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Efficacy of Dynamic Neuromuscular Stabilization (DNS) in Musculoskeletal Rehabilitation: A Narrative Review

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Abstract

Dynamic Neuromuscular Stabilization (DNS) focuses on helping individuals control movements using the principles of how humans normally develop. This method is recognized in rehabilitation for helping improve posture, relieve joint pain, make movements easier, and restore balance. This review takes a critical look at DNS and explores how well it addresses chronic pain, rehabilitates the body from orthopedic conditions, aids in sports medicine, and corrects postural problems. The literature search was done through peer-reviewed databases from 2019 to 2024 that included all RCTs, case studies, quasi-experiments, and comparative interventions. Findings from the literature indicate that DNS offers a better way to improve core stability, activate muscles, sense of movement, and move freely. Because of the supportive findings, DNS can be recommended in current rehabilitation protocols.

Keywords: Dynamic Neuromuscular Stabilization (DNS), Musculoskeletal Rehabilitation, Core Stability, Postural Correction

Introduction

Traditional rehabilitation methods mainly focus on strengthening, enhancing flexibility, and manual therapy however, these approaches may fall short in addressing neuromuscular coordination deficits, which are crucial for restoring movement efficiency and pain-free function. [1] Dynamic Neuromuscular Stabilization (DNS), developed by Pavel Kolar, is an innovative rehabilitation technique rooted in developmental motor control principles.[2] Unlike conventional interventions that concentrate solely on muscle strengthening, DNS emphasizes optimal joint stabilization, core activation, posture correction, and movement pattern restoration by retraining the central nervous system to achieve efficient neuromuscular control.[3] By targeting deep stabilizing musculature, DNS improves postural integrity, functional mobility, and movement coordination, offering significant benefits in sports rehabilitation, chronic pain syndromes, orthopedic recovery, and neurological rehabilitation.[4] Despite the growing integration of DNS into physiotherapy and sports medicine, research is still evolving regarding its long-term efficacy, optimal intervention dosage, and comparative effectiveness against other rehabilitation strategies. This review systematically synthesizes existing literature to assess the clinical relevance and therapeutic impact of DNS across various musculoskeletal conditions.

Musculoskeletal disorders are a major public health challenge, which impacts millions of individuals worldwide leading to chronic pain, postural misalignment, and movement dysfunction. [5] Supportive care during rehabilitation is aimed at exercising, boosting flexibility and offering manual therapy, yet it might not be enough to help with problems of neuromuscular coordination, a key aspect in recovering normal movements without pain.[6] DNS, which is based on developmental movements, Contrary to regular exercises focused just on muscles, DNS focuses on strengthening of joints, activation of core, correcting bad posture and retraining brain to give the best control to muscles. [7] By improving the function and strength of muscles responsible for posture, DNS helps people with rehabilitation after sports injuries, pain syndromes, joint problems and conditions affecting the nervous system.[8] Even though DNS has been widely integrated into rehabilitation for physiotherapy and sports medicine, studies are still ongoing to evaluate its lasting use, the optimal amount needed, and how it compares with other rehabilitation strategies.

Methodology

This review followed a planned approach to assess how DNS helps in musculoskeletal rehabilitation. For summarizing studies publications from 2019 to 2024 were collected from PubMed, Scopus, Google Scholar and ScienceDirect by using Boolean terms together (“Dynamic Neuromuscular Stabilization” OR “DNS therapy”), (“musculoskeletal rehabilitation” OR “physical therapy”), (“pain relief” OR “functional mobility” OR “postural control” OR “core stability”) and (“randomized controlled trial” OR “intervention study”). The studies had to meet the following inclusion criteria: evaluation of DNS using peer-reviewed publications, focus on chronic pain, postural issues, orthopedic conditions, dysfunctions of the pelvic floor or sports rehabilitation and report pain relief, activation of muscles, reactions to movements, control of posture or functional movement. Case reports, editorials, and unclear studies were not included in this review. After reviewing the titles and abstracts, 19 studies were selected by reviewing the full-text papers. The studies included randomized trials, quasi-experiments, case studies, and analyses of comparative interventions with participants ranging from 10 to 90.

Results

A total of 19 studies investigating DNS interventions across various musculoskeletal conditions were reviewed. Below is a summary of the studies, including methodological design, outcome measures, and key findings:

Table 1: Summary of DNS Studies Across Various Musculoskeletal Conditions

S.no	Authors	Year of Publication	Sample Size	Intervention	Outcome measure	Findings
1	Udhoji *et al.*	2024	60 subacute stroke patients	Three-arm parallel randomized clinical trial	Trunk Impairment Scale (TIS), Dynamic Gait Index (DGI), gait parameters	DNS showed greater improvement in trunk control and gait stability compared to NDT and PNF. PNF was effective in improving dynamic balance, while NDT facilitated neuromuscular coordination and functional independence.
2	Kang *et al.*	2024	24 middle-aged women (12 DNS, 12 control)	Randomized controlled trial over 12 weeks	Center of Pressure (COP) displacement, RMS, movement area, Functional Movement Screen (FMS)	DNS training significantly improved dynamic stability, single-leg stance, and torso stability, leading to reduced COP displacement and enhanced functional movement.
3	Rabieezadeh *et al.*	2024	29 individuals with non-specific chronic low back pain	Randomized clinical trial (8-week intervention, 2-month follow-up)	Pain intensity (VAS), Functional disability (Oswestry Disability Index), Quality of life (SF-36)	DNS exercises significantly improved pain, disability, and quality of life immediately post-intervention ($p < 0.05$), but the effects diminished after 2 months of detraining.
4	Kalphidaa *et al.*	2024	20 patients with Mechanical Low Back Pain	Quasi-experimental study (pre-posttest design)	Numeric Pain Rating Scale (NPRS)	DMST significantly reduced pain compared to Conventional Exercises ($p < 0.05$), supporting its role in functional improvement and pain relief.
5	Sharma *et al.*	2024	90 women aged 18-40 years with mild to moderate SUI	Single-blinded randomized controlled trial (DNS vs. Kegel exercises over 12 weeks)	Perineometer readings, EMG (average, peak, MVC), Pressure Biofeedback Unit (PBU), UDI-6	DNS significantly improved pelvic floor muscle strength and core activation compared to Kegel exercises ($p < 0.005$). Effect sizes showed medium to large effects favoring DNS intervention. No significant difference in transverse abdominis activation between groups.
6	Ibrahim & Saad	2024	10 female artistic gymnasts (aged 14-15)	Experimental study with pre-post measurements over 10 weeks	Numeric Pain Rating Scale (NPRS), Modified Oswestry Disability Questionnaire (MODQ), Fear-Avoidance Beliefs Questionnaire (FABQ), Breath-holding time, Respiratory rate, Back muscle strength	DNS significantly reduced lower back pain, improved respiratory indicators, and enhanced back muscle strength ($p < 0.05$), confirming its role in spinal stabilization and neuromuscular control.
7	Taha *et al.*	2024	60 hypertensive patients (54-64 years)	Randomized controlled trial (DNS vs. diaphragmatic breathing and balance training, 8-week intervention)	Biodex Balance System (BBS), Timed-Up-and-Go (TUG), Modified Star Excursion Balance Test (mSEBT), Pittsburgh Sleep Quality Index (PSQI), SF-12 (QoL)	DNS significantly improved postural stability, sleep quality, and overall QoL compared to control ($p < 0.01$), but PCS scores showed no significant difference ($p > 0.05$).
8	Kaushik *et al.*	2024	40 NSCLBP patients (MCI subgroup)	Randomized controlled trial (DNS vs. SFE, 6-week intervention)	Active lumbar repositioning error test, Luomajoki MCI test battery, Patient-Specific Functional Scale (PSFS)	DNS exercises significantly improved lumbar proprioception, movement control, and functional activity limitation ($p < 0.05$), while SFE showed no significant effect on repositioning error.
9	Gulrandhe *et al.*	2023	100 overweight and obese individuals (50 DNS, 50 conventional physiotherapy)	Randomized controlled trial	Six-minute Walk test (SMWT), Body Mass Index (BMI)	Both DNS and conventional physiotherapy significantly improved functional capacity (SMWT distance and BMI reduction), but the difference between groups was not statistically significant. Further research is needed for long-term effectiveness.
10	Nurhayati *et al.*	2023	50 elderly individuals with genu osteoarthritis	Quasi-experimental study (pre-posttest with control group)	Numeric Rating Scale (NRS) for pain assessment	DNS exercise significantly reduced pain in the experimental group compared to the control group ($p=0.044$). The study suggests altering DNS exercise dosage for future research to optimize effectiveness.
11	Sharma *et al.*	2023	24 women with mild to moderate SUI	Single-blinded pilot study (DNS vs. Kegel exercises over 12 weeks)	Perineometer readings, EMG (average, peak, MVC), UDI-6	DNS led to significantly greater improvements in pelvic floor muscle strength, EMG measures, and UDI-6 scores compared to Kegel exercises ($p < 0.005$). Both interventions were effective, but DNS had a larger effect size.
12	Shin *et al.*	2019	43 young adults with FHP	Experimental study comparing DNS vs. Isometric Chin-Tuck (ICT)	Sitting Height Ratio, LC Thickness, LC/SCM Ratio	DNS significantly increased sitting height compared to ICT ($p < 0.0001$). Both DNS and ICT improved LC muscle thickness and LC/SCM ratio compared to baseline. No significant difference in LC muscle thickness between DNS and ICT.
13	Panse *et al.*	2020	40 race walkers (20 males, 20 females)	Comparative study (DNS vs. Parachute Resistance Training, 4-week intervention)	VO2max (Cooper test), Sprint test	DNS showed significant improvement in race walkers' performance (VO2max $p = 0.003$, sprint speed $p = 0.001$). Both methods were effective in improving endurance and race-walking biomechanics.
14	Mulye *et al.*	2019	50 office workers with mechanical	Randomized controlled trial (DMST vs.	Cornell Musculoskeletal Discomfort Questionnaire (CMDQ), Oswestry Low	DMST led to significantly greater reductions in LBP and improved physical and psychological QoL compared to conventional exercises ($p < 0.001$). The

			low back pain (LBP)	Conventional Exercises, 8 weeks)	Back Pain Disability Questionnaire (OLBPDQ), WHOQOL-BREF	correlation between OLBPDQ and QoL domains was statistically significant.
15	Mohammad Rahimi *et al*.	2020	52 sedentary students	Randomized controlled 6-week trial (DNS breathing vs. control)	Upper Chest Mobility (UCM), Lower Chest Mobility (LCM), Trunk Extensor Endurance, Thoracic Kyphosis	DNS breathing significantly improved UCM, LCM, trunk endurance, and kyphotic alignment ($p < 0.001$), while the control group showed no significant changes.
16	Park *et al*.	2021	36 healthy adults (8 females)	Randomized controlled study comparing DNS vs. AB techniques during horizontal shoulder adduction with loads (8 lb, 17 lb)	EMG activity of Upper Trapezius (UT), Anterior Deltoid (AD), Pectoralis Major (PM), Internal Oblique (IO)/Transverse Abdominis (TrA), External Oblique (EO)	DNS significantly decreased UT, AD, and PM activation while increasing bilateral IO/TrA activation compared to AB ($p < 0.05$). DNS demonstrated better neuromuscular control for stabilizing the trunk while reducing excessive shoulder muscle activation.
17	Makke *et al*.	2019	30 cyclists with low back pain	Experimental study (4-week intervention)	Pain (VAS), Core Strength (Pressure Biofeedback), Quality of Life (Oswestry Disability Index)	Both static and dynamic stabilization exercises improved pain, core strength, and QoL, but dynamic stabilization had significantly greater effects ($p = 0.0031$, $p < 0.0001$, $p = 0.0297$).
18	Bae *et al*.	2021	45 adults with FHP	Randomized intervention study (6-week exercise period)	Forced Vital Capacity (FVC), Forced Expiratory Volume in 1 Second (FEV1), FEV1/FVC ratio, VO_2max, Volume of Expired Gas (VE)	DNS significantly improved all respiratory function measures over time ($p < 0.05$), but no significant differences were found between DNS, neck stabilization, and stretching/extensor strengthening exercises.
19	Mousavi *et al*.	2022	20 males with non-specific chronic low back pain	Quasi-experimental study (8-week intervention)	Pain intensity (VAS), hamstring flexibility, balance (Y-Balance & Stork Test), abdominal muscle endurance, quality of life (SF-36)	Both DNS and core stability exercises significantly improved pain, abdominal muscle strength, and static balance ($p < 0.05$). DNS led to greater improvements in QoL, while core stability exercises showed superior gains in hamstring flexibility. No statistically significant differences were observed between the two methods in other study variables.

Discussion

DNS in Chronic Low Back Pain (CLBP)

Various studies prove that DNS helps people with long-term back pain, as it significantly improves their sense of balance, coordination, and alleviates pain. DNS could correct movement issues for patients with NSCLBP Kaushik *et al*. & Ahmad *et al*. (2024), whereas Rabieezadeh *et al*. (2024) confirmed a reduction in pain and disability, even though these effects decreased with time if no further training was done. Comparing DNS to conventional exercises concludes that they have similar improvement ability; however, only DNS excels in proper control of muscles and reorganizing movements.

DNS in Postural and Movement Disorders

Evidence proves that DNS improves posture stability, respiratory efficiency, and trunk control among many people. After following a 12-week DNS program in the water, middle-aged women experienced improved torso stability and dynamic balance. Kang *et al*. (2024) Furthermore, Bae *et al*. (2021) revealed that performing DNS can be beneficial for respiratory function in people with forward head posture highlighting its role in breathing mechanics.

DNS in Sports and Athletic Rehabilitation

Studies have proven that DNS helps in improving athletic ability, core stability, and neuromuscular control. Park *et al*. (2021) highlighted that using DNS reduced unnecessary use of the shoulder muscles while improving trunk stability and efficiency of movement in overhead sports. Makke *et al*. (2019) concluded that DNS-based dynamic stabilization exercises were superior to static stabilization techniques for increasing core strength in cyclists with low back pain.

DNS in Pelvic Floor and Orthopedic Rehabilitation

The role of DNS has been explored in the realm of pelvic floor dysfunction and orthopedic conditions. Sharma *et al*. (2023, 2024) in their study found that DNS's is superior to Kegel exercises in treating stress urinary incontinence, significantly improving pelvic floor muscle strength, core activation, and neuromuscular coordination. In orthopedic rehabilitation, DNS can significantly improve pain in elderly individuals with genu osteoarthritis, underscoring its efficacy in managing degenerative joint conditions. Nurhayati *et al*. (2023)

Conclusion

DNS is helpful during musculoskeletal rehabilitation, supporting new movement patterns, muscle activation and movement control strategies for chronic pain conditions, proper posture alignment, gymnastics, back pain, pelvic floor rehabilitation and sports rehab. Future research should first promote standard approaches for using DNS, test its long-term effects, and compare it with other recently developed rehabilitation methods.

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