Research Article

Effect of Dynamic Neuromuscular Stabilization Exercises on Activity of External Oblique Muscle in Non-Specific Low Back Pain

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Short title: DNS on EMG of external oblique in NSLBP

Abstract:
Background: The dynamic neuromuscular stabilization (DNS) core stabilization exercises have been used to improve core stability, but its effect on non-specific low back pain (NSLBP) is still not fully understood. This study aimed to investigate the effect of DNS exercises on the electromyography (EMG) activity of the external oblique muscle in people with NSLBP.
Material and Methods: In a randomized clinical trial, 44 people with chronic NSLBP were randomly assigned to two groups: the experimental group and the control group, with 22 participants in each group. The control group received standard physical therapy exercises, while the experimental group performed DNS exercises. Each group underwent an 8-week therapeutic exercise program, consisting of 5 sessions per week, with each session lasting approximately 60 minutes. Surface EMG was utilized to assess the core muscle activity of the external oblique. The

EMG activity of the external oblique was measured in both groups before and after the 8-week interventions.
Results: Nineteen people in the control group and 21 in the DNS group were analyzed. The results showed that after the 8-week intervention, patients in the DNS group obtained, on average, an 8.82% (95% CI: 6.53 to 11.10) higher increase in the EMG activity of the external oblique muscle compared to the patients in the control group ($P < 0.001$, effect size: 0.622).
Conclusion: The use of DNS exercises can be recommended for improving the activation of superficial core muscle like external oblique in individuals with NSLBP.
Keywords: Low back pain, Electromyography, Core stability, Exercise, Abdominal oblique muscles

1. Introduction

Low back pain (LBP) is a significant health, social, and economic issue. It is a common musculoskeletal problem and a frequent cause for medical center visits. Epidemiological studies have indicated that the prevalence of LBP among adults in Australia, America, and Western Europe is approximately 79.2% (1). Non-specific LBP (NSLBP) refers to pain that cannot be attributed to a specific known pathology. Research has shown that individuals with chronic NSLBP experience problems with proprioception and instability in the skeletal and muscular structure of the entire body, leading to dysfunction in the back area (2, 3). Consequently, researchers are presently seeking training methods that can alleviate pain and enhance performance in NSLBP patients by improving postural stability and making kinematic corrections (4, 5) .

Therapeutic exercise methods vary widely, and there is no definitive evidence supporting the superiority of one method over another (4, 5) .Because the central region of the body and the interaction of its muscles play a crucial role in organ functioning, exercises aimed at stabilizing the spine have garnered significant attention from researchers. These exercises prioritize spine stability in various positions, target the superficial or deeper muscles in the spine, facilitate the relearning and maintenance of proper body posture by strengthening these muscles, and are effective in reducing pain and improving function by establishing stability in the spine (2, 6).

In the last decade, a set of exercises known as dynamic neuromuscular stabilization (DNS) has been suggested as a way to improve overall stability. The DNS exercises concentrate on stabilizing the spine in various positions and target the smaller muscles at the back of the spine. By strengthening these muscles, they assist in relearning and maintaining the proper body posture, creating stability in the spine, and effectively improving pain and function (7). The DNS protocol is based on the principles of developmental kinesiology and outlines the ideal postural and movement patterns based on physiological development. The DNS approach involves using the positions observed in a growing child (from 3 to 18 months old) to promote optimal postural and movement performance in patients. When it comes to spinal issues, DNS exercises concentrate on controlling intra-abdominal pressure and the integrated stability system of the spine, as these can be impacted by insufficient postural function of the diaphragm. This, in turn, could lead to an increase in spinal compression force (8).

Numerous studies have found that DNS exercises are effective for improving central muscle activation and trunk stability. These exercises promote optimal coordination among the stabilizing muscles of the trunk, leading to increased maximum force in the upper limb. Additionally, DNS exercises increase the activity level of the core muscles as shown in electromyography (EMG) studies. Furthermore, the use of DNS exercises leads to significant improvements in balance and walking ability (9, 10). Research also suggests that improving trunk stability through abdominal muscles can reduce pain and enhance the performance of individuals with NSLBP(11, 12). The abdominal muscles like external oblique are vital in providing core stability for functional movements during most activities(13). However, to our knowledge, there is a lack of studies assessing the impact of DNS exercises on muscle activity of external oblique in individuals with NSLBP. Therefore, this study aimed to compare the effects of DNS exercises and standard physiotherapy on the EMG activity of the external oblique muscle among adults with chronic NSLBP. We hypnotized that 8-week intervention of DNS exercises could be effective in increasing the EMG activity of the external oblique muscle compared to standard physical therapy exercises.

2. Material and Method

2.1 Participants

In this single-blind (evaluator), randomized controlled trial, forty-four adults with chronic NSLBP aged 20 to 50 years old were randomly assigned to either the control group (n=22) or the experimental group (n=22). The evaluator who recorded EMG data was blind to groups. The inclusion criteria were individuals with chronic LBP between the 12th rib and the buttock that lasted for more than 6 weeks, along with performance problems and physical disability that did not extend to the lower extremities. The following individuals were excluded from the study: those with a history of nerve or spinal cord damage in the lumbar spine, recent fracture or trauma, severe disorders of the lumbar spine such as disc herniation, alignment disorder, facet arthritis, spondylolisthesis or spondylolysis, pregnant individuals, and those who had performed exercises targeting the back muscles in the past 3 months before the study (14). The VAS score at the baseline was above 3 for pain and the score of Roland-Morris Disability Questionnaire was above 4. The participants had not done any treatment exercises before this study base of our inclusion criteria.

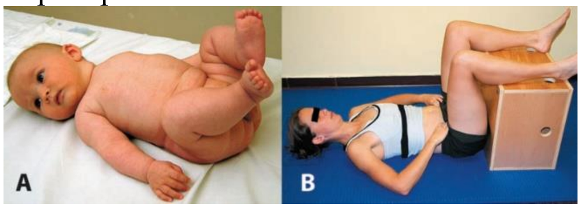
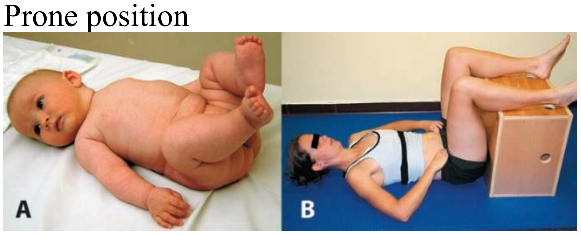
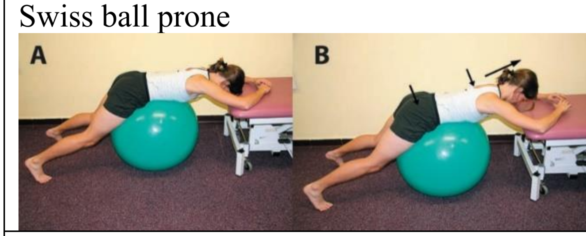
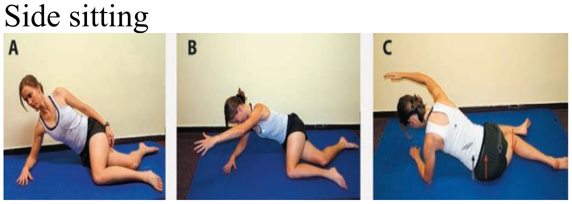
2.2 Intervention

The examinee filled out the demographic characteristics form, while the examiner completed the inclusion/exclusion criteria form based on the individual's medical history and clinical examinations. The activity level of the external oblique muscle was recorded using EMG. The subjects were then randomly divided into two groups, DNS exercises (experimental) and physical therapy standard exercises (control), using the block randomization method. An independent researcher used the Block randomization method, employing a computer-generated random number list to assign participants into DNS and control groups. The allocation ratio was 1:1, and random block sizes of 2 were used. Additionally, the allocation sequence was concealed from the researcher enrolling and evaluating participants.

Each group underwent an 8-week therapeutic exercise program, consisting of 5 sessions per week lasting about 60 minutes each. Three sessions took place in the physiotherapy clinic under the supervision of a physiotherapist, and two sessions were conducted at home. Patients were followed up daily by phone calls on the days of exercising at home to ensure they were following the exercises appropriately. At the beginning of each session, all patients engaged in 15 minutes of stretching exercises as a warm-up, and at the end of each session, they repeated the exercises for 10 minutes as a cool-down.

All exercises were performed in the treatment room under the therapist's supervision. The therapist ensured that each participant was positioned correctly to facilitate optimal muscle contraction. The DNS exercises consisted of 10 movements based on positions typical of a growing child (aged 3 to 18 months). The types of positions for DNS exercises and their descriptions are presented in Table 1. Each developmental position was considered a training position. During these exercises, individuals were required to maintain a normal breathing pattern and intra-abdominal pressure first, then focus on stabilizing the spine, and finally ensure that all joints were in the most favorable condition for maximum mechanical muscle benefit, which is known as joint centration.

Table 1. Taught dynamic neuromuscular stabilization exercises during the study (15)

Types of positions	Exercises
Supine position 	- When the child is 4 months old, he/she raises his/her legs in the supine position and is placed in a 90/90 hip and knee position - For training, the person is placed in the same position and support is placed under the feet. In this position, the spine and chest should be in a neutral position. The patient was asked to take deep breaths and apply pressure to the abdomen with his/her hands. The exercises was conducted 5 times for each set and 3 sets of repetitions
	-Without using support, he/she raises his/her legs in the supine position and is placed in a 90/90 hip and knee position. The patient was asked to take deep breaths
	-The person is placed in the same position as before and extends the legs and flexes the hands respectively. In the next step, the arm and leg of the opposite side are flexed and extended at the same time.
Prone position 	When the baby is 3 months old, the baby is placed on the forearm, the pelvis is stable, and the lower thoracic and lumbar spine and head are in a neutral position. The upper thoracic moves into extension For training, in the mentioned position, upper thoracic is extended without extension in the head and neck.
Swiss ball prone 	Prone on the ball, foot in neutral and toes on the floor, hand on the bed, and doing trunk extension to mid-thoracic
Side sitting 	- The child is placed on one hand and one leg, the upper leg is slightly forward, and the lower limb is placed in a 90/90 position. - For training, in the mentioned position, , the person performs shoulder flexion
	Like the exercise of the previous step, but the person bears weight on his/her feet instead of the knees
Modified side sitting	- The lower knee and hip are in a greater range of flexion. The person takes a sitting position and the upper limb is supported on the hand (not

	the forearm) and performs flexion with the upper limb.
Position on all fours (7 months old) 	The patient is placed on all fours with the elbow parallel to the shoulder and the knee parallel to the hip. The patient makes a rhythmic forward and backward movement with elbow extension along with inhaling and exhaling deeply.
Squat (12 months old) 	The person squats, slowly raises the arms while bending the knees.

The standard exercises consist of classic and standardized movements that are designed to activate the abdominal, back, and lumbar-pelvic belt muscles while minimizing strain on the lumbar spine. These movements include bringing one or both knees to the chest, lifting the hips off the ground (bridging), alternating straightening of each leg after bridging, pedaling motion while lying on the back, sliding the heels or legs, performing lower abdominal crunches, and doing movements on all fours such as alternately straightening each arm and leg, and finally straightening the opposite arm and leg.

2.3. Electromyography device

In order to measure the EMG activity of the external oblique muscle, an eight-channel MegaWin device was used with a sampling frequency of 1000 Hz and a contraction time of 4 seconds (16). The recording was conducted on the right side of the body. To ensure accurate measurements and prevent any interference, excess hair in the examined areas was shaved and the skin was cleaned with alcohol. Stabilizing electrodes for the external oblique muscle were placed above the anterior superior iliac spine (ASIS) in the middle of the line connecting the crest of the ilium to the ribs (17). The participants were positioned in the Crook lying position, lying supine with both hip joints at a 60° angle and feet flat on the surface. Each participant was asked to hold each contraction for 4 seconds, repeat each maneuver 3 times with a 5-second rest interval, and the recording was done during this time frame. The EMG signal was obtained from the Root Mean Square (RMS) of the raw electromyographic signal to calculate muscle activity. The average RMS of 3 repetitions was considered the RMS of the maximum muscle activity, and these values were normalized by dividing them into the amplitude of this muscle during performing the maximum voluntary muscle contraction. To eliminate background noise from the signal, we applied a 50 Hz filter to remove the effects of city electricity, as well as a band-pass filter set to 10-500 Hz. We also used 30-millisecond time windows for both the main signal and the MVC signal. We the the explanation into the text.

The position of maximum voluntary isometric activity for the right external oblique muscle involved the person making a maximum effort to sit to the right side while the legs are turned to the left and fixed there (16).

2.4 Statistical analysis
The normality of the data was assessed using the Shapiro-Wilk test. The ANCOVA was used to compare the EMG activity between the DNS and control groups after the 8-week intervention while also controlling for pretest scores. Additionally, we calculated the partial eta squared (η2p) as a measure of effect size, where values of 0.01-0.06, 0.06-0.14, and >0.14 were considered small, medium, and large, respectively(18). The statistical analysis was conducted using SPSS 26 software with a significance level of $P<0.05$.

5. Results
The flowchart illustrating the progression of participants through the study is shown in Figure 1. A total of 62 patients were screened, and 44 of them were randomized. Post-test data were available for 40 patients, with 19 in the control group and 21 in the DNS group (Figure 1). There were no significant differences in the demographic characteristics of the patients between the two groups ($P > 0.05$), as shown in Table 2."

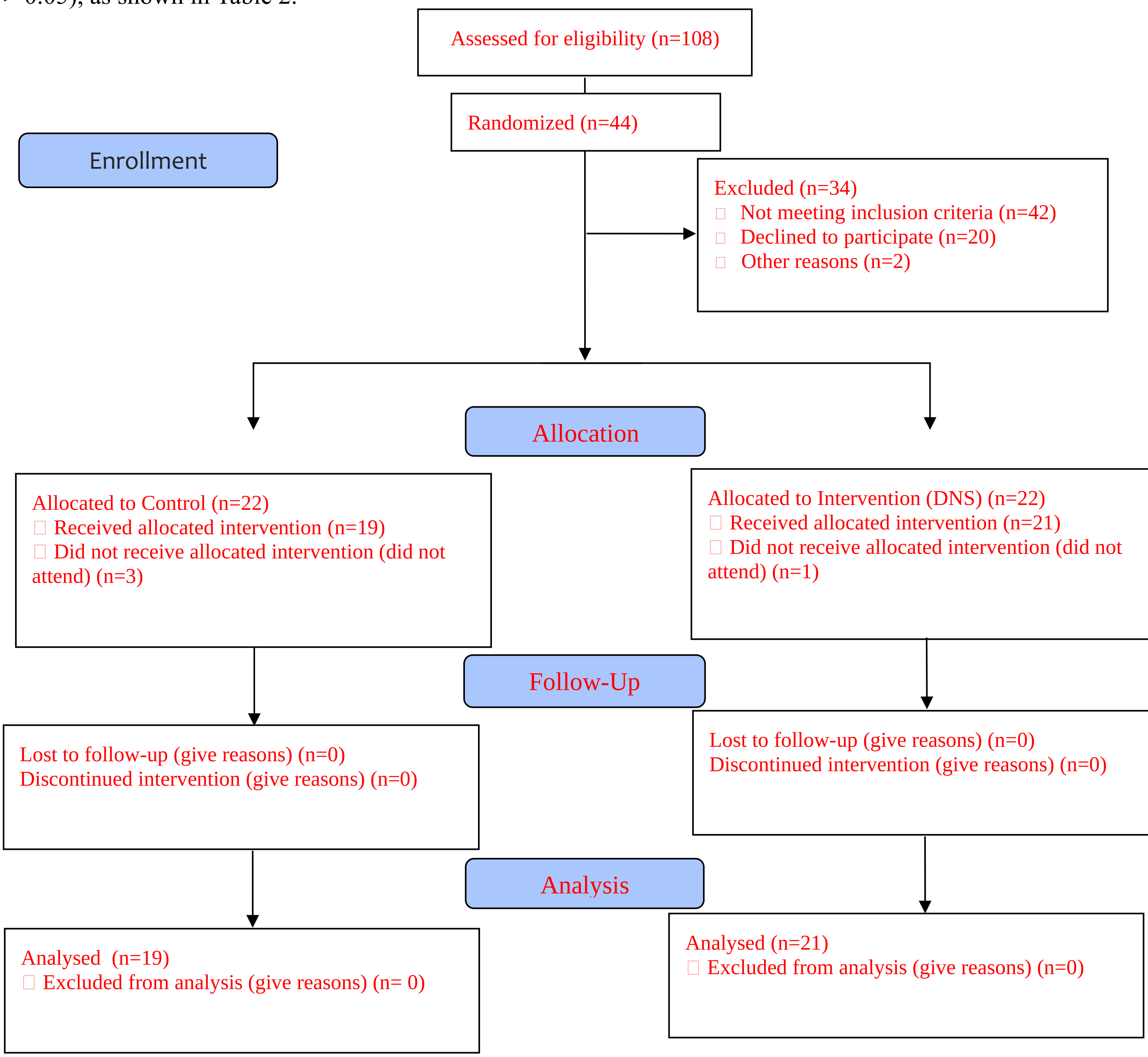


Figure 1. CONSORT flowchart

Table 2. Baseline characteristics of patients

		Total (n=40)	Group		P-value
			Control (n=19)	DNS (n=21)	
Age (years), mean (SD)		35.40 (4.31)	36.26 (5.05)	34.62 (3.44)	0.233
Sex, n (%)	**Male**	17 (42.5)	8 (42.1)	9 (42.9)	0.607
	Female	23 (57.5)	11 (57.9)	12 (57.1)	
Weight (kg), mean (SD)		74.90 (7.73)	74.53 (7.93)	75.24 (7.73)	0.776
Height (m), mean (SD)		168.70 (8.44)	169.32 (8.28)	168.14 (8.74)	0.666
BMI (kg/m2), mean (SD)		26.41 (2.94)	26.11 (3.26)	26.68 (2.67)	0.548

Abbreviations. SD: Standard Deviation; DNS: Dynamic neuromuscular stabilization; BMI: Body mass index.

After adjusting for pretest values, the posttest assessment showed that patients in the DNS group had, on average, an 8.82% (95% CI: 6.53 to 11.10) higher increase in EMG activity of the external oblique muscle compared to the patients in the control group ($F(1,37)=60.91$, $P<0.001$, $\eta 2P=0.622$, Figure 2). This indicates a large effect size ($\eta 2P=0.622$) as shown in Table 3.

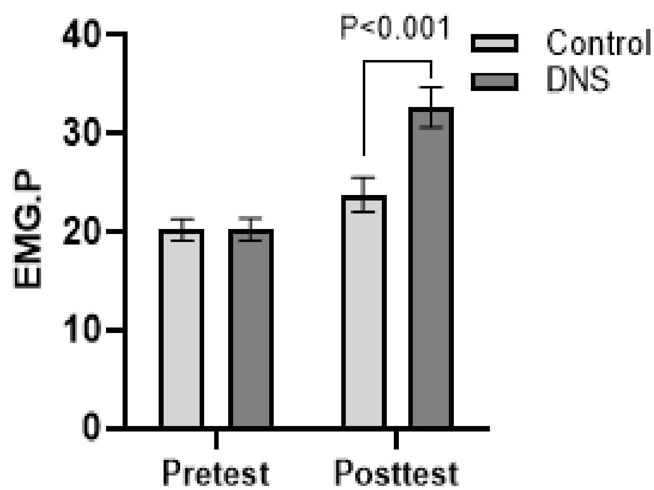


Figure 2. The effect of dynamic neuromuscular stabilization on EMG activity of external oblique in individuals with NSLBP

Data are mean and 95% confidence interval (95% CI).
Abbreviations. DNS: Dynamic Neuromuscular Stabilization, NSLBP: non-specific low back pain
P-value calculated using ANCOVA adjusted for pretest scores.

Table 3. Examining dynamic neuromuscular stabilization on electromyography activity of external oblique

	Control (n=19)	DNS (n=21)	Adjusted mean difference (95% CI)	F(1,37)	*P*	η2p
	Mean (SD)	Mean (SD)				
EMG						
Pretest	20.24 (2.25)a	20.32 (2.47)				
Posttest	23.81 (3.64)	32.69 (4.46)	8.82 (6.53 to 11.10)	60.91	<0.001	0.622

Abbreviations. DNS: Dynamic Neuromuscular Stabilization; CI: Confidence Interval, NSLBP: non-specific low back pain

a Data are mean (SD), unless otherwise specified.

P-value calculated using ANCOVA adjusted for pretest scores.

η2p values of 0.01-0.06, 0.06-0.14, and >0.14 were considered as small, medium, and large effect size, respectively.

4. Discussion

The purpose of this study was to investigate the influence of DNS exercises on the EMG activity of the external oblique muscle in individuals with NSLBP. The magnitude of a signal is related to the intensity of muscle contraction. Since the external oblique muscle is one of the core muscles, improving its activity level can help enhance people's function and reduce their pain(12). Studies have shown that the signal magnitude of the external oblique muscle is lower in people with low back pain than in those without low back pain. Therefore, increasing the activity level of this muscle can be an indicator of the patient's recovery(19). Our results revealed that muscle activity was significantly higher in the DNS group compared to the control group. DNS, which is rooted in neurodevelopmental kinesiology, focuses on core stabilization by concurrently engaging the pelvic floor muscles, diaphragm, multifidus, and transversus abdominals/internal oblique in conjunction with the superficial core muscles such as external oblique. This coordinated activation aims to create ample intra-abdominal pressure for stabilizing spinal dynamics (20). To the best of our knowledge, no study has previously examined the impact of DNS exercises on the activity level of external oblique muscle in individuals with NSLBP. Nonetheless, past studies have explored the effects of DNS on core muscle activity in people without LBP.

In a study by Yoon et al. (2017), the effect of DNS was compared over 3 consecutive sessions in 5 normal subjects and 5 hemiparesis stroke patients. It was found that in both groups, the EMG amplitude and transversus abdominis/internal oblique muscles were higher in the DNS group compared to the control group (neurodevelopmental treatment). However, there was less activation in the superficial external oblique muscle during DNS treatment than during neurodevelopmental treatment (21). In another study by Son et al. (2017), the 4-week effects of DNS on activation of core muscles in 15 spastic diplegic CP patients were evaluated. The results showed that activation of the transversus abdominals/internal oblique was remarkably increased after the intervention, but not for the external oblique (10). The results of these studies are not consistent with our study, which found greater muscle activity in the group receiving DNS compared to the group receiving standard exercises. It is important to note that the population in our study consisted of those with NSLBP, while the populations in the mentioned studies were those suffering from neurologic disorders. Furthermore, the lack of improvement of muscle activation of external oblique in past studies may be due to the small number of treatment sessions (less than one month), unlike the current study conducted for 8 weeks of therapeutic exercise, including 5 sessions per week.

The DNS is based on the assumption that basic motor patterns are preprogrammed in healthy children and remain in the central nervous system (CNS) into adulthood. The brain may forget these basic movements when daily movements are done incorrectly. DNS exercises aim to restore the ideal exercise program from childhood that has been misunderstood and forgotten by the CNS.

DNS also involves comparing the movement pattern of a patient with that of a healthy child, allowing a disturbed movement pattern to be transformed into a developmentally optimal kinesiology pattern (20).

Finally, the abdominal muscles, including the obliques, are important for stabilizing the body and are associated with intra-abdominal pressure and back pain. DNS exercises involve spinal and trunk movements, and the oblique muscles play a significant role in these movements. To measure oblique muscle activity, surface EMG of the external oblique muscles was considered in this study because the internal oblique muscle is deeper and more difficult to study with surface EMG due to crosstalk.

The research had some limitations. One was the lack of follow-up after the treatment period, so we could not determine how long the treatment's effect lasted on muscle activity in people with NSLBP. Another limitation was that only NSLBP was evaluated, so we should be cautious about applying the results of this study to other types of LBP. It is advisable to conduct additional research to explore other spinal muscles, such as the pelvic floor muscles and diaphragm, through DNS exercises. Finally, we could not measure the EMG of other core muscles because crosstalk of these muscles was severe.

5. Conclusion

Based on the results of the present study, DNS exercises were more effective than standard exercises in activating the external oblique muscle in individuals with NSLBP. Therefore, the use of DNS exercises can be recommended for improving the activation of superficial core muscle like external oblique in individuals with NSLBP.

Authors contributions:

Conceptualization Sedigheh Sadat Naimi and Abbas Rahimi; Methodology: Abbas Rahimi and Hediyeh Hosseini; Investigation: Hediyeh Hosseini and Sedigheh Sadat Naimi; Data Analysis: Khodabakhsh Javanshir; Writing-original draft: Mohammad Taghipour and Aliyeh Daryabor, Writing-review, and editing: Aliyeh Daryabor

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Conflict of interest:

The author reported no conflict of interest

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References:

1. Ehrlich GE. Back pain. The Journal of Rheumatology Supplement. 2003;67:26-31.
2. Letafatkar A, Nazarzadeh M, Hadadnezhad M, Farivar N. The efficacy of a HUBER exercise system mediated sensorimotor training protocol on proprioceptive system, lumbar movement control and quality of life in patients with chronic non-specific low back pain. Journal of back and musculoskeletal rehabilitation. 2017;30(4):767-78.

3. Mohamad Chan EW, Adnan R, Azmi R. Effectiveness of core stability training and dynamic stretching in rehabilitation of chronic low back pain patients. Malaysian Journal of Movement Health & Exercise. 2019;8:1-13.
4. Rubinstein SM, de Zoete A, van Middelkoop M, Assendelft WJJ, de Boer MR, van Tulder MW. Benefits and harms of spinal manipulative therapy for the treatment of chronic low back pain: systematic review and meta-analysis of randomised controlled trials. BMJ (Clinical research ed). 2019;364:l689.
5. Sertpoyraz F, Eyigor S, Karapolat H, Capaci K, Kirazli Y. Comparison of isokinetic exercise versus standard exercise training in patients with chronic low back pain: a randomized controlled study. Clinical rehabilitation. 2009;23(3):238-47.
6. Nasrin F, Homan M, Reza R. Comparing the Effects of the Postural Restoration Exercises with and without Core Stability Exercises in Patients with Non-Specific Chronic Low Back Pain. Journal of Modern Rehabilitation. 2024;18(1).
7. Sharma K, Yadav A. Dynamic neuromuscular stabilization-a narrative. International Journal of Health Sciences and Research. 2020;10(9):221-31.
8. Kolar P, Sulc J, Kyncl M, Sanda J, Cakrt O, Andel R, et al. Postural function of the diaphragm in persons with and without chronic low back pain. The Journal of orthopaedic and sports physical therapy. 2012;42(4):352-62.
9. Mansori M, Tabrizi Y, Mohammadkhani K. Evaluation of the Effectiveness of Dynamic Neuromuscular Stability Exercises on Balance and Walking Function in the Elderly. Iranian Rehabilitation Journal. 2021;19:279-88.
10. Son MS, Jung DH, You JSH, Yi CH, Jeon HS, Cha YJ. Effects of dynamic neuromuscular stabilization on diaphragm movement, postural control, balance and gait performance in cerebral palsy. NeuroRehabilitation. 2017;41(4):739-46.
11. Aluko A, DeSouza L, Peacock J. The effect of core stability exercises on variations in acceleration of trunk movement, pain, and disability during an episode of acute nonspecific low back pain: a pilot clinical trial. Journal of manipulative and physiological therapeutics. 2013;36(8):497-504. e3.
12. Kumar T, Kumar S, Nezamuddin M, Sharma V. Efficacy of core muscle strengthening exercise in chronic low back pain patients. Journal of back and musculoskeletal rehabilitation. 2015;28(4):699-707.
13. Adams L, Pace N, Heo A, Hunter I, Johnson AW, Mitchell UH. Internal and external oblique muscle asymmetry in sprint hurdlers and sprinters: a cross-sectional study. Journal of Sports Science & Medicine. 2022;21(1):120.
14. Apeldoorn AT, Ostelo RW, van Helvoirt H, Fritz JM, Knol DL, van Tulder MW, et al. A randomized controlled trial on the effectiveness of a classification-based system for subacute and chronic low back pain. Spine. 2012;37(16):1347-56.
15. Kolar P. Clinical rehabilitation: Alena Kobesová; 2014.
16. Tahan N, Rasouli O, Arab A, Khademi Kalantari K, Neisani Samani E. Reliability of the ultrasound measurements of abdominal muscles activity when activated with and without pelvic floor muscles contraction. Journal of back and musculoskeletal rehabilitation. 2013;27.
17. Workman JC, Docherty D, Parfrey KC, Behm DG. Influence of pelvis position on the activation of abdominal and hip flexor muscles. Journal of strength and conditioning research. 2008;22(5):1563-9.
18. Cohen J. Statistical power analysis for the behavioral sciences: routledge; 2013.
19. Cole MH, Grimshaw P. Electromyography of the trunk and abdominal muscles in golfers with and without low back pain. Journal of science and medicine in sport. 2008;11(2):174-81.

20. Frank C, Kobesova A, Kolar P. Dynamic neuromuscular stabilization & sports rehabilitation. International journal of sports physical therapy. 2013;8(1):62-73.
21. Yoon HS, You JSH. Reflex-mediated dynamic neuromuscular stabilization in stroke patients: EMG processing and ultrasound imaging. Technology and health care : official journal of the European Society for Engineering and Medicine. 2017;25(S1):99-106.