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The effect of 8 weeks of dynamic neuromuscular stabilization training on postural control, functional performance and quality of life in healthy elderly men

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Abstract

Background: Beyond biological changes, ageing is often associated with degenerative and progressive changes in functional and physiological performance. Different types of exercise and rehabilitation method were introduced for resolving or preventing aging complications.

Aim: The aim of this study was to investigate the effects of 8- week- dynamic neuromuscular stabilization (DNS) training on functional performance and quality of life in healthy elderly men.

Materials and Methods: Twenty-eight old men were selected by convenience sampling manner and divided randomly in two groups of experimental (n=13, age: 65.8±4.3 years, height: 1.63±5.92 cm, weight: 69.1±7.4 kg) and control (n=15, age: 66.3±3.8 years, height: 1.64±4.89 cm, weight: 70.1± 6.3 kg). The experimental group received neuromuscular stabilization training for 8 weeks and 3 sessions for 1 hour in a clinic in Baghdad. Static balance (by functional reach test), dynamic balance (by time-up and go test), functional performance (by Berge test), and quality of life (by Leiden-Padua (LEIPAD e questionnaire) were measured before and after training. Data was analyzed by repeated measure ANOVA in SPSS software. P value was set at $P \leq 0.05$.

Results: The results showed that the intergroup interaction in the variables of functional performance (F=53.3, P=0.00), quality of life (F=65.04, P=0.00), static (F=106.7, P=0.00) and dynamic (F=26.99, P=0.00) balance was significant with the superiority of the DNS group.

Conclusion: Postural control, functional performance and quality of life improved after training protocol. Therefore, DNS training can be used as a complementary method for rehabilitation of elderly.

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1. Introduction

The past century was a period of increasing life expectancy throughout the age range. This resulted in more people living to old age and to spending more years at the older ages. Every country in the world is experiencing growth in both the size and the proportion of older persons in the population [1]. By 2030, 1 in 6 people in the world will be aged 60 years or over. At this time, the share of the population aged 60 years and over will increase from 1 billion in 2020 to 1.4 billion [2, 3]. The number of persons aged 80 years or older is expected to triple between 2020 and 2050 to reach 426 million [4].

Aging is a period of living that is associated with degenerative and progressive changes in functional and physiological performance [5]. Older adults are more likely to have problems with balance. Balance problems can be caused by neuromuscular problem in elderly people functional performance related to balance function which were originally considered as possible risk factors for falls [6]. Therefore, prevention and reduction of this problem is essential.

Proper exercise intervention must be taken into account [7]. Neuromuscular training uses specific exercise to target the neural and muscular components of movement. This training program is aimed at improving sensorimotor control and attaining functional joint stabilization by addressing the quality of movement in all three movement plane [8]. Successful components of a neuromuscular training program include core stability, balance, and multiplanar movement [9]. Dynamic Neuromuscular Stabilization (DNS) is an assessment and rehabilitation modality in physical therapy, chiropractic and personal training fields. DNS works by stimulating the central nervous system to retrain the neurophysiological aspect of the locomotion system [10].

DNS methods demonstrated efficacy in improving global trunk stabilizing patterns with noted gains in extremity movement and strength [11]. Therapeutic effects of DNS training were found to train optimal spinal segmental motion, reducing back pain and improving the quality of sensory perception [12]. DNS can also be used to improve muscles coordination to treat postural instability [13]. Furthermore, DNS methods were found to be effective in the rehabilitation of balance, gait, stance and core stabilization in neurological disorders [14] or stroke [15].

Therefore, this study was conducted to investigate the effects of DNS training on postural control and quality of life of elderly males.

2. Materials and Methods

2.1. Participation

Twenty-eight healthy elderly men were selected and divided randomly in two experimental (13 people) and control (15 people) groups. The sample size was calculated by G-POWER software by considering the statistical power of 0.8 at the significance level of 0.05 [16]. The inclusion criteria were men aged 60 and over, the willingness to participate in the study, lack of history of spine and lower limb surgeries, lower limb abnormalities, neuromuscular disorders, neurological disease, osteoporosis, and any cardiovascular disorders.

2.2. Instrument

Functional reach test (FRT) was used for static balance assessment. The recording started with the subject in the standing position and with the right index finger

pointing forward for 10 s. The subject leant forward as far as possible without moving his feet. The recording was stopped when the subject took his heel(s) off the ground or when his index finger reached the maximum distance. Five consecutive trials were recorded. The test instructions were repeated before each trial [17].

The Timed “up & go” test (TUG) is performed for dynamic balance function assessment. The participants sit on a standard arm chair (seat height 46 cm as in the original setting, arm height 67 cm) with his back against the chair, arms resting on the chair's arms and walking aid at hand. Participant wear their regular footwear and use their customary walking aids. After the patient states that he is ready, the test starts. On the word “go” the patient stands, walks to a line on the floor 3 m away (on a standard short-piled carpet with a length of 4 m and a width of 1 m), turns, walks back to the chair, and sits down again. The end of the test is defined when the patient’s buttocks first touch the seat surface. Participant choose their own comfortable and safe walking speed. A stopwatch is used to time the performance (in seconds) [18].

The Berg balance test consists of 14 subtests performed in a standard order (sitting to standing, standing unsupported, sitting unsupported feet on floor, standing to sitting, transfers, standing unsupported with eyes closed, standing unsupported with feet together, reaching forward with outstretched arms, pick up object from the floor, turning to look behind/ over left and right shoulders, turn 360 degrees, count number of times step touch measured stool, standing unsupported, one foot in front, standing on one leg). Each task is scored on a five-point scale (0-4) according to the quality of the performance or the time taken to complete the task, as ranked by the test developers. The maximum score for this assessment is 56. Based on clinical experience, Berg et a1., 6 contend that scores below 45 indicate that someone is impaired, with an increased risk for falls [19].

The Leiden-Padua (LEIPAD) Questionnaire is particularly for the elderly. This questionnaire consists of 31 questions that examine the quality of life in seven dimensions (physical function, self-care, depression and anxiety, mental performance, social function, sexual function, and life satisfaction) [20].

2.3. Protocol

The experimental group were done dynamic neuromuscular training program for a whole period of 8 weeks (three 45-60 min sessions per week), whereas the control group have their daily program [21]. The exercises included diaphragmatic breathing, Baby Rock (supine 90–90), prone, rolling, side lying, oblique sit, tripod, kneeling, squat and czech get up (CGU). Progressive overload was applied by gradually increase the weight, frequency, or use of elastic band program [10].

2.4. Statistic

The normal distribution of the parameters was evaluated by the Shapiro-Wilk test. Additionally, the influence of the intervention was determined by Repeated Measures Analysis of Variance (RM-ANOVA).

3. Results

Demographic data were shown in Table 1. The results of RM-ANOV were shown in Table 2. According to this table, interaction is significant for all dependent variables.

Concerning group mean differences

can be concluded that DNS group changes were significantly improve while control group changes were very little.

4. Discussion

Aging is associated with a variety of physical and psychological symptoms and different abnormalities in sensory and motor function such as postural control and functional performance [3]. Elderly people will face many difficulties in their lives for ambulating, and they lose a great deal of independency. Therefore, they need to different rehabilitation program for attaining independency and preventing their problem [22]. DNS is one of the well-known neuromuscular training method that is recently used in the exercise rehabilitation of various people such as the elderly [23].

This study was done to investigate the effect of DNS training on postural control, functional performance and quality of life of elderly people.

Table 1. Participant demographics data (mean± standard deviation)

	Age (year)	Weight (kg)	Height (m)
DNS (n=13)	65.8±4.3	69.1±7.4	1.63±5.92
Control (n=15)	66.3±3.8	70.1±6.3	1.64±4.89
sig	0.32	0.70	0.17

Table 2. Variables descriptive statistics and result of repeated measure analysis of variance

Criteria	Group	Pretest	Posttest	Group interaction
		mean's ± SD	mean's ± SD	df [1, 26]
Static balance (cm)	DNS	20.4±4.3	32.8±3.9	F=106.7. *P*=0.00*, η^2=0.73
	Control	17.4±3.6	18.4±2.9	
Dynamic balance(s)	DNS	13.6±1.3	7.8±1.1	F=26.99, *P*=0.00*, η^2=0.45
	Control	11.4±1.6	11.6±1.9	
Functional performance	DNS	23.7±5.1	31.3±4.9	F=53.3, *P*=0.00*, η^2=0.51
	Control	24.2±4.7	25.1±3.9	
Quality of life	DNS	95.7±11.3	103.3±10.8	F=65.04, *P*=0.00*, η^2=0.61
	Control	97.9±9.8	99.3±10.1	

DNS: dynamic neuromuscular stabilization; SD: Standard deviation

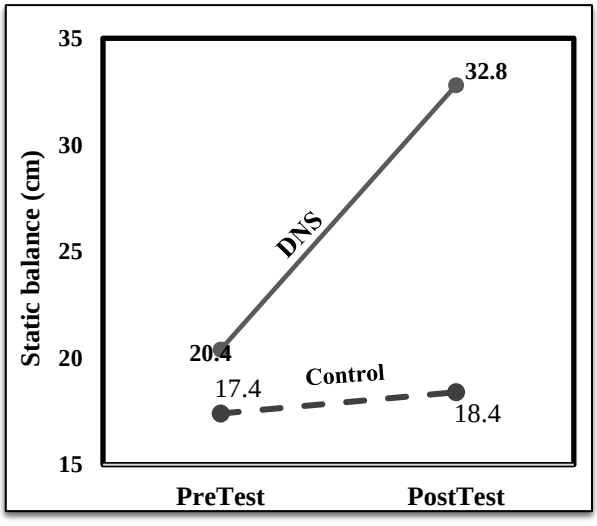

Figure 1. Chart line of static balance

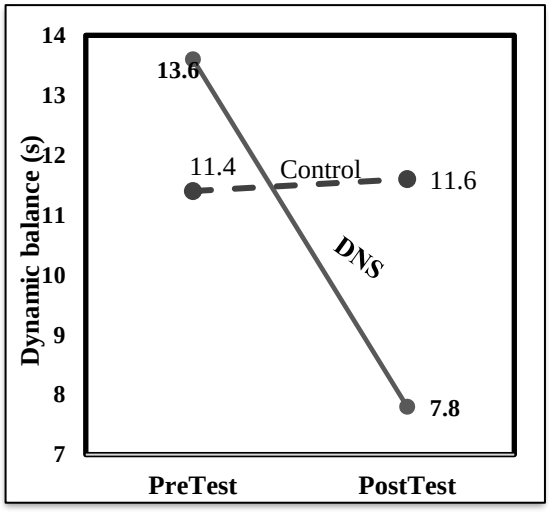

Figure 2. Chart line of dynamic balance

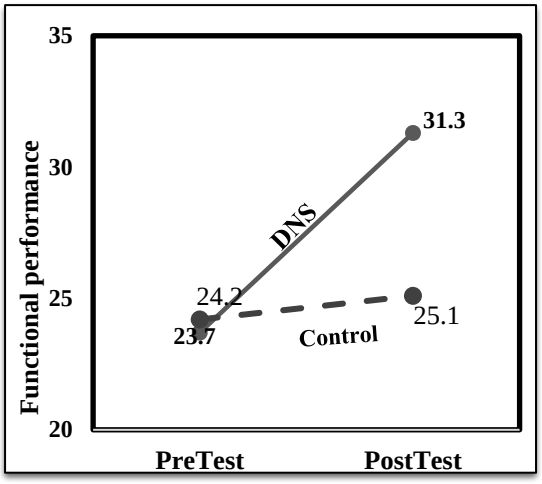

Figure 3. Chart line of functional performance

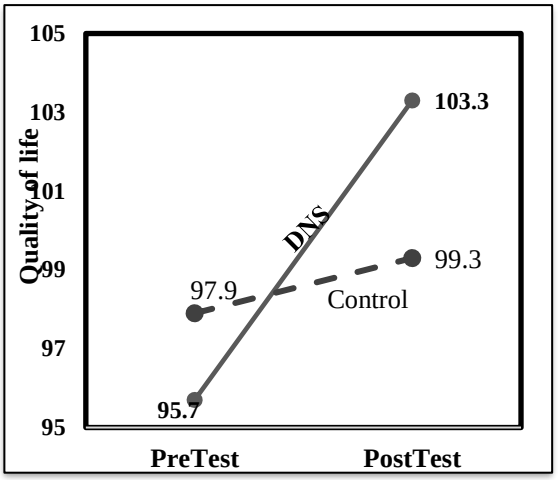

Figure 4. Chart line quality of life

Postural control was measured by functional reach (as static balance) and time up and go test (as dynamic balance). Group interaction in functional reach test was significant (F=106.7, *P*=0.00, η^2=0.73). In this test, the experimental group progressed by 10 cm, while the control group progressed by 1 cm. These changes were shown 60% improvement in DNS group.

Also, in dynamic balance, group interaction was significant (F=26.99, *P*=0.00*, η^2=0.45). The test time in the experimental group decreased by 5.8 sec and in the control group it increased by 0.2 sec.

Postural control is a term used to describe the way our central nervous system (CNS) regulates sensory information from other systems in order to produce adequate motor output to maintain a controlled, upright posture [24].

The postural control system has two main functions. First, to build up posture against gravity and ensure that balance is maintained; and second, to fix the orientation and position of the segments that serve as a reference frame for perception and action with respect to the external world [25].

Opposing the effect of gravity, the antigravity muscles help maintain an upright, balanced posture. These muscles consist of namely the soleus muscles, the extensors of the leg, the Gluteus Maximus, the Quadriceps Femoris and the muscles of the back [26].

DNS training protocol in present study involves most of the mentioned muscles. On the other hand, control of postural sway in DNS training involves continuous muscle activity (especially about the lower limb) in response to integrated sensory inputs. The involvement of relative contribution of visual, vestibular and proprioceptive systems in DNS training could be the reason for improving balance.

Group interaction in Berg Balance Scale test was significant (F=53.3, *P*=0.00*, η^2=0.51) in these criteria. Functional performance refers to the capacity of the people to fulfil its requirements task in the specific situations. Performing functional activities are important for older adults living in long-term care settings. Performing these activities not only improves and maintains function in older adults, but also can improve physical and emotional health and

quality of life [27]. The improvement of the participant's performance in this test can be related to the improvement of posture control. In other words, postural control is necessary for good execution of all 14 sub-tests in berg test. Performing exercises in three positions (lying down, sitting and standing) and in both static and dynamic ways prepare participant to perform the Berge test.

Quality of life interaction was significant (F=65.04, P=0.00*, η^2=0.61). Quality of life is often defined as the degree to which a person is healthy, comfortable, and able to participate in or enjoy life events. Quality of life is the most important factor that humans always strive to improve. The WHO model of rehabilitation outcomes provides a suitable framework to document the objective and subjective benefits of exercise and sport and their likely influence on QOL [28]. Since, QOL is now regarded as a key outcome measure of successful rehabilitation [29]. The QOL assessment would be an important parameter to assess the effects of the treatments and interventions [30]. Psychological aspects have received considerable attention in health care settings and clinical research, and have been widely used as a clinical outcome of persons with disabilities in general, and elderly persons in particular [31]. QOL improvement can be related to postural control and functional performance improvement. Since, quality of life is strongly associated with both physical and mental age-related factors. Carrying out exercises in a group and improving social relations are other important factors to improve the quality of life of the participants.

This study was restricted with some limitations; Engagement with the elderly due to fear of movement, distress, laughter, restlessness, and other physical and psychological problems, which led to omitting large number of elderly from the study.

Tracking the results of the research due to the difficulty in accessing the samples and the time constraints was another limitation.

This study conducted in a one city in single center in the age range of 60–70 years and the homogeneity of samples was one of the limitations.

5. Conclusions

The results of this study confirmed that DNS training could improve the balance, functional performance and quality of life of older adults. It suggests that DNS training is a useful complementary method for older adults.

Conflict of interest

The authors declared no conflicts of interest.

Authors' contributions

All authors contributed to the original idea, study design.

Ethical considerations

The authors have completely considered ethical issues, including informed consent, plagiarism, data fabrication, misconduct, and/or falsification, double publication and/or redundancy, submission, etc. The ethical committee of University of Isfahan with the reference number of IR.UI.REC.1400.129 approved this study. Written informed consent has been obtained from the patient(s) to publish this paper.

Data availability

The dataset generated and analyzed during the current study is available from the

corresponding author on reasonable request.

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