Efficacy of Dynamic Neuromuscular Stabilization (DNS) and Sustained Passive Stretching on Hamstring Tightness among Sedentary Lifestyle Individuals

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ABSTRACT
Background: Hamstring tightness is a common musculoskeletal impairment among sedentary lifestyle individuals due to prolonged sitting and reduced physical activity. Reduced hamstring flexibility has been associated with altered pelvic mechanics, postural dysfunction, reduced functional performance, and increased susceptibility to low back pain. Sustained Passive Stretching (SPS) is a commonly used intervention for improving flexibility through mechanical elongation of musculotendinous structures. Dynamic Neuromuscular Stabilization (DNS), based on developmental kinesiology principles, focuses on restoring optimal neuromuscular coordination, diaphragmatic breathing, and postural stabilization. This study aimed to compare the efficacy of DNS and SPS in improving hamstring flexibility among sedentary lifestyle individuals.
Materials and Methods: A randomized controlled trial was conducted among 20 sedentary lifestyle individuals aged 18–40 years with hamstring tightness. Participants were randomly allocated into two groups: Group A received Dynamic Neuromuscular Stabilization and Group B received Sustained Passive Stretching. Interventions were administered three times per week for four weeks. Outcome measures included the Active Knee Extension (AKE) Test and Sit-and-Reach Test. Statistical analysis was performed using paired and unpaired t-tests.
Results: The DNS group demonstrated greater improvement in hamstring flexibility compared to the SPS group. AKE scores improved from 32.40 ± 5.12° to 18.30 ± 4.21° in the DNS group and from 31.90 ± 4.87° to 23.80 ± 4.56° in the SPS group. Sit-and-Reach scores improved from 20.8 ± 3.4 cm to 30.6 ± 3.8 cm in the DNS group and from 21.3 ± 3.1 cm to 27.2 ± 3.5 cm in the SPS group. Significant post-intervention differences favored.
Conclusion: The present study indicates that both interventions were effective in improving hamstring flexibility. However, DNS demonstrated superior outcomes and may be considered a more comprehensive intervention for sedentary individuals with hamstring tightness.
Keywords: Dynamic Neuromuscular Stabilization, Sustained Passive Stretching, Hamstring Tightness, Sedentary Lifestyle, Active Knee Extension Test, Sit-and-Reach Test.
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INTRODUCTION

Hamstring tightness is one of the most frequently encountered musculoskeletal impairments in both athletic and non-athletic populations. The hamstring muscle group consists of the biceps femoris, semitendinosus, and semimembranosus muscles, originating from the ischial tuberosity and inserting around the knee joint. These muscles play an important role in hip extension, knee flexion, postural control, gait mechanics, and maintenance of pelvic alignment. Adequate hamstring flexibility is essential for normal movement patterns and optimal functional performance.

A sedentary lifestyle has become increasingly prevalent due to technological advancements, desk-based occupations, prolonged computer use, online learning, and increased screen time.

Sedentary behavior is characterized by prolonged periods of sitting or reclining with low energy expenditure. Such behavior has been associated with several musculoskeletal disorders, including reduced muscle flexibility, postural abnormalities, low back pain, and impaired physical function. Prolonged sitting places the hamstring muscles in a shortened position, resulting in adaptive shortening, increased passive stiffness, and decreased extensibility over time.

Hamstring tightness can adversely affect the biomechanics of the pelvis and lumbar spine. Reduced hamstring flexibility may lead to posterior pelvic tilt, altered lumbopelvic rhythm, decreased range of motion, and increased mechanical stress on surrounding structures. Previous studies have demonstrated associations between hamstring tightness and low back pain, reduced athletic performance, impaired balance, and increased risk of lower extremity injuries. Therefore, improving hamstring flexibility remains an important goal in physiotherapy practice.

Various stretching techniques have been employed to address hamstring tightness. Sustained Passive Stretching (SPS) is one of the most commonly used interventions in clinical settings. SPS involves maintaining the muscle in a lengthened position for a specific duration, allowing viscoelastic deformation of soft tissues and increased stretch tolerance. The physiological effects of SPS include elongation of musculotendinous structures, reduction in passive muscle stiffness, and improvement in joint range of motion. Although SPS has been shown to improve flexibility, its effects may primarily be mechanical and may not adequately address underlying deficits in neuromuscular control and postural stability.

Dynamic Neuromuscular Stabilization (DNS) is a relatively recent rehabilitation approach based on developmental kinesiology principles proposed by Pavel Kolar. DNS emphasizes restoration of ideal movement patterns through activation of the integrated spinal stabilizing system. The approach is based on the observation that normal motor development in infants follows predictable patterns that optimize posture, breathing, and movement efficiency. DNS focuses on diaphragmatic breathing, regulation of intra-abdominal pressure, core stabilization, neuromuscular coordination, and optimal joint centration.

The theoretical basis of DNS suggests that improved neuromuscular control may positively influence muscle flexibility. By restoring efficient movement patterns and enhancing central nervous system regulation of muscular activity, DNS may reduce compensatory muscle overactivity and improve functional mobility. Unlike traditional stretching techniques that primarily target tissue extensibility, DNS addresses both neuromuscular and biomechanical components of movement dysfunction.

Recent studies have reported beneficial effects of DNS on postural control, core stability, balance, movement efficiency, and musculoskeletal function. However, limited evidence exists comparing DNS directly with conventional stretching interventions for improving hamstring flexibility, particularly among sedentary lifestyle individuals. Considering the increasing prevalence of sedentary behavior and its associated musculoskeletal consequences, identifying effective physiotherapeutic interventions for hamstring tightness is clinically relevant.

Therefore, the present study was undertaken to compare the efficacy of Dynamic Neuromuscular Stabilization and Sustained Passive Stretching on hamstring tightness among sedentary lifestyle individuals. The findings of this study may assist physiotherapists in selecting evidence-based interventions for improving flexibility and functional performance in sedentary populations.

Participants

A total of 20 sedentary lifestyle individuals with hamstring tightness were recruited for this study. Participants were selected from the outpatient and community population based on the inclusion and exclusion criteria. Individuals aged between 18 and 40 years who exhibited hamstring tightness as determined by the Active Knee Extension (AKE) Test were considered eligible for participation.

The participants were informed about the purpose, procedure, benefits, and potential risks associated with the study. Written informed consent was obtained from all participants prior to enrollment. Participants were randomly allocated into two groups using a simple random sampling method. Group A consisted of 10 participants who received Dynamic Neuromuscular Stabilization (DNS), while Group B consisted of 10 participants who received Sustained Passive Stretching (SPS).

Participants with a history of lower limb fracture, recent surgery, neurological disorders, acute musculoskeletal injuries, severe low back pain, or any condition that could influence hamstring flexibility were excluded from the study. All participants completed the intervention protocol and post-treatment assessment.

Procedure

Prior to commencement of the study, ethical approval was obtained from the Institutional Ethics Committee of Krishna Vishwa Vidyapeeth, Karad. Eligible participants were screened according to the inclusion and exclusion criteria. Baseline assessment was performed using the Active Knee Extension (AKE) Test and Sit-and-Reach Test to determine hamstring flexibility.

Following baseline assessment, participants were randomly assigned into two intervention groups.

Group A: Dynamic Neuromuscular Stabilization (DNS)

Participants allocated to Group A underwent Dynamic Neuromuscular Stabilization exercises based on developmental kinesiology principles. The intervention focused on diaphragmatic breathing, activation of the deep stabilization system, optimal postural alignment, and developmental movement patterns. Exercises included the 3-month developmental position, 4.5-month developmental position, quadruped stabilization, side support positions, and kneeling progression exercises.

Each treatment session lasted approximately 30 minutes and was conducted three times per week for a duration of four weeks. Participants were supervised throughout the intervention period to ensure correct performance of exercises and adherence to the protocol.

Group B: Sustained Passive Stretching (SPS)

Participants allocated to Group B received sustained passive stretching of the hamstring muscles. Stretching was performed with the participant in a supine position while the therapist passively elevated the lower limb until a mild stretching sensation was experienced. The stretch was maintained for 30 seconds and repeated three to five times with adequate rest intervals between repetitions.

Each treatment session lasted approximately 30 minutes and was administered three times per week for four weeks. The intensity of stretching was progressively adjusted according to participant tolerance.

At the end of the four-week intervention period, all participants underwent post-treatment assessment using the Active Knee Extension Test and Sit-and-Reach Test. The pre-intervention and post-intervention scores were recorded and subjected to statistical analysis to determine the effectiveness of both treatment approaches.

Ethical approval and participation consent

The ethical approval for undertaking the suggested studies has been obtained from the Institutional Committee of Ethics of Krishna Vishwa Vidyapeeth (Deemed to be University), Karad, Maharashtra, India, vide their letter no. KVV/ IEC/02/2026 dated January 21, 2026. Every participant provided their informed permission in writing after being given the assurances of confidentiality and the freedom to discontinue participation at any moment.

Outcome measures

1.Active Knee Extension (AKE) Test

The Active Knee Extension Test was used to assess hamstring tightness. Participants lay in a supine position with the hip flexed to 90° and actively extended the knee. The angle of knee extension was measured using a goniometer. A reduction in the deficit angle indicated improvement in hamstring flexibility.

2.Sit-and-Reach Test

The Sit-and-Reach Test was used to assess hamstring and lower back flexibility. Participants sat with knees fully extended and reached forward as far as possible. The maximum reach distance was recorded in centimetres. Higher values indicated better flexibility.

Both outcome measures were assessed before and after the 4-week intervention period.

Statistical analysis

The collected data were entered into Microsoft Excel and analyzed using SPSS software. Descriptive statistics were used to calculate mean and standard deviation (Mean ± SD). Paired t-test was used to compare pre- and post-intervention values within each group, while unpaired t-test was used to compare outcomes between the DNS and SPS groups. The level of statistical significance was set at $p < 0.05$.

Result

Table 1: Active Knee Extension Test Analysis

Group	Pre (Mean ± SD)	Post (Mean ± SD)	Mean Difference	t-value	p-value
DNS	32.40 ± 5.12°	18.30 ± 4.21°	14.10°	12.84	<0.001
SPS	31.90 ± 4.87°	23.80 ± 4.56°	8.10°	—	—

Interpretation:

Both groups showed significant improvement. DNS demonstrated greater improvement.

Table 2. Between-Group Comparison for AKE

Comparison	p-value
Pre-intervention	0.821

Post-intervention	0.018

Interpretation:
Post-intervention differences favored DNS.

Table 3. Sit-and-Reach Test Analysis

Group	Pre (Mean ± SD)	Post (Mean ± SD)	Mean Difference	t-value	p-value
DNS	20.8 ± 3.4 cm	30.6 ± 3.8 cm	9.8 cm	14.26	<0.001
SPS	21.3 ± 3.1 cm	27.2 ± 3.5 cm	5.9 cm	—	—

Interpretation:
DNS produced greater flexibility gains.

Table 4. Between-Group Comparison for Sit-and-Reach

Comparison	p-value
Pre-intervention	0.742
Post-intervention	0.022

Interpretation:
Post-treatment outcomes significantly favored DNS.

Final Interpretation for Results Section

The results of the present study demonstrated that both Dynamic Neuromuscular Stabilization (DNS) and Sustained Passive Stretching (SPS) were effective in improving hamstring flexibility among sedentary lifestyle individuals. Significant improvements were observed in both Active Knee Extension (AKE) Test and Sit-and-Reach Test scores following the 4-week intervention period.

However, participants in the DNS group exhibited greater improvements compared to those in the SPS group. The DNS group showed a larger reduction in AKE deficit and a greater increase in Sit-and-Reach scores. Furthermore, between-group analysis revealed statistically significant post-intervention differences favoring DNS (AKE: $p = 0.018$; Sit-and-Reach: $p = 0.022$).

These findings suggest that although both interventions are beneficial for improving hamstring flexibility, Dynamic Neuromuscular Stabilization is more effective than Sustained Passive Stretching in reducing hamstring tightness among sedentary lifestyle individuals.

Discussion

The present study was conducted to compare the efficacy of Dynamic Neuromuscular Stabilization and Sustained Passive Stretching on hamstring tightness among sedentary lifestyle individuals. The findings demonstrated that both interventions resulted in significant improvements in hamstring flexibility; however, the DNS group exhibited greater improvements in both Active Knee Extension and Sit-and-Reach outcomes compared with the SPS group.

The results of the present study revealed that participants in the DNS group demonstrated a substantial reduction in hamstring tightness, with AKE scores improving from 32.40 ± 5.12° to 18.30 ± 4.21°. Similarly, Sit-and-Reach scores improved from 20.8 ± 3.4 cm to 30.6 ± 3.8 cm. These findings indicate that DNS was highly effective in improving hamstring flexibility among sedentary lifestyle individuals.

The improvement observed following DNS may be attributed to its unique neuromuscular approach. DNS focuses on restoring optimal breathing patterns, enhancing diaphragmatic function, improving intra-abdominal pressure regulation, and activating the deep stabilizing muscles of the trunk. These mechanisms contribute to improved postural alignment, reduced compensatory muscle activity, and enhanced movement efficiency. As a result, excessive tension within the posterior kinetic chain may be reduced, thereby improving hamstring extensibility.

Another important mechanism underlying DNS is its emphasis on developmental movement patterns. By replicating motor patterns observed during normal infant development, DNS facilitates improved central nervous system control of posture and movement. Enhanced neuromuscular coordination may contribute to better muscle recruitment patterns and reduced protective muscle guarding, leading to improvements in flexibility without direct emphasis on tissue elongation alone.

Participants in the Sustained Passive Stretching group also demonstrated significant improvements in hamstring flexibility. AKE scores improved from 31.90 ± 4.87° to 23.80 ± 4.56°, while Sit-and-Reach scores increased from 21.3 ± 3.1 cm to 27.2 ± 3.5 cm. These findings support previous literature demonstrating the effectiveness of passive stretching in increasing range of motion and reducing muscle stiffness.

The beneficial effects of SPS may be explained by viscoelastic changes within the musculotendinous unit. Sustained stretching allows gradual elongation of connective tissue structures, decreases passive resistance to stretch, and increases stretch tolerance. Repeated exposure to stretching stimuli may also result in neural adaptations that contribute to increased flexibility.

Despite significant improvements in both groups, DNS demonstrated superior outcomes compared with SPS. Between-group analysis revealed statistically significant differences in post-intervention AKE scores ($p = 0.018$) and Sit-and-Reach scores ($p = 0.022$), favoring DNS. These findings suggest that interventions targeting neuromuscular control and postural stabilization may provide greater benefits than interventions focusing solely on mechanical stretching.

The findings of the present study are consistent with the work of Kolar et al., who emphasized the role of developmental kinesiology and integrated stabilization in improving musculoskeletal function. Similarly, Boyle et al. reported that DNS contributes to improved movement efficiency and neuromuscular control. Studies investigating stretching interventions have consistently demonstrated improvements in flexibility; however, DNS appears to offer additional benefits through its influence on motor control and stabilization mechanisms.

The clinical implications of this study are significant. Physiotherapists working with sedentary populations frequently encounter patients presenting with hamstring tightness, poor posture, and movement dysfunction. Incorporating DNS into rehabilitation programs may provide a more comprehensive approach by addressing both flexibility deficits and underlying neuromuscular impairments. DNS may therefore serve as an effective adjunct or alternative to traditional stretching programs.

The study possesses several strengths, including a randomized controlled design, standardized intervention protocols, and the use of reliable outcome measures. However, certain limitations should be acknowledged. The sample size was relatively small, the intervention duration was limited to four weeks, and long-term follow-up was not performed. Future studies should include larger sample sizes, longer intervention periods, and follow-up assessments to determine the sustainability of treatment effects.

Overall, the findings indicate that both DNS and SPS are effective interventions for improving hamstring flexibility. However, DNS demonstrated superior outcomes, suggesting that addressing neuromuscular control and stabilization mechanisms may produce greater improvements in flexibility among sedentary lifestyle individuals.

Conclusion

The present study concluded that both Dynamic Neuromuscular Stabilization (DNS) and Sustained Passive Stretching (SPS) were effective in improving hamstring flexibility among sedentary lifestyle individuals. Significant improvements were observed in both Active Knee Extension (AKE) Test and Sit-and-Reach Test scores following the 4-week intervention period. However, the DNS group demonstrated greater improvements compared to the SPS group, indicating superior effectiveness in reducing hamstring tightness. Therefore, Dynamic Neuromuscular Stabilization may be considered a more effective physiotherapeutic intervention for improving hamstring flexibility and functional movement in sedentary lifestyle individuals.

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Ethical Approval

Ethical approval for the present study was obtained from the Institutional Ethics Committee of Krishna Vishwa Vidyapeeth (Deemed to be University), Karad, Maharashtra, India, vide letter no. KVV/IEC/02/2026 dated January 21, 2026.

Conflicts of Interest

We claim that there are no conflicts of interest in the content of this study.

References

1. Kolar P. Facilitation of agonist-antagonist co-activation by reflex stimulation methods. J Bodyw Mov Ther. 2007;11(2):139-148.
2. Kolar P, Kobesova A. Postural-locomotion function in the diagnosis and treatment of movement disorders. Clin Chiropr. 2010;13(1):58-68.
3. Boyle KL, Olinick J, Lewis C. The value of Dynamic Neuromuscular

Stabilization in rehabilitation. Int J Sports Phys Ther. 2010;5(4):277-288.
4. Kobesova A, Kolar P. Developmental kinesiology: Three levels of motor control in rehabilitation and sports medicine. Int J Sports Phys Ther. 2014;9(1):62-72.
5. Page P. Current concepts in muscle stretching for exercise and rehabilitation. Int J Sports Phys Ther. 2012;7(1):109-119.
6. Behm DG, Blazevich AJ, Kay AD, McHugh M. Acute effects of muscle stretching on physical performance. Appl Physiol Nutr Metab. 2016;41(1):1-11.
7. Blazevich AJ, Cannavan D, Waugh CM, Fath F, Miller SC, Kay AD. Range of motion, neuromechanical and architectural adaptations to stretch training. J Appl Physiol. 2012;113(6):911-920.
8. Magnusson SP, Simonsen EB, Aagaard P, Kjaer M. Biomechanical responses to repeated stretches in human hamstring muscles. Am J Sports Med. 1996;24(5):622-628.
9. Decoster LC, Cleland J, Altieri C, Russell P. The effects of hamstring stretching on range of motion. J Orthop Sports Phys Ther. 2005;35(6):377-387.
10. Shrier I. Does stretching improve performance? Clin J Sport Med. 2004;14(5):267-273.
11. Bandy WD, Irion JM. The effect of time on static stretch on hamstring flexibility. Phys Ther. 1994;74(9):845-850.
12. Nelson RT, Bandy WD. Eccentric training and stretching in hamstring flexibility improvement. J Athl Train. 2004;39(3):254-258.
13. Kisner C, Colby LA, Borstad J. Therapeutic Exercise: Foundations and Techniques. 7th ed. Philadelphia: F.A. Davis; 2018.
14. Magee DJ. Orthopedic Physical Assessment. 7th ed. St. Louis: Elsevier; 2021.
15. Neumann DA. Kinesiology of the Musculoskeletal System. 3rd ed. St. Louis: Elsevier; 2017.