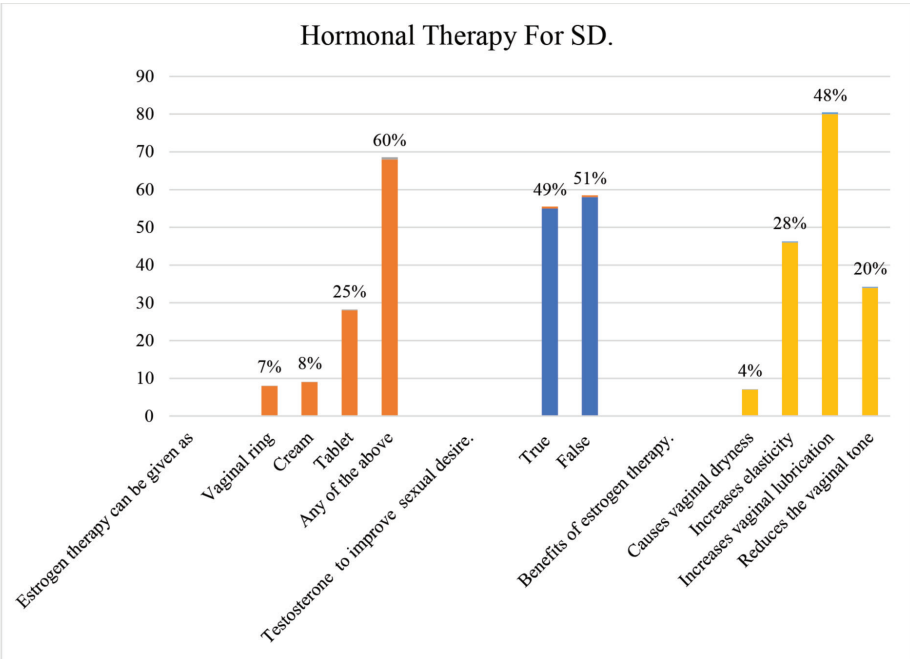

Figure 2: Hormonal Management Approaches for SD

- Fig. 3 shows the awareness related to Pelvic floor PT approaches. When asked about pelvic physiotherapy approaches for increases tone or spasm, it was observed thatonly 17% were aware about diaphragmatic breathing, only 11% were aware about MET, 13% were aware about Trigger point therapy and 14% were aware about urogenital mobilization.

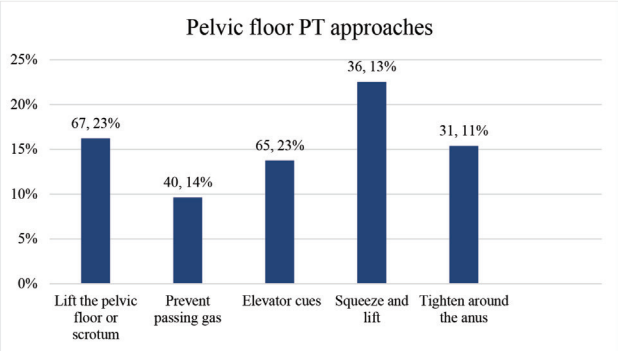

Figure 3: Pelvic Floor PT Approaches for increased tone or spasm.

Discussion

In this study, the authors tried to find awareness about all the possible management approaches for sexual dysfunction after SCI in practicing physiotherapists. For this, the authors used a self-made, validated by the field experts' questionnaire for male and female sexual dysfunction management approaches. A total of 23 questions were asked, 13 for males and 10 for females SD.

According to a study conducted by John Zizzo et al. (2022), to date, multiple safe and effective treatments are available to address many of the sexual and reproductive obstacles posed by SCI. Applying multiple pharmacological treatment modalities for sexual dysfunction strengthens relationships.[6] In the current study, it was found that 63% of physiotherapists are not aware about the purpose of vasoactive medications and that it is used to restore erections. This can be attributed to less focus on the curriculum of pharmacology in the syllabus or the physiotherapy practitioners not focusing on the holistic approach, which would require them to catch up on current trends for better rehabilitation hand in hand with pharmacology.

Recent trends suggest that in cases where pharmacological treatment is not responsive or when medications are contraindicated, mechanical therapies such as vacuum devices, prosthesis surgery, and shockwaves may be considered based on patient preferences.

A survey in 2006 administered to professionals to determine current treatment methods for infertility in couples with SCI male partners found that one-fourth of the infertility clinics did not offer either PVS (Penile Vibratory Stimulation) or EEJ (Electroejaculation), stating they were untrained or unfamiliar with the sperm retrieval methods and equipment, and about one-third did not offer IUI (Intrauterine Insemination).[7] The current study also shows that regarding Electroejaculation, maximum physiotherapists were unaware about electroejaculation; few were not even aware about the type of currents used in it, and 68% were unaware that it does not require intact reflexes. Electrotherapy being used so worldwide in physiotherapy for minor to major injuries but still getting neglected in sexual rehabilitation, this needs to be brought to the attention that as physiotherapists, it should be a shame to not be aware of such treatment methods that would bring so much relief to the patients. Furthermore, if the fertility clinics themselves do not have the treatment equipments and could not offer the required care for patients, physiotherapists alone would not be able to provide holistic care for the patients.

Some of the most common methods of management for erectile dysfunction post SCI include penile implants, oral phosphodiesterase (PDE) inhibitors, vacuum devices, intraurethral prostaglandins, and intracavernous injections.[8] Awareness about these options to induce penile erection was found to be very low in this study.This can be attributed to physiotherapists not keeping up with recent trends as discussed before, and the curriculum giving more importance to sensory and motor impairments. Penile implants being a surgical procedure might not be preferred by many patients, but still, as a

physiotherapist, it is an important duty to lay down all the options for the patients so that they could make an informed decision. Besides, the patient spends most of the time with them, and therefore it is of utmost importance to talk to them about such a crucial issue. And to do so, physiotherapists should be aware of the same.

Sexual desire is associated with the fixed partner, masturbation, and last event of the sexual intercourse of the patient. Fixed partner, ejaculation, and masturbation are protective factors for sexual dysfunction. Erectile dysfunction, orgasmic dysfunction, and infrequent sex dysfunction are predictors of sexual dysfunction.[9] In this study, questions also included about such protective and predictive factors, and it was found that only 25.3% were aware of protective factors and 33% about predictive factors. This can be attributed to a lack of communication with the patients about these issues and social stigma. The patients are usually not so aware of what they should and should not do in order to get their sexual health back, so they might resort to taking unhealthy measures to somehow regain their sexuality. In order to prevent this, the physiotherapists should make them aware of the protective and predictive factors for SD.

Home options to induce erections at home include catheter manipulation, application of hot towels to the penile shaft, applying a constrictive band to the root of the penis, or vibratory stimulation. [11] In this study, awareness about vibratory stimulation was better than the other options, which might be due to the easy availability of sex toys and vibrators used regularly by common people as well. Not being aware of other home options can be attributed to not applying basic age-old practices to induce erection and educating the patients about the same.

According to Prevalence and trends in physical therapy interventions for erectile dysfunction (ED): A Scopus-based bibliometric analysis (1989–2022), Recent trends also include extracorporeal shock wave therapy, a non-invasive treatment that improves penile blood flow by stimulating new blood vessel growth in the penile shaft. Other modalities in PT, particularly physical activities and pelvic floor exercises, have been the latest topic trending from 2016 to 2022. Men with ED should be informed about the use of a VED (Vacuum Erection Device) as a treatment option.

According to a study conducted by Simon JA et al. in 2011, estrogen therapy could be given as a vaginal ring, cream, or tablet. Local vaginal therapy with estrogen creams, rings, or tablets may be more appropriate for women without other indications for systemic estrogen therapy. Estrogen therapy causes vaginal lubrication, reduces the vaginal tone, and increases elasticity.[10] When physiotherapists were asked questions related to hormonal therapy, awareness was found to be really low. Estrogen and Testosterone therapy although very commonly used, is not being advised to participants with SCI. This can be attributed to the very low incidence of female SCI. Since female SCI is not so common, physiotherapists tend to not read much about it, hence the lack of awareness.

There are lots of treatments to manage the pelvic floor weakness among which Kegel exercises are the most popular therapies because people can implement them as a daily routine. According to the study of McLennan et al., 46.1% of patients didn't receive the information about Kegel exercises.[11] In the current study, 15% of physiotherapists were not aware that Kegel's exercises help in achieving better orgasm. Kegel's exercises being such a common treatment method for all the females in general for pelvic floor health and still not being used by physiotherapists for SD is really a shock. Such basic exercises should be known to every physiotherapist.

A retrospective review from 2010 demonstrated that 25 of 26 patients experienced statistically significant improvement when physiotherapy was combined with vaginal and/or rectal suppositories fororgasmic dysfunction.The medical treatment of orgasmic problems is challenging, although there have been reports of success with mindfulness, yoga, the use of sex toys, and sex therapy.[12] Despite these available treatment options stated above, physiotherapists are unaware of the same, which can be attributed to a lack of updates, fewer options for female sexual dysfunction, fewer articles on the same, or social taboo to openly discuss these issues.

There is emerging evidence that pelvic floor muscle training (PFMT) may be useful for treating some urogenital conditions in people with spinal cord injury (SCI). Pelvic floor physical therapy should be employed for at least 8–12 weeks; patients with a longer symptom history may require more sessions to experience improvement.[10]

A recent research study carried out by Ben Ami and Dar [2018] looked at the best cues for pelvic floor activation in 57 physiotherapy students without symptoms of pelvic health dysfunction. They investigated different cues, including "Squeeze around the anus" and "Stop the flow of urine." They found that 90% in the posterior group ["Squeeze around the anus"] achieved a correct pelvic floor activation, compared with 65% in the anterior group ["Stop the flow of urine"]. This is an interesting finding as the cue "Squeeze around the anus" is easy to do; most women would be able to perform that contraction without any visual imagery required.[13] Pelvic floor retraining in females with sexual dysfunction has always been an available option with so many modifications. The results of the current study clearly implies that either due to lack of knowledge or not applying women's health treatment approaches in SCI, awareness about these treatment methods is not so great among physiotherapists for such basic and simple cues.

A recent practice survey by Raveendran A. V. et al. in 2020 found that the majority of doctors are reluctant to ask about their patients sexual issues. Lack of proper training to address sexual health issues is a major obstacle in managing sexual problems, which can be addressed by improving training in sexual medicine for both medical students and medical practitioners.

This study also found that when participants were asked to participate in the study, many of the physiotherapists frowned upon the topic and hesitated at first, but after filling out the questionnaire, they were shocked to know that they have a lot of recent trends to catch up to so that they can give the best possible care to their patients. This also implies that once the social taboo has been overcome by the patients as well as the medical practitioners, the spinal cord injury patients will get the most benefit and the best possible care.

Conclusion

This study concluded that there is very little awareness about possible management approaches for Sexual dysfunction of adults with spinal cord injury in practicing Physiotherapists. The awareness for pharmacological as well as electrotherapeutic methods of management for Sexual dysfunction is very less among physiotherapists.The finding that more than 80% of participants stated that their SCI had altered their sexual sense of self and that improving sexual function would improve their QoL demonstrates how critically important this topic is and that this area of research needs to be greatly expanded. Additionally, this study creates scope of changes in the Physiotherapy curriculum that would focus on Sexual health and Rehabilitation along with sensory and motor impairments in the cases of Spinal Cord Injuries. This study paves way to many more studies that should be done in the areas of sexual dysfunction and look for the social taboo that is preventing the medical practitioners from addressing this issues.

Ethical Clearance: Ethical clearance was taken from IEC of college Sancheti Institute for Orthopedics and Rehabilitation College of Physiotherapy, Ref no IEC –SIOR/Agenda 076 , dated : 20/11/23.

Support - Nil

Conflicts of interest - Nil

References

1. Hess MJ, Hough S. Impact of spinal cord injury on sexuality: broad-based clinical practice intervention and practical application. The journal of spinal cord medicine.2012 Jul 1;35(4):211-8.
2. DeForge D, Blackmer J, Moher D, Garritty C, Cronin V, Yazdi F, Barrowman N, Mamaladze V, Zhang L, Sampson M. Sexuality and Reproductive Health Following Spinal Cord Injury: Summary. AHRQ Evidence Report Summaries. 2004 Dec.
3. Alexander M, Rosen RC. Spinal cord injuries and orgasm: a review. Journal of Sex & Marital Therapy. 2008 Jun 19;34(4):308-24.

4. Abramson CE, McBride KE, Konnyu KJ, Elliott SL. Sexual health outcome measures for individuals with a spinal cord injury: a systematic review. Spinal cord. 2008 May;46(5):320-4.
5. Susan B. O' Sullivan. Thomas J. Schmitz. George D. Fulk. Physical Rehabilitation. 7th edition. New Delhi: Jaypee Brothers Medical Publishers; *2019*
6. John Zizzo et al. Sexuality, Intimacy, and Reproductive Health after Spinal Cord Injury; 2022, 48(7): 225-9.
7. Kafetsoulis A, Brackett NL, Ibrahim E, Attia GR, Lynne CM. Current trends in the treatment of infertility in men with spinal cord injury. Fertility and sterility. 2006 Oct 1;86(4):781-9.
8. Linsenmeyer TA. Treatment of erectile dysfunction following spinal cord injury. Current urology reports. 2009 Nov;10(6):478-84.
9. de Oliveira Ferro JK, Lemos A, da Silva CP, de Paiva Lima CR, Raposo MC, de Aguiar Cavalcanti G, de Oliveira DA. Predictive factors of male sexual dysfunction after traumatic spinal cord injury. Spine. 2019 Sep 1;44(17):1228-37.
10. Simon JA. Identifying and treating sexual dysfunction in postmenopausal women: the role of estrogen. Journal of women's health. 2011 Oct 1;20(10):1453-65.
11. Chen H, Yang N, Yang H, Huang G, Zhou W, Ying Q, Mou J, Chen S, Dai Z, Li Z, Lan J. Efficacy of Kegel exercises combined with electrical stimulation on the restoration of postpartum pelvic floor muscle function. American Journal of Translational Research. 2023;15(1):622.
12. Krakowsky Y, Grober ED. A practical guide to female sexual dysfunction: An evidence-based review for physicians in Canada. Canadian Urological Association Journal. 2018 Jun;12(6):211.
13. Ben Ami N, Dar G. What is the most effective verbal instruction for correctly contracting the pelvic floor muscles? Neurourology and urodynamics. 2018 Nov;37(8):2904-10.

Correlation of Chester Step Test and Six Minute Walk Test in COPD Patients

Rachna D Arora[1], Maryam N Syed[2]

[1]Assistant Professor, P.T. School and Centre, T.N.M.C, Mumbai, Maharashtra, India [2]Post Graduate, P.T. School and Centre, T.N.M.C, Mumbai, Maharashtra, India

How to cite this article: Rachna D Arora, Maryam N Syed. Correlation of Chester step test and six minute walk test in COPD patients. Indian Journal of Physiotherapy and Occupational Therapy / Vol 19 No 2 April-June 2025

Abstract

Background: A cross sectional study was done to use Chester step test, a graded submaximal test that mimics stair climbing, for assessing functional capacity in COPD patients.

Purpose: To correlate Chester step test (CST) and six minute walk test (6MWT) in COPD patients.

Methods: Sixty five COPD patients performed a 6MWT on a 30 m hallway and CST on a 15-20 cm high step, randomly on the same day after giving a rest interval between the tests. The distance walked and the number of steps performed, during the 6MWT and CST were recorded respectively. Data analysis was done using SPSS 16 software. Spearman correlation was used to correlate between six minute walk distance and number of steps.

Conclusion: The mean 6MWD was 344.68 m $\pm$ 106.47 m and the mean number of steps performed during CST was 76.50 $\pm$ 65.08. A significant positive linear correlation (rho = 0.713, p = 0.000) between 6MWD and a number of Steps was seen, therefore number of steps in CST showed a strong correlation with the distance walked in the 6MWT in patients with COPD, which confirms the applicability of CST to assess the functional capacity of patients with COPD.

Keywords: Chronic obstructive pulmonary disease (COPD), Six minute walk test (6MWT), Six minute walk distance (6MWD), Chester step test (CST).

Introduction

"Chronic obstructive pulmonary disease (COPD) is a common, preventable and treatable disease that is characterized by persistent respiratory symptoms and airflow limitation that is due to airway and/or alveolar abnormalities, usually caused by significant exposure to noxious particles or gasses." It is the fourth leading cause of death in the world currently. COPD is said to be considered in any patients having dyspnoea, chronic cough or sputum production, history of recurrent lower respiratory tract infection and has a history of exposure to various risk factors for the disease[1,2]. Peripheral muscle dysfunction is considered one of the main systemic changes in COPD that contributes to the loss of exercise capacity, which in turn interferes with the activities of daily living (ADL) of the patients. 6MWT and the shuttle test are the commonly used tests to assess functional capacity in COPD patients, but these tests require a large space, making clinical practice difficult [3].

Corresponding Author: Maryam N Syed- Post Graduate, P.T. School and Centre, T.N.M.C, Mumbai, Maharashtra, India

E-mail: marybpth@gmail.com

Submission: Aug 12, 2024 **Revision:** November 4, 2024 **Published date:** April 11, 2025

Chester step test (CST) was developed by Kevin Sykes et al.[4] in order to assess aerobic capacity of healthy individuals and hence prescribe physical activity [3,5]. It is a submaximal, multistage fitness test which measures heart rate (HR) and rate of perceived exertion (RPE) continuously during exercise [4], while requiring the participants to step onto and off a low step at a rate set by metronome beat[6]. It is highly applicable to a wide variety of ages, conditions of people and their abilities and also highly adaptable. Being inexpensive, easy to standardize, portable, and safe it is therefore applicable for use by exercise and health professionals in different workplaces and community settings[4,5,7,8,9,10,11]. Patients with COPD find the task of going up and down the stairs difficult on account of breathlessness [12].

Six minute walk test (6MWT) is the most common among the field walking test, originally developed to assess patients with pulmonary diseases[13]. It is a self-paced submaximal test employed to determine the functional capacity, intensity of the disease and its progression in COPD patients. It is well standardized by the American Thoracic Society (ATS) and the American Association for Respiratory Care. It is administered in the 30 m hallway, where the patients are instructed to cover the maximal distance in 6 min[14,15,16].

Materialand Methods

This is a cross sectional study design in which sixty-five COPD patients coming to the Pulmonary Medicine OPD were included. The study was done as a postgraduate research thesis during a period of 6 Months (January 2021-June 2021). Figure 1 shows the Study Design Flowchart which includes Inclusion (clinically diagnosed COPD patients) and exclusion criteria (Difficulty in climbing stairs, Quadriceps muscle strength <4 as per MRC scale, Acute exacerbation in last month, Resting RR>35, spo2 <90, Subjects with heart disease, Subjects with uncontrolled systemic diseases, Neurological deficit in lower extremity, Musculoskeletal pain >2 on NPRS, Subjects unwilling to participate.) Figure 2 shows the study material required. Demographic data (Age in years, Gender, Weight in kg, height in m, FEV1/FVC in percentage) of patients was recorded. Simple randomization by the chit picking method was done, where group A patients performed 6MWT first followed by rest and CST and vice versa for group B patients. Lower limb stretching exercises (figure 3) were given for 5-10 minutes as warm up and cool down before and after the tests, to prevent delayed onset muscle soreness[17,18,19]. Instructions for the tests were given to the patients and if they reported symptoms during the exercise tests, the tests would be terminated (figure 4)[16, 13, 20]. Demonstration of CST test was given, a trial was given for the patients to get accustomed to the test. After a rest interval of 15 minutes, final CST was performed (figure 5). CST is a 5 stage test, each of 2 minutes, which gives a total test time of 10 minutes. The step test is set with a metronome starting at 15 steps/min and increases by 5 steps/min every 2 min (each stage), till it reaches 35 steps/min at stage 5. The test will be performed on a 15-20cm bench or step. 8" (20cm) Step is generally suitable for those under 40 years of age who take little or no regular physical exercise and for those under-40's who are moderately overweight. 6" (15cm) Step is generally suitable for those over 40 years of age who take little or no regular physical exercise and for those under-40's who are moderately overweight.Heart rate, rate of perceived exertion was recorded after each stage for all patients[6]. 6MWT was performed according to American Thoracic Society (ATS) guidelines (figure 6) [14,16]. Adequate rest intervals were given between the two tests.

Tables and Figures

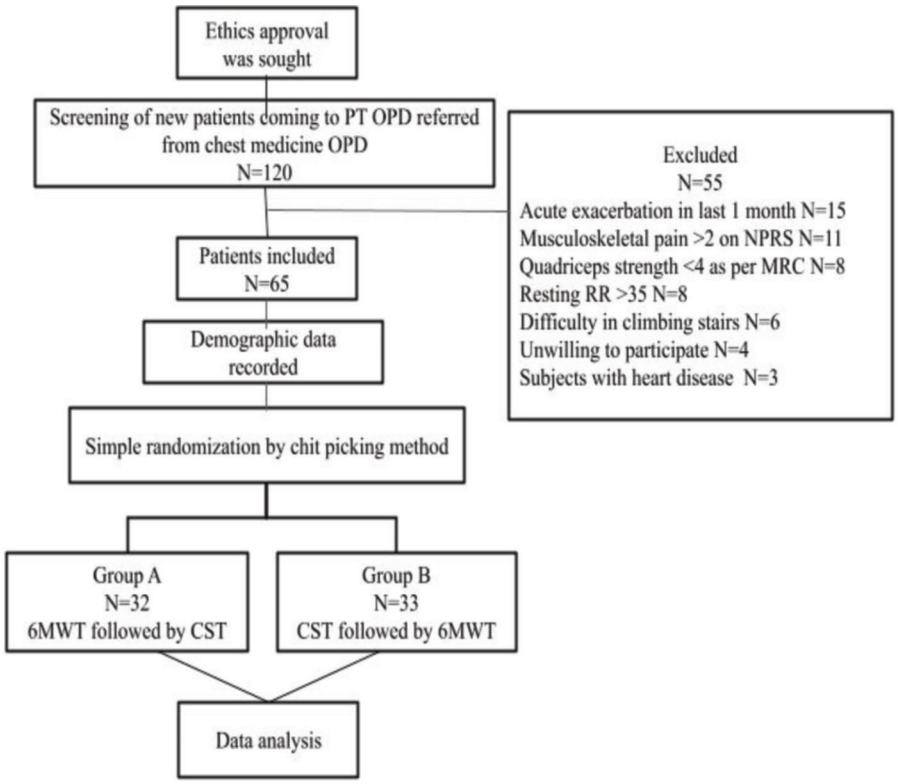

Figure 1: Study Design Flowchart

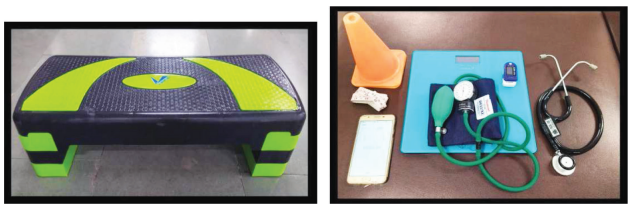

Figure 2: Study material

Figure 3: Lower limb stretching

Termination criteria for the tests:

- Perception of any limiting symptom (dizziness, strong dyspnoea, headache, chest pain, staggering, diaphoresis, and pale or ashen appearance.) by the participant.
- Pain and fatigue in lower limbs.
- The applicant reaches 80% of maximum heart rate at any point during the test.
- O2 saturation in blood <88%
- Rate of perceived exertion (RPE) >7.
- Unable to maintain metronome set pace.
- Applicant reports needing to stop.

Figure 4

Figure 5: Performance of CST

Figure 6: Performance of 6MWT

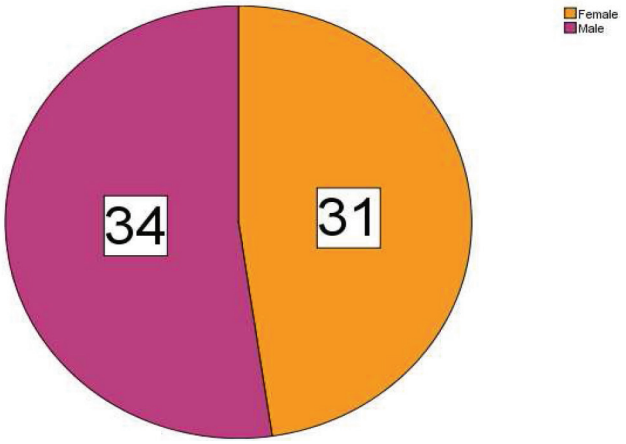

Figure 7: Gender distribution

The above graph is a pie chart which shows there were 31 female (47.7%) and 34 male (52.3%) subjects in the study.

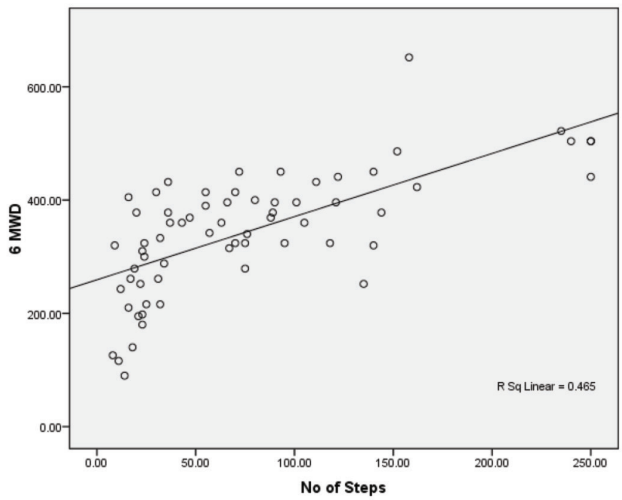

Figure 8: Correlation of 6 MWD and number of Steps during CST

The above graph is a scatterplot which shows a positive linear relation between 6 MWD and number of steps performed during CST. (rho =.713, p = 0.000)

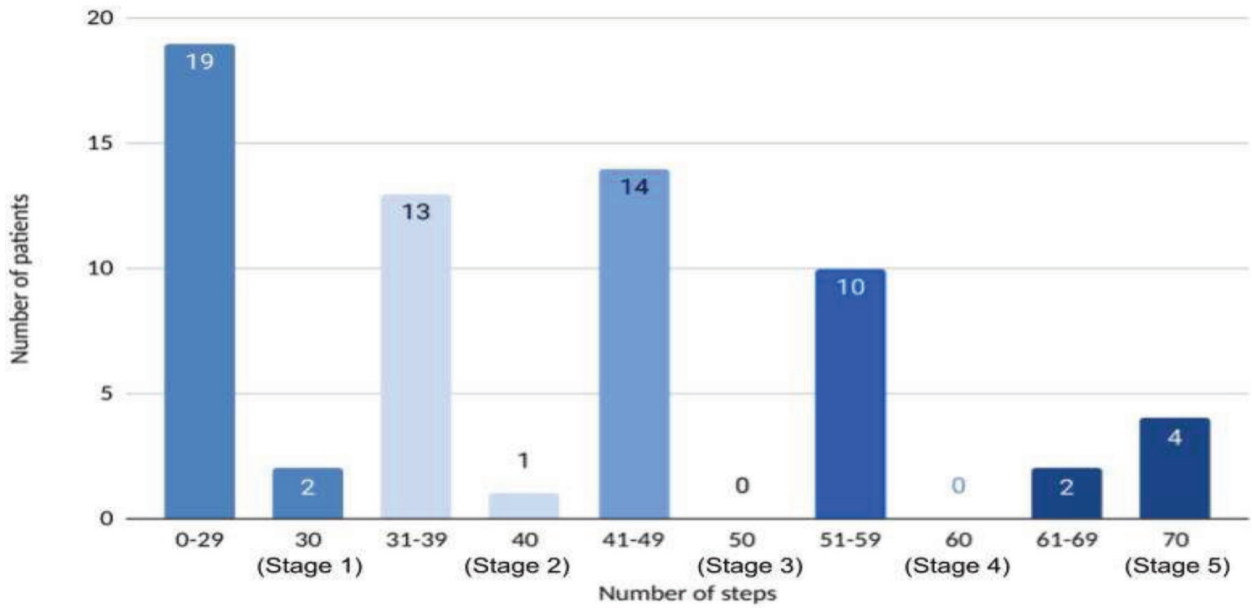

Figure 9: Distribution of number of patients in each stage of CST

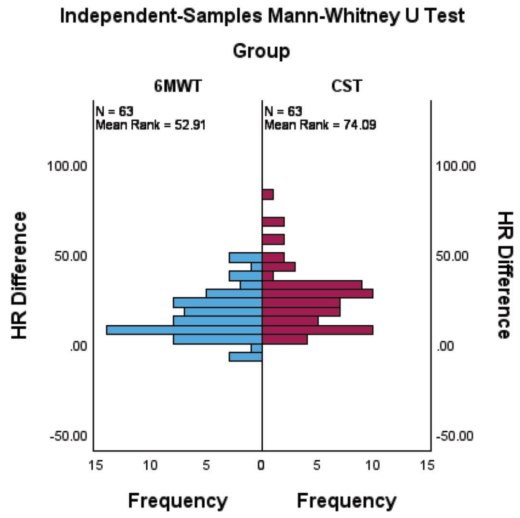

Figure 10: HR difference between groups

There was a significant increase in HR post CST as compared to 6MWT (p = 0.001)

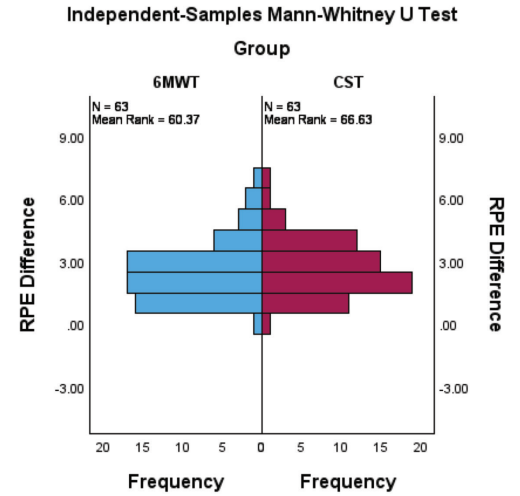

Figure 11: RPE difference between groups

There was no significant difference in rate of perceived exertion between both 6MWT and CST.

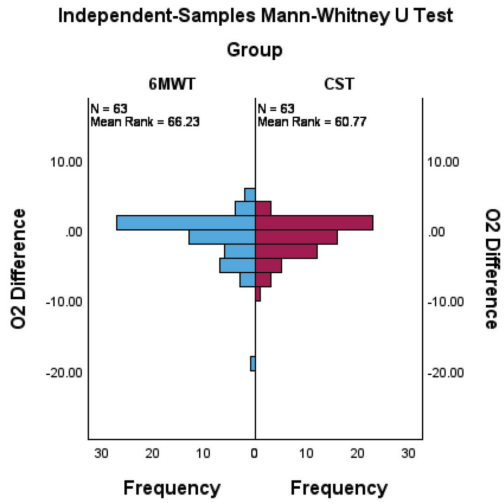

Figure 12: O2 saturation difference between groups

There was no significant difference in O2 saturation between both groups.

Table 1. Descriptive Statistics of gender

	Frequency	Percent
Male	34	52.3
Female	31	47.7
Total	65	100.0

Table 2. Descriptive Statistics of Age, BMI, 6 MWD, Number of Steps

	N	Mean	Std. Deviation	Std. Error Mean	95% Confidence interval
Age	65	50.9231	±12.42768	1.54146	47.84 - 54.00
BMI	65	23.8000	±5.16460	.64059	22.52 - 25.07
6 MWD	65	344.68	±106.47918	13.20712	318.29 - 371.06
No of Steps	65	76.5077	±65.08987	8.07340	60.37 - 92.63

The above table shows that mean age of subjects was 50.92 years ± 12.42 years, mean BMI was 23.8 kg/m² ± 5.16 kg/m², mean 6 MWD was 344.68 meters ± 106.47 meters and mean number of steps performed during Chester Step Test was 76.50 ± 65.08.

Table 3. Descriptive Statistics of HR

	Mean	Std. Deviation	Std. Error Mean	95% Confidence interval
HR pre	89.3333	±14.71120	1.85344	85.62- 93.03
HR peak 6MWT	106.1111	±21.92812	2.76268	100.58- 111.63
HR peak CST	115.2698	±20.94171	2.63841	109.99- 120.54

The above table shows that mean HR pre tests of subjects was 89.33 bpm ± 14.71 bpm, mean HR peak during 6MWT was 106.11 bpm ± 21.92 bpm, mean HR peak during CST was 115.26 bpm ± 20.94 bpm

Results

The data was analyzed using SPSS 16 software. Data was tested for Normality using the Shapiro Wilk Test. Spearman correlation was used to correlate between 6MWD and number of steps.There were 31 female and 34 male COPD patients (figure 7). Mean age of the subjects was 50.92 years ± 12.42 years, and mean BMI of subjects was 23.80 kg/m2 ± 5.16 kg/m2. The mean 6MWD walked was 344.68 m ± 106.47 m and the mean number of steps performed during the CST was 76.50 ± 65.08 (Table 2). A strong significant positive linear correlation (rho=0.713, p=0.000) between 6MWD and number of steps during CST was seen (figure 8). The mean HR pre tests of subjects was 89.33 bpm ± 14.71 bpm, mean HR peak during 6MWT was 106.11 bpm ± 21.92 bpm, mean HR peak during CST was 115.26 bpm ± 20.94 bpm (Table 3). There was a significant increase in HR post CST as compared to 6MWT (p=0.001). Heart rate response is directly related to intensity of exercise [24] Stepping up and down involves lifting the body up against gravity and lowering it and hence it is an exercise of higher intensity or MET value as compared to level walking (figure 10). [25] There was no significant difference in rate of perceived exertion between both tests (figure 11), as in CST, as most of the patients could only complete stage 1 of CST (figure 9) which is a slow paced stage of 15 steps/min.[28] There was no significant difference in O2 saturation between both groups (figure 12), In both groups, there was an equal drop in oxygen saturation which returned to baseline during recovery period.[24]

Discussion

Similar findings were seen in studies done by De Camargo AA et al. (2011) [12] and by Karloh M et al. (2013) [3] De Camargo et al studied the reliability of CST in patients with COPD and correlated it with pulmonary function test. They found a significant correlation between the number of steps in CST and 6MWD in COPD patients (r= 0.60, p=0.001) [12]. Karloh M et al compared the CST with other tests of functional capacity like 6MWT and 6 minute Shuttle Walk Test in COPD patients and compared the cardiorespiratory responses with healthy individuals. They found a positive correlation between CST and Shuttle walk test (r=0.67, p<0.05) as well as 6MWT (r=0.83, p<0.05) [3]. Hence, CST can be used as a test for functional capacity in patients with COPD.

Sunil Kumar et al (2020) [21] compared the effect of ground walking versus stair climbing on exercise capacity in patients with moderate COPD. They found that stair climbing showed a better improvement in exercise tolerance, 6MWD and reduction in the amount of resting intervals during 6MWT as compared to ground walking, because of the improvement in peripheral muscle strength [21,22] Step training has been used as part of aerobic training in pulmonary rehabilitation programs, but the protocols for training are not standardized. Usually, aerobic training is based on a percentage of

the maximum load reached in a maximum test. Thus, the step training should be done in the same way. In this context, we have suggested that, first, the subject undergo CST to establish the peak workload, which is represented by the total number of steps, and then a percentage of it that is around 60-80% would be performed during the training session [28] and there should be a gradual increase in the workload by 10% each week as per the guidelines suggested by ACSM.[13] Study conducted by Grove T. (2020) [11] reviewed the practical applications of the CST in the context of its validity, reliability and predictability in measuring cardiorespiratory fitness, where he found that the CST can provide valuable information on the patient's exercise tolerance to specific levels of sub-maximal stress, risk stratification, and physical activity/exercise prescription by giving example of a case study.[30] Hence CST can be used not only as a test for functional capacity for COPD patients but also as an exercise prescription.[10]

CST is a graded step test, where after every stage the speed of stepping up and down is increased and hence a better VO2 is achieved as compared to 6MWT. Its advantage is that it may be used to assess functional capacity when long hallways are unavailable; requiring less infrastructure, a stepper which is one of the primary requirements in a densely populated urban city in India; and is also comparatively cheaper. The number of steps was used as an outcome measure for CST due to the wide variation between subjects at each stage of CST (figure 9). During CST, patients were able to manage performing the test initially, that is at the rate of 15 steps per minute but with increase in the stepping rate by 5 steps per minute after each stage, they were unable to match the pace that caused anxiety and hyperventilation in them as they are intolerant to exercise due to peripheral muscle dysfunction, and ventilatory limitations that led to early termination of the test (figure 4), this is supported by the study done by Carlos et. al (2012) [28] where they compared the exercise tolerance time, cardiopulmonary stress, and perception of effort between CST and a modified incremental step test (MIST) and found that a slower and progressive increment in work rate during step test is better tolerated by subjects with COPD.[28]

6MWT is the gold standard tool for assessing functional capacity (6MWD) and CST has a strong correlation with 6MWD, hence CST can also be used as a clinical tool for assessing functional capacity.

According to a review article "Home-based and remote exercise testing in chronic respiratory disease, during the COVID-19 pandemic and beyond: a rapid review" by Holland AE et al (2020), pulmonary rehabilitation clinicians can confidently perform STS, step and TUG tests at home in people with chronic lung disease, where in-person supervision is possible[23], Another study done by A. Alves et al. (2022)[27] stated that step tests emerged as a reliable and validated measure during the COVID-19 pandemic, when the need to transfer patients to rehabilitation facilities or discharge them to home increased exponentially and so did the demand for home-based and/or remote rehabilitation. [27] Therefore in a pandemic situation, where telerehabilitation has gained popularity, CST can be used as an exercise test which can be performed indoors under supervision of a caregiver.

Conclusion

The number of steps in CST showed a strong correlation with the distance walked in the 6MWT in patients with COPD, which confirms the applicability of CST to assess the functional capacity of patients with COPD.

Future Recommendations

Whenever the space is compromised CST can be an alternative clinical tool for assessing functional capacity since a step or a stool is easily available as compared to a long corridor in a densely populated urban city in India. In a pandemic situation, where telerehabilitation has gained popularity, CST can be used as an exercise test which can be performed indoors under supervision of a caregiver. Future research should be done to explore CST practicality and reliability in different environments and prepare guidelines for exercise prescription.

Funding Sources if applicable: "Research Society, TN Medical College & BYL Nair Ch Hospital, Mumbai".

Ethical Clearance: The study has been approved by the Ethics Committee for Academic Research Projects (ECARP), TN Medical College & BYL Nair Ch Hospital, Mumbai, Maharashtra, India. (Date 13/02/2020, Project no. ECARP/2019/155)

Conflicts of interest statement: There are no conflicts of interest

References

1. Pocket guide to COPD diagnosis, management and prevention, a guide for health care professionals 2019 report.
2. Rajkumar P, Pattabi K, Vadivoo S, Bhome A, Brashier B, Bhattacharya P, Mehendale SM. A cross-sectional study on prevalence of chronic obstructive pulmonary disease (COPD) in India: rationale and methods. BMJ open. 2017 May 1;7(5):e015211.
3. Karloh M, Corrêa KS, Martins LQ, Araujo CL, Matte DL, Mayer AF. Chester step test: assessment of functional capacity and magnitude of cardiorespiratory response in patients with COPD and healthy subjects. Brazilian journal of physical therapy. 2013;17:227-35.
4. Sykes K, Roberts A. The Chester step test—a simple yet effective tool for the prediction of aerobic capacity. Physiotherapy. 2004 Dec 1;90(4):183-8.
5. Buckley JP, Sim J, Eston RG, Hession R, Fox R. Reliability and validity of measures taken during the Chester step test to predict aerobic power and to prescribe aerobic exercise. British journal of sports medicine. 2004 Apr 1;38(2):197-205.
6. Chester Step Test – Version 1.0 – 08.09.2014.
7. Renfro MO, Wickstrom R, Emigdio Angeles SP, Colton Cardon SP, Madison Ho SP, Andrea Valdez SP, Dallan Valle SP. PRESIDENT'S MESSAGE.
8. Maggio AB, Vuistiner P, Crettenand A, Tabin R, Martin XE, Beghetti M, Farpour-Lambert NJ, Deriaz O. Adapting the" Chester step test" to predict peak oxygen uptake in children. Swiss medical weekly. 2017 Jun 21;147.
9. Izquierdo MC, Lopes S, Teixeira M, Polónia J, Alves AJ, Mesquita-Bastos J, Ribeiro F. The Chester step test is a valid tool to assess cardiorespiratory fitness in adults with hypertension: reducing the gap between clinical practice and fitness assessments. Hypertension Research. 2019 Dec;42(12):2021-4.
10. Potdar KP, Vardhan GDV. Effect of Chester's step test on physical fitness index in students of age group 18-25 years. Int J Health Sci Res. 2019; 9(10):183-188.
11. Grove T. Chester Step Test in patients with cardiovascular disease: practical applications in a cardiovascular prevention and rehabilitation setting. British Journal of Cardiac Nursing. 2020 Jan 2;15(1): 1-0.
12. de Camargo AA, Justino T, de Andrade CH, Malaguti C, Dal Corso S. Chester step test in patients with COPD: reliability and correlation with pulmonary function test results. Respiratory care. 2011 Jul 1;56(7):995-1001.
13. Williams L, Wilkins L. ACSM's guidelines for exercise testing and prescription. American College of Sports Medicine. 2009:152-80.
14. Chandrasekaran B, Reddy KC. Six-minute walk test as a guide for walking prescription for patients with chronic obstructive pulmonary diseases. Indian J Respir Care. 2018 Jul 1;7(2):73.
15. Ramanathan RP, Chandrasekaran B. Reference equations for 6-min walk test in healthy Indian subjects (25-80 years). Lung India. 2014 Jan 1;31(1): 35-8.
16. ATS A. Statement: guidelines for the six-minute walk test. ATS Committee on Proficinecy Standards for Clinical Pulmonary Function Laboratories. Am J Respir Crit Care Med. 2002;166(111-117).
17. https://www.topendsports.com/testing/warm-up.htm, Accessed 12/22/2019
18. https://www.topendsports.com/medicine/stretches/lunge-side.htm, Accessed 12/23/2019
19. https://www.exercisegoals.com/forward-bends.html
20. Borg GA. Psychophysical bases of perceived exertion. Medicine and science in sports and exercise. 1982 Jan 1;14(5):377-81.
21. Kumar TS, Kilani K, Swathi G. Effectiveness of Ground Walking Versus Stair Climbing on Exercise Capacity in Subjects with Moderate Chronic Obstructive Pulmonary Disease. Indian Journal of Physiotherapy & Occupational Therapy. 2020 Apr 1;14(2).
22. Cavalheri V, Donária L, Ferreira T, Finatti M, Camillo CA, Ramos EM, Pitta F. Energy expenditure during daily activities as measured by two motion sensors in patients with COPD. Respiratory medicine. 2011 Jun 1;105(6):922-9.
23. Holland AE, Malaguti C, Hoffman M, Lahham A, Burge AT, Dowman L, May AK, Bondarenko J, Graco M, Tikellis G, Lee JY. Home-based or remote exercise testing in chronic respiratory disease, during the COVID-19 pandemic and beyond: a rapid review. Chronic respiratory disease. 2020 Aug 24;17:1479973120952418.

24. Burton DA, Stokes K, Hall GM. Physiological effects of exercise. Continuing Education in Anaesthesia, Critical Care & Pain. 2004 Dec 1;4(6):185-8.

25. Herrmann SD, Willis EA, Ainsworth BE, Barreira TV, Hastert M, Kracht CL, Schuna Jr JM, Cai Z, Quan M, Tudor-Locke C, Whitt-Glover MC. 2024 Adult Compendium of Physical Activities: A third update of the energy costs of human activities. Journal of Sport and Health Science. 2024 Jan 1;13(1):6-12.

26. Alves A, Oliveira A, Ferreira PG, Martins V, Marques A. Reliability and validity of the Chester step test in patients with interstitial lung disease. Pulmonology. 2022 Dec 5.

27. de Andrade CH, De Camargo AA, De Castro BP, Malaguti C, Dal Corso S. Comparison of cardiopulmonary responses during 2 incremental step tests in subjects with COPD. Respiratory Care. 2012 Nov 1;57(11):1920-6.

Prevalence of Locomotor Disability amongst the Physically Challenged population of Ahmednagar District – A Retrospective Study

[1]Samruddhi Petkar, [2]Sayali Khairnar, [3]Deepak Anap

[1]BPT, Vithalrao Vikhe Patil Foundation's College of Physiotherapy, Sayali Khairnar, [2]MPT, Musculoskeletal Physiotherapy, Vithalrao Vikhe Patil Foundation's College of Physiotherapy, [3]PhD, Professor and HOD, Musculoskeletal Physiotherapy, Vithalrao Vikhe Patil Foundation's College of Physiotherapy

How to cite this article: Samruddhi Petkar, Sayali Khairnar, Deepak Anap. Prevalence of Locomotor Disability amongst the Physically Challenged population of Ahmednagar District – A Retrospective Study. Indian Journal of Physiotherapy and Occupational Therapy / Vol 19 No 2 April-June 2025

Abstract

Background: Locomotor Disability is one of the major public health problems in the developing countries. Eighty percent of the physically challenged population reside in rural areas. Therefore, this study was carried out in the rural population of Ahmednagar as it will be a useful contribution in proper health care planning for the people with locomotor disability.

Method: It was a retrospective study carried out in the population of Ahmednagar with a convenient sampling method. Inclusion Criteria for the study was, both Gender and the physically challenged people who were assessed during the 'Assistance to Disabled Persons' camp. Screening was started in January 2022 and ended in December 2022

Result: The total prevalence of Locomotor Disability in Ahmednagar District was 448 out of total 925 physically challenged population (48.4%). Prevalence of Males affected (74.3%) is more as compared to the females (25.7%). Various causes of locomotor disability were Post-Polio Residual Palsy (48%), Amputation (15%), Stroke (14%), Cerebral Palsy (10%) and Trauma (3%) etc.

Conclusion: It was observed that the prevalence of Locomotor Disability is more than that of the other disabilities in the physically challenged population of Ahmednagar. Amongst them post-polio residual palsy was the most common cause of Locomotor Disability.

Keywords: Disabled, Locomotor Disability, Physically challenged, Prevalence.

Introduction or back ground

Disability has been defined by World Health Organization (WHO) as impairment, limitation, or restriction in activity caused mainly by health issues and environmental factors. [1] According to WHO estimates, 10% of the world's population has some kind of disability and around 80% of the disabled population resides in rural areas.[2] The prevalent disability rates vary vividly due to differing definitions of disability, different methodologies of data collection, and variation in the quality of study design.[3]

Corresponding Author: Sayali Khairnar MPT, Musculoskeletal Physiotherapy, VithalraoVikhePatil Foundation's College of Physiotherapy

E-mail: sayalibkhairnar@gmail.com

Submission: Oct 6, 2024 **Revision:** November 22, 2024 **Published date:** April 11, 2025

Globally, about one billion (15%) individuals face some form of disability, and 20% have severe functional limitations. [1]Over 1 billion people i.e. about 15% of the global population is estimated to be living with disability. Around 975 million (19.4%) persons live with disability and around 190 million (3.8%) have severe forms of disability namely blindness, quadriplegia & severe depression, according to Global Burden of Disease.[2]

As per Census 2011, in India, out of the 121 Crore population, about 2.21% of the total population is Disabled. Among the total disabled in India, 12.6 million and 9.3 million are males and females, respectively.[4] As per 2011 census, around 1.46 Lakh people In Ahmednagar District around are reported as physically challenged in Ahmednagar District.

The most common form of disability is Locomotor Disability.[1] Definition of Locomotor Disability is, a person's inability to execute distinctive activities associated with movements of self and objects resulting from affliction of musculoskeletal or nervous system or both.[5] Locomotor disability is considered to be the most important single physical disability because of its dramatic effects on the activities of daily life. [5] Locomotor disabilities accounted for 44.70%. [1] Locomotor disability is significantly more common in Indian men than in Indian women.[1]

The people with disability suffer from poverty, low literacy and unemployment more than the general population.[6]

Various causes of traumatic Locomotor Disability include - road traffic accidents, railway accidents, falls, bullet injuries, machine injuries. [7]It is observed that of all, persons having Locomotor Disability, the proportion (per 1000) of them with deformity of limb is the maximum among the different types of Locomotor Disability.[7]

National Sample Survey Organization (NSSO) did a survey, which showed that 15% of the elderly population in Rural Uttar Pradesh suffered from Locomotor Disability.[7] A large scale sample survey reported that 63.70% elderly suffered from Locomotor Disability.[7] A study done in New Delhi showed that 4.80% of the elderly suffered from Locomotor Disability.

There are various factors like economic status, literacy, age group and the geographical area due to which there are difference in the prevalence of locomotor disability in the literature. There is lack of literature on prevalence of Locomotor Disability in Maharashtra and Ahmednagar District. So this retrospective study aimed at determining the prevalence of Locomotor disability in physically challenged population of Ahmednagar City.

Material and Methods

It was a retrospective observational study conducted at District Disability Rehabilitation Centre (DDRC), Ahmednagar. A total of 925 physically challenged patients who visited the assessment camps, which was arranged by DDRC Ahmednagar and ALIMCO Kanpur in the year 2022, were conveniently sampled with Locomotor Disabilities and the data was analyzed in the study.

The data was derived from the statistics of assessment camps of the DDRC, Ahmednagar. Study population comprised of both male and female, with age ranging from 1-80 years and already diagnosed with a specific disability by Civil Hospital, Ahmednagar. Data was collected from statistics of the assessment camp and total prevalence of Locomotor Disability was calculated.

Table no.1 and Fig no. 1 shows the prevalence of Locomotor Disability from Total number of physically challenged population. Total number of people with Locomotor Disability were 448/925 with a percentage prevalence of 48.40%.

Table 1. Total number of physically challenged individuals with locomotor disability:

Total no. of physically challenged people	Total no. of physically challenged with Locomotor Disability	Prevalence of Locomotor Disability
925	448	48.4%

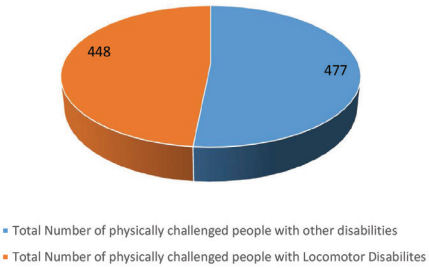

Figure 1: prevalence of locomotor disability

Table no.2 and Fig no. 2 shows the Gender-wise prevalence of Locomotor Disability among the people affected with Locomotor Disability. Number of affected males were 333 and females were 115 with percentage prevalence of 74.3% and 25.7% respectively.

Table 2. Gender-wise prevalence of locomotor disability:

No. with Locomotor Disability	Gender	No. affected	Prevalence
448	Male	333	74.3%
448	Female	115	25.7%

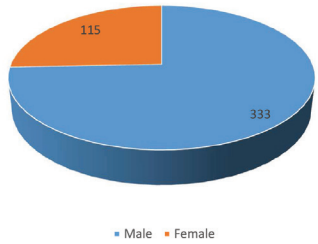

Figure 2: Gender-Wise prevalence

Table no.3 and Fig no. 3 shows the age wise prevalence of Locomotor Disability. The number of people affected with Locomotor Disability were more in the age groups of 31-40 years and 41-50 years with percentage prevalence of 20.76% and 21.88% respectively.

Table 3. Age-wise prevalence of locomotor disability:

Age Group	No. affected	Prevalence
1–10	18	4.02%
11–20	66	14.73%
21–30	60	13.39%
31–40	93	20.76%
41–50	98	21.88%
51–60	64	14.29%
61–70	27	6.03%
71–80	18	4.02%

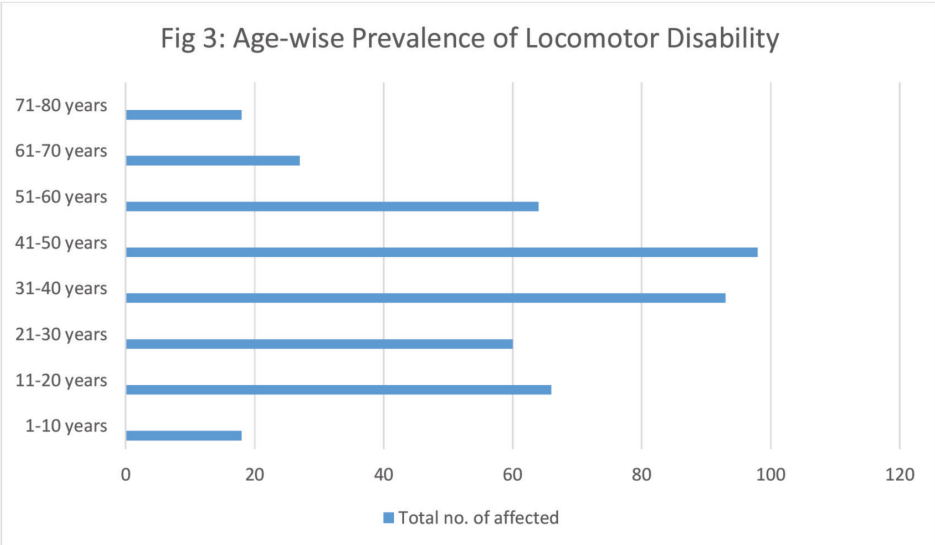

Figure 3: Age-Wise prevalence of locomotor disability

Table no. 4 and Fig no. 4 shows the percentage-wise prevalence of locomotor Disability. The number of affected people with Locomotor Disability were more in the interval of 71-80% (severe disability) with percentage prevalence of 24.8%.

Table 4. Percentage-wise prevalence of locomotor disability

Percentage of disability	No. affected	Percentage
40–50%	87	19.4%
51–60%	97	21.8%
61–70%	42	9.29%
71–80%	111	24.8%
81–90%	43	9.7%
91–100%	67	15%

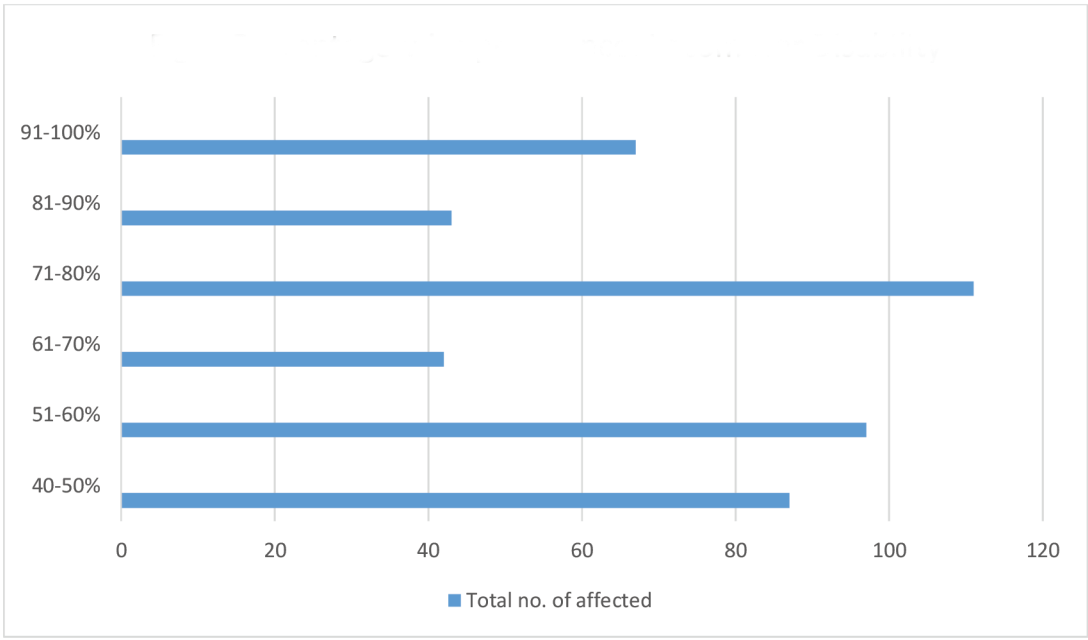

Figure 4: Percentage-Wise prevalence: locomotor disability

Table no.5 and Fig no. 5 shows the prevalence of Diagnosis in Locomotor Disability. The Post-Polio Residual Paralysis (PPRP) was the most common cause for the Locomotor Disability (48%) followed by Amputation, Stroke, Cerebral Palsy (CP), Trauma, Ankylosing Spondylitis and other congenital causes.

Table 5. Prevalence of diagnosis in locomotor disability:

Diagnosis	No. affected	Prevalence
Post-Polio Residual Paralysis (PPRP)	215	48%
Amputation	67	15%
Stroke	63	14%
Cerebral Palsy (CP)	45	10%
Trauma	13	3%
Ankylosing spondylitis	9	2%
Congenital	9	2%

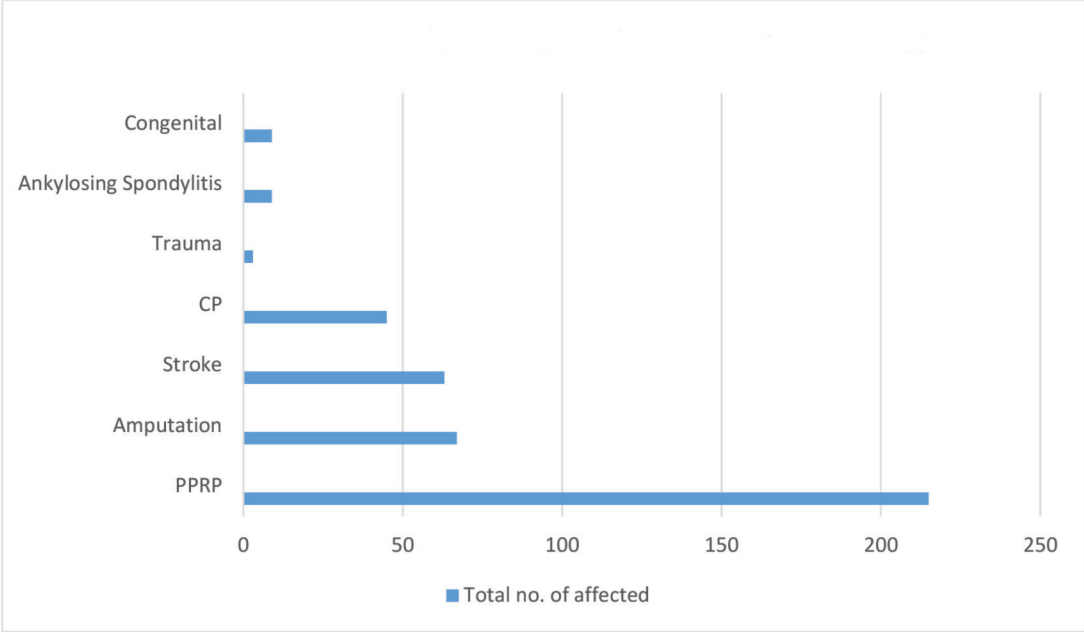

Figure 5: Prevalence of diagnosis In Locomotor Disabilities

Results

The study was conducted in Ahmednagar District to determine the prevalence of Locomotor Disability among the physically challenged population. A total of 925 individuals who attended the Assistance to Disabled Persons (ADIP) camp were included in the study. The analysis focused on the prevalence of locomotor disability and its distribution by gender, age, percentage of disability and causes. The data on individuals with locomotor disability were categorized by gender, age, percentage of disability, and diagnosis, followed by an analysis to calculate the prevalence percentages for each category.

Discussion

The overall prevalence of locomotor disability in Ahmednagar, based on data from the District Disability Rehabilitation Centre (DDRC), was found to be 48.40%. The prevalence was significantly higher in males (74.3%) compared to females (25.7%). The highest rates of locomotor disability were observed in the 31-40 and 41-50 age groups, with prevalence rates of 20.76% and 21.88%, respectively. The most common cause of locomotor disability was Post-Polio Residual Paralysis (PPRP), followed by amputation, stroke, cerebral palsy, trauma, ankylosing spondylitis, and congenital disorders.

In this study, the overall prevalence of locomotor disability was 48.40%. This result aligns with findings by Mohd Maroof et al., who reported a prevalence of 25.8% (sample size = 225), though this percentage is slightly lower than the one found in our study.[8] Other studies conducted earlier revealed different prevalence rates: 10% in Bareilly (sample size = 900)[9], 2.08% in Jodhpur District (sample size = 1,656)[5], 1.8% in rural Karnataka (sample size = 100)[10], 0.92% in rural Goa (sample size = 4,868), 5.57% in Mumbai slums (sample size = 3,665)[12], 0.91% in rural Puducherry (sample size = 4,040)[13], and 3.7% in rural Uttar Pradesh (sample size = 2,107)[7]. The variation in prevalence rates may be due to differences in the age groups studied. Our study included individuals ranging from 1 to 80 years of age, whereas other studies focused on specific age groups, such as the elderly, as in Mahmood S. et al.'s study.[9]

Our findings suggest that males are more likely to experience locomotor disability than females, with a prevalence of 74.3% compared to 25.7%. This

contrasts with a study conducted in rural Haryana, where disability was found to be lower in men (35.9%) than in women (38.8%).[14] This discrepancy may be attributed to factors such as males being more prone to accidents, injuries, and non-communicable diseases due to their participation in risky activities and physically demanding jobs, including mining, telecommunications, electrical work, and commercial driving.[14]

In terms of age, our data analysis showed that locomotor disability was more prevalent in adults aged 31-40 and 41-50, with rates of 20.76% and 21.88%, respectively. This is consistent with the findings of Yadav and Singh et al. (2020), who reported that adults have a higher prevalence of disability compared to children and older adults. This increased prevalence may be linked to a higher incidence of non-communicable diseases, road traffic accidents, and risky behaviors such as alcoholism, tobacco use, and drug abuse.[15]

This study is the first, to our knowledge, to analyze the relationship between the percentage of locomotor disability and its prevalence. Our results indicate that individuals with 71-80% disability made up the largest group of affected patients, accounting for 24.80%.[16]

There are various known causes of locomotor disability in the literature. In our study, Post-Polio Residual Paralysis (PPRP) was the most common cause, with a prevalence of 48%, followed by amputation (15%), stroke (14%), cerebral palsy (10%), trauma (3%), ankylosing spondylitis (2%), and other congenital causes (2%). Our findings are consistent with a study by Halder S. et al., which found polio to be the most common cause of locomotor disability, with a prevalence of 46%. Polio is a highly infectious viral disease that attacks the nervous system, often resulting in irreversible paralysis, particularly in the legs. The higher prevalence of PPRP in rural populations may be due to factors such as malnutrition, poor hygiene and sanitation, illiteracy, lack of disease awareness, and delayed or insufficient medical care. These conditions facilitate the spread of infectious diseases like polio and may contribute to the progression and severity of the disease.[16]

Physiotherapy rehabilitation can be highly beneficial for individuals with locomotor disabilities by addressing physical limitations and improving quality of life through pain management, enhanced mobility, balance and coordination, use of assistive devices, and customized treatment plans. Rehabilitation can help patients achieve functional independence and prevent complications.[17, 18] Therefore, there is a need to raise awareness among rural populations about the benefits of physiotherapy to improve their quality of life.

Conclusion

The overall prevalence of locomotor disability in Ahmednagar District is 48.40%. To address this issue, intervention strategies should focus on education, health promotion, and awareness about rehabilitation services, ensuring that government-provided services are accessible to all who need them.

Limitations

This study focused on individuals who were already certified with locomotor disabilities. There may be undiagnosed secondary disabilities or musculoskeletal dysfunctions present, which would require further assessment.

Conflict of Interest

Nil

Sources of Funding

Self

Ethical Clearance

Ethical Clearance was obtained from Institutional Ethical committee on 3rd February 2023.

References

1. Pattnaik S, Murmu J, Agrawal R, Rehman T, Kanungo S, Pati S. Prevalence, pattern and determinants of disabilities in India: Insights from NFHS-5 (2019-21). Front Public Health. 2023 Feb 27;11:1036499. doi: 10.3389/fpubh.2023.1036499. PMID: 36923034; PMCID: PMC10009251.

2. Hartley S, Ilagan V, Madden R. World report on Disability 2011 – World Health Organization.
3. Sanhori Z, Lien L, Hauff E, Ayazi T, Mdala I, Eide AH. Change in Disability Associated with Psychological Distress among Internally Displaced Persons in Central Sudan. Int J Environ Res Public Health. 2022 Apr 28;19(9):5347. doi: 10.3390/ijerph19095347. PMID: 35564742; PMCID: PMC9104266.
4. World Report on Disability 2011. Geneva: World Health Organization; 2011. 2, Disability – a global picture. Available from: https://www.ncbi.nlm.nih.gov/books/NBK304071/
5. Mishra K, Siddharth V, Bhardwaj P, Elhence A, Jalan D, Raghav P, Mahmood SE. The prevalence pattern of locomotor disability and its impact on mobility, self-care, and interpersonal skills in rural areas of Jodhpur District. Nigerian Medical Journal: Journal of the Nigeria Medical Association. 2019 May;60(3):156.
6. Banks LM, Kuper H, Polack S. Poverty and disability in low- and middle-income countries: A systematic review. PLoS One. 2017 Dec 21;12(12):e0189996. doi: 10.1371/journal.pone.0189996. Erratum in: PLoS One. 2018 Sep 26;13(9):e0204881. PMID: 29267388; PMCID: PMC5739437.
7. Srivastava DK, Khan JA, Pandey S, Pandey R, Shah H. Prevalence of physical disability in rural population of district Mau of Uttar Pradesh. India during May 2007. Glob J Med Public Health 2007;1:19.
8. Maroof M, Ahmad A, Khalique N, Ansari MA. Locomotor problems among rural elderly population in a district of Aligarh, North India. Journal of Family Medicine and Primary Care. 2017 Jul;6(3):522.
9. Mahmood SE, Singh A, Zaidi ZH. Disability in the rural areas of Bareilly, India. Indian Journal of Health Sciences and Biomedical Research (KLEU). 2015 Jul 1;8(2):115.
10. Ganesh KS, Das A, Shashi JS. Epidemiology of disability in a rural community of Karnataka. Indian J Public Health. 2008 Jul-Sep;52(3):125-9. PMID: 19189833.
11. Borker S, Motghare DD, Kulkarni MS, Venugopalan PP. Prevalence and causes of locomotor disability in the community staying near the rural health center in Goa: A community-based study. Indian Journal of Community Medicine. 2010 Jul 1;35(3):448.
12. Padhyegurjar SB, Padhyegurjar MS. Study of factors affecting individuals having locomotor disability and their adjustment with their families in urban slums of Mumbai. Indian J Public Health Res Dev 2014;5:3943.
13. Suganthi S, Kandaswamy M. Prevalence and pattern of locomotor disability in rural Puducherry. Int J Curr Res Rev 2015;7:503.
14. Gupta P, Mani K, Rai S, Nongkynrih B, Gupta S. Author' s Reply to 155_14 and 233_14: Functional disability among elderly persons in a rural area of Haryana. Indian J Public Health. (2014) 58:293–4. doi: 10.4103/0019-557X. 146310
15. Kumar Yadav A, Singh A. Age- and Sex-Specific Burden of Morbidity and Disability in India: A Current Scenario [Internet]. Evaluation of Health Services. IntechOpen; 2020. Available from: http://dx.doi.org/10.5772/intechopen.89709
16. Halder S, Talukdar A. Nature and Causes of Locomotor Disabilities in India. Journal of the American Academy of Special Education Professionals. 2013;48:62.
17. Prosser LA, Skorup J, Pierce SR, Jawad AF, Fagg AH, Kolobe THA, Smith BA. Locomotor learning in infants at high risk for cerebral palsy: A study protocol. Front Pediatr. 2023 Feb 23;11:891633. doi: 10.3389/fped.2023.891633. PMID: 36911033; PMCID: PMC9995839.
18. Mikhailova AA, Korchazhkina NB, Koneva ES, Sidyakina IV, Lupanova KV, Kotenko KV. Possibilities of physiotherapy methods for improving the microcirculation of the affected limb in patients with spasticity after acute cerebral circulation during the late recovery period. VoprKurortolFizioter Lech Fiz Kult. 2022;99(6. Vyp. 2):19-25. Russian. doi: 10.17116/kurort20229906219. PMID: 36511462.

Establishing the Correlation between Identifying Slow and Advanced learners Scale on Regular Academics among Undergraduate Students

[1]Sushil Kumar, [2]Sanjiv Kumar

[1]Assistant Professor, Department of Biomechanics, KAHER Institute of Physiotherapy, Karnataka, Belagavi, India, [2]Professor and Principal, Head of Department of Neuro-Physiotherapy, KAHER Institute of Physiotherapy, Karnataka, Belagavi, India

How to cite this article: Sushil Kumar, Sanjiv Kumar. Establishing the correlation between identifying slow and advanced learners scale on regular academics among undergraduate students. Indian Journal of Physiotherapy and Occupational Therapy / Vol 19 No 2 April-June 2025

Abstract

Purpose: Education is changing drastically with innovation impacting it the most. Bringing changes in the constantly changing world is important. This can only occur when we identify and categorizeour students into various types of learners, which can help us correctly deliver the knowledge. This was achieved by using the traditional method of categorizing the scores of students from the previous exams they have taken for example their 12th marks or previous years result. This method does not contain other domainsthat can focus on areasthat can improve the overall score of the student as a learner. The study aimed to find the reliability and correlation to effectively identify slow and advanced learners.

Methods: The study was conducted at a health university. First-year BPT undergraduate students were selected to identify slow and advanced learners. Data collection was carried out by a subject teacher appointed to assess students during class sessions. Students were evaluated per lecture, using the tool over the whole academic year.

Results: The overall scale demonstrates strong internal consistency with a Cronbach's alpha of 0.9307. While most items contribute positively to the scale's reliability. The correlations between total scores and other scores show that higher academic performance in these areas is positively associated with total scores.

Conclusions: The tool demonstrates strong reliability and validity in identifying slow and advanced learners, making it a valuable resource for educators aiming to enhance student learning outcomes.

Keywords: slow and advanced learner, identifying slow and advanced learner scale, reliability, correlation

Introduction

In today's educational landscape, the diversity of learning abilities among students has become increasingly evident. As educators strive to provide quality education to all, one of the fundamental challenges they face is the identification and support of slow and advanced learners.[1] Traditional educational systems often employ a one-size-fits-all approach, which inadequately addresses the unique needs of each learner.[2] This discrepancy can lead to slow learners falling behind and advanced learners not being sufficiently challenged, thereby hindering their educational progress.[3]Recognizing

Corresponding Author: Professor and Principal, Head of Department of Neuro-Physiotherapy, KAHER Institute of Physiotherapy, Karnataka, Belagavi, India

E-mail: sanjiv3303@rediffmail.com

Submission: Oct 7, 2024 **Revision:** November 25, 2024 **Published date:** April 11, 2025

these limitations, the development of tools to better identify and support these distinct groups of learners has become a critical objective.[4]

Existing methods for identifying learners who deviate from the norm in terms of learning pace are often subjective and based on limited criteria, such as standardized test scores and teacher observations.[1] While these methods can offer some guidance, they frequently lack the depth needed to fully capture the complexities of individual learning processes. For slow learners, this can result in delayed identification and intervention, exacerbating learning gaps over time. Conversely, advanced learners may not receive the stimulation and resources they require to continue progressing, potentially leading to disengagement and underachievement.[5]

The development of a tool has significant implications for educational practices. With more precise data on learner capabilities, educators can design targeted interventions that address specific learning challenges or accelerate advanced learners.[6] For slow learners, this could mean the implementation of tailored support programs, differentiated instruction, and regular progress monitoring. For advanced learners, this tool could facilitate access to enriched curriculum, advanced placement opportunities, and mentorship programs.[7] Ultimately, this targeted approach can enhance educational outcomes, foster a more inclusive learning environment, and contribute to the overall goal of equitable education.[8,9]

The purpose of this study is to present a comprehensive framework and assess the reliabilityof a tool (identifying slow and advance learner scale) and its correlationto identify slow and advanced learners effectively. This tool employs a data-driven methodology that considers various educational metrics, behavioural patterns, and cognitive abilities to create a nuanced understanding of each learner's capabilities. By doing so, it provides educators with actionable insights to tailor their teaching strategies, ensuring that each student receives the appropriate level of support and challenge.

The introduction of a novel tool for the identification of slow and advanced learners seeks to bridge these gaps by integrating multiple data sources and advanced analytical techniques. By utilizing a more holistic approach, this tool can provide a more accurate and timely identification of learners' needs. This comprehensive analysis allows for a more personalized educational experience that aligns with each student's unique learning profile.

Procedure

The study was conducted at a health university, where a specialized[Identifying Slow and Advance Learner Scale (ISAL)] tool was developed and patented. First-year BPT undergraduate students were selected to identify slow and advanced learners. Data collection was carried out by a subject teacher appointed to assess students during class sessions. A maximum of five students were evaluated per lecture, using the tool developed for this purpose. This assessment process continued throughout the academic year. After scoring all the students, their 12th-grade marks and internal assessments were recorded, and an overall score was calculated. The collected data was then recorded and analysed.

The tool comprises five components: Lesson Awareness, Lecture Deliberation, Practice, Recall, and Performance. Lesson Awareness and Lecture Deliberation each include four subsets, Practice includes three subsets, and Recall and Performance each have two subsets. Each subset was scored on a scale from 0 to 4, with 0 representing poor, 1 as fair, 2 as average, 3 as good, and 4 as excellent. The lowest possible score for a subset was 0, and the highest was 4.

Students were categorized based on their overall score as follows: a score of 0 to 15 indicated a poor learner, 16 to 30 indicated a below-average learner, 31 to 40 indicated an average learner, 41 to 50 indicated a good learner, and 51 to 60 indicated an advanced learner. Additionally, classification was based on 12th-grade marks and class test performance: students scoring less than 40% were classified as poor learners, less than 50% as below-average learners, 50% to 60% as average learners, 60% to 85% as good learners, and more than 85% as advanced learners. The identification of slow and advanced learners

was further refined using theReceiver-operating characteristic curve (ROC), with details provided in the Results section.

Statistical Analysis

The data was analysed using SPSS software, version 29.0. To assess the reliability of the tool, Cronbach's alpha test was employed, which measures the internal consistency of a scale. This test evaluates whether different items within the scale are related to each other, indicating their reliability. The correlation between 12th-grade marks, overall scores, and internal assessment marks was determined using Pearson's correlation coefficient. A t-test was conducted to compare the marks between male and female students. Additionally, to identify slow and advanced learners, the ROC curve was utilized. This analysis illustrates the sensitivity (true positive rate) versus (1 - specificity) (false positive rate) across the entire range of test thresholds.

Table 1. Overall Cronbach alpha: 0.9307 Standardized alpha: 0.9313

Items	Mean if deleted	SD if deleted	Item total correlation	Alpha if deleted
1.1	36.1212	7.9191	0.7076	0.9249
1.2	36.2020	7.8031	0.7605	0.9231
1.3	36.4950	7.8346	0.7389	0.9238
1.4	36.5859	7.9137	0.6639	0.9261
2.1	35.7273	8.0489	0.6441	0.9269
2.2	35.8283	8.1004	0.5298	0.9295
2.3	36.7475	7.8320	0.6394	0.9274
2.4	37.1313	7.9119	0.5699	0.9296
3.1	36.3232	7.9313	0.6473	0.9266
3.2	36.1212	8.0344	0.6586	0.9265
3.3	36.0808	7.8890	0.7522	0.9236
4.1	36.1616	7.8363	0.7926	0.9224
4.2	36.3434	7.7683	0.8195	0.9213
5.1	36.0808	7.9515	0.7757	0.9236
5.2	36.6364	8.2724	0.2756	0.9354

Table 2. Spilt half reliability of the scale

Summery	Value
Cronbach alpha, full scale	0.9308
Standardized alpha	0.9310
Cronbach alpha, first half	0.8660
Cronbach alpha, second half	0.8598
Split-half reliability	0.9591
Guttman split-half	0.9550
Intrinsic validity	0.9793

Table 3. Correlation between Total scores with 12th marks and internals marks by Karl Pearson's correlation coefficient

Variables	Mean	Std.Dv.	r-value	t-value	p-value
Total scores	71.2632	9.1235			
12th marks	38.8947	8.2171	0.2890	2.9113	0.0045*
Total scores	9.1684	2.2344			
1st internal	38.8947	8.2171	0.2681	2.6836	0.0086*
Total scores	10.6526	2.6847			
2nd internal	38.8947	8.2171	0.2269	2.2467	0.0270*
Total scores	10.1263	2.5401			
3rd internal	38.8947	8.2171	0.3865	4.0411	0.0001*

*p<0.05

Table 4. Comparison of male and female students with total scores, 12th marks and internals marks by t test

Variables	Male		Female		t-value	p-value
	Mean	Std.Dev.	Mean	Std.Dev.		
Total scores	37.48	5.83	39.28	9.11	–0.8603	0.3917
12th marks	69.62	9.30	71.54	8.98	–0.8628	0.3904
1st internal	8.45	2.80	9.27	2.09	–1.4522	0.1497
2nd internal	9.43	3.26	10.81	2.56	–2.0544	0.0427*
3rd internal	9.14	2.78	10.39	2.41	–2.0398	0.0441*

*p<0.05

Table 5. Sensitivity and specificity summery

Cut off Value		95% CI			95% CI		LR+	PPV	NPV	Accuracy	
		Lower	Upper		Lower	Upper					
>=26	0.9583	0.8575	0.9949	0.0784	0.0218	0.1888	1.0399	0.4946	0.6667	0.5051	0.0368
>=27	0.9583	0.8575	0.9949	0.0980	0.0326	0.2141	1.0625	0.5000	0.7143	0.5152	0.0564
>=28	0.9167	0.8002	0.9768	0.0980	0.0326	0.2141	1.0163	0.4889	0.5556	0.4949	0.0147
>=29	0.8958	0.7734	0.9653	0.1176	0.0444	0.2387	1.0153	0.4886	0.5455	0.4949	0.0135
>=30	0.8958	0.7734	0.9653	0.1373	0.0570	0.2626	1.0384	0.4943	0.5833	0.5051	0.0331
>=31	0.8542	0.7224	0.9393	0.1569	0.0702	0.2859	1.0131	0.4881	0.5333	0.4949	0.0110
>=32	0.8542	0.7224	0.9393	0.2157	0.1129	0.3532	1.0891	0.5062	0.6111	0.5253	0.0699
>=33	0.8542	0.7224	0.9393	0.2549	0.1433	0.3963	1.1464	0.5190	0.6500	0.5455	0.1091
>=34	0.8125	0.6737	0.9105	0.3137	0.1911	0.4589	1.1839	0.5270	0.6400	0.5556	0.1262
>=35	0.7500	0.6040	0.8636	0.3725	0.2413	0.5192	1.1953	0.5294	0.6129	0.5556	0.1225
>=36	0.6875	0.5375	0.8134	0.3725	0.2413	0.5192	1.0957	0.5077	0.5588	0.5253	0.0600
>=37	0.6667	0.5159	0.7960	0.4902	0.3475	0.6340	1.3077	0.5517	0.6098	0.5758	0.1569
>=38	0.6458	0.4946	0.7784	0.5686	0.4225	0.7065	1.4972	0.5849	0.6304	0.6061	0.2145
>=39	0.5625	0.4118	0.7052	0.6078	0.4611	0.7416	1.4344	0.5745	0.5962	0.5859	0.1703

Continue....

>=40	0.5000	0.3523	0.6477	0.6863	0.5411	0.8089	1.5938	0.6000	0.5932	0.5960	0.1863
>=41	0.4792	0.3329	0.6281	0.7059	0.5617	0.8251	1.6292	0.6053	0.5902	0.5960	0.1850
>=42	0.4792	0.3329	0.6281	0.7255	0.5826	0.8411	1.7455	0.6216	0.5968	0.6061	0.2047
>=43	0.3750	0.2395	0.5265	0.7451	0.6037	0.8567	1.4712	0.5806	0.5588	0.5657	0.1201
>=44	0.2917	0.1695	0.4406	0.8039	0.6688	0.9018	1.4875	0.5833	0.5467	0.5556	0.0956
>=45	0.2708	0.1528	0.4185	0.8039	0.6688	0.9018	1.3813	0.5652	0.5395	0.5455	0.0748
>=47	0.2708	0.1528	0.4185	0.8627	0.7374	0.9430	1.9732	0.6500	0.5570	0.5758	0.1336
>=48	0.2292	0.1203	0.3731	0.8627	0.7374	0.9430	1.6696	0.6111	0.5432	0.5556	0.0919
>=49	0.2083	0.1047	0.3499	0.8627	0.7374	0.9430	1.5179	0.5882	0.5366	0.5455	0.0711
>=50	0.1875	0.0895	0.3263	0.8824	0.7613	0.9556	1.5938	0.6000	0.5357	0.5455	0.0699
>=51	0.1875	0.0895	0.3263	0.9020	0.7859	0.9674	1.9125	0.6429	0.5412	0.5556	0.0895
>=52	0.1458	0.0607	0.2776	0.9412	0.8376	0.9877	2.4792	0.7000	0.5393	0.5556	0.0870
>=53	0.1042	0.0347	0.2266	0.9412	0.8376	0.9877	1.7708	0.6250	0.5275	0.5354	0.0453

The Cut-off point of total score is >=38

Table 6. Area under curve (AUC) of accuracy pf predication of high learners

Criterion	Count	AUC	SE	Z-value	P-Value	95% Confidence Limits	
						Lower	Upper
Total scores	99	0.6031	0.0574	1.7970	0.0723	0.4787	0.7038

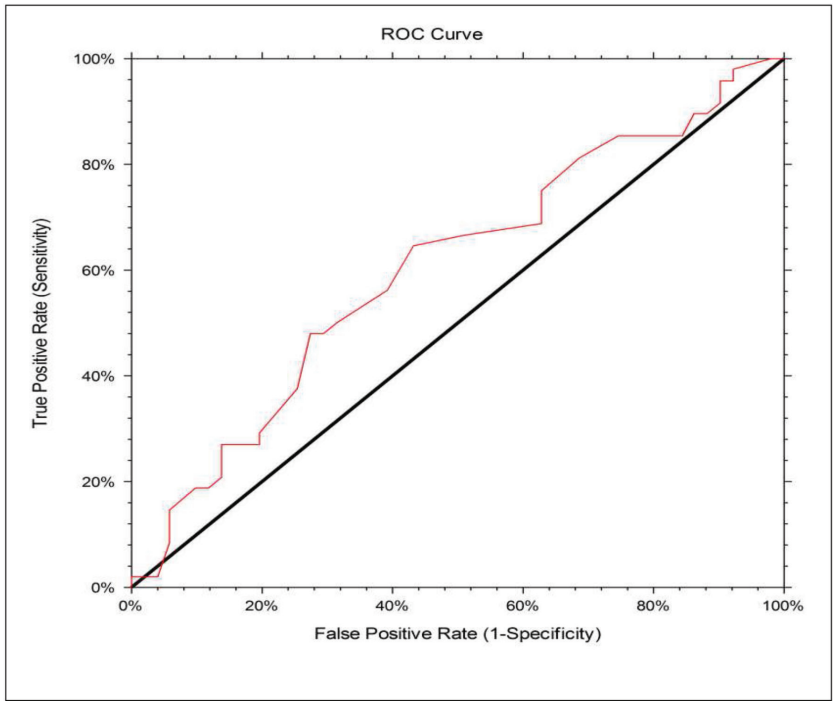

Figure 1: ROC curve

Results

The overall Cronbach's alpha for the scale is 0.9307, and the standardized alpha is 0.9313. These high values indicate excellent internal consistency, suggesting that the scale reliably measures the intended learning attributes across different student groups.

Item Analysis

Each item's contribution to the scale's reliability was analysed to determine its impact on the overall Cronbach's alpha if the item were deleted. Items 1.1 to 4.2 have strong item-total correlations (0.6441 to 0.8195), indicating good alignment with the total scale score. Their removal leads to only a minor decrease in Cronbach's alpha, suggesting they positively contribute to the scale's internal consistency. Items 1.2 (0.7605), 1.3 (0.7389), and 1.4 (0.6639) have high item-total correlations and slightly lower alpha values if deleted (0.9231 to 0.9261), indicating they contribute to the scale's overall consistency but can be removed with minimal impact. In contrast, items 2.2 (0.5298) and 2.4 (0.5699) have lower correlations. Their removal increases Cronbach's alpha to 0.9295 and 0.9296, indicating these items may not align well with the scale's construct and their deletion could enhance reliability.Item 5.2 has a low item-total correlation of 0.2756 and a significantly lower alpha if deleted (0.9354), suggesting it is the least consistent with the scale. Removing it could enhance the overall reliability, indicating it may not effectively measure the intended construct. (Table 1).

The full-scale Cronbach's alpha of 0.9308 indicates high internal consistency. The first half's alpha is 0.8660, and the second half's is 0.8598, both reflecting good reliability but lower than the full scale. The slight difference suggests that both halves are consistent but could be improved to match the overall reliability (Table 1).

Split-Half Reliability (0.9591) and Guttman Split-Half Reliability (0.9550) indicate very high reliability between the two halves of the scale, demonstrating consistent measurement of the construct. A high split-half reliability reflects the scale's internal consistency and stability. Intrinsic Validity (0.9793) shows the scale's effectiveness in accurately measuring the intended construct, highlighting how well the items fit together and comprehensively cover the construct (Table 2).

Correlation

There are moderate positive correlations between total scores and 12th marks ($r = 0.2890$, $p = 0.0045$) and between total scores and 1st internal marks ($r = 0.2681$, $p = 0.0086$), indicating that higher marks in these areas are associated with higher total scores. A weak positive correlation exists between total scores and 2nd internal marks ($r = 0.2269$, $p = 0.0270$), suggesting a weak association. In contrast, there is a strong positive correlation with 3rd internal marks ($r = 0.3865$, $p = 0.0001$), indicating a significant relationship where higher marks correlate strongly with higher total scores (Table 3).

Analysis between the Genders

Comparison of male and female students' academic performance using t-tests reveals no significant differences in total scores, 12th marks, and 1st internal marks ($p > 0.05$). The t-value is close to zero for these metrics, indicating similarity between genders. However, significant differences were found in 2nd and 3rd internal marks ($p < 0.05$), with female students scoring higher in 2nd internal marks, suggesting that gender impacts these scores (Table 4).

Sensitivity and Specificity

Sensitivity: The proportion of true positives correctly identified by the test. It ranges from 0.1042 to 0.9583, with higher values indicating better ability of the test to detect positives when they are present. Specificity: The proportion of true negatives correctly identified. It ranges from 0.0784 to 0.9412, with higher values indicating better ability of the test to identify negatives when they are absent (Table 5).

At a cut-off of 26, sensitivity is high (0.9583), but specificity is low (0.0784), leading to many false positives. While it effectively identifies most

positives, accuracy is low (0.5051) and the Youden Index is also low (0.0368), indicating poor overall performance. Lower cut-offs provide high sensitivity but lack precision, resulting in many incorrectly labelled negatives. (Table 5).

At a cut-off of 38, sensitivity is 0.6458 and specificity is 0.5686, indicating a more balanced performance compared to lower cut-offs. With a Youden Index of 0.2145, this cut-off offers a better overall balance between correctly identifying positives and negatives. Intermediate cut-offs like this one improve overall test performance by effectively balancing sensitivity and specificity (Table 5).

At a cut-off of 52, sensitivity is low (0.1458) while specificity is high (0.9412), indicating the test is effective at identifying negatives but poor at detecting positives. The Youden Index of 0.0870 is lower than at other cut-offs, reflecting less effective overall performance. Higher cut-offs provide high specificity but miss many positives (Table 5).

The cut-off of 38 is optimal, balancing sensitivity (0.6458) and specificity (0.5686) with reasonable accuracy and a higher Youden Index than lower cut-offs. It effectively distinguishes between slow (n = 50) and advanced learners (n = 49), categorizing students based on scores. (Table 6 and figure 1).

Discussion

The findings from the current study underscore the robustness of the scale used to assess the academic performance of undergraduate students, as evidenced by the high Cronbach's alpha values of 0.9307 and 0.9313. These figures indicate excellent internal consistency, confirming that the scale effectively measures the intended learning attributes across diverse student populations.

The item analysis reveals that items 1.1 to 4.2 contribute positively to the scale's reliability, with item-total correlations ranging from 0.6441 to 0.8195. These strong correlations suggest that these items align well with the overall construct being measured. Importantly, the minimal decline in Cronbach's alpha upon their removal implies that these items are integral to the scale's reliability. In contrast, items 2.2, 2.4, and especially item 5.2 demonstrate weaker correlations, with the latter exhibiting an item-total correlation of just 0.2756. The significant improvement in Cronbach's alpha if these items were excluded points to their inadequate alignment with the overall construct, suggesting a need for review or potential removal to enhance scale reliability.[10]

The split-half reliability analysis further affirms the scale's consistency, with high reliability coefficients indicating that both halves of the scale measure the intended constructs effectively. The intrinsic validity score of 0.9793 highlights the scale's capacity to accurately assess the relevant attributes, reinforcing the overall efficacy of the measurement tool.[11]

The correlations between total scores and various academic performance metrics reveal insightful trends. Notably, a moderate positive correlation exists between total scores and 12th-grade marks (r = 0.2890) as well as 1st internal marks (r = 0.2681), indicating that higher performance in these areas is associated with better total scores. The strongest correlation is observed with 3rd internal marks (r = 0.3865), suggesting a substantial relationship and highlighting the importance of ongoing academic assessment in predicting overall performance.[12]

Interestingly, the weak positive correlation between total scores and 2nd internal marks suggests that while there is some association, it is less pronounced than with other measures. These findings emphasize the need for targeted support for students, particularly in internal assessments, to optimize overall academic performance.

The analysis reveals no significant differences in total scores, 12th marks, or 1st internal marks between male and female students. However, significant gender differences are noted in 2nd and 3rd internal marks, with female students performing better in these areas. This highlights the complex dynamics of academic performance across genders and suggests that while overall metrics may be similar, specific assessments may reveal gender-related trends that warrant further exploration.[13]

The evaluation of the diagnostic tool reveals varying sensitivity and specificity at different cut-off

points. While the lower cut-off (>=26) demonstrates high sensitivity, it suffers from low specificity, resulting in many false positives. The optimal cut-off of >=38 strikes a balance, providing a reasonable accuracy and better performance in distinguishing between slow and advanced learners. This finding is critical for educators in tailoring interventions based on student performance, ensuring that both high and low performers receive appropriate support.[14]

Conclusion

The tool demonstrates strong reliability and validity in identifying slow and advanced learners, making it a valuable resource for educators aiming to enhance student learning outcomes. Its effectiveness in correlating with academic performance and distinguishing between different learner types highlights its potential for broader application in various educational contexts. ISAL helps the teacher to identify the differential learner and cater them according to the need of the learner. This immediately classify the student into slow and advance learner, a slow learner can be addressed with extra focus and special care to accommodate their need and advance learner can be challenged with lateral information to upgrade their knowledge and can be encouraged be a part of research at an early stage. Further research could explore the tool's applicability across different age groups, disciplines, and cultural settings, as well as investigate the underlying factors contributing to the observed gender differences in academic performance.

Ethical Clearance/: Since the study is an observational study data was collected through the interview method no ethical clearance was taken. Oral consent from the participants was taken.

Conflict of interest: Nil

Source of funding : Nil

References

1. Tomlinson CA, Moon TS. Assessment and student success in a differentiated classroom. Alexandria (VA): ASCD; 2013.
2. Sternberg, R. J., & Grigorenko, E. L.Practical Intelligence and the Role of Traditional Intelligence in Education.Educational Psychologist, 2004; 39*(1), 1-10.*
3. Reis, S. M., & Renzulli, J. S.The Schoolwide Cluster Grouping Model: A Practical Strategy for Differentiating Instruction and Improving Student Learning.Gifted Child Quarterly, 2010; *54*(4), 263-274.
4. Boudah, D. J.The Use of Curriculum-Based Measurement to Identify and Support Struggling Readers.Journal of Learning Disabilities, 2006; 39(2), 148-159.
5. Joffe V, Duffield L. Understanding the needs of students who deviate from the norm: A review of current practices and strategies for improvement.J Educ Psychol.2022;114(3):498-512. doi:10.1037/edu0000452.
6. Fuchs, D., & Fuchs, L. S.Assessment-Based Instruction: Developing Tools to Identify and Address Diverse Learning Needs.J Learn Disabil. 2017;50(5):494-506. doi:10.1177/0022219416633591.
7. Hattie, J.Visible Learning: A Synthesis of Over 800 Meta-Analyses Relating to Achievement.Routledge; 2009.
8. Siemens, G.Learning Analytics: The Emergence of a Discipline.European Journal of Education. 2013;48(3):442-448. doi:10.1111/ejed.12014.
9. Hall T, Vue G, & Palmer D. Differentiated instruction and the role of formative assessment.J Spec Educ.2018;52(4):206-215. doi:10.1177/0022466918771964.
10. Tavakol M, Dennick R. Making sense of Cronbach's alpha. International Journal of Medical Education. 2011;2:53-55. doi:10.5116/ijme.4dfb.8dfd.
11. Field A. Discovering Statistics Using SPSS. 5th ed. London: SAGE Publications; 2018.
12. Reddy M, Sulaiman A. Development and validation of an academic performance assessment scale for university students. Journal of Educational Psychology. 2021;113(4):512-523. doi:10.1037/edu0000461.
13. Gendal H, Bowers A. Gender differences in academic performance: A longitudinal study in higher education. Educational Research and Reviews. 2020;15(6):321-329. doi:10.5897/ERR2019.3898.
14. Elmore R, Kauffman J. Identifying and supporting slow learners: Strategies for higher education. Journal of Higher Education. 2022;93(3):345-362. doi:10.1080/00221546.2022.1234567.

Original Article DOI: https://doi.org/10.37506/y025zn29

Correlation of Visuo-Spatial Skills, Executive Function and Psychomotor Speed on Fall Risk and Overall Functional Mobility in Patients with Parkinson's Disease

Swati Kulkarni[1], Sudhir Bhatbolan[2], Sharmila Dudhani[2] Sriram K[3]

[1]Senior Physiotherapist, QI Spine Clinic, Pune. [2]Professor, SDM College of Physiotherapy, SDM University, Dharwad, [3]Research Scholar, SDM College of Physiotherapy, SDM University, Dharwad

How to cite this article: Swati Kulkarni, Sudhir Bhatbolan Sharmila Dudhan, Sriram K. Correlation of Visuo-Spatial Skills, Executive Function and Psychomotor Speed on Fall Risk and Overall Functional Mobility in Patients with Parkinson's Disease. Indian Journal of Physiotherapy and Occupational Therapy / Vol 19 No 2 April-June 2025

Abstract

Background and Objectives: Spectrum of cognitive impairments, is frequently observed in early stages of Parkinson's disease. Diminished functional mobility, often manifesting as falls, is commonly seen in conjunction with these impairments. This study aims to explore the correlation between visuospatial skills, executive function, and psychomotor speed with fall risk and overall functional mobility in patients with early Parkinson's disease.

Study design: Cross sectional study with correlational analysis.

Methods: 52 Parkinson's patients in Hoehn and Yahr stage 1 and 2 were included and evaluated for Visuospatial skills and Psychomotor speed by using Digit Symbol Substitution Test (DSST), Executive functions by using Trail Making Test-A (TMT-A), Fall-risk and overall functional mobility by Timed Up and Go Test (TUG) with its subscales.

Results: The data normality was established by Kolmogorov Smirnov test and Karl Pearson's correlation coefficient test was used to draw correlational analysis. Significant negative correlation was observed between Visuospatial skills, Psychomotor speed (DSST) with fall risk and overall functional mobility-TUG Normal ($r = 0.3284$), Cognitive Dual task ($r = -0.4270$ and Motor Dual Task $r = -0.4334$) and a significant positive correlation between Executive function (TMT-A) with fall risk and functional mobility-TUG Normal ($r = 0.5846$), Cognitive Dual task ($r = 0.4364$) and Motor Dual Task ($r = 0.4039$).

Conclusions: Results indicate that Visuo spatial skills, Executive function and psychomotor speed have a substantial relationship with fall risk and overall functional mobility as demonstrated by significant correlation between all 3 variants of Timed up and go test.

Keywords: Visuo-spatial skills; Executive function; Psychomotor- speed; Fall risk; Functional mobility.

Corresponding Author: Sudhir Bhatbolan, Professor, SDM College of Physiotherapy, SDM University, Manjushree Nagar, Sattur Dharwad -580009, Karnataka, India.

E-mail: sudhirbhatbolan@sdmuniversity.edu.in

Submission: Oct 25, 2024 **Revision:** December 5, 2024 **Published date:** April 11, 2025

Introduction

Parkinson disease first described in 1817 as a 'shaking palsy' is a progressive neurodegenerative disorder of central nervous system with both motor and non-motor symptoms.[1,2].

A population-based survey in Gujarat, India revealed that age related prevalence rate was 308.9 per 100000 populations above the age of 60.[3] Gender specific prevalence rate was reported higher in men than women in India as well as across the world.[4]

While the disease has a progressive deteriorating effect on mobility and muscle control [3]it may also present with an array of cognitive deficits ranging from subjective-cognitive-decline (PD-SCD) to mild-cognitive-impairment (PD-MCI) and late-stage-dementia (PD-D)[5]. About 31% of diagnosed patients are known to present with measurable cognitive decline**even in the early stages of the disease besides an associated bradyphrenia.[6,7]**

Patients with PD demonstrate limited ability to cope with tasks that require complex cognitive demandsassociated with walking like perceiving and avoiding obstacles, capacity to prioritize and interpret the task demandsand divided attention for dual tasks.[8] The executive function deficit was seen to be associated with gait impairment and freezing of gait (FOG).[9,10] Overall, cognitive abilities are considered vital determinants of one's functional-mobility which is a known predictor of mortality and hospitalization.[11]

A phenomenon of fall is usually an expression of diminished functional mobility and is often seen in patients with Parkinson's disease.[12] It is estimated that 70% to 87% of individuals with Parkinson's disease fall at some point during the course of their disease.[13]It is well emphasized that preserving functional-mobility and preventing falls is one of the most important facets of PD management. Early employment of potential strategies to prevent falls is critical howeverit is an un-met need in PD[14].

In view of the above scenario, precisely understanding the interplay between the specific cognitive components and overall functional-mobility and fall riskcould be deemedsignificant. Further, there are fewer studies, which address the early cognitive decline in Parkinsons and its influence on functional mobility and fall risk. This study was hence conducted, with an objective to evaluate specific cognitive attributes namely executive functions, visuo-spatial skills and psychomotor speed in early stages of PD and further correlate it with fall risk and functional mobility.

Materials and Methods

This cross- sectional study included patients in early stages of Parkinson's disease.The participants were recruited from the urban and sub-urban communities of Hubli-Dharwad.

Purposive sampling was employed **to ensure inclusion, of participants who specifically met the criteria for early PD as determined by screening outcomes and who hadbasic formal education**. **This method was chosen to target individuals with characteristics relevant for this study.**The sample size was calculated considering the age- related prevalence of Parkinson's disease in India[3] over the age of 60, using the formula

$$n = Z^2 \times P \times (1-P)/d^2.$$

where n is the required sample size, prevalence P = 0.00309, Z-score for the desired confidence level for 95%; Z = 1.96, d is the desired precision of 2% the required minimum sample size was calculated as 29.58~ 30 participants. The study was conducted over a duration of 1 year and included 52 participants.

Inclusion criteria: Patients of any gender diagnosed with and in early stages of Parkinson's disease, i.e. Hoehn and Yahr[15]stage 1 and 2, with an ability to read and write (at-least 5 years of formal education) and willing to participate were included.

Exclusion criteria: Patients diagnosed with Alzheimer's disease or Parkinson-plus syndromes, and patients with communication impairments (verbal, nonverbal, or both). Additionally, patients with a history of or co-existing chronic neurological conditions, visual deficits, diabetic neuropathy, or musculoskeletal conditions that limited their independent mobility in the last three months were excluded.

Data Collection: The contact details of patients diagnosed with idiopathic Parkinson's disease by a qualified medical practitioner/ Neurologist were taken from the Medical Record Department and were contacted via a phone call and explained about the research. The patients who were willing to participate were invited to the Neuro-physiotherapy OPD for screening of inclusion and further study procedures. Willing patients who could not visit the outpatient facility were screened for inclusion and evaluated in their home settings by the researcher personally visiting such patients. The patients were explained the study procedure and an information sheet was shared with all requisite details explained. Patients were evaluated in their ON phase of medication. The demographic details of every participant were noted and they were evaluated for visuospatial skills and psychomotor speed by using **Digit symbol substitution test (DSST)[16], executive functions by using Trail making test- Part A (TMT-A)[17], and Functional mobility using Timed up and go test (TUG)[18]** with cognitive and motor dual tasks. The data obtained was analyzed statistically using SPSS version 20.0.

The study was presented to the Institutional Ethics Committee (IEC) of SDM Medical College and Hospital and the approval was obtained. The study was also registered under the Clinical Trials Registry India (CTRI) with No CTRI/2021/01/030811before the patient recruitments were initiated.

Results

The socio-demographic characteristics of the participants i.e. age, gender and educational levels were noted. The present study recruited 52 patients with Parkinson's disease which included 35 (67.31%) male and 17 (32.69%) female participants. Mean age of the participants was 66.52±6.4 years. The level of education of the participants was segregated in 3 categories. The maximum numbers of respondents were in secondary schooling group i.e. 26 (50.0%), 17 (32.69%) were in a category of primary schooling and the least number of participants were in degree + group i.e. 9 (17.51%) participants. While the mean DSST scores were comparable between genders, female gender fared better with mean TMT scores. Both cognitive parameter scores were better among participants with greater educational levels. (Table 1)

Table 1. Mean scores of DSST and TMT as per Gender and Education levels among study population.

Criteria	No. of respondents	% of respondents	DSST score		TMT score	
Gender			Mean	SD	Mean	SD
Male	35	67.31	24.6	8.01	121	47
Female	17	32.69	22.8	9.83	104	45.8
Total	52	100				
Educational level/ Qualification						
Primary	17	32.69	16.9	5.08	145	23
Secondary	26	50	26.2	7.04	101	46.4
Degree+	9	17.31	32.9	7.92	93	58.8
Total	52	100				

Kolmogorov Smirnov test was used to analyze the data normality of Digit Symbol Substitution Test, Trail Making Test Part A, TUG (Normal), TUG (Cognitive) and TUG (Motor) values of study population, and the scores of all these were found to follow a normal distribution. (Table 2) Therefore, the parametric correlational tests were applied for further analysis.

Table 2. Normality of DSST scores, TMT A (secs) scores, TUG Normal (secs), TUG Cog (secs) and TUG Motor (secs) by Kolmogorov Smirnov test.

Variables	Z-value	p-value
DSST scores	1.139	0.149
TMT A (secs)	1.13	0.1546
TUG normal (secs)	1.181	0.123
TUG cog (secs)	1.043	0.227
TUG motor (secs)	1.107	0.1038

Correlation between Executive functions (TMT part A), Visuo spatial skills, psychomotor speed (DSST) and Fall risk and functional mobility (TUG normal, cognitive and motor dual tasks) was done using Karl Pearson's correlation coefficient method. p value ≤ 0.05 (95% CI) was considered as statistically significant.

Table 3. Correlational analysis of DSST and TMT- A scores with TUG (Normal, Cognitive and Motor) scores

Correlation between DSST scores with TUG (normal), TUG (cog) and TUG (motor)	
Variables	**r- value**
TUG Normal (secs)	–0.3284 (p = 0.0175*)
TUG Cog (secs)	–0.4270 (p = 0.0016*)
TUG Motor (secs)	–0.4334 (p = 0.0013*)
Correlation between TMT A (secs) scores with TUG (normal), TUG (cog) and TUG (motor)	
TUG Normal (secs)	0.5846 (p = 0.0001*)
TUG Cog (secs)	0.4364 (p = 0.0012*)
TUG Motor (secs)	0.4039 (p = 0.0001*)

There is a significant negative correlation observed between Visuo- spatial skills, Psychomotor speed (Digit Symbol Substitution Test) with fall risk and overall functional mobility -Timed Up and Go (TUG) Normal, Cognitive and Motor Dual Task. (Table 3 and Figure 1)

A significant positive correlation was observed. between Executive Function (Trail Making Test- Part A) with Fall Risk and Overall Functional Mobility -Timed Up and Go (TUG) Normal, Cognitive, Motor Dual Task. (Table 3 and Figure 2)

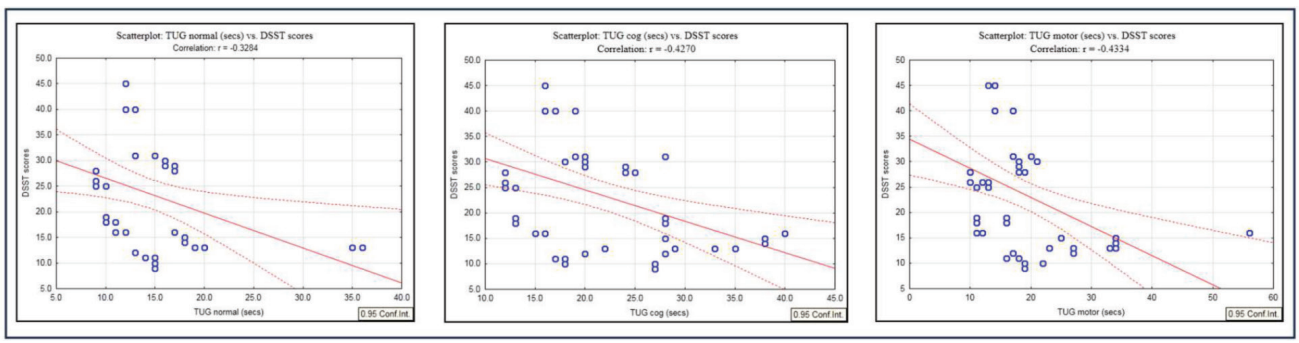

Figure 1: Correlation between DSST scores with TUG Normal (secs), TUG Cog (secs) and TUG Motor (secs).

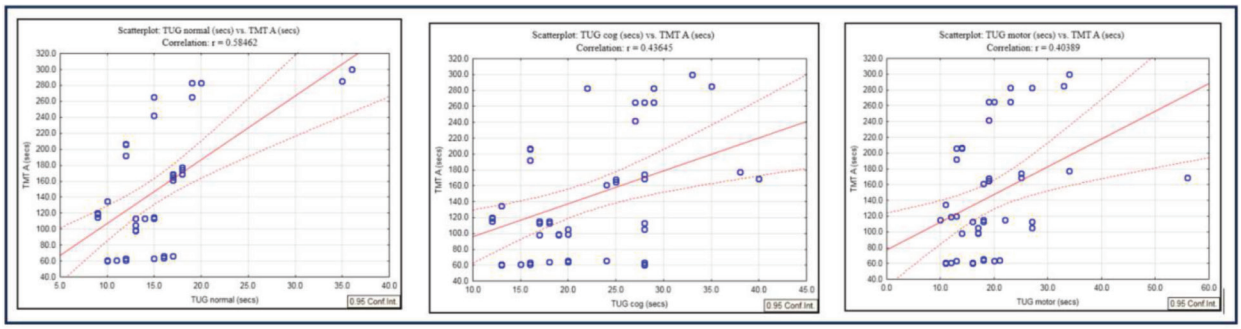

Figure 2: Correlation between TMT A (secs) scores with TUG normal (secs), TUG cog (secs) and TUG motor (secs)

Discussion

Cognitive impairments are known to occur in the early stages of Parkinson's Disease (PD), notably in domains such as executive function, visuospatial skills, attention, and psychomotor speed.[6, 7, 19] These cognitive deficits are critical as they directly impact functional mobility components such as gait, static and dynamic balance, and turning during gait. Literature suggests that executive function and attention are strongly related to gait,[20, 21] while visuospatial skills and attention are linked to measures of static balance and gait initiation.[22]Additionally, impaired psychomotor or processing speed is reported to be associated with difficulties in turning during gait even in early disease stages.[23]

In the early stages of PD, patients generally remain mobile, however the combination of cognitive deficits may impair functional mobility and manifest as an increased risk of falls. Earlier, it was considered that falls are an occurrence in the later stages of the disease[24] primarily due to motor symptoms, and as patients become wheelchair-bound or bedridden, the risk of falling diminishes as they are no longer ambulant. On the contrary, our study findings show early-stage cognitive impairments in PD like executive function, visuospatial skills, and psychomotor speed[19,25, 26,] impacting functional mobility in early stages,as demonstrated by a significant correlation with all three variants of the Timed Up and Go (TUG) test. This outcome aligns with findings of some other previous research reports.[27, 28.] We noted a decline in executive functions in male more than female participants as confirmed by TMT mean scores while psychomotor speed score of DSST were similar between genders. Additionally, all the parameters were progressively better in participants who had greater educational levels and was clearly observable by the mean scores of DSST and TMTwhich corroborates with the earlier reports that higher education is protective and may be predictive of cognitive decline[11]

Postural control requires the integration of multiple systems, including visual, somatosensory, and vestibular systems, with motor processes to maintain spatial position of the body and orientation as per changing environmental conditions.[29] The basal ganglia, modulated by dopaminergic projections, play a crucial role in mediating cognitive and motor functions to produce appropriate actions. PD patients exhibit a significant reduction in dopaminergic projections to the striatum, impacting both cognitive and motor functions.[20] Bradyphrenia largely interferes with movement planning and increasing reaction time. The existence of bradyphrenia in PD has been debated due to overlap with dementia, aging, and depression, all of which also slow cognitive processing.[7,31]

Our study had the following strengths: 1. Usage of specific and salient cognitive measures inclusive of visuo-spatial skills, attention, executive function and psychomotor speed with respect to postural control and gait; 2. Patients with homogeneity in terms of disease staging; 3. Assessment performed in the ON stage of medication; 4. Functional mobility assessment through a standardized, quantitative tool with cognitive and motor dual tasks.

However, our study had some limitations. 1. The recruited patients were in the initial stages of PD, so the results may not generalize to later stages. 2. Future studies could include larger sample sizes and consider evaluating patients during both ON and OFF phases to account for the influence of medication on motor and non-motor symptoms. 3. While the current study presents a significant correlation among cognitive parameters and fall-risk, it does not establish a cause-and-effect relationship.This may be a further research interest. 4. **Additionally,the correlation between cognitive parameters and fall risk was not analyzed with respect to certain attributes like age, gender or educational qualifications of patients and could be considered in future research.**

Physical therapy interventions typically focus on strength, flexibility, and balance training for PD patients. However, given the significant relation of cognitive impairments on fall risk and functional mobility, tailored interventions addressing these factors utilising evidenced strategies and newer technology tools may be incorporated into rehabilitation programs.[32, 33] for a prolonged preservation of mobility domains. Further longitudinal research is necessary to validate these findings and provide a comprehensive understanding of the underlying mechanisms of fall risk in individuals with parkinsonian disorders.

Conclusion

Our study confirms that executive function, visuospatial skills, and psychomotor speed are on a decline in early disease stages and we conclude that these significantly influence fall risk and overall functional mobility in Parkinson's Disease, as evidenced by their correlation with the Timed Up and Go test variants. These findings underscore the importance of incorporating cognitive training into rehabilitation programs for PD patients to enhance functional mobility and reduce fall risk.

Source of funding: Nil
Coflict of interest: Nil

References

1. Twelves D, Perkins KSM, Counsell C. Systematic review of incidence studies of Parkinson's disease. Mov Disord. 2003;18(1):19-31.
2. O'Sullivan S, Schmitz T, Fulk G, O'Sullivan S. Physical rehabilitation. 6th ed. New Delhi: Jaypee Brothers Medical Publishers; p. 807-9.
3. Je G, Arora S, Raithatha S, Barrette R, Valizadeh N, Shah U, et al. Epidemiology of Parkinson's Disease in Rural Gujarat, India. Neuroepidemiol. 2021;55(3): 188-95.
4. Gourie-Devi M. Epidemiology of neurological disorders in India: review of background, prevalence and incidence of epilepsy, stroke, Parkinson's disease and tremors. Neurol India. 2014;62(6):588-98.
5. Cosgrove J, Alty J. Cognitive deficits in Parkinson disease: current perspectives. J Park Restless Legs Syndr. 2018;8:1-11.
6. Kandiah N, Narasimhalu K, Lau PN, Seah SH, Au WL, Tan LC. Cognitive decline in early Parkinson's disease. Mov Disord. 2009;24(4):605-8.
7. Wilson RS, Kaszniak AW, Klawans HL, Garron DC. High speed memory scanning in Parkinsonism. Cortex. 1980;16(1):67-72.
8. Kelly VE, Johnson CO, McGough EL, Shumway-Cook A, Horak FB, Chung KA, et al. Association of cognitive domains with postural instability/gait disturbance in Parkinson's disease. Parkinsonism RelatDisord. 2015;21(7):692-7.
9. Fernandez-Lago H, Bello O, Lopez-Alonso V, Sanchez JA, Morenilla L, Fernandez-del-Olmo MA. Gait pattern and cognitive performance during treadmill walking in Parkinson disease. Am J Phys Med Rehabil. 2015;94(11):931-40.
10. Walton CC, O'Callaghan C, Hall JM, Gilat M, Mowszowski L, Naismith SL, et al. Antisaccade errors reveal cognitive control deficits in Parkinson's disease with freezing of gait. J Neurol. 2015;262(12):2745-54.
11. Jahan AM. The most important considerations in the assessment of functional decline in seniors: a literature review. Asian Pac J Health Sci. 2017;4(1):61-70.
12. Mollà-Casanova S, Pedrero-Sánchez J, Inglés M, López-Pascual J, Muñoz-Gómez E, Aguilar-Rodríguez M, et al. Impact of Parkinson's Disease on functional mobility at different stages. Front Aging Neurosci. 2022;14:935841.

13. Nocera JR, Stegemoller EL, Malaty IA, Okun MS, Marsiske M, Hass CJ, et al. Using the Timed Up & Go test in a clinical setting to predict falling in Parkinson's disease. Arch Phys Med Rehabil. 2013;94(7):1300-5.
14. Contreras A, Grandas F. Risk of falls in Parkinson's disease: a cross-sectional study of 160 patients. Parkinson's Dis. 2012;2012:362572.
15. Goetz CG, Poewe W, Rascol O, Sampaio C, Stebbins GT, Counsell C. Movement disorder society task force report on the Hoen and Yahr staging scale: status and recommendations. Mov Disord. 2004; 19 (9): 1020-28
16. Jaeger J. Digit symbol substitution test. J Clin Psychopharmacol. 2018; 38(5): 513-19
17. Strauss E, Sherman EMS, Spreen O. A compendium of Neuropsychological tests: Administration, norms and commentary. 3rd Ed. Oxford University Press. 2006, 655-677
18. Da Silva BA, Faria CDCM, Santos MP, Swarowsky A. Assessing Timed Up and Go in Parkinsons disease: Reliability and validity of Timed Up and Go asswssment of biomechanical strategies. J Rehabil Med. 2017; 49 (9): 723- 31
19. Pal A, Pegwal N, Kaur S, Mehta N, Behari M, Sharma R. Deficit in specific cognitive domains associated with dementia in Parkinson's disease. J Clin Neurosci. 2018;57:116-20.
20. Arie L, Herman T, Shema-Shiratzky S, Giladi N, Hausdorff JM. Do cognition and other non-motor symptoms decline similarly among patients with Parkinson's disease motor subtypes? Findings from a 5-year prospective study. J Neurol. 2017;264(10): 2149-57.
21. Pigott K, Rick J, Xie SX, Hurtig H, Chen-Plotkin A, Duda JE, et al. Longitudinal study of normal cognition in Parkinson disease. Neurology. 2015;85(15):1276-82.
22. Boripuntakul S, Sungkarat S. Specific but not global cognitive functions are associated with gait initiation in older adults. J Aging Phys Act. 2017;25(1):128-33.
23. Morris R, Martini DN, Smulders K, Kelly VE, Zabetian CP, Poston K, et al. Cognitive associations with comprehensive gait and static balance measures in Parkinson's disease. Parkinsonism RelatDisord. 2019;69:104-10.
24. Kalia LV, Lang AE. Parkinson's disease. Lancet. 2015;386:896-912.
25. Sabbagh MN, Lahti T, Connor DJ, Caviness JN, Shill H, Vedders L, et al. Functional ability correlates with cognitive impairment in Parkinson's disease and Alzheimer's disease. Dement GeriatrCognDisord. 2007;24(5):327-34.
26. Buczek A, Borończyk M, Hudzińska P, Bigajski H, Białas A, Balcerzak W, et al. Risk factors for falls in Parkinson's disease and other parkinsonisms. Arch GerontolGeriatr Plus. 2024;100054.
27. Muslimovic D, Post B, Spleeman JD, De Haan RJ, Schmand B. Cognitive decline in Parkinson's disease: a prospective longitudinal study. J Int Neuropsychol Soc. 2009;15(3):426-37.
28. Allcock LM, Rowan EN, Steen IN, Wesnes K, Kenny RA, Burn DJ. Impaired attention predicts falling in Parkinson's disease. Parkinsonism RelatDisord. 2009;15(2):110-5.
29. Horak FB. Postural orientation and equilibrium: what do we need to know about neural control of balance to prevent falls? Age Ageing. 2006;35(Suppl 2)
30. Li Y, Zheng JJ, Wu X, Gao W, Liu CJ. Postural control of Parkinson's disease: a visualized analysis based on Citespace knowledge graph. Front Aging Neurosci. 2023;15:1136177.
31. Wang W, Baker K, Umamahesan C, Gilmour S, Charlett A, Taylor D, et al. Bradyphrenia and tachyphrenia in idiopathic parkinsonism appear, in part, iatrogenic: an observational study with systematic review background. J Clin Med. 2023;12(20):6499.
32. Geroin C, Nonnekes J, de Vries NM, Strouwen C, Smania N, Tinazzi M, et al. Does dual-task training improve spatiotemporal gait parameters in Parkinson's disease? Parkinsonism RelatDisord. 2018;55:86-91.
33. Fernandes Â, Rocha N, Santos R, Tavares JMRS. Effects of dual-task training on balance and executive functions in Parkinson's disease: a pilot study. Somatosens Mot Res. 2015;32(2):122-7.

Chest Physiotherapy for COPD Patients: A Case Series

Vishnu K Nair[1], PSB Roshan[2]; Prathik[3]

[1]Assistant professor [2]Assistant professor [3]PG student Laxmi memorial college of physiotherapy, Balmatta, Mangalore, Rajiv Gandhi university of health sciences, Karnataka

How to cite this article: Vishnu K Nair, PSB Roshan, Prathik. Chest Physiotherapy for COPD Patients: A Case Series. Indian Journal of Physiotherapy and Occupational Therapy / Vol 19 No 2 April-June 2025

Abstract

Background: As per the reports of the American Thoracic Society and the European-Respiratory Society, chronic obstructive pulmonary disease (COPD) is the third leading cause of mortality globally. Chest physiotherapy is often employed to alleviate symptoms and improve lung function in COPD patients.

Objective: To assess the effectiveness of chest physiotherapy on chest expansion, dyspnea, and airway clearance in COPD patients.

Methods: Eight patients diagnosed with COPD were enrolled using purposive sampling. Data on chest expansion (axillary, nipple, and Xiphisternal levels), dyspnea (modified Medical Research Council Dyspnea Scale), and cough-related quality of life (Leicester Cough Questionnaire) were collected before and after a two-week chest physiotherapy intervention. Statistical analysis was performed using paired t-tests.

Results: Significant improvements were observed in chest expansion measurements at all three levels ($p < 0.05$). Dyspnea scores decreased significantly ($p < 0.001$), indicating reduced breathlessness post-intervention. The Leicester Cough Questionnaire scores also showed statistically significant improvement ($p < 0.001$) across physical, psychological, and social domains. Additionally, mean oxygen saturation levels increased significantly ($p = 0.001$) post-intervention.

Conclusion: This study shows physiotherapy intervention significantly improved clinical outcomes and quality of life for COPD patients. These improvements suggest a potential for reducing hospital stays among COPD patients.

Key Message: The efficacy of chest physiotherapy in managing COPD symptoms and improving patient outcomes, providing evidence for its potential benefits in clinical practice.

Keywords: COPD, Chest physiotherapy, Chest expansion, Dyspnea, Leicester Cough Questionnaire, Oxygen saturation

Background

As per the reports of the American Thoracic Society and the European-Respiratory Society, chronic obstructive pulmonary disease (COPD) is the third leading cause of mortality globally.[1,2]COPD symptoms include not only shortness of breath, chronic cough, and sputum production, but also reduced exercise tolerance and quality of life.[1,3,4] In COPD degradation of elastic fibers contributes significantly to the loss

Corresponding Author: Prathik, Postgraduate, Department of Cardiorespiratory Physiotherapy, Laxmi memorial college of physiotherapy, Balmatta, Mangalore 575002, Karnataka, India.

E-mail: prathiksuraj8@gmail.com

Submission: Oct 16, 2024 **Revision:** December 25, 2024 **Published date:** April 11, 2025

of lung elasticity.[5,6] Chest Physiotherapy like, Purse lip breathing exercise, Postural drainage and Active Cycle of Breathing Technique (ACBT), It has major objectives to enhance mucus clearance, decrease the risk of lung infection, halt pulmonary function deterioration.[7,8] Thus, This case series investigates the impact of chest physiotherapyon COPD and assesses its role in reducing hospital stay.Treatment currently consists of pharmacological interventions complemented by hospital-based physiotherapy rehabilitation, oxygen therapy in the more severe patients.[9]

It is a highly prevalent disease affecting >10% of the population worldwide.[10] Between 2009 and 2019, the mortality rate of COPD increased by 35.4%. Furthermore, WHO mortality and disease burden projections state that COPD will be the third leading cause of death worldwide by 2030.[11] The presence of more than 1 comorbidity more than doubles the risk of mortality, and many patients with COPD die because of their comorbidities rather than their COPD, particularly in the mild and moderate phases.[12]

Patients hospitalized by COPD will initially be submitted to chest physical therapy techniques that aim to re-establish lung's volume and capacities, rebalancing oxygen supply and intake. Once compensated, the patient is then able to receive physical exercise that require greater energetic consumption.To this date, there is still not enough studies and, therefore, there is no consensus about the strength training on patients with chronic pulmonary disease.[13]

Chronic Obstructive Pulmonary Disease (COPD) carries a substantial economic burden – both on an individual and at a societal level. The direct costs of treatment and care for COPD are mainly composed of costs of exacerbations, hospitalizations, outpatient follow-up, visits at the general practitioner, pharmaceutical interventions, laboratory testing, rehabilitation, etc.[14]

Case Series

All 8 patients were admitted between January 13 2024 to May 13 2024 at a tertiary centre in Mangalore, Karnataka, India. 8 consecutive patients with a history of COPD were analysed for Dyspnea, Chest expansion, Quality of life and functional health. Clinically diagnosed patients were included in the series. Patients with history of recent Myocardial infarction, Cases of Heart failure or cardiac arrhythmia, Lung cancer were excluded. Ethical clearance wasobtained. 8 patients under medical treatment in the tertiary hospital were given chest physiotherapy for 2 weeks once a day. Spo2, MMRC dyspnea scale, Chest expansion, L.C.Q questionnaire outcome measures were taken on 1st day and after 2 weeks.

Outcome Measures

Chest Expansion

Chest expansion (CE) is defined as the difference between chest circumferences at maximal inhalation and maximal exhalation.[15]Chest expansion will be measured using inch tape method. Patient will be seated comfortably in chair. Inch tape will be placed around their chest. Chest Expansion will be measure at 3 levels: (1) Axillary (2) Nipple level (3) Xiphisternal level. And asked to "inhale slowly and rhythmically through the nose against the inch tape to open up the lungs as much as you can,"and then the subjects were asked to "exhale through the mouth completely." Chest expansion measurement was taken at the end of the inspiration and expiration cycles.[16]The typical thoracic expansion range diminishes with age, falling between 50% and 60% for individuals aged 15 to 75 years. Various studies suggested that thoracic expansion among men is 20% more than in women because male lungs are wider and bigger as compared to female lungs.[17]The chest expansion values of these 3 levels will be converted into ratio. Chest Expansion of 1:2:1 will be considered normal any ratio except that will be considered as abnormal. Inter tester reliability of 0.99 and intra-tester reliability 0.97 to 0.98.[18]

Mmrc Dyspnea Scale

The modified-Medical Research Council (mMRC) breathlessness scale classifies the disability associated with breathlessness by identifying

different levels of activities that induce or are restricted by breathlessness. The mMRC version consists of scale ranges from grade 0 to 4. It measures the degree of activity at which a person gets breathlessness such as "with strenuous exercise" or limits what a person can do such as "too breathless to leave the house". The mMRC breathlessness scale has good discriminative ability and is a simple method of categorising patients with COPD in terms of their disability and survival.[19]Thus, it is recommended for use as a marker of disability in international COPD guidelines.[20]The ICC was 0.82 for the mMRC scale.[21]

Leicester Cough Questionnaire

The Leicester Cough Questionnaire is a patient-reported questionnaire evaluating the impact of cough on quality of life. It was originally developed in the United Kingdom for use in people with idiopathic chronic cough and has since been validated for use in people with bronchiectasis and chronic obstructive pulmonary disease. The Leicester Cough Questionnaire comprises 19 items and takes 5 to 10 minutes to complete. Each item assesses symptoms, or the impact of symptoms, over the last 2 weeks on a seven-point Likert scale. Scores in three domains (physical, psychological and social) are calculated as a mean for each domain (range 1 to 7). A total score (range 3 to 21) is also calculated by adding the domain scores together. Higher scores indicate better quality of life.[22]The Leicester Cough Questionnaire has been shown to haveInternal consistency and repeatability in chronic obstructive pulmonary disease (Cronbach alpha = 0.67 to 0.86; ICC = 0.79 to 0.93).[23]

SpO2

SpO_2 **between 88% and 92% in an acute hospital setting for patients with COPD. While COPD is the most common chronic disease in clinical practice to cause hypercapnia**.In patients who are not at risk of hypercapnic respiratory failure, recommendations vary between professional bodies, with the British Thoracic Society, **advocating for maintenance of an SpO_2 between 94% and 98% and the Thoracic Society of Australia and New Zealand recommending** maintenance of an SpO_2 **between 92% and 96%.**[24]

Table 1. Baseline characteristics of patients

Parameters	Patient1	Patient 2	Patient 3	Patient 4	Patient 5	Patient 6	Patient 7	Patient 8
Age	26	57	58	59	79	54	65	46
Gender	Male	Male	Male	Male	Male	Male	Male	Male
Fever	No	No	No	Yes	No	Yes	No	No
Cough	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Breathlessness	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Chest pain	Yes	Yes	No	Yes	Yes	Yes	No	No

Table 2. Patient Assessment

Assessment	Patient 1	Patient 2	Patient 3	Patient 4	Patient 5	Patient 6	Patient 7	Patient 8
Chest deformity	Barrel chest	No deformity	Barrel chest	Barrel chest	Pigeon chest	Barrel chest	Barrel chest	No deformity

Continue....

Auscultation	crackles in apical and middle lobes and wheeze in left lower lobe	crackles heard on both sides	Wheeze on expiration	Bilateral air entry	Bilateral rhonchi and on inspiration crepitus	rhonchi and crepitus bilateral present	crackles present in bilateral apical r egion	Right side crackles and left side wheeze
ABG analysis	–	–	–	–	–	–	Respiratory alkalosis	Respiratory acidosis
HR	82	86	72	80	92	78	108	78
RR	20	24	26	20	22	20	20	22
BP	120/80	110/70	150/90	120/80	130/80	120/80	150/90	110/80
SPO2	98	94	94	98	92	95	96	98
CT SCAN	cystic bronchiectatic changes in left lower lobe and patchy consolidation in right middle lobe.	cylindrical bronchiectasis in bilateral lung fields. Hyperinflated lung fields in bilaterally	–	–	–	fibrotic areas with cavitatory lesions, bronchiectatic changes and pleural thickening in bilateral upper lobes	–	–
x-ray	–	–	A linear shadow of visceral pleura with lack of lung markings	hyperinflated both the lung	–	–	Consolidation in the lungs	Consolidation in the lungs
Medications	gentamycin	neb duolin	Deriphyline	neb-duolin	Neb ipravent	Neb duolin	inj zostum.	duolin
Chest Physiotherapy	Postural drainage, ACBT and Purse lip breathing 2 weeks 12 session 45mins	ACBT and Purse lip breathing 2 weeks 12 session 45mins	Postural drainage, ACBT and Purse lip breathing 2 weeks 12 session 45mins	ACBT and Purse lip breathing 2 weeks 12 session 45mins	ACBT and Purse lip breathing 2 weeks 12 session 45mins	Postural drainage, ACBT and Purse lip breathing 2 weeks 12 session 45mins	ACBT and Purse lip breathing 2 weeks 12 session 45mins	Purse lip breathing, ACBT, 2 weeks 12 session 45mins

Results

Below mentioned findings suggest that all eight individuals experienced various degrees of life changes across different domains, with some showing more pronounced changes than others in L.C.Q Cough questionnaire related to quality of life. The chest expansion increased in all 8 patients after chest physiotherapy for 2 weeks from 1:1:1 to 1:2:1. Dyspnea reduced and spo2 improved significantly.

Table 3. Comparison in Physical domain

		Mean	Std. Deviation	t value	p value
physical	Pre	2.8413	.63285		
	Post	4.1063	.75491	6.664	p<0.001

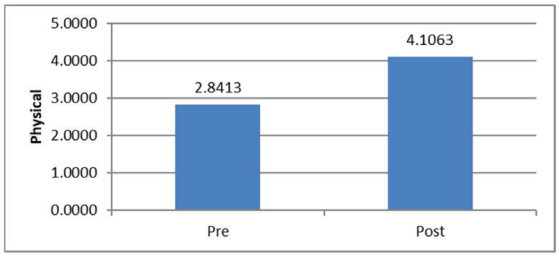

Figure 1: Graph for Physical domain

The mean score for the physical domain significantly increased from 2.84 ± 0.63 before to 4.11 ± 0.75 after the intervention. The observed difference in mean was statistically significant (t = 6.664, p < 0.001).

Table 4. Comparison in Psychological domain

		Mean	Std. Deviation	t value	p value
psycho-logical	Pre	2.8700	.59038		
	Post	4.1738	.65027	9.989	p<0.001

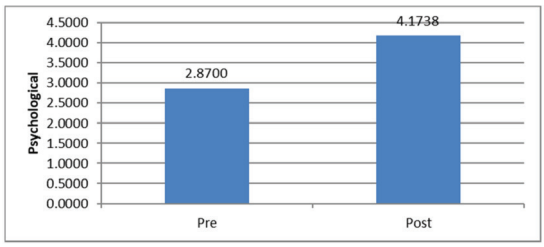

Figure 2: Graph for Psychological domain

The mean score for the psychological domain significantly increased from 2.87 ± 0.59 before to 4.17 ± 0.65 after the intervention. The observed difference in means was statistically significant (t = 9.989, p < 0.001).

Table 5. Comparison in social domain

		Mean	Std. Deviation	t value	p value
social	Pre	2.4688	.61872		
	Post	4.1250	.85565	5.768	0.001

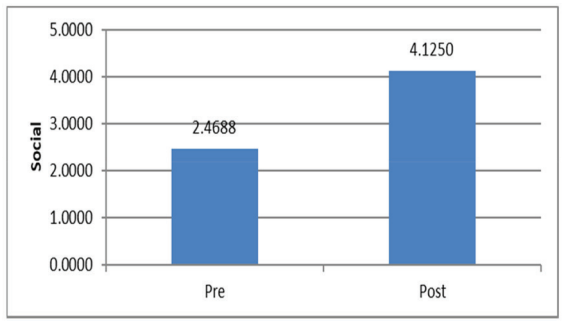

Figure 3: Graph for social domain

The mean score for the social domain significantly increased from 2.47 ± 0.62 before to 4.13 ± 0.86 after the intervention. The result is statistically significant with t = 5.768 and p = 0.001.

Table 6. Comparison on total LCQ

		Mean	Std. Deviation	t value	p value
Total LCQ	Pre	8.1175	1.75915		
	Post	12.4050	2.18007	8.099	p<0.001

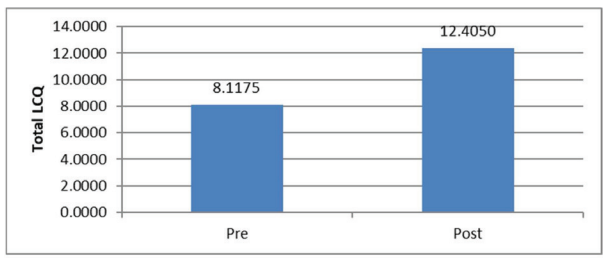

Figure 4: Graph for total LCQ

The mean total LCQ score significantly increased from 8.12 ± 1.76 before to 12.41 ± 2.18 after the intervention. The result is statistically significant with t = 8.099 and p < 0.001.

Table 7. Comparison in SPO2

		Mean	Std. Deviation	t value	p value
SPO2	Pre	92.8750	4.05101		
	Post	97.8750	1.95941	5.401	0.001

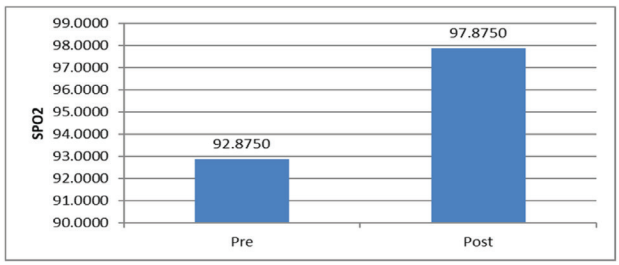

Figure 5: Graph for comparison of spo2

The mean SPO2 significantly increased from 92.88 ± 4.05 before to 97.88 ± 1.96 after the intervention. The difference between the group is statistically significant with t = 5.401 and p = 0.001.

Table 8. Comparison in Dspnea scale

		Mean	Std. Deviation	t value	p value
Dyspnea	Pre	3.5000	.53452		
	Post	1.3750	.11755	17	p<0.001

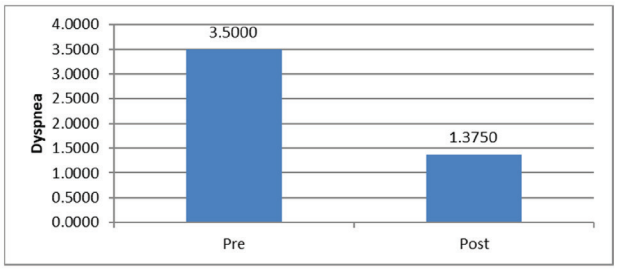

Figure 6: Graph for Dyspnea scale

The mean Dyspnea score significantly decreased from 3.50 ± 0.53 before to 1.38 ± 0.12 after the intervention or during the specified time period. The difference between the group is statistically significant with t = 17, p < 0.001.

Discussion

COPD, a respiratory condition marked by gradual airflow limitation, is preventable and manageable. Following a Chest physiotherapy regimen, the patient reports enhanced breathing capacity and overall quality of life. All techniques administered were well received by the patients. Significant disparities in Spo2 levels, chest expansion, cough-related quality of life, and reduced dyspnea were observed during the two-week treatment period. This study demonstrated that all treatments led to a notable and immediate enhancement in mucus clearance among patients with COPD.[25]

Chest physiotherapy serves as a complementary approach aimed at mobilizing pulmonary secretions. By facilitating the release of retained secretions, which become more fluid and easier to expel, it promotes airway clearance, ventilation, and enhances haemoglobin binding. This improvement is reflected in the normalization of oxygen saturation levels. Different techniques such as chest percussion, vibration, and Postural Drainage (PD) have been shown to effectively increase oxygen saturation in patients with inadequate airway clearance.[26]

Chest physiotherapy provides significant benefits for individuals with both acute and chronic respiratory conditions. Widely employed in managing and preventing conditions like Chronic Obstructive Pulmonary Disease (COPD) and restrictive respiratory diseases—including those stemming from neuromuscular disorders—it proves effective in enhancing airway clearance efficacy and overall lung function.

Chest physiotherapy is administered daily, incorporating, breathing exercise, postural drainage, percussion, and vibration techniques for a duration of 40 minutes, followed by a 5-minute period in the Fowler position. This regimen aims to facilitate secretion removal, alleviate patient breathlessness, and influence the improvement of oxygen saturation levels in COPD patients. This evidence-based non-pharmacological intervention underscores the role of physiotherapy in independent clinical practice. Physiotherapists can leverage these findings as a viable approach in delivering comprehensive care to individuals with COPD.Top of Form

Conclusion

This study shows that a two-week physiotherapy intervention significantly improved clinical outcomes and quality of life for COPD patients.Notably, these improvements suggest a potential for reducing hospital stays among COPD patients.Thisstudy highlights the importance of chest Physiotherapy in improving COPD symptoms. Hence it should be part of integrated treatment protocol. It underscores the significance of integrating chest physiotherapy into COPD management protocols to prevent mechanical ventilation, enhance lung function, promote chest expansion, alleviate dyspnea, and subsequently reduce mortality rates.

Ethical clearance:

Date:24-06-2024. Reference number: EC/NEW/INST/2020/741

Source of funding:

Self-funded

Conflict of interest statement:

No conflict of interest

References

1. Rutkowski S, Rutkowska A, Kiper P, Jastrzebski D, Racheniuk H, Turolla A, Szczegielniak J, Casaburi R. Virtual reality rehabilitation in patients with chronic obstructive pulmonary disease: a randomized controlled trial. Int J Chron Obstruct Pulmon Dis. 2020;15:117-24.
2. Celli BR, Decramer M, Wedzicha JA, et al. An official American Thoracic Society/European Respiratory Society statement: research questions in COPD. Eur Respir J. 2015;45(4):879-905.
3. Al-Shair K, Kolsum U, Singh D, Vestbo J. The effect of fatigue and fatigue intensity on exercise tolerance in moderate COPD. Lung. 2016;194(6):889–95.
4. Fastenau A, Van Schayck OC, Winkens B, Aretz K, Gosselink R, Muris JW. Effectiveness of an exercise training programme in COPD in primary care: A randomized controlled trial. Respir Med. 2020 Apr;165:105943.
5. Rodrigues SD, Cunha CM, Soares GM, Silva PL, Silva AR, Goncalves-de-Albuquerque CF. Mechanisms, pathophysiology and currently proposed treatments of chronic obstructive pulmonary disease. Pharmaceutics. 2021 Sep 26;14(10):979.
6. Karakioulaki M, Papakonstantinou E, Stolz D. Extracellular matrix remodelling in COPD. Eur Respir Rev. 2020 Dec 31;29(158).
7. Labib MA, Hassan BA, Helmy NA, Moussa HH, Obeya HE. Active cycle of breathing with postural drainage versus autogenic drainage on airway resistance in chronic obstructive pulmonary disease. J Pharm Neg Results. 2022 Dec 25:4466-74.
8. Zisi D, Chryssanthopoulos C, Nanas S, Philippou A. The effectiveness of the active cycle of breathing technique in patients with chronic respiratory diseases: A systematic review. Heart Lung. 2022 May-Jun;53:89-98.
9. Effing T, Zielhuis G, Kerstjens H, van der Valk P, van der Palen J. Community based physiotherapeutic exercise in COPD self-management: a randomised controlled trial. Respiratory medicine. 2011 Mar 1;105(3):418-26.
10. Decramer M, Cooper CB. Treatment of COPD: the sooner the better? Thorax. 2010 Sep 1;65(9):837-41.
11. AL Wachami, N., Guennouni, M., Iderdar, Y. *et al.*Estimating the global prevalence of chronic obstructive pulmonary disease (COPD): a systematic review and meta-analysis. *BMC Public Health* 24, 297 (2024). https://doi.org/10.1186/s12889-024-17686-9
12. Recio Iglesias J, Díez-Manglano J, López García F, Díaz Peromingo JA, Almagro P, Varela Aguilar JM. Management of the COPD patient with comorbidities: an experts recommendation document. International journal of chronic obstructive pulmonary disease. 2020 May 7:1015-37.
13. de Alvarenga GM, Remigio Gamba H, Elisa Hellman L, Ganzert Ferrari V, Michel de Macedo R. Physiotherapy intervention during level I of pulmonary rehabilitation on chronic obstructive pulmonary disease: a systematic review. The open respiratory medicine journal. 2016 Feb 29;10(1).
14. Løkke A, Lange P, Lykkegaard J, Ibsen R, Andersson M, de Fine Licht S, Hilberg O. Economic burden of COPD by disease severity–a nationwide cohort study in Denmark. International journal of chronic obstructive pulmonary disease. 2021 Mar 10:603-13.
15. Pun DB, Shresta P, Choudhury PR, Amatya M. Correlation Between Vital Capacity and Maximum Chest Expansion among Nepalese Young Adults. Journal of Kantipur Dental College. 2020;1(1):20-4.
16. Reddy RS, Alahmari KA, Silvian PS, Ahmad IA, Kakarparthi VN, Rengaramanujam K. Reliability

of chest wall mobility and its correlation with lung functions in healthy nonsmokers, healthy smokers, and patients with COPD. Canadian respiratory journal. 2019 Oct;2019.

17. Ved N, Sharma A. Challenges and importance of thoracic expansion measuring device: A systemic review. Indian Journal of Physical Therapy and Research. 2022 Jul 1;4(2):97-102.
18. Sharma J, Senjyu H, Williams L, White C. Intra-tester and inter-tester reliability of chest expansion measurement in clients with ankylosing spondylitis and healthy individuals. Journal of the Japanese physical therapy association. 2004;7(1):23-8.
19. Yorke J, Khan N, Garrow A, Tyson S, Singh D, Vestbo J, Jones PW. Evaluation of the individual activity descriptors of the mMRC breathlessness scale: a mixed method study. International Journal of Chronic Obstructive Pulmonary Disease. 2022 Jan 1:2289-99.
20. UK NC. Chronic Obstructive Pulmonary Disease: Management of Chronic Obstructive Pulmonary Disease in Adults in Primary and Secondary Care [Internet].2010
21. Mahler DA, Ward J, Waterman LA, McCusker C, ZuWallack R, Baird JC. Patient-reported dyspnea in COPD reliability and association with stage of disease. Chest. 2009 Dec 1;136(6):1473-9.
22. Ward N. The Leicester cough questionnaire. Journal of physiotherapy. 2016 Jan;62(1):53.
23. Berkhof FF, Boom LN, ten Hertog NE, Uil SM, Kerstjens HA, van den Berg JW. The validity and precision of the Leicester Cough Questionnaire in COPD patients with chronic cough. Health and quality of life outcomes. 2012 Dec; 10:1-8.
24. Cousins JL, Wark PA, McDonald VM. Acute oxygen therapy: a review of prescribing and delivery practices. Int J Chron Obstruct Pulmon Dis. 2016 May 24;11:1067-75. doi: 10.2147/COPD.S103607. PMID: 27307722; PMCID: PMC4888716.
25. Mahmoud MG. Effects of chest physiotherapy on patients with chronic obstructive pulmonary disease (COPD). Bull Phys Ther Res Stud. 2023 Jan 1;1(1):12-7.
26. Zuriati MS, Ananda Y. Textbook for Medical Surgical Nursing Care Disorders in the Respiratory System. 2017.

Call for Papers / Article Submission

Indian Journal of Physiotherapy and Occupational Therapy has commenced publication since 2006. IJPOT will he published four times in a year.

Purpose & Scope: IJPOT is a multidisciplinary refereed journal devoted to disseminating rigorous research on all aspects of the physiotherapy and occupational therapy to enhance learning. The journal seeks to be a catalyst for multidisciplinary dialogue amongst researchers and practitioners worldwide in the fields of learning and cognition, education, and technology, with a view to improving practice and achieving real-world impact in technology enhanced learning.

The journal encourages research from theoretical perspectives, research reports of evidence based practice as well as praxis research work that focuses on the interface between theory and practice and how each can support the other. In addition, the journal strongly encourages reports of research carried out within or involving countries in the Asia— Pacific region.

Invitation to submit papers: A general invitation is extended to authors to submit journal papers for publication in IJPOT.

The following guidelines should be noted:

- The article must be send by E-mail in word only as attachment. Hard copy need not be send.
- The article should be accompanied by a declaration from all authors that it is an original work and has not been sent to an other journal for publication.
- As a policy matter, journal encourages articles regarding new concepts and new information.
- Article should have a Title
- Names of authors
- Your Affiliation (designations with college address)
- Abstract
- Key words
- Introduction or back ground
- Material and Methods
- Findings • Conclusion
- Acknowledgements • Interest of conflict
- References in Vancouver style.
- Please quote references in text by superscripting
- Word limit 2500-3000 words, MSWORD Format, single file

Our Contact Info:

Institute of Medico-Legal Publications Pvt Ltd

Logix Office Tower, Unit No. 1704, Logix City Centre Mall
Sector- 32, Noida - 201 301 (Uttar Pradesh)
Phone: +91 120 429 4015, E-mail: editor.ijpot@gmail.com,
Website: www.ijpot.com

Indian Journal of Physiotherapy and Occupational Therapy

CALL FOR SUBSCRIPTIONS

About the Journal
Print-ISSN: 0973-5666 Electronic - ISSN: 0973-5674, Frequency: Quarterly (4 issues per volume).

An essential journal for all Physiotherapists & Occupational therapists provides professionals with a forum in which to discuss today's challenges-identifying the philosophical and conceptural foundations of the practice; sharing innovative evaluation and treatment techniques; learning about and assimilating new methodologies developing in related professions; and communicating information about new practice settings. The journal serves as a valuable tool for helping therapists deal effectively with the challenges of the field. It emphasizes articles and reports that are directly relevant to practice. The journal is internationally indexed.

Journal Title	Print Only
Indian Journal of Physiotherapy and Occupational Therapy	INR 12000/-

NOTE FOR SUBSCRIBERS

- Advance payment required by cheque/demand draft in the name of **"Institute of Medico-Legal Publications"** payable at New Delhi.
- Cancellation not allowed except for duplicate payment.
- Claim must be made within six months from issue date.
- A free copy can be forwarded on request.

Send all payment to :

Institute of Medico-Legal Publications Pvt Ltd

Logix Office Tower, Unit No. 1704, Logix City Centre Mall
Sector- 32, Noida - 201 301 (Uttar Pradesh)
Phone: +91 120 429 4015,
E-mail: editor.ijpot@gmail.com, Website: www.ijpot.com

Registered with Registrar of Newspapers for India
(Regd. No. DELENG/2007/20988)

Printed: Printpack Electrostat G-2, Eros Apartment, 56, Nehru Place, New Delhi-110019

Published at: Institute of Medico Legal Publications Pvt. Ltd., Logix Office Tower, Unit No. 1704, Logix City Centre Mall, Sector- 32, Noida - 201 301 (Uttar Pradesh) Ph. No: +91 120- 429 4015