RESEARCH ARTICLE

©2023 The Academy of Environmental Biology, India

Journal of Ecophysiology and Occupational Health, *Vol 25(2), DOI: 10.18311/jeoh/2025/46430, 1-7, June 2025*

ISSN (Online) : 0972-4397
ISSN (Online) : 0974-0805

Effect of 6-Week Dynamic Neuromuscular Stabilization Training on Pain, Disability and Quality of Life in Patients with Mechanical Low Back Pain: A Randomized Controlled Trial

Moumita Dutta Roy[1], P. Sathya[1*], Feba Roy[1] and Jibi Paul[2]

[1]College of Physiotherapy, School of Health Sciences, Dayananda Sagar University, Harohalli - 562112, Karnataka, India; drsathyagp@gmail.com

[2]Department of Physiotherapy, Dr. M.G.R. Educational and Research Institute, Chennai - 600095, Tamil Nadu, India

Abstract

Background: Mechanical low back pain is a common musculoskeletal ailment that is the most common disability in those under 45 years of age and is caused by excessive mechanical strain on collagen fibers without causing structural tissue damage. About 84% of people experience low back pain at some stage, with a higher recurrence rate. Research demonstrates that dysfunction in spinal stabilizers leads to pain by compromising both movement control and joint stability. Dynamic Neuromuscular Stabilization (DNS), is an approach that aims to improve the muscular system's dynamic stability, hence improving movement and reducing pain. **Aim:** To determine the effect of 6-week Dynamic Neuromuscular Stabilization (DNS) training on pain, disability, and quality of life of patients with mechanical low back pain. **Method:** 80 patients who have fulfilled the inclusion and exclusion criteria were randomly divided into two groups. The intervention group (n=20) received Dynamic Neuromuscular Stabilization (DNS) training and the control group (n=20) received general core strengthening exercises. Treatment was given for 3 sessions per week for 6 weeks for both groups. Visual analogue scales, pressure algometer, Oswestry disability index, and MMT are the pre-test and post-test outcome measures. **Result:** There was a significant difference seen in both the groups individually ($p<0.05$) but on comparison experimental Group was more effective than control group in improving the ODI score (P value 0.019). **Conclusion:** This study concluded; Dynamic neuromuscular stabilization as an effective treatment for patients with mechanical low back pain.

Major Findings: The study found that both Dynamic Neuromuscular Stabilization (DNS) training and general core strengthening exercises significantly improved pain, disability, and muscle strength in patients with mechanical low back pain. However, the DNS group showed greater improvements in Oswestry Disability Index (ODI) scores compared to the control group ($p = 0.019$), indicating superior effectiveness in enhancing movement control and reducing disability. These findings support DNS as an effective intervention for improving functional outcomes in individuals with mechanical low back pain.

Keywords: Disability, Dynamic Neuromuscular Stabilization, Mechanical Low Back Pain, Neuroplasticity, Quality of Life, Spinal Stability

**Author for correspondence*

Article Received on: 16.10.2024 Revised on: 26.12.2024 Accepted on: 30.12.2024

1. Introduction

Low back pain is a prevalent musculoskeletal condition that manifests as a range of symptoms, such as stiffness, restricted range of motion, pain. This common musculoskeletal ailment affects people of all ages and backgrounds and ranges in severity from minor discomfort to severe pain[1]. There are several root causes that leads to onset of back pain. When it pertains to Low Back Pain (LBP), it can be both mechanical or non-mechanical in nature. In mechanical type, the pain is confined between the inferior gluteal folds and the costal border that develops without causing structural damage to tissue. It is usually caused by excessive mechanical strain or tension on collagen fibres, main contributing cause being incorrect posture when standing, sitting, or lifting heavy objects[2,3]. In India, 48% of people can anticipate having low back discomfort at some point in their lives wherein the rates are greater in women, in people living in rural areas, and in elementary workers, causing a significant financial impact due to immediate medical costs in addition to indirect losses from interrupted work causing work absenteeism and hence decreased productivity[4,5]. There are several established methods to address low back pain that are evidence-based and tailored to address the individual needs and goals of each patient. Dynamic Neuromuscular Stabilization (DNS) is a manual rehabilitative approach aiming to maximise movement by improving themuscular system's dynamic stability. The primary goal of DNS is to target neuromuscular deficiencies during these exercises and in everyday tasks, with the goal of activating adequate respiratory-postural function, regulation of intra-abdominal pressure and integration of the spinal stabilizing system to improve movement patterns and reduce joint stress[6-8]. Patients often report physical discomfort and functional limitationsas well as low levels of physical activity and reduced social participation due to their pain, and their disability. Hence the study aims to find the effect of a 6-week dynamic neuromuscular stabilisation exercise program, in patients with mechanical low back pain which could be beneficial in minimizing pain, disability, improving strength and patients overall quality of life[9]. Thus, outcome measures such as visual analogue scale and pressure algometer (for pain), Oswestry disability questionnaire (for functional disability) and MMT (strength) were used as pre-test and post-test of intervention to check the effect of DNS in reducing pain and disability, improving strength and quality of life.

2. Materials and Methods

2.1 Study Procedure

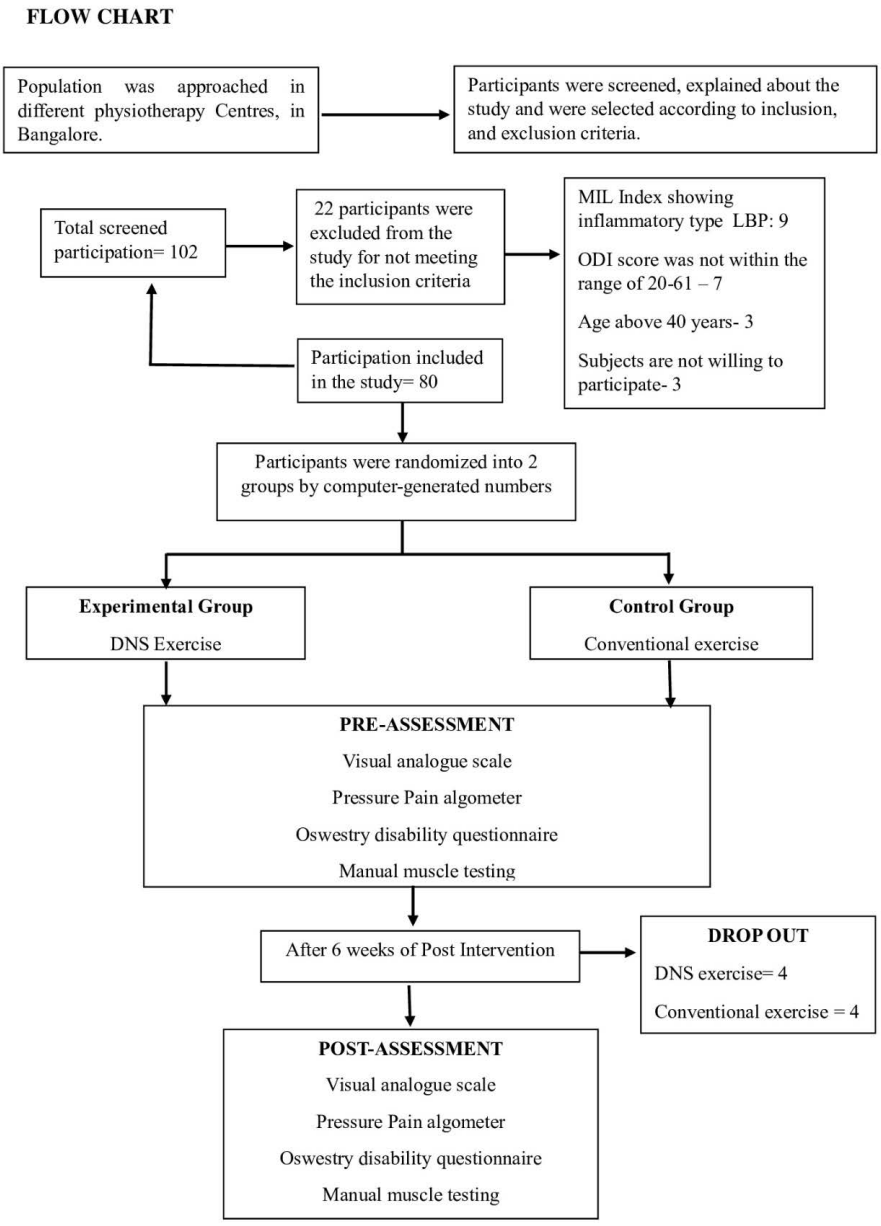
An experimental study was conducted with 80 subjects aged between 20-40 years who had mechanical low back pain with Oswestry Disability Index (ODI) scores between 20-61 years who were willing to participate voluntarily and signed the written informed consent form[10]. Ethical clearance has been obtained from the College of Physiotherapy, School of Health Sciences, Dayananda Sagar University, Devarakaggalahalli, Harohalli, Kanakpura road, Ramanagara, Karnataka (IEC/IRB/DSU/MPT/2023/009).

The sampling technique used was simple random sampling. Subjects with the presence of any pathological causes of low back pain such as a tumour, infection, ankylosing spondylitis, spinal deformity, radiculopathy, history of any major trauma to the spine, and recent surgery (spinal or abdominal) were excluded[11]. After getting ethical approval from the institutional ethical committee, subjects were included per the selection criteria. The procedure was thoroughly explained to the subjects and written consent was taken. Pre-intervention assessment was done using outcome measures. Subjects were divided into control and experimental groups usingcomputer-generated numbers. The intervention was given for 6 weeks. Post-intervention assessment was done. Statistical analysis was carried out to find out the results and the level of significance using a student t-test.

2.2 Intervention

Experimental Group - Included structured exercise program of 40-minute duration involving 5-minute warm-up session followed by DNS movements coordinated with breathing exercises. These exercises were carried out in the following fundamental positions: Baby rock (supine 90-90), prone lying, rolling movements, side-lying exercises, oblique sit, tripod positions, kneeling, and squats. During the 17th and 18th sessions, participants were introduced to Czech Get Up exercises. Which combine all fundamental positions and are performed for 10 minutes[8,12].

Control Group- The control groups participants engaged in conventional exercise therapy for 40 minutes,



which included a combination of aerobic, stretching, and strength training activities. Stretching exercises included hamstring, iliopsoas, and back extensor stretches. Strengthening exercises was performed by the participants concentrating on the abdominal muscles[13,14].

2.3 Outcome Measures

2.3.1 Pain

Pressure Algometer: The patient lies comfortably in a prone position and is asked to indicate the back areas that is most painful, and the areas are identified. Subsequently, the pressure algometer is placed at the designated location and gradually applies vertical pressure at a rate of 1 kg/sec. When the patient starts to experience pain, they are instructed to inform verbally, and the measurement value is recorded at that point[15].

Visual analogue scale: Participants are asked to mark a 10-centimeter line scale with numbers ranging from 0 to 10 to indicate how much pain they are experiencing[16].

2.3.2 Functional Limitation

Oswestry Disability Index Score: There are 10 questions total, with 5 possible points for each. To describe the

impairment level as a percentage score, the Oswestry Disability Index (ODI) total score is calculated by adding up all applicable item scores, dividing this total by the highest possible score, and then multiplying the result by 100[17].

2.3.3 Strength

Manual Muscle Testing: MMT was assessed for trunk flexors and trunk extensors. The most extensively used technique is the Medical Research Council Manual Testing range, which involves measuring the patient's muscle against examiner resistance and assigning a strength rating on a range from grade 0 to grade 5[18].

3. Statistical Analysis

1. Descriptive statistics were used to summarize the data, including frequency, percentage, mean, and standard deviation.
2. The Independent sample "t" test was used to compare the outcome measures between the groups. The Paired "t" test was employed for comparing within groups.
3. Data were analyzed by using the SPSS software (SPSS Inc.; Chicago, IL) version 29.0.

Table 1. Descriptive statistics for age, and BMI

(n = 80)	Range	Mean	S.D.
Age (Years)	21 to 40	29.36	5.30
BMI(Kg/M^2)	18.2 to 31.2	24.89	2.29

4. Results

In this study, 80 patients participated with a mean age of 29.36 ranging from 20-40 years.

The Paired "t" test was applied to compare VAS, Algometer, ODI score, Trunk flexors MMT, and Trunk extensors MMT within the groups. There was a difference ($p < 0.05$) in VAS, Algometer, ODI score, Trunk flexors MMT as well asTrunk extensors MMT within both the groups: Experimental and control. The Independent sample "t" test was used to compare VAS, Algometer, ODI score, Trunk flexors MMT, and Trunk extensors MMT according to gender. There was a difference ($p < 0.05$) in Algometer (Both pre-test and post-test), Trunk flexors MMT (Pre-test) as well as Trunk extensors MMT(Both pre-test and post-test) between males and females.

5. Discussion

The study was conducted with 80 subjects aged between 20-40 years who had mechanical low back pain. The finding of the above study shows that after 6-weeks of intervention, the experimental group, which received DNS intervention, showed significant improvements across multiple metrics. Within-group comparisons from

Table 2. Comparison of VAS, Algometer, ODI score, Trunk flexors MMT, and Trunk extensors MMT within groups

Mean		Experimental				Control			
		S.D.	"t"	p Value	Mean	S.D.	"t"	p Value	
VAS (mm)	Pre-test	69.61	12.76	16.57	< 0.001*	76.56	8.42	25.35	< 0.001*
	Post-test	18.44	18.47			16.72	13.35		
Algometer (Kg/Cm^2)	Pre-test	5.19	1.92	-9.07	< 0.001*	4.86	1.66	-6.02	< 0.001*
	Post-test	6.81	2.11			5.96	1.96		
ODI score (%)	Pre-test	33.00	11.08	8.97	< 0.001*	37.27	8.31	14.00	< 0.001*
	Post-test	18.74	9.80			23.72	7.71		
Trunk flexors MMT	Pre-test	3.22	0.83	-8.71	< 0.001*	2.97	7.71	-12.55	< 0.001*
	Post-test	4.08	0.60			3.97	7.71		
Trunk extensors MMT	Pre-test	2.75	0.81	-9.58	< 0.001*	2.72	7.71	-9.00	< 0.001*
	Post-test	3.72	0.66			3.47	7.71		

("t" = Paired "t" test; * Significant)

pre-test to post-test revealed significant improvements in both the experimental and control groups with p-values 0.001 ($p < 0.05$). The gender distribution and demographic characteristics were similar across both the groups, ensuring a balanced representation for a fair comparison (Table 3).

The independent sample "t" test revealed significant gender differences in several measurements. As shown in (Table 4), The algometer readings, trunk flexors and extensors MMT (both pre-test and post-test) showed significant differences between males and females, with $p<0.05$. This difference in pain perception can be due to hormonal differences, as past studies support this finding stating, estrogen modulates the endogenous pain control system, influencing pain perception and analgesia in women, wherein testosterone has been shown to have analgesic properties, contributing to lower pain sensitivity in men[19]. The VAS scores, showed a substantial reduction post-treatment in both groups. In Experimental group, mean VAS score decreased suggesting that DNS treatment is effective in reducing pain intensity. Mean algometer readings increased from 5.19 (pre-test) to 6.81 (post-test) (Table 5). The above findings were supported by the study done by Casiano E. *et al.*[20] which highlighted the role of central and peripheral mechanisms in pain modulation, emphasizing the release of endogenous opioids during therapeutic exercises, and other neurochemical changes that reduce pain perception. This suggests that DNS treatment enhances pain tolerance by inhibiting pain signal transmission at the spinal cord level and modulating pain processing areas in the brain and reduces sensitivity by the desensitization of peripheral nociceptors and enhanced central pain processing and an improvement in muscle function.

The mean ODI score declined from 33.00 (pre-test) to 18.74 (post-test), demonstrating that DNS treatment effectively reduces disability and improves functional capacity, this aligns with a study done by Macedo, Maher *et al.*, demonstrating that motor control training for persistent, non-specific low back pain significantly improved functional outcomes[21]. Hence DNS, a form of motor control exercise, led to substantial reductions in ODI scores, indicating improved daily functioning and reduced disability. For trunk flexors mean MMT scores increased and for trunk extensors (Table 5), indicating DNS as an effective treatment strategy in enhancing muscle strength and better neuromuscular control. This enhanced muscle function can be attributed to improved motor unit recruitment and synchronization, which are critical for generating force and maintaining stability. The above findings were supported by Hodges and Cholewicki, which highlighted that DNS exercises emphasize on correct breathing patterns and postural alignment which enhances the neuromuscular control and stability, particularly in stabilizing muscles around the spine[22].

The effect of DNS exercise on improving the quality of life is supported by Frank *et al.*, which states that, targeted exercises of DNS can lead to neuroplastic changes, improving motor control and functional outcomes[23]. Hoffman and Gabel stated that, through targeted and repetitive exercises, DNS aims to replace maladaptive movement patterns associated with pain and dysfunction[24]. This process is crucial for recovery from chronic pain conditions, as it promotes the adaptation of new, more effective movement strategies.

A significant negative correlation ($p < 0.001$) was found between VAS and Algometer scores, indicating that as pain intensity decreases, pain tolerance increases. A significant negative correlation ($p < 0.001$) was also found between ODI scores and trunk flexors or extensors MMT, suggesting that as disability decreases, muscle strength increases. Additionally, a significant positive correlation ($p < 0.001$) was found between trunk flexors and extensors MMT, indicating that improvements in trunk flexor strength are associated with improvements in trunk extensor strength. These significant correlations provide a comprehensive understanding of the effectiveness of DNS treatment.

5.1 Limitations

1. The specific prevalence of MLBP pain in Indian population is not yet determined, highlighting a gap in current research.
2. The study focused on young adults aged 20-40 years, which may restrict the generalizability of findings to a broader population.
3. There was no post-treatment follow-up to assess the durability of treatment effects, limiting understanding of the intervention's long-term impact.

6. Conclusion

The current study provides significant evidence that DNS treatment significantly improves pain, muscle strength,

and functional ability in individuals with MLBP and these findings are well-supported by recent research, which underscore the importance of incorporating DNS techniques in-patient rehabilitation programs and improving patient's quality of life. Healthcare professionals and clinicians can use these insights to make well-informed decisions when customizing treatment plans.

7. Acknowledgement

The authors would like to thank the participants for their cooperation throughout the study.

8. References

1. Schnurrer T, Vrbanic L. Low back pain-from definition to diagnosis. NLM. 2011; 58(2):105-107. PMID: 22232956
2. Hartvigsen J, Hancock M, Kongsted A, *et al*. What low back pain is and why we need to pay attention. Lancet. 2018; 391(10137):2356-2367. PMID: 29573870. https://doi.org/10.1016/S0140-6736(18)30480-X
3. Casiano VE, Sarwan G, Dydyk AM. Back pain. NCBI. 2023.
4. Shetty GM, Jain S, Thakur H, *et al*. Prevalence of low back pain in India: A systematic review and meta-analysis. Work. 2022; 73(2). https://doi.org/10.3233/wor-205300
5. Kulkarni VR, Borkar P. Epidemiology of low back pain among information technology professionals across India-a systematic review. IJHSR. 2022; 12(8):89-96. https://doi.org/10.52403/ijhsr.20220812
6. Frank C, Kobesova A, Kolar P. Dynamic neuromuscular stabilization and sports rehabilitation. Int J Sports Phys Ther. 2013; 8(1):62-73. PMID: 23940503.
7. Kobesova A, Kolar P. Developmental kinesiology: Three levels of motor control in the assessment and treatment of the motor system. J Body Mov Ther. 2014; 18(4):498-507. https://doi.org/10.1016/j.jbmt.2013.04.002
8. Smith BE, Littlewood C, May S. An update of stabilisation exercises for low back pain: A systematic review with meta-analysis. BMC Musculoskelet Disord. 2014; 15:416. https://doi.org/10.1186/1471-2474-15-416.Cook C,
9. Hegedus EJ, Ramey K. Physical therapy exercise intervention based on classification using the patient response method: A systematic review of the literature. JMMT. 2005; 13(3):152-159. https://doi.org/10.1179/106698105790824950
10. GBD 2019 Diseases and Injuries Collaborators. Global burden of 369 diseases and injuries in 204 countries and territories, 1990-2019: A systematic analysis for the Global Burden of Disease Study 2019. Lancet Glob Health Metrics. 2020; 396(10258):1204-22. https://doi.org/10.1016/S0140-6736(20)30925-9. Erratum in: *Lancet*. 2020 Nov 14; 396(10262):1562. https://doi.org/10.1016/S0140-6736(20)32226-1. PMID: 33069326; PMCID: PMC7567026
11. Ghagholestani BN, Gandomi F, Assar S. Effects of dynamic neuromuscular stabilization and aquatic exercises on pain, disability, lumbopelvic control, and spinal posture of patients with non-specific low back pain. Iran Rehabil J. 2022; 20(3):333-344. https://doi.org/10.32598/irj.20.3.1319.2
12. Mahdieha L, Zolaktafa V, Karimi MT. Effects of Dynamic Neuromuscular Stabilization (DNS) training on functional movements. Hum Mov Sci. 2020; 70:102568. https://doi.org/10.1016/j.humov.2019.102568
13. Toward Optimized Practice Low Back Pain Working Group. Evidence-informed primary care management of low back pain: Clinical practice guideline. Toward Optimized Practice. 3rd ed; 2017.
14. Singh SK, Khan N, Agarwal R. Effect of rhythmic stabilization exercise *vs* conventional physiotherapy on pain and disability with patients of chronic mechanical low back pain. Indian J Physiother Occup Therapy. 2019; 13(4):122-126. https://doi.org/10.5958/0973-5674.2019.00146.1
15. Suzuki H, Tahara S, Mitsuda M, *et al*. Current concept of quantitative sensory testing and pressure pain threshold in neck or shoulder and low back pain. Healthcare. 2022; 10(8):1485. https://doi.org/10.3390/healthcare10081485
16. Shafshak TS, Elnemr R. The visual analogue scale versus numerical rating scale in measuring pain severity and predicting disability in low back pain. J Clin Rheumatol. 2021; 27(7):282-285. https://doi.org/10.1097/rhu.0000000000001320
17. Lee CP, Fu TS, Liu CY, Hung CI. Psychometric evaluation of the Oswestry Disability Index in patients with chronic low back pain: Factor and Mokken analyses. HRQOL. 2017; 15:192. https://doi.org/10.1186/s12955-017-0768-8
18. Daniels L, Worthingham K. Muscle testing- Techniques of manual examination. 7th ed. Saunders Co; 2002.
19. Fillingim RB, King CD, Dasilva MCR, *et al*. Sex, gender, and pain: A review of recent clinical and experimental findings. J Pain Res. 2009; 10(5):447-485. https://doi.org/10.1016/j.jpain.2008.12.001
20. Casiano E, Stokes D, Kendrick M. Mechanisms of pain modulation in physical therapy. J Pain Res. 2023; 36(4):215-223.
21. Macedo LG, Maher CG, Latimer J, *et al*. Motor control exercise for persistent, nonspecific low back pain: A systematic review. Phys Ther. 2009; 89(1):9-25. https://doi.org/10.2522/ptj.20080103
22. Davies R. Spinal control: The rehabilitation of back pain, state of the art and science. Physiother Can. 2015; 67(4):394. https://doi.org/10.3138/ptc.67.4.rev1

23. Frank C, Kobesova A, Kolar P. Dynamic neuromuscular stabilization and sports rehabilitation. Int J Sports Phys Ther. 2013; 8(1):62-73. PMID: 23439921.

24. Hoffman J, Gabel CP. The origins of Western mind-body exercise methods. Physical Therapy Reviews. 2015; 20(5-6):315-324. https://doi.org/10.1080/10833196.2015.1125587

Access this journal online	
Website: www.informaticsjournals.co.in/index.php/JEOH/index	**Quick Response Code**