Original Article

Effectiveness and durability of whole body vibration exercise on balance in elderly men

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ABSTRACT

Background: The aim of this study was to assess static and dynamic Balance changes after eight weeks Whole Body Vibration Training (WBVT) and detraining period in elderly men subjects. Methods: in this quasi-experimental study, 28 elderly men's based on inclusion and exclusion criteria's were selected and randomly divided into two groups: whole body vibration and control. Before and after eight weeks training, and after four weeks of detraining Biodex static stability test and TUG (time up to go) test was performed to test for evaluation of static and dynamic balance respectively in older people. Results: The results of statistical analysis and analysis of variance with repeated measure ANOVA showed that after doing the exercises, static and dynamic balance in WBVT significantly increased ($p \leq 0.05$). Also in WBVT group between pre-test and follow up (four weeks of detraining) there wasn't a significant difference ($p \leq 0.05$).

Conclusion: According to the results, WBVT could affect static and dynamic balance among healthy elder subjects and reduce the risk of falling among them. Moreover, the effects of this training are not persistent; hence it is possible that WBVT can be recommended as safe and quick balance training for elderly subjects.

Keywords: Elderly, whole body vibration training, detraining, balance.

Introduction

one of the most common and serious problems of old age is falling and it has physical (hip fracture, disability, loss of physical ability and death), psychological (loss of confidence and self-esteem and reduce life expectancy) and financial consequences [1, 2]. Approximately 28-35% of people aged of 65 and over fall each year [3] increasing to 32-42% for those over 70 years of age. The frequency of falls increases with age and frailty level [4]. The incidence of falls appears to vary among countries as well. For instance, a study in the South-East Asia Region found that in China, 6-31% [5-7] while another, found that in Japan, 20% [8] of older adults fell each year. Medical expenses related to falls, is impressive, for example, injuries related to falling in sixty years and older, 981 million pounds cost for the British government in 2010 [9].

Research has shown that the causes of the falling of the elderly in both internal factors (including weakness of the lower limbs, loss of balance, loss of mental ability, loss of sensory information and the slow movement responses) and external factors (factors that caused by environmental conditions, including the use of psychotropic drugs and hypnotics, environmental conditions such as poor light traffic areas, uneven surfaces, the mobility of the surface and glide, appliances and cumbersome in the direction of travel) are located) [10]. The studies documented that one of the main causes of falling among the elderly is impaired balance [11], so the balance factor and rehabilitation in this age group has been of interest to researchers [12, 13]. Balance is one of the basic needs for daily activities that play an important role in static and dynamic activities [12, 14, 15]. Postural control system and balance is complex mechanism and the combination and coordination of three systems in balance is crucial. These systems are the visual system, vestibular system and proprioception (somato-sensory) system [16]. It is well documented in studies of traditional training programs that aim to increase the balance, caused significant improvement in balance, walking ability, strength and aerobic endurance and in some cases to reduce the

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incidence of falls among the elderly [17, 18]. Although doing traditional exercises are done on the ground is beneficial for many seniors, however, certain medical conditions (such as osteoporosis, arthritis, stroke and obesity) [19] in older people due to pain or decreased mobility of joints, The ability of their participation in the training programs reduces or prevents them from doing these exercises. The researchers emphasize that the recent findings of WBVT provide a way of exercise for people who have low tendency to participate in sports classes and training sessions or people who have walking difficulties [20-22]. Because of Whole Body Vibration exercise is done standing on a vibration platform, the risk of exercise-related injuries such as falls and stress fractures decreases and it is likely that WBVT can be introduced as appropriate training method for older people.

Previous studies have reported on the vibration improves neuromuscular system, for example, a study by Van Ness et al (2006) support the idea that vibration training has the potential as a treatment to reduce the risk of falling and increased postural control in the elderly [23, 24]. Presumably if vibration training can stimulate muscles effectively, it must have the ability to improve balance in elderly subjects [24]. A review of studies on WBVT, it was observed that studies the effects of WBVT compared to the balance of this age group have offered conflicting results [24]. On the other hand detraining period (the period after the intervention exercises that do not take any exercise) and in studies of Whole Body Vibration on older, less attention has been paid to this issue and has not been studied. The aim of this study was to investigate the effects of WBVT and detraining on the Balance, risk of falling in healthy elderly men.

Research Method:

This study was a quasi-experimental study with a pretest-posttest with an exercise intervention group and a control group. The population of this study was men aged 60 to 75 years old in Shiraz. 28 elderly men with a mean age of 68 ± 5.6 years, height 167 ± 7.2 cm and weight 69 ± 6.6 kg, based on health assessment (according to alertness test and vestibular test) men older adults living in nursing homes selected and randomly classified to two groups, WBVT and control (each group of 14 subjects). Participants were asked to record the possible dislocation of joints and a history of falling. According to the research interest subjects were excluded from the study if they have one of the following situations: they haven't the ability to perform cognitive tests and vestibular function, have a history of falling in the last 12 months, have dislocation or any operation in lower extremities, and have chronic arthritis or dizziness [25]. But none of the subjects participating in this study did not have these conditions and were not excluded from the study. The purpose and methodology of the study and ethical considerations fully explained to the subjects and all subjects participating in the research study and signed a consent form. In the case of WBVT, the group for eight weeks and each week in three sessions and each session 20 minutes practiced by device whole body vibration platform model NEMS El B, Bosco system (Table 1).

Table 1: Whole Body Vibration training intervention

Intervention weeks	1	2	3	4	5	6	7	8	12
Exercise set WBV 1-minute exercise 1 minute rest	5×15 Hz	2×15 3×20 Hz	5×20 Hz	2×20 3×25 Hz	5×25 Hz	2×25 3×30 Hz	5×30 Hz	2×30 3×35 Hz	Detraining test 1

After the training program, participants from both groups were assessed. After the test, to evaluate and compare the maintenance effects of exercise group, after four weeks, both groups were repeated. Each of the tests for each subject performed three times and the average score was recorded. To assess Static balance, we used the Biodex stability test in the difficulty level of 8 to 12. This test measure subjects' ability to maintain a static balance and scores in this test indicates deviations from the central, so lower scores are better [26, 27]. After taking participants on a Biodex plate trying to keep their center of gravity on the base of support for 20 seconds while watching the monitor. Between each trial they rest for 10 seconds. For measuring the dynamic balance test TUG (time up to go) was used to measure time [28]. The TUG (Timed Up and Go) test was developed in 1991 as a modified timed version of the Get up and Go test [29, 30]. To perform the TUG test as described in the original derivation study, the patient is timed while they rise from an arm chair (approximate seat height 42 cm) walk at a comfortable and safe pace to a line on the floor three meters away, turn and walk back to the chair and sit down again. The subject walks through the test once before being timed to become familiar with the test [30]. A faster time indicates a better functional performance. Testing was performed by people who are unaware of the Group of subjects.

SPSS version 23 software used for data analysis and Shapiro-Wilk test revealed data subjects was normal (P>0 /05).

To analyze the effect of WBVT on the balance of subject's analysis of variance with repeated measures and ANOVA was used. Analysis of variance with repeated measures within groups by a factor of three levels (time, including pre-test, post-test, durability test after four weeks the durability test) and two factor between groups (two groups) were used to assess changes in performance on static and dynamic balance. For further investigation, for each of the varying levels of intra-group analysis of variance and to assess changes in each group during three tests, analysis of variance with repeated measures (within-group) at a significance level ($\alpha \leq 0.05$) and finally Gabriel's post hoc test were used to assess differences between the groups [31].

Results:

The sample consisted of descriptive data; age, weight and height for each group are shown in Table 2.

Table 2: Descriptive data subjects in each group

Group*	Age	Height	weight
Whole body vibration	68±5.6	168±4.8	70±7.9
Control	69±4.2	170±5.4	70±9.5

Distribution of subject's data in groups is normal

Analysis of variance with repeated measures on the interaction between the static stability test (3 tests) and groups (2 groups) showed ($P = 0.001$ and $F_{4, 112} = 22/61$), the main effect of time ($P = 0.001$ and $F_{4, 112} = 22/61$) was significant. Analysis of variance with repeated measures (within the group) separately for each group in this test showed that the effect of whole body vibration exercise group had a significant difference ($P = 0.001$ and $F_{5, 56} = 33/61$), No significant difference was observed in the control group ($P = 0.325$ and $F_{5, 56} = 1/9$). The results of ANOVA (between groups) of the test showed that the two groups in the pre test ($P = 0.454$ and $F_{1, 29} = 0.56$) No significant difference, but the performance during post test and follow up ($P = 0.012$ and $F_{1, 29} = 7.56$) There was no significant difference between the two groups. Mean and standard deviation for each group in the pre-test, post-test and detraining periods after the four-week follow-up test results are shown in Table 3.

Table 3: The average and SD deviation of the pre-test and post-test in the dependent variables

Group	Pre test	Post test	Follow up
Whole body vibration	Static: 2.18 ± 0.63	Static: 1.57 ± 0.75	Static: 1.86 ± 0.49
	Dynamic: 12.02 ± 1.78	Dynamic: 11.55 ± 1.66	Dynamic: 11.87 ± 1.81
control	Static: 1.86 ± 0.53	Static: 2.02 ± 0.44	Static: 1.93 ± 0. 64
	Dynamic: 12.12 ± 1.52	Dynamic: 12.32 ± 1.43	Dynamic: 12.27 ± 1.67

Discussion:

The aim of this study was to evaluate and compare the effect of WBVT on the static and dynamic balance in healthy elderly men. Our main hypothesis was that old people who participate WBVT for eight weeks, compared with the control group showed significant improvements in static and dynamic balance, and after four weeks of practicing this capability will be maintained. Results of our study confirm the effects of WBVT on the factors mentioned in the elderly group.

Scores for static and dynamic balance for whole body vibration group was decreased and this decrease in static stability and TUG tests indicates that an improvement in static and dynamic balance exercises in intervention group. The results of this study are similar to results of previous studies that report WBVT group improved static and dynamic balance. The effects of WBVT immediately after exercise were diagnosed. A possible reason for the improvement in Balance and the resulting balance observed in this study can be increased recruitment motor units simultaneously [32, 33]. The previous studies showed that WBVT indicators of Rate of perceived exertion (PRE) and blood lactate levels increased [34, 35]. This process can improve neuromuscular stimulation and motor units recruitment increases. In addition, synergistic muscles of the lower limbs or increase the activity of the antagonist muscle inhibition caused by stretching reflex activation may also explain the results [35, 36]. In this study, subjects with a knee flexion (110 degrees) standing on a platform vibration, so the quadriceps muscle group activity (agonist) and through a stretching reflex, inhibition hamstring group muscles (antagonist) increases. This posture can increase motor units recruitment of synergistic muscles by increasing the involuntary contraction and improvement in neuromuscular performance [21, 33]. The results of this study are not consistent with the results of some previous studies. While the studies noted after WBVT courses significant changes not appeared in muscle strength, neuromuscular performance and the ability to walk and muscle function [20, 22, 35] however, the probable reason for haven't seen a significant difference between the groups in these studies can be using a low frequency in WBVT group in compare to control group [23, 24, 32]. Detraining period after the exercise program is period that does not do any exercise. As can be seen in the results tables in WBVT, test scores after four weeks of detraining levels reached to pre-test scores, and there is a significant difference between post-test and follow up scores. Since one of the objectives of the exercise program to maintain its effects on the body, it can be said that the effect of WBVT on static and dynamic balance in elderly not last long. From the perspective of physiological strength through resistance training occurs in two phases, at the beginning of training increase muscle strength caused by neuromuscular coordination and then structural changes and muscle hypertrophy lead to muscle strength and muscle power [37, 38]. WBVT activates Tonic Vibration Reflex; this reflex by improving muscle strength is increased neuromuscular coordination [38]. The first factor that affected in the detraining period and decreases is neuromuscular adaptation. This factor can explain the rapid return of WBVT group balance.

Conclusion:

The results of this study showed that whole body vibration training may improve the static and dynamic balance and thus reduce the risk of the elderly falling. In addition, WBVT as a type of exercise is safe and well-tolerated for older people, however, the effect of the exercise training period after stopping quickly returns to its original level and not permanent. Further studies on the use of these exercises alongside other traditional exercises can show that whether the use of WBVT alongside other traditional exercises can have acceptable lasting effects or not.

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