Original Article

# The Effects of Weight-Bearing Exercise on Postural Control and Fatigue Index of Elderly Males

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## Abstract

**Aims:** Functional decline in activities of daily living caused by chronic fatigue and postural control weakness are common symptoms of aging that needed to be considered. Therefore, the aim of the study was to investigate the effects of weight-bearing exercise (WBE) on postural control and Fatigue Index of elderly males. **Materials and Methods:** Fifty-two elderly men of Qazvin City were volunteered to participate in the research and were allocated randomly into the two groups of either WBE ($n = 26$; 67.3 ± 2.4 years) or control group ($n = 26$; 68.1 ± 2.9 years). Functional test including maximal tolerance to treadmill walking (MTW) and test of Blood Lactate Acid Concentration (BLA) were considered as Fatigue Index before and after exercise intervention. In addition, good balance test was used to measure postural balance via static and dynamic balance. The exercise group performed (WBE) in a seven consecutive day, lasting 30 min in a session. Independent *t*-test and paired *t*-test were used to analyze the data at the significance level of 0.05. **Results:** The results suggested that both functional test (MTW [$P = 0.003$]; BLA [$P = 0.02$]) and postural control (static balance index [$P = 0.001$]; dynamic balance indices [$P = 0.001$]) were significantly improved in exercise group compared to control group. **Conclusion:** It appears that WBE would improve the functional performance of daily activities (postural control and fatigue tolerance) in the geriatric population.

**Keywords:** Balance, fatigue, functional capacity, geriatric, posture

## Introduction

Providing the appropriate strategy and action plan in the aged population and increasing health-care system plays a key role in goal setting which provides the aged population with healthy aging. Unlike previous decades, the importance of preventative approaches to uncontagious diseases has become more prominent, which can be especially beneficial for elders.[1-5] In pursuit of these goals, therapeutic exercises have always been effective in the geriatric population. Due to physical limitations, it is necessary to use proper exercises which fit for this age group. Muscle atrophy, fatness, and sarcopenia are those factors leading to a decline in motor control of the aged population. Apparently, any appropriate exercise intervention that improves body composition can be of great help.[6,7] To this end, fatigue, which is primarily originated from muscle, has gradually been diminishing the physical activity of the elderly and reduced functional capacity in daily activities.[8-11]

Fatigue, as an important geriatric syndrome, is accompanied by low physical activity, which leads to anxiety, lethargy, laziness, and muscle aches.[12-16] There are research evidence demonstrating that elders with fatigue syndrome are more vulnerable to catch joint problems,[10,17] muscle skeletal disorders,[18] depression,[19] and insomnia.[20,21] Increasing the strength of the muscles, especially in the lower limbs, is very important for the elderly because their potentials for fall is high due to the deterioration of physiological and physical systems. Hence, improving balance for the prevention of such trouble

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and reducing chronic fatigue can be of utmost importance in improving the quality of life of the elderly. Some studies indicated that proper kind of exercise would not only maximize the energy levels of the elderly, but also improve physical fitness of the aged persons.[3,22,23] It was hypothesized in the current study that weight-bearing exercise (WBE) would improve the postural control by lowering the rate of fatigue in aged males.

## Materials and Methods

### Participants

Fifty-two men were volunteered to participate in the research and were allocated randomly into the two groups of either WBE ($n$ = 26; 67.3 ± 2.4 years) or control group ($n$ = 26; 68.1 ± 2.9 years). In the experiment, six participants were removed from the study due to the absence in training session or not having inclusion criteria (lack of cardiovascular disease; age: above 65 years old; tolerance to WBE). Functional test of maximal tolerance to treadmill walking (MTW) and test of blood lactate acid concentration (BLC) were considered as Fatigue Index before and after exercise intervention. They were asked to walk on treadmill with their preference speed. In addition, good balance test (an accurate, reliable instrument for measuring postural balance) was used to measure postural balance via static and dynamic balance. All the tests were repeated in posttest. The feedback provided by visual stimuli was given them to maintain the balance. The validity and reliability of the instrument has been shown in several studies.[24,25] The intensity of their exercise was considered as relative to their weight as a percentage of their weight and was changed based on exercise repetition (3 sets, 10 reps) and all procedure were performed in exercise physiology laboratory.

The exercise group performed lower extremities exercises in a seven consecutive day, lasting 30 min in a session. The exercise protocol consisted of performing hip flexor, hamstring, and gastronomies stretching exercises.[26] In the exercise sessions, the participants used WBE rather than the force of an external weight or an assisting person. Participants were instructed to perform 4 sets of stretches, holding each stretch for 30 s and alternating the right and left limb (8 stretches in total).[26] The WBE proceeded and were followed by a warm-up and cool-down period. In warm-up phase, they were asked to get sidestepping to the right and the left four times in each direction, and then, 3 sets of walking forward 3 steps, clapping, and walking backward 3 steps and clapping was performed, and finally, they held on to a chair and performed 4 sets of lifting the right knee up and then the left knee. In the cool-down phase, they took breath while bringing both arms over the head and letting the breath out while bringing the arms back down and then shaking out the arms and legs was conducted and finally rotating the wrists and ankles were done alternatively in both directions of clockwise and then counterclockwise.[26] Independent $t$-test and paired $t$-test were used to analyze the data at the significance level of 0.05.

## Results

The Kolmogorov–Smirnov test showed that the distribution of data was normal. Therefore, parametric methods were used to analyze the data. The general characteristics of the participants in the exercise and control groups are presented in Table 1. The results of independent $t$-test before intervention did not show a significant difference in postural control (static and dynamic tests) and functional tests (BLA and MTW) ($P > 0.05$).

Paired $t$-test result showed that the MTW were significantly increased ($P = 0.001$) [Figure 1]. In other words, walking time tolerances was significantly improved in the exercise group. Furthermore, the results of independent $t$-test indicated that there was a significant difference between MTW of the two groups in posttest ($P = 0.003$).

As it can be seen in Figure 2, blood lactate acid (BLC) levels of exercise group were significantly lower in posttest rather than control group ($P = 0.02$).

Th results regarding the balance are shown in Figure 3. As shown, the covered area (Static Balance Index) for maintaining the balance in the test was significantly lessened in the posttest in exercise group compared to control group ($P = 0.001$). In addition, Independent $t$-test result indicated that covered area of exercise group was significantly lower in posttest rather than control group ($P = 0.02$).

Independent $t$-test result indicated that both traveled time and speed of exercise group was significantly improved in posttest rather than control group ($P = 0.01$; $P = 0.001$).

As shown in Figure 4, traveled time (dynamic balance indices) area for maintaining the balance in the test was significantly lessened in the posttest in exercise group compared to control group ($P = 0.001$).

As shown in Figure 4, traveled time and speed (dynamic balance indices) area for maintaining the balance in the test was significantly lessened in the posttest in exercise group compared to control group ($P = 0.001$).

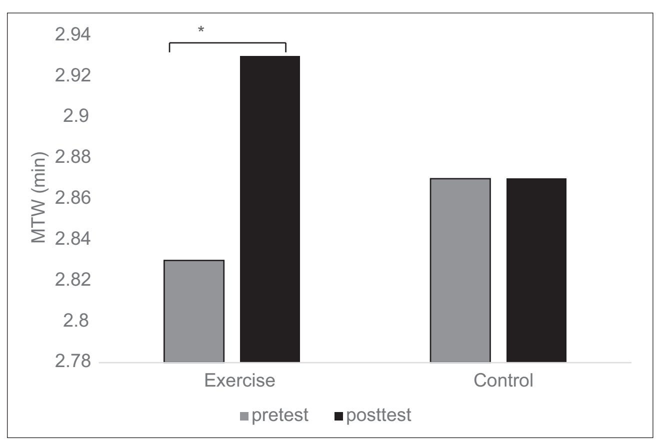


**Figure 1:** Walking time tolerance before and after intervention

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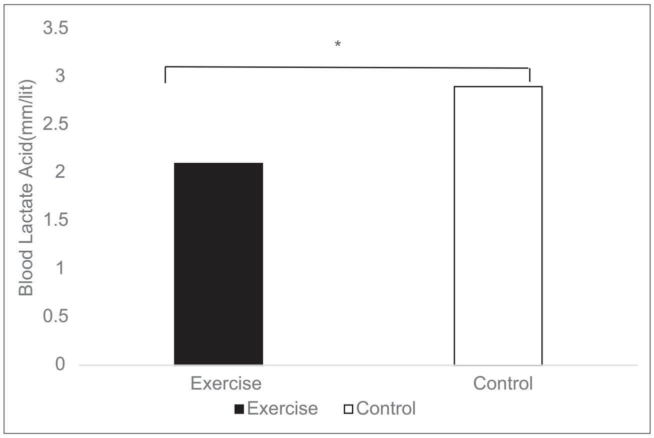


**Figure 2:** Blood lactate before and after intervention

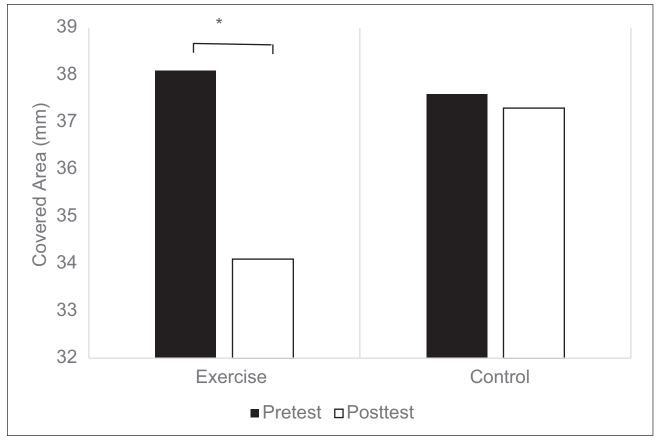


**Figure 3:** Static balance (covered area) before and after intervention

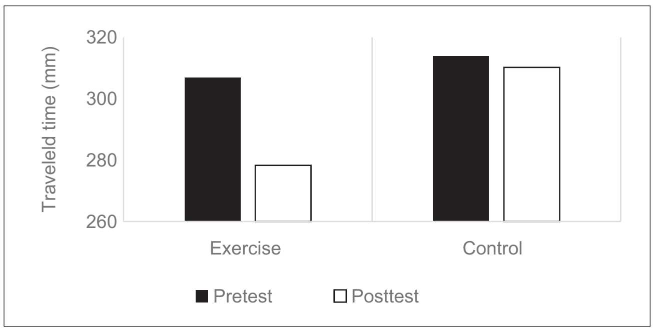


**Figure 4:** Dynamic balance (traveled time) before and after intervention

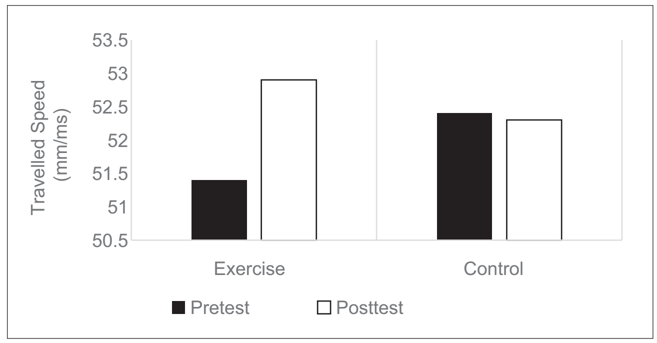


**Figure 5:** Dynamic balance (traveled speed) before and after intervention

**Table 1: Individual characteristics of participants and fatigue indices in pretest (mean±standard deviation)**

| Variable | Group | | *P* |
|---|---|---|---|
| | Exercise | Control | |
| Age (year) | 2.4±67.3 | 2.9±68.1 | 0.49 |
| BMI (kg/m$^2$) | 1.1±25.3 | 1.2±25.8 | 0.06 |
| Walking time (min) | 1.19±8.8 | 0.88±9.1 | 0.15 |
| Static balance | | | |
| Covered area (mm) | 38.1±1.4 | 37.6±1.3 | 0.18 |
| Avg_X_speed (mm/ms) | 0.43±0.03 | 0.42±0.05 | 0.16 |
| Avg_Y_speed (mm/ms) | 1.15±0.02 | 1.14±0.05 | 0.35 |
| Dynamic balance | | | |
| Traveled time | 306.8±11.3 | 3131±193 | 0.16 |
| Traveled length | 19.4±1.5 | 18.8±1.1 | 0.10 |
| Traveled speed | 51.2±6.2 | 524±48 | 0.43 |

BMI: Body mass index

As shown in Figure 5, traveled speed (dynamic balance indices) area for maintaining the balance in the test was significantly lessened in the posttest in exercise group compared to control group ($P = 0.001$).

## Discussion

Improvement of motor function and functional capacities in the elderly has ever been considered by researchers and policy-makers in the field of health. Hence, the research was conducted to see the effects of WBE on postural control and Fatigue Index of the geriatric population. The findings indicated that this type of exercise is capable of improving the fatigue indices (MWT and BLA) in the elderly males. In addition, it was found that the participants in exercise group confronted a better static balance (covered area index) after intervention. With respect to dynamic balance, traveled time and speed indices were performed better in exercise group.

One of the possible reasons for improving the static and dynamic balance of participants following training programs can be due to improved muscle strength of the lower extremity because exercises focused on the lower extremities. This result is consistent with the findings of Taheri and Irandoust[11] who suggested that the endurance and weight-bearing exercises improved reaction time and postural balance in elderly females. Apparently, there is a difference in the measurement method in these two studies. In Taheri study, timed up and go test was used, while more precise laboratory techniques were used in the current study to assess the balance. Although, to the best of our knowledge, there have been no studies on the effectiveness of WBE on interrelated indices of postural control and fatigue, several studies have worked on the use of resistance and aquatic exercises for improving the fatigue.[27,28] In justifying the improvement of walking performance on the treadmill, it can be noted that the exercises used in the study, has improved the balance and on the other hand, the Fatigue Index has been

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improved, which has led to a reduction in lactic acidity in the exercise group rather than the control group. Based on other evidence, resistance exercises can have a good effect on flexibility and range of motion, leading to better and optimal steps and increased travel time with less energy.[27] Since it was not possible to measure the strength of the lower extremity muscles, therefore, it is strongly recommended that the assessment of strength in upcoming studies be conducted. On the other hand, providing interventions with a longer duration and different intensities can more fully explain the effect of the exercise. In addition, considering the mental characteristics of elderly along with assessing more physiological parameters related to the study variables are proposed for future research. Since mental fatigue is a key barrier for doing exercise in the geriatric population, taking it into consideration is highly recommended. It should be noted that the results cannot be generalized to the elderly population due to low sample size, therefore, more participants are highly needed to future studies.

## Conclusion

Given the proven effects of WBE on postural control and Fatigue Index in aged persons, it is necessary to have the aged people do WBE in order to improve the functional performance of daily activities and making them independent.

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Nil.

### Conflicts of interest

There are no conflicts of interest.

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