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ARTICLE

Effect Of Two Sensory-Motor and Otago exercises Program on Physical Performance, Functional Balance and Quality of Life of elderly men

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ABSTRACT: As people get older some may experience reduced mobility and more physical challenges that can affect their quality of life negatively. The research focused on investigating how two different types of training programs sensori-motor and Otago affect the abilities, functional balance and overall well being of men.This study was semi-experimental. This research included 45 men aged 65 to 70 who were selected in an accessible and purposeful and then randomly divided into three groups.. With 15 individuals, in each group, for sensorimotor training group the Otago training group and a control group. Respective exercise groups underwent a total of 24 training sessions done in 8 weeks. To measure abilities and being impact effectively, in this study various assessment methods were used such as Short Physical Performance Battery (SPBB) tests together with time up and go (TUG) evaluations besides implementing SF36 quality of life survey questionnaire. ANOVA and paired sample t-tests were done for data analysis with a significance level set at p≤ 0.05 using SPSS software version 23. The outcomes showed a Significant different, in groups prior and post exercise experimental (p=0.001). Significant variations were noted in the test results when comparing the sensorimotor and Otago groups to the control group at a significance level of p=0.001 for inter group comparisons; whereas no notable variations were observed among the groups during the pre test phase.Both sensorimotor and Otago exercises effectively enhance physical performance, functional balance, and quality of life in elderly men. Since no significant difference was found between the two experimental groups, it can be concluded that either type of exercise can be beneficial for improving these aspects of health in older men.

KEYWORDS: Aged, Sensory-Motor, Quality of Life, Otag, Balance.

1 Introduction

Aging is described as a process or a set of processes characterized by the loss of adaptability and reduced performance (1). Considering the specific needs of this period, attention to the quality of life and physical activities in the elderly is considered a very important matter that should not be overlooked. With advancing age, disturbances in physiological functions occur, becoming more pronounced in the sixth decade of an individual's life. Various studies indicate that as age increases, disturbances arise in different bodily systems, particularly due to reduced physical activity, which decreases the ability of elderly individuals to maintain balance (2). In the present century, with declining fertility rates and increasing life expectancy worldwide, the elderly population has significantly increased. Predictions suggest that by 2025, elderly individuals will comprise 26% of the total global population (3). In Iran, the number of elderly individuals is also rapidly increasing, with forecasts indicating that within the next 50 years, 20% of the population will be elderly, resulting in 26 million people aged over 60. These statistics underscore the necessity of addressing the phenomenon of aging more than ever. Therefore, ensuring the health of the elderly in various physical, functional, psychological, and social dimensions has always been a focus of researchers (4). The increasing trend of aging has emerged as an important priority in public health and social care policies, especially considering that aging and disability are key determinants in this context. Elderly individuals in society experience a high rate of functional decline and disability, gradually jeopardizing their independence, self-esteem, and quality of life (5). The sensorimotor system encompasses all processes and components of afferent, efferent, and central integration that are involved in the functional stability of joints. With increasing age, this ability becomes limited, leading to significant biomechanical changes in gait (6). The loss of mobility, reduced muscular strength, and lack of balance all contribute to increased dependence (7). Therefore, sensorimotor exercises enhance the balance of elderly individuals and promote confidence in walking It has been demonstrated that strengthening each of the factors involved in maintaining balance and walking, such as sensory systems (vestibular and proprioceptive) and motor systems (strength and flexibility), can be an appropriate strategy for the treatment and prevention of walking, balance, and quality of life issues in the elderly (1). Several studies have reported improvements in balance and clinical mobility performance due to sensorimotor exercises. Sensorimotor exercises also contribute to the development of motor skills, improvement in balance, increased flexibility, and enhancement of cognitive abilities(8). To achieve a better and healthier life and to prevent premature aging and related diseases, the principle of prevention being better than treatment has become a focus. In this regard, Otago exercises, a strength and balance training program, have been designed to prevent falls and enhance health status in elderly individuals. In addition to the Otago exercises, which concentrate on improving balance and strength, the FaLPROF exercises, which have also won a national award in the United States, utilize a multidimensional approach, incorporating stretching, strength, and balance exercises to assess and address balance-related issues (9). In this context, Almarzouki et al (2020) studied the effects of 8 weeks of modified Otago exercises on the balance of middle-aged individuals. Their study results showed that the modified version of the Otago exercises has a significant impact on the dynamic balance parameters of middle-aged individuals. Albarnous and et al (2018) studied the effectiveness of the Otago exercise program in reducing the risk of falls among adults aged 65 to 80, comparing group and individual exercises. Their study results indicated that group exercises are more effective than individual exercises (10, 11). Given the conflicting results of recent research and the limitations of existing studies, as well as the exercises performed on physical performance, functional balance, and the quality of life of elderly individuals, there is a challenge in selecting the best type of training regimen. This research aims to address the question of which type of sensorimotor and Otago exercises has the greatest impact on improving the physical performance, functional balance, and quality of life of elderly men.

2 Methods

2.1 Participants

The present study has been reviewed and approved by the Ethics Committee of Guilan University of Medical Sciences, with the identification number IR.GUILAN.REC.1403.128. This study is of a semi-experimental type, using a pre-test and post-test design. In this research, 45 elderly men aged 60 to 75 years constituted the statistical population. These individuals were selected through convenient and purposeful sampling. In a briefing session prior to the exercises, a summary of the research was explained to the participants. Then, individuals voluntarily completed a consent form to participate in the study and were randomly assigned to three groups: sensorimotor training, Otago, and control group. The criteria for selecting participants in the present study included: 1) being male, 2) the ability to walk without assistive devices, and 3) being in the age range of 60 to 75 years. The exclusion criteria for participants were: 1) individuals with a prior injury or surgery, particularly in the lower limbs, 2) serious visual or auditory impairments, and 3) missing more than 3 exercise sessions

2.2 Measurement and Tools

Short Physical Performance Battery

Three-meter walk test

Individuals who recorded a time of less than 4.82 seconds received a score of '4', those who recorded a time between 4.82 and 6.2 seconds received a score of '3', individuals who recorded a time between 6.21 and 8.7 seconds received a score of '2', and individuals who recorded a time greater than 8.7 seconds received a score of '1'. Finally, individuals who were unable to complete the test received a score of '0' (1).

Sit-to-stand test

In this phase, the participant was asked to cross their arms over their chest. They were to perform as many repetitions as they could, up to five. After each stand, the participant had to sit down and then stand up again. The stopwatch was stopped when the participant stood up after the fifth repetition. Individuals who recorded a time of less than 11.10 seconds received a score of '4'. Those who recorded a time between 11.20 and 13.60 seconds received a score of '3'. Individuals who recorded a time between 13.70 and 16.60 seconds received a score of '2', and those who had a time greater than 16.70 seconds received a score of '1' (1).

Tandem test

Participants were asked to maintain three standing positions that increasingly became more difficult for a duration of 10 seconds. These positions included standing with parallel feet, the semi-tandem position (standing with the heel of one foot touching the toe of the other foot), and the tandem position (placing one foot such that the heel of the front foot touches the toes of the back foot). Scoring is done as follows: If a participant can maintain the parallel feet position for 10 seconds but cannot maintain the semi-tandem position for 10 seconds, they receive a score of '1'. If they can hold the semi-tandem position for 10 seconds but cannot maintain the tandem position for more than 2 seconds, they receive a score of '2'. Additionally, if a participant can hold the semi-tandem position for 10 seconds and the tandem position for between 2 to 9 seconds, they receive a score of '3'. Finally, if a participant can maintain the tandem position for 10 seconds, they receive a score of '4' (1).

Timed Up and Go

The timed get-up-and-go test was used (reliability 99%), which consists of six consecutive phases. To conduct this test, a chair without arms was placed three meters away from an obstacle (end of the path).

The individual started from a seated position and, upon hearing the command, moved and the time was measured from the start to the end of the movement (12).

Quality of Life

The SF-36 questionnaire was used to assess the quality of life of the elderly. In 2005, Montazeri and colleagues validated this questionnaire, and the Cronbach's alpha coefficient for all scales, except for the vitality scale, was found to exceed the recommended value (≥0.7). This scale includes 36 questions divided into 8 subscales: physical functioning, role limitation due to physical problems, bodily pain, general health, role limitation due to emotional problems, social functioning, vitality, and emotional well-being. The score for each question ranges from 0 to 100. The score for each subscale was obtained by calculating the mean score of the questions in that subscale (13)

Exercise Protocol

Sensory-Motor Exercises: The exercise programs in this study will be conducted for 8 weeks, 3 days a week, for a duration of 60 minutes, with an estimated time of 6 minutes for each exercise model and a 2-minute rest between each exercise model. The descriptions of each exercise are as follows (1).

Star: On a soft, non-slip surface, the star shape with 8 points is formed by verbal instructions given by the researcher to the participant.

Obstacle Course: The participant walks along a 3.6-meter path on a soft, non-slip mat.

Colored Path: On a soft mat, 7 gray paper squares and 7 blue paper squares were placed. These squares, measuring 15x15 cm, were arranged in a zigzag pattern.

Rubber Step: The participant attempts to maintain their balance at the top of the obstacle.

Table 1. Sensory-Motor Training Protocol

instructions	Sensory-motor	
Four-point star measuring 40 centimeters	Stage One	Adhesive star
Four-point star with different dimensions (anterior point: 40 centimeters, posterior point: 30 centimeters, right point: 40 centimeters, and left point: 30 centimeters).	Stage two	
Eight-point star measuring 40 centimeters	Stage three	
Eight-point star measuring 40 centimeters: Eight-point star with different dimensions (anterior point: 40 centimeters, posterior point: 30 centimeters, right point: 40 centimeters, left point: 30 centimeters, anterior-right diagonal point: 40 centimeters, posterior-right diagonal point: 30 centimeters, anterior-left diagonal point: 30 centimeters, and posterior-left diagonal point: 40 centimeters)	Stage four	
Three obstacles measuring 5 centimeters in height, 8 centimeters in width, and 40 centimeters in length.	Stage One	

Randomly placed obstacles measuring 10 centimeters in height, 8 centimeters in width, and 40 centimeters in length	Stage Two	Obstacles on the Path
Three cones (in blue, green, and white) each with a height of 20 centimeters will be placed randomly.	Stage Three	
The length of the path will consist of a combination of obstacles	Stage Four	
The participant walks along the path and returns by stepping on the squares of the same color	Stage One	Colored path
They follow the path with one color and, upon returning, finish with the opposite color	Stage Two	
They follow the path using alternating colors	Stage three	
The participant continues along the path with the colors requested by the researcher	Stage Four	
The initial height of the step will be 5 centimeters, and the participant will throw a lightweight ball with a diameter of 22 cm and a circumference of 68 cm toward the researcher according to verbal instructions	Stage One	Rubber step
The participant must go up and down the step and then throw the ball toward the researcher	Stage Two	
The participant stands on a step at a height of 10 centimeters and then throws the ball toward the researcher.	Stage three	
The participant should go up and down the 10-centimeter step and then throw the ball toward the researcher	Stage Four	

Otago Exercises

The Otago exercise program will be conducted for eight weeks, with three sessions per week, each lasting45 minutes under the supervision of an examiner. The Otago exercises include balance and strength exercises, and the training will be tailored to the participants' conditions (14).

Table 2. Otago Exercise Program

Walking on heels	Alternating toe-heel walking	Otago exercises	
20 repetitions forward and backward		Week One and Two	Balance exercises

25 repetitions forward and backward	Week Three and four	
30 repetitions forward and backward	Week Five and six	
40 repetitions forward and backward	Week Seven and Eight	
Lunge Squat Side Leg Raise		
3 sets / 12 repetitions	Week one and TWO	Strength Exercises
4 sets / 12 repetitions	Week Three and four	
5 sets / 12 repetitions	Week Five and six	
6 sets / 12 repetitions	Week seven and eight	

2.3 Statistical Analysis

of the data was performed using SPSS version 23. To examine the type of data distribution, the Shapiro-Wilk test was utilized. For comparing the means of the research variables, ANOVA, paired t-tests, and Bonferroni post hoc tests were employed. All hypothesis tests were conducted at a significance level of 0.05 or less.

3 Results

1.Demographic characteristics of participants in the groups

The demographic characteristics of the participants are reported in Table 3. The comparison of means between groups in this section was conducted using independent t-tests, which indicated that there were no significant differences in the demographic characteristics of the participants between the groups. Results.

Table 3. Demographic Information of Participants (Mean ± Standard Deviation)

Level of significance	Control group	Otago group	Sensory-motor group	variable
0/355	70/00 ±3/13	69/53 ± 2/92	68/53 ± 2/32	age (years)
0/898	70/52 ±2/71	70/71 ± 4/46	71/10 ± 2/91	Weight(Kg)
0/051	1/71 ±0/02	1/73 ± 0/03	1/70 ± 0/03	Height(meters)
0/061	23/99 ± 1/03	23/53 ± 1/16	24/53 ± 1/17	Body mass index

* significance= $p<0.05$

2. Results of the between-group

comparison of variables

The distribution of the data was examined using the Shapiro-Wilk test, and the results indicated that normal distribution was upheld for all variables of interest (p ≥ 0.05). Therefore, ANOVA was used to assess the differences between groups, and if the ANOVA indicated significant differences, the Bonferroni test was employed for pairwise comparisons between the groups and to determine the extent of their differences.

Table 4. ANOVA Test Results for Comparing Group Means of Variables in Post-Test

Effect size	Significance level	F	Mean squares	Degrees of freedom	Sum of squares	effect	variable
0/670	0/001*	42/579	70/289	2	140/578	**Within-group**	Physical performance
			1/651	42	69/333	**Between-group**	
			-	44	209/911	**Total**	
0/740	0/001*	59/838	45/571	2	91/142	**Within-group**	Functional balance
			0/762	42	31/986	**Between-group**	
			-	44	123/129	**Total**	
0/911	0/001*	215/734	2809/012	2	5618/024	**Within-group**	Quality of life
			13/021	42	546/871	**Between-group**	
			-	44	6164/895	**Total**	

* significance= p<0.05

The results of the ANOVA comparing the differences between groups in the pre-test indicated that there were no significant differences among the groups at baseline, meaning the groups did not differ significantly from one another (p ≤ 0.05). Following the significant differences observed in the post-test of the variables, the Bonferroni test was used to determine the differences between the groups, and the results are reported in Table 4.

Table 5. Post Hoc Bonferroni Test Results for Between-Group Comparison

Significance level	Mean difference	Comparisons	variable
1/000	0/400	Sensorimotor exercises with Otago exercises	Physical performance
0/001*	3/933	Sensory motor exercises with the control group	

0/001*	3/533	Otago exercises with control group	
1/000	-0/225	Sensorimotor exercises with Otago exercises	Functional balance
0/001*	-3/125	Sensory motor exercises with the control group	
0/001*	-2/900	Otago exercises with control group	
1/000	-0/134	Sensorimotor exercises with Otago exercises	Quality of life
0/001*	23/634	Sensory motor exercises with the control group	
0/001*	23/769	Otago exercises with control group	

* significance= p<0.05

Data analysis in the intergroup section showed that the effect sizes of the exercises were (moderate, moderate, high). This effect size indicates the differences between the experimental groups compared to the control group. The results of the Bonferroni test in terms of percentage changes showed that sensory-motor exercises had effects compared to Otago exercises in the variables of physical performance (-3.77), functional balance (2.14), and quality of life (0.19). These percentage changes indicate that both training groups were able to have a nearly comparable impact on the variables of interest in the present study.

2. Results of the within-group comparison of variables

Given the normal distribution of the data, the paired t-test was used to compare the within-group changes.

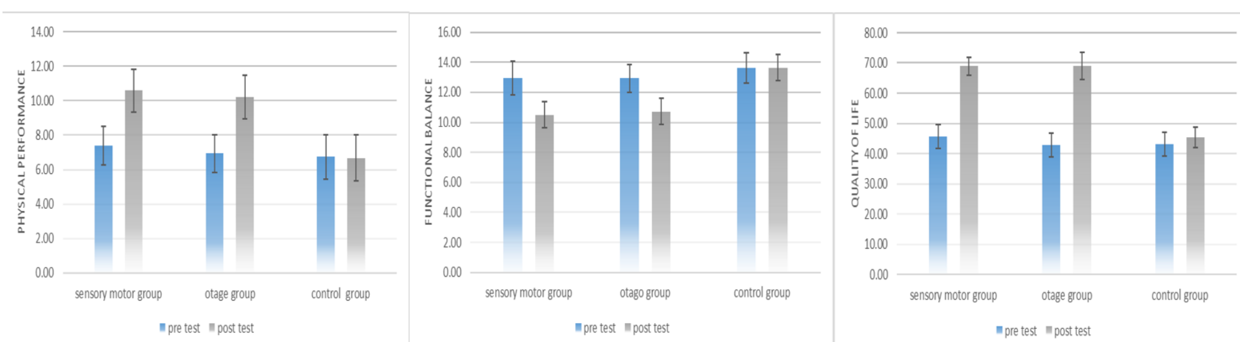

Figure 1. Intragroup comparison

* significance= p<0.05

was considered. Among the research groups, the sensory-motor and Otago groups showed significant differences between the pre-test and post-test. The control group did not show significant differences in all the variables of interest. The effect size in the physical performance and quality of life sections indicated a high effect of the exercises (EF ≥ 0.9). In the variable of functional balance, the effect size for the training groups also indicated a high effect (EF ≥ 0.7).

5. Discussion and Conclusion

The objective of the current study was to compare the effects of two exercise programs, sensory-motor and Otago, on the physical performance, functional balance, and quality of life of elderly men. Data analysis shows that sensory-motor exercises have significantly improved the functional balance and quality of life of these individuals. Furthermore, the Otago program has been more effective in improving the physical performance of the elderly compared to sensory-motor exercises. According to the results of the current study, both the sensory-motor and Otago exercise programs had a significant impact on the physical performance of the elderly. The findings of this study regarding physical performance align with the results of studies by Barboza Rezende, Almarzooki, et al, as well as Khazanin et al (10, 15). Evidence suggests that a multifaceted exercise program focusing on flexibility, strength, balance, and endurance can effectively improve balance and functional mobility (16, 17). The sensory-motor and Otago exercise programs encompass these aspects, and given the effectiveness of the exercises while being simple, they can be considered appropriate training programs for the elderly (18, 19). The results of this study regarding the effects of sensory-motor and Otago exercises on functional balance are in line with the findings of Farsi et al (2015), Zarei et al, as well as Nam et al(2016) (20). All these studies highlighted the positive impact of various exercises on improving the balance of elderly individuals, and the findings from these studies emphasize the importance and positive effects of using different training programs. Explaining the factors and mechanisms behind balance improvement requires highlighting the various components of the sensory-motor system responsible for maintaining balance, which consists of sensory, motor, and central processing components. The function of this system arises from the integration and combination of information obtained from different senses, which occurs in relation to flexible motor-performance tasks. This motor-performance skill can be improved through practice. The central nervous system needs to evaluate information from sensory receptors throughout the body to be aware of the body's status and position in space. Normally, this information is provided to the central nervous system through the visual, vestibular, and somatosensory systems, allowing it to assess and analyze the body's status and position, as well as its movement in relation to gravity and the surrounding environment. In the central processing areas, this information is integrated and valued to determine their significance and relationships, and appropriate motor responses, including balance reactions, are selected and executed with the appropriate speed and intensity (21). The information collected by the visual, vestibular, and somatosensory systems is processed at three distinct levels of motor control, which include the spinal cord, the brainstem, and higher levels such as the cerebellum, basal ganglia, and cerebral cortex (21). Researchers have stated that the effectiveness of exercise on balance requires responses at three motor levels. At the spinal level, its primary role is to regulate muscle reflexes. The sensory information obtained from the mechanoreceptors in the joints, following the occurrence of balance reflexes, reflexively induces a supportive contraction around the joint, preventing excessive pressure on passive and motion-restricting structures of the joint. At the level of the brainstem, the occurrence of balance reflexes helps to control body stability. At higher centers (such as the cerebral cortex and cerebellum), the individual consciously attempts to control the position of the joints and their body balance with focus and attention. Control at each of these levels requires sensory information obtained from the visual, vestibular, and sensory-motor systems. Consequently, as the training conditions become more challenging (for example, changes in training levels), the load on the aforementioned senses increases(21, 22, 23). According to physiological adaptations in skill learning, functional balance exercises can lead to reduced variability in the use of motor units, increased plasticity of the motor cortex, or assist elderly individuals in learning (or re-learning) to optimally utilize their muscles for motor tasks. Considering that the balance of elderly individuals in this study showed significant improvement after eight weeks of sensory-motor and Otago-type exercises, both training methods had a meaningful effect on functional balance. Additionally, the comparison of the two training programs indicated a greater effect of sensory-motor exercises compared to Otago exercises on functional balance. This type of training helps elderly individuals develop better awareness of their body posture, enabling them to control movements more effectively. Consequently, with improved balance and motor control, seniors will have greater confidence in mobility and daily activities. It is recommended that if the goal of training for elderly individuals is to improve balance and enhance performance, exercises that involve daily motor tasks should be used. In the context of comparing the results obtained from the effects of sensory-motor exercises and Otago exercises on quality of life, the findings of the current study align with those of Diaz et al. and Mugis et al. (24, 25). It is important to note that quality of life is influenced by continuous changes. These changes arise from transformations in values, needs, and individual and social attitudes following life events and experiences. Moreover, each dimension of quality of life (including physical performance, social functioning, bodily pain, general health, and life satisfaction) can significantly affect other dimensions. Therefore, the improvement of quality of life for elderly individuals depends on enhancing their health level, and one of the key factors in this regard is regular physical activity. Numerous studies have examined the impact of exercise and an active lifestyle on the quality of life of the elderly. Ebrahimi et al., Bastani et al., and Bazrafshan et al. have assessed the quality of life of elderly individuals after implementing exercise programs. The results of these studies generally indicate a positive effect of physical activities on the quality of life of elderly individuals (26, 27, 28). However, some studies have presented different results compared to previous research, which may be attributed to the type of exercises utilized or limitations in the number of participants. Additionally, in studies that divided elderly individuals into active and inactive groups using questionnaires, Souri et al., Tavakoli et al., and Ahmadi et al. concluded that there is a significant relationship between physical activity and the quality of life of the elderly (8, 29, 30). This positive relationship is attributed to the impact of physical activities on fitness factors such as strength, muscular endurance, flexibility, speed, agility, and balance, which can, in turn, enhance the quality of life for elderly individuals (31). Moreover, the results of comparing the two training programs indicate that sensory-motor exercises have a greater impact on the quality of life of the elderly compared to Otago exercises. Sensory-motor training, due to its variety of movements, helps improve coordination, balance, and muscle flexibility. For this reason, elderly individuals can improve their motor skills and daily functioning; additionally, sensory-motor exercises can stimulate various senses and enhance body awareness and sensory perception, which in turn contributes to improving the quality of life for seniors. On the other hand, the nature of the Otago training program is primarily based on strength and balance exercises, whereas sensory-motor exercises are more akin to everyday activities. These characteristics allow sensory-motor training to yield better results in enhancing the quality of life for elderly individuals.

Conclusion

The results of the current study indicate that both sensory-motor exercises and Otago training have led to improvements in physical performance, functional balance, and quality of life in elderly men. Given that no changes were observed in these indices within the control group, it can be concluded that the enhancements in all measures are attributable to the effects of these exercises.

Ethical considerations

Compliance with ethical guidelines

All ethical principles in the present research have been adhered to. Participants were allowed to withdraw from the study at any time they wished, and all participants were informed about the research process. Their information was kept confidential

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authors' contribution

All authors contributed equally to the preparation of this article.

conflict of interest

The present research has no conflicts of interest.

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