

EFFECT OF PHYSICAL ACTIVITY ON STATIC AND DYNAMIC BALANCE AMONG THE ELDERLY

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ABSTRACT

Introduction: with advancing age, and the impact of age-related chronic diseases, a decline in balance as a cognitive capability function is also observed. Therefore, this study aimed to investigate the effect of physical activity on the static and dynamic balance of the elderly living in the nursing home. **Materials and Methods:** In this study, 36 healthy subjects with no history of regular exercise (71.8 ± 5.6 years old and body mass index 23.4 ± 6.8) were selected by convenient sampling. After obtaining informed written consent and the physician permission, qualified subjects were enrolled in the study and were examined before and after physical exercise. To evaluate dynamic and static balance of the subjects, we used TUG and Sharpend-Romberg tests. The exercises were progressively implemented for 8 weeks and 3 hours per week. To analyze the data, appropriate statistical tests at the significant level of $P < 0.05$ and SPSS version 20 were used.

Results: The results of this study showed that there is no significant difference between the static and dynamic balance of the elderly before and after the intervention ($p < 0.05$). Therefore physical exercises can increase the static and dynamic balance of the elderly.

Conclusion: The results of this study suggest that physical exercise has a significant effect on the static and dynamic balance of the elderly. Therefore, it is recommended to use these balance exercises to improve the static and dynamic balance of the elderly.

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Introduction

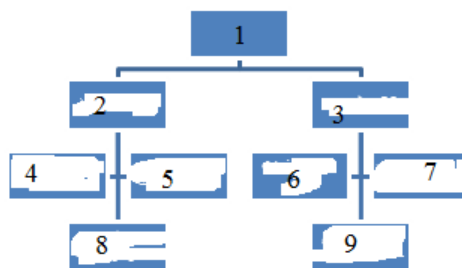
Today, the population aged 60 or over is growing at a faster rate than the total population in almost all world regions. The population is aging faster than ever before in the history of humanity. Today, for the first time in history, most people can expect to live into their sixties and beyond(1). According to the UN report, between 2015 and 2050, the proportion of the world's population over 60 years will nearly double from 12% to 22% and the population of people aged over 80 is projected to increase (2). An aging process has a negative and adverse effect on the musculoskeletal system; it leads to a decline in muscle mass, strength, and muscle movements and the weakness and atrophy muscles of the hands and feet are significantly observed (3,4). Also, muscle strength loss ranges from 20% to 40% from the third to the eighth decades (5). During the aging process, increasing age and the impact of age-associated chronic diseases can lead to the loss of balance as a cognitive functioning capacity (6). Balance changes begin at age 45 and affect three sensory systems (somatosensory, visual and

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vestibular) and physical characteristics (flexibility, balance power, coordination) (7). Balance is an important component for an independent living and having a successful seniority (6). To maintain a static balance depends on three elements of vision, atrium and deep tendon reflexes senses that possibly decline with aging (8). It has also been reported that a decrease in physical activity levels is heavily associated with a high probability of increasing imbalance. Decreased physical activity means a reduction in reaction time (3). Balance can be achieved through a proper physical activity. By increasing bone strength, programs such as walking, swimming will help prevent falls and the risk of fracture. However, there is no mentionable criterion regarding the type, intensity and time of exercises (9). Nowadays, falls are one of the largest public health problems among elderly people due to the high morbidity, mortality and costs for the family and society. Falls are a major public health problem across the world with an estimated 424,000 fatalities occurring each year, making it the second leading cause of unintentional injury and death after road traffic accidents. Over 80% of fall-related fatalities occur in low- and middle-income countries (1). At least 20-35% of the elderly people in the community experience falls. However, the incidence of falls is three times higher among institutionalized elderly than among those living at home (10). People who are at risk of falling or are afraid of it tend to be less likely to engage in physical activity (10). Given the growing global population of the elderly, the interest in research on sports and physical activity of the elderly people has dramatically increased over the past decade. There is plethora of literature on the benefits of exercise to prevent the risk of falling and walking at high speed, but there is little information about the effect of physical activity on the balance of the elderly while exercising and understanding the role of exercise and its effect on balance are often ignored. However, exercise is an important concept in studies of the elderly (6). Generally, sedentary lifestyle and lack of exercise are associated with an increased inflammatory level of psychokinesis, increased oxygen free radical production, or disturbance of detoxification, decreased production of anabolic hormones, malnutrition and reduced nerve function have been cited as the agents for sarcopenia. One of the critical challenges of population ageing is the clinical condition of frailty and the closely associated manifestation of sarcopenia(4). In the past, physiologists believed that only exercises at a young age would improve muscular endurance and strength with increasing age, whereas recent research suggests that exercise is beneficial for everyone at any age and is viewed as a one way to slow the aging process and to be active. Recent studies reveal that the older adults who do physical activity are more successful than any other age group. In this regard, Angela D. Smith, president of the American College of Sports Medicin believe that getting fit in midlife, better late than never. Even octogenarians can double their strength with weight training. There is a lot of evidence suggesting that people with higher level of physical activity experience less pain (11). By helping them maintain and improve their physical health problems and effective management of conditions threatening their physical activeness, the elderly nurses are able to help them (4). A review of studies conducted in nursing home also indicates that exercise can significantly improve the mobility and strength as well as the health status of the elderly, and even a number of patients have left wheelchairs after doing exercise (11). By identifying the elderly who are at high risk for musculoskeletal problems and designing physical exercises to prevent these problems, as well as creating a rehabilitation program for people with chronic inactivity, elderly nurses can improve their functional capacity, life satisfaction and increased quality of life in the elderly (4). According to the above, the researcher made an attempt to investigate the effect of physical exercises on the elderly living in the nursing home.

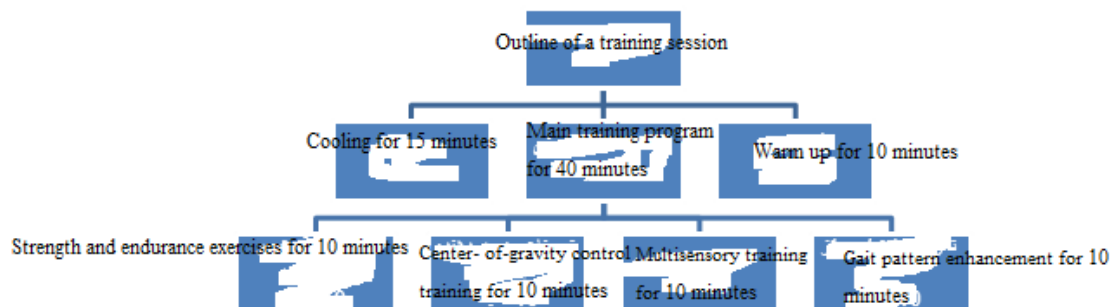
Method:

This is a quasi-experimental study in which 36 elderly people in the age range of 60 to 85 years (age 71.6 ± 5.6), body mass index (23.4 ± 6.8), residence for more than 3 months in the nursing home of Sabzevar and without a history of falling were investigated through a pre-test and post-test comparisons. Prior to entering the program, the elderly were evaluated for physical activity using a physical activity readiness questionnaire. According to this questionnaire, elderly patients with history of heart disease, hypertension, physician's order for non-doing exercise or workout, nerve dysfunction, dizziness, eye and ear diseases (other than presbyopia and presbycusis), previous fractures of the involved bones in the balance (femur, tibia and fibula) and the BMI greater than 36, the absence of more than 3 sessions in the exercise were excluded from the study. After the physical activity was completed, the eligible elderly were visited by a physician at the nursing home and obtained a permission to participate in the research. Finally, written informed consent was obtained from the subjects for participation in the study. After initial tests and physician permission, 41 elderly (26 women, 15 men) declared their readiness to participate in the research. Initially, all subjects were evaluated by a tool for measuring static and dynamic balance measurements and data obtained were recorded. The elderly were trained for 8 weeks and 3 sessions per week in group. Sampling was carried out in December and January 2016. Exercises were performed under the direct supervision of specialist in physical activity. Three of the 41 assessed elderly people were excluded from the study due to absence of more than 3 sessions, 1 elderly due to admission to the hospital during the intervention and 1 elderly also due to colds and ear infection. 24 elderly women and 12 elderly men were present in the research until the end of the intervention.



1. 41 elderly
2. 15 male elderly
3. 26 female elderly
4. 1 elderly due to admission to the hospital
5. 2 elderly due to absence of more than 3 sessions
6. 1 elderly due to colds and ear infection
7. 1 elderly due to absence of more than 3 sessions
8. 12 male elderly present in the research
9. 24 female elderly present in the research

The exercises were performed in groups of 6 - 8 people for 40 minutes in the initial weeks and 1 hour in the final weeks. In order to facilitate the exercise and providing more focus on the elderly, subjects were divided into 5 exercise groups. The exercises were performed at women's center with three groups of 8 people and men's center with two groups of 6 people each day. The exercise intensity was gradually increased. For example, to do the exercises, the center of gravity from the seat was firstly used, then from a balance ball ring and a ball without the ring in the end weeks. In addition, in order to stimulate the deep tendon reflex in the early weeks, the elderly walked barefoot on a rug and they gradually walked on soft mattresses. To stimulate other senses of balance in the elderly, the elderly's sight was firstly diverted by focusing on the moving hand of the instructor, then using smoky glasses and finally blindfold. The exercises were divided into three 10-minute warm-up, 40 minutes training program and 10 minutes of cooling. Warm-up involves continuously moving of the body in all direction. At this stage, stretching exercises and flexibility were implemented. The main training session was divided into 4 sets of 10 minutes. The first set included 1) center- of-gravity control training, (2) multisensory training, 3) gait pattern enhancement, 4) strength and endurance training. Cooling phase involves flexion of upper and lower limb, breathing and relaxation.



A warm-up set of 10 repetitions was performed. Exercise intensity was gradually increased based on the physical ability and hemodynamic symptoms during the training period (Fig. 1). After 8 weeks of training, the static and dynamic balance was re-examined. Results before and after the training of each subject were compared and interpreted. Descriptive statistics including mean and standard deviation were reported. A paired t-test was used to compare before and after each group. T-test was also used to examine the relationship between sex, history of disease and exercise with balance. In addition, the relationship between age and the presence of elderly in the nursing home was investigated with Pearson correlation coefficient scores of balance and the number of children was analyzed using Spearman test.

Data collection tool

The data collection tool consists of the "Standardized Physical Activity Questionnaire" including 7 closed questions to measure the individual's readiness to start physical activity. Content validity was used for validation in the study. The questionnaire was organized based on the purpose of the research and was given to 10 faculty members of the Faculty of Nursing and Midwifery of Shaheed Beheshti after it was confirmed by a supervisor and and counselor and final modifications in the questionnaire were made according to their opinion. The demographic information questionnaire also contains 10 items about age, sex, level of education, number of children, history of chronic disease, length of stay in a nursing home, history of exercise, education, weight, height, and BMI. The face validity of this questionnaire was also measured by a researcher and supervisor. "Sharpened Romberg test" was used to examine the static balance. According to Sadeghi et al. (12), for eyes open, the reliability was reported 0.90-0.91 and for eyes closed, 0.76 and 0.77. The participant was asked to stand straight with naked feet, putting one foot in front of the other and his or her arms crossed upon the chest; the score given to each individual was the time he could maintain a stable state. The average recorded for the subject in this test is 60 seconds. Failure to record this time means to reduce the balance. To measure dynamic balance, we used the "Time up & Go test" and walking. According to Abdoli et al. (13), the reliability and validity of this test are 99% and 81%, respectively and it also predicts the risk of falling. The subject was asked to get up

from a chair, walk a distance of 3 meters, turn around, walk back to the chair and sit down again.

The time will be recorded for the subject the starting to move was ordered until the subject returns and leans on the chair. The average recorded time for each subject aged 60-69 (7-1: 9-1) is 8.1 seconds and for 70-84 (8.2-10.2); 9.2 seconds implying a balance between the two age categories. Other tools used were included stopwatch, barometer, stethoscope, balance and centimeter. To perform the validity, the instrument calibration method was used by medical engineers. The reliability of the instrument was assessed according to the model name, manufacturer and registration number.

Findings:

The purpose of this study was to investigate the effect of physical activity on the static and dynamic balance of the elderly. For this purpose, 36 elderly were voluntarily selected as sample according to the health status questionnaire and were trained for 8 weeks by physical training. Static and dynamic balance tests were performed before and after the training period, where the results are as follows:

Dynamic balance:

To estimate dynamic balance, "Time up and Go test" was used in both the before and after intervention stages. In this test, the recording time ranged 7.1 to 10.2 seconds, indicating the balance in the elderly of 60-84. The mean dynamic balance score was before the intervention was reported to be 13.9 which decreased to 11.22 after 8 weeks of regular intervention. The results indicated that the mean dynamic balance score decreased significantly after the intervention ($P < 0.001$).

Static balance: In this study, Sharpend-Romberg test with eyes closed was used to determine the static balance in the elderly aged 60 years and over. The time range the balance of this age group for represents is 60 seconds. Failure to record this time can mean imbalance. The mean score of the subjects before and after the intervention were 49.69 and seconds 76.61, respectively. In fact, an increase in the time represents increased ability to balance in a static state after 8 weeks of intervention ($P < 0.001$).

Body mass index: Subjects with a BMI below 36 were enrolled in the study. In the current study, BMI is 23.9; according to statistical data, there was no meaningful relationship between BMI with static and dynamic balance. Static and balance dynamic was calculated to be ($P < 0.092$) and ($P < 0.432$), respectively.

Duration of stay: Subjects who stayed longer than 3 months were enrolled in the study. There was also no significant correlation between the length of stay in the nursing home and the static and dynamic balance. Static balance was calculated ($P = .392$) and dynamic ($P = 0.108$).

History of chronic disease: The statistical results showed that there was no statistically significant relationship between the static balance variable and the chronic history of disease. Subjects with chronic heart diseases and hypertension and bone problems were excluded from the study. 47% of the studied elderly stated that they had a history of chronic disease such as diabetes mellitus, mild Alzheimer's, and mild psychological problems. 91.7% of the participants were illiterate. In addition, 67% of subjects were female and 33% male. 47.2% were single and 38.9% widowed. The average number of children in the subjects was 1. There was no significant relationship between education, sex, marital status and number of children, and the static and dynamic balance in the elderly. The results of Table 1 show that there is no significant relationship between age, BMI and duration of stay in a nursing home with a static and dynamic balance.

Table 1: Correlation Coefficient and p-value of age, BMI and duration of stay with static and dynamic balance

	Balance	P-value	Pearson Correlation
Age	Static balance	0.855	0.032
	Dynamic balance	0.623	0.085
BMI	Static balance	0.438	0.133
	Dynamic balance	0.092	0.285
Duration of stay	Static balance	0.198	0.272
	Dynamic balance	0.392	0.147

Findings of other studies:

The findings of a study by Sohbatihia et al. (14) aimed to investigate the impact of hydrotherapy on the static and dynamic balance of the elderly were in line with those of the study by Yadegaripour et al. (15); according to the findings, hydrotherapy results in improved static and dynamic balance among the elderly. However, there was no significant difference between water and land based groups in terms of balance ($p < 0.01$). Likewise, the results of a study by Noobia et al. (16) are consistent with those of two studies above; the authors found that the endurance and muscular program can significantly improve the static and dynamic balance of the elderly. They also came to the conclusion that both interventions in water and land led to an improvement in the balance. Based on the results of this study, land-based exercise can also be as effective as water exercise on the static and dynamic balance of the elderly. Furthermore, due to limited access to the pool for the elderly living in the nursing room, the method of training in this study can be combined with the beneficial effects on the elderly balance and also minimize the cost and risks of using the pool. In addition, the results of a study by Azimzadeh et al. (17) were in line those of some previous research based on the fact that these exercises can improve balance; however, these types of exercises are not sufficiently specific and suitable for improvement of neuro-muscular adaptation of the balance. Therefore, combined exercises are able to activate stature responses as a result of external impairment and thus reduce the risk of falling. The finding of this study confirms the result of the present study based on the fact that the use of combined exercises has a better and more lasting effect on the balance of the elderly. The present study used 4 sets of physical activities including center- of-gravity control training, multisensory training, gait pattern enhancement, strength and endurance training to enhance balance in the elderly. Pau et al (9) also reported that more accurate and heavier workouts had a greater effect on the balance of individuals than light exercises, so that the impact of heavy exercise on balance was reported to be acceptable ($p < 0.05$). Yet, this effect has been reported to be very low in the second group. Consistent with the result of the present study, our findings showed that a precise exercise program and gradual increase in the exercise intensity can be effective on elderly balance. Haji Niya et al. (18) also observed that elderly adults walking on a regular basis and in the morning have a better balance than inactive elderly ones. The results of this study can confirm the role of physical activity in balancing. Furthermore, in a study by Mannini et al(19) performed on 32 healthy subjects with an average age of 75 years in two groups of physical activity, the results showed that there was no significant difference between the intervention and control groups at the end of the intervention and the subjects performed their daily tasks without any changes; these results are not in agreement with the present study. In addition, the

findings of a study by Alfieri et al(20) entitled as Comparison of Multi-sensory and Endurance exercises on postural control in the elderly in 2012, were inconsistent with the results of our study. The aim of this study was to investigate the effect of multi-sensory exercises on the elderly. This was a single-blinded study with 46 subjects in experimental and control groups for 12 weeks. The muscular strength and stability control the condition were measured by a force plate device. The results of this test showed no decrease in fluctuations of the control group. However, some fluctuations were observed in the experimental group, but they were not statistically significant ($p = 0.02$). In spite of better results in the experimental group, it cannot be proved that the training program is effective in improving balance control. The results of this study are also inconsistent with the studies by Brid et al. (21), Coa et al. (22) and Mannini et al. (19).

Discussion and conclusion:

Fall is one of the most important concerns of the global health community of the elderly people. Sight problems, presbyopia, unsafe environment, physical illness, muscular weakness and imbalance have been cited as falling factors among the elderly. Among these, imbalances is perhaps one of the main causes of falling among the elderly resulting in unwanted effects of reduced quality of life, dependence and even death. Increasing muscular strength through physical activity can lead to an increase in the elderly's balance of mind, and in addition to building self-confidence and doing daily activities, they make a contribution to the elderly's independence. Elderly people who have experienced the fall are always afraid of the repeated falls and this fear of fall is regarded as one of the main causes of the decline of independence and the isolation of the elderly in community. Education, prevention and treatment are three principles in community health, and as we know, prevention is always better than cure. Nurses, as the main health care providers, are always recognized as pioneers in preventing unwanted incidents, especially for at-risk people. Therefore, the presence of nurses with the elderly and sometimes living with them has made it more tangible for nurses to take a step for providing preventive care. In this study, we sought to demonstrate that by offering proper physical exercises and simple and low cost sports equipment, caring nurses at home or nursing home can take steps to prevent falls and increase the balance of the elderly. Using exercises at home or nursing home can reduce the level of falling among the elderly and prevent further complications in them.

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