



## Scholars Research Library

Annals of Biological Research, 2011, 2 (6):240-246  
(<http://scholarsresearchlibrary.com/archive.html>)



Scholars Research  
Library  
ISSN 0976-1233  
CODEN (USA): ABRNBW

### Comparisons of Berg Balance Scale Following Whole Body Vibration Training and Aquatic Balance Training in Male Elderly subjects

Seied Sajad Hosseini, Hossein Rostamkhany and Mehriyeh Panahi

Department of Physical Education & Sport Sciences, Faculty of Humanities, Abhar Branch,  
Islamic Azad University, Abhar, Iran

---

#### ABSTRACT

*Since imbalance considers as main cause of falling among the elderly, balance is part of the scientific challenge for last decades. The aim of this study was to Comparisons of Berg balance scale (BBS) following eight weeks Whole Body Vibration training (WBVT) and Aquatic balance training (ABT) in male elderly able-bodied individuals. Forty five adult male subjects (age:  $70 \pm 9.6$  years, height:  $168 \pm 6.9$  cm, mass:  $70 \pm 10.5$  kg) voluntarily participated in study and assigned in to WBVT, ABT and control group ( $n = 15$  per groups). BBS test, as a predictor of falling as well as static and dynamic balance among elder subjects, were taken as pre-test and post-test and also after four, six, and eight weeks of detraining. Results of repeated measure ANOVA and one-way ANOVA showed that BBS scores improved significantly for two trained groups. Significant differences observed between post-test and six and eight week detraining period in WBVT group, while no significant differences seen in these parameters in ABT group. Due to results, ABT are more persistent than WBVT and increase static and dynamic balance, and also reduce the risk for falling in male elderly able-bodied individuals. However, WBVT can be recommended as an additional exercise besides ABT.*

**Key words:** Elderly, Whole body vibration training, Aquatic balance training, Berg balance scale.

---

#### INTRODUCTION

Falling is among the most common and serious problems whose potential of occurrence increased with ageing. It usually has physical (pelvic fracture, disability, loss of physical ability and death), psychological (loss of confidence and self esteem and life expectancy reduction), and financial consequences [1, 2]. Just from financial aspects, in the United States, \$10 billion are annually imposed on families and society for the treatment of hip fractures among elder persons who fall [3]. It has been documented that the causes of falling among elderly subjects could be

attributed to internal factors (including lower limb muscle weakness, loss of balance, reduced mental ability, loss of sensory information and slow motor responses) and external factors (factors that are induced by environmental conditions, including psychotropic drugs, environmental conditions such as dim light in passageways, uneven surfaces, moving the base of support and gliding, cumbersome furniture in passageways) [4].

It has been also documented that balance deficit is one of the main risk factors that affect falling among adults [3-5]; therefore, its aspects including rehabilitation of balance is the main concern the researchers and physiotherapist attend to. Balance is a component of basic needs for daily activities and it plays an important role in static and dynamic activities. Postural control or balance system is a complicated mechanism that coordination in three balance systems include visual, vestibular and proprioceptive systems have the basic role in it [6, 7]. It is well proven that the conventional training programs, which had been used to improve balance, significantly affected balance, gait, strength and aerobic endurance; while in some occasion, they led to reduce incidence of falling among adults [7-10]. Though the conventional exercises perform on the ground have benefits for many adults, however, there are certain medical conditions among adult subjects (i.e. osteoporosis, arthritis, stroke and obesity) which, because of pain and/or decrease in joint mobility, decrease their ability to participate or prevent them from doing training programs [11].

Recent findings emphasize that WBVT may provide another way of training for those who are less willing to participate in exercise classes in gyms, or the ones who have difficulty in walking [12]. Since the WBVT done while standing on the Vibration platform, it reduces the probability of risk for injuries such as falling and stress fracture associated with other exercises; it is also possible to introduce WBVT as a suitable method for adults. Studies on vibration have reported improvement in neuromuscular system too [12-14]. A Study conducted by Van Nes & colleagues (2004) supports the idea that WBVT has the potential to be used as a therapeutic tool for reducing the risk for falling and improving postural control in elderly [15]. The probable hypothesis is if WBVT is able to stimulate the muscles effectively, it must have the ability to improve neuromuscular performance, balance and walking ability in adult subjects.

The water environment, due to its unique nature, such as buoyancy, viscosity and hydrostatic pressure, also makes it unique to develop confidence and reduces the effect of weight bearing from the Earth's gravity, and allows adults to be interested in doing exercise and physical activity without Pain [1, 11]. Recent studies have reported multiple gains from exercise in water for the adults, which they include postural oscillations reduction [16], blood lipids diminish, increased maximal oxygen uptake, strength, muscular endurance and flexibility enhancement [17], increase in the reaching distance [18], as well as greater independence in daily tasks [19]. Many studies have investigated the effects of ABT on balance and mobility in the elderly that mainly their results confirm the positive effects of ABT on their balance [1, 11, 18, 20-22], however, with our knowledge there is not any study that examine the effect of detraining after ABT on elderly balance.

Reviewing the literature did not show any studies that compare the effect of WBVT and ABT in the elder group. Also no study was available to consider the effect of detraining (a period after the exercise intervention that subjects do not do any exercise) after ABT, while there are just a

few studies which have examined the effects of detraining after WBVT. Regarding that the purpose of any exercise training is to maintaining of that's effects on body, the aim of this study was to Comparisons of BBS following eight weeks WBVT and ABT in male elderly able-bodied individuals.

## MATERIALS AND METHODS

### Study Participants

Current study was a Quasi-experimental one with pretest - posttest design on two experimental groups and one control group. Forty five healthy male adults (age:  $70 \pm 9.6$  years, height:  $168 \pm 6.9$  cm, mass:  $70 \pm 10.5$  kg) voluntarily participated in this study; they were randomly assigned in to three groups of WBVT, ABT and control (15 subjects per group). All participants signed an informed consent document approved by the Institution human subjects review board. Participants were asked to fully explain the history of possible dislocation of joints and falling. Participants who had a history of falling or suffered from any kind of displacement or dislocation of joint in the past 12 months, or had chronic arthritis or dizziness were excluded.

### Study Protocol and Intervention

This study was approved by the university institutional review board. Initially, subjects' balances examined by BBS test which is a criteria for falling, static and dynamic balance in adults [23-25]. WBVT group performed exercises for eight weeks, three sessions per week and each session about 30 minutes using Whole Body Vibration Plate system, The Nemes-LB Bosco System (Table 1).

**Table 1: Whole body vibration training program intervention**

Training weeks	1	2	3	4	5	6	7	8	12	14	16
WBVT sets		2×15		2×20		2×25		2×30			
1 min exercise	5×15 Hz	3×20 Hz	5×20 Hz	3×25 Hz	5×25 Hz	3×30 Hz	5×30 Hz	3×35 Hz	First detraining test	Second detraining test	Third detraining test
1 min rest		Hz		Hz		Hz		Hz			

The ABT group performed exercises in water with the aim of increasing the neuromuscular performance, balance and walking ability for eight weeks and three 60-minute sessions per week in accordance with previous studies done in this regard [1, 18, 20, 26]. All exercises were conducted in water with subjects' chest high depth. Each exercise session in water was divided into three stages: adaptation with water environment, stretching exercises, and static and dynamic ones for balance. Aquatic balance training was designed to improve the control of center of gravity and ability to combine sensory information, compensatory postural control, and walking. All eight-week activities were progressively consolidated due to manipulated and switching hands position (i.e. cross arms to be placed on the breasts) or an increase in the difficulty of performed activities (i.e. to move with closed eyes, walking in different directions or use the insoles). Duration of each exercise session was approximately 60 minutes, each session were started with a 10-minute warm-up including walking in water, aerobic activity in water, resistance training and flexibility activities; the exercise were ended with 10-minute cool-down one, including static flexibility. The remaining time of each session (about 40 minutes) was allocated to balance and walking exercises in water. Post-tests were performed on three groups

after training. After the post-test, to assess and compare persistence of exercises in groups, tests were taken after four, six and eight weeks on all three groups.

### Statistical Analysis

Subjects' distribution in groups was normal according to Kolmogorov-Smirnov test. Descriptive statistics, repeated measure analysis of variance, and one-way ANOVA were applied to examine and compare the effects of WBVT and ABT on BBS in subjects. To examine the score changes in BBS, a repeated-measure analysis of variance with a within-subjects factor (time, including pre-test, post-test, persistence test after four, six, and eight weeks) and a between-subjects factor (three groups) were used. One-way ANOVA was used on each varying levels of within-subjects factor; for further analysis repeated-measure ANOVA was used to examine changes in each group over the five tests (within group) at the significant level of  $P \leq 0.05$ .

## RESULTS

Descriptive data of subjects including age, height and mass is given in Table 2.

**Table 2: Mean and SD of participants**

Group*	Age (yr)	Height (cm)	Mass (kg)
ABT	71 ± (7.4)	168 ± (6.5)	69 ± (11.5)
WBVT	70 ± (8.2)	170 ± (4.9)	71 ± (9.8)
Control	70 ± (8.8)	167 ± (7.9)	70 ± (10.3)

\*subjects' distribution in groups are normal

Repeated-measure ANOVA results on BBS test showed significant interaction between time (five tests) and groups (3 experimental groups) ( $F_{8, 168} = 28.37, P = 0.000$ ). Furthermore, the main effect of time ( $F_{4, 168} = 68.91, P = 0.000$ ) and experimental intervention ( $F_{2, 42} = 9.60, P = 0.000$ ) were significant. The results of repeated-measure ANOVA (within groups) separately for each groups in BBS test showed that the effect of time in the ABT group ( $F_{4, 56} = 87.47, P = 0.000$ ) and WBVT group ( $F_{4, 56} = 33.64, P = 0.000$ ) was significant, but this effect in the control group was not significant ( $F_{4, 56} = 1.19, P = 0.325$ ).

The result of one-way ANOVA (between groups) for this test showed that the three groups did not have any significant difference in the pre-test ( $F_{2, 42} = 0.28, P = 0.752$ ), but the performance during the post-test ( $F_{2, 42} = 11.33, P = 0.000$ ), after four weeks of detraining ( $F_{2, 42} = 18.45, P = 0.000$ ), six weeks of detraining ( $F_{2, 42} = 19.07, P = 0.000$ ) and eight weeks of detraining ( $F_{2, 42} = 15.23, P = 0.000$ ) had significant differences in three groups. Mean and standard deviation in scores of each group during pre-test, post-test, and detraining periods as well as the post hoc test results can be seen in Table 3.

**Table 3: Mean and standard deviation for training groups in pre-test, post-test, and after four, six and eight weeks of detraining and post hoc test results for the BBS Test**

	pretest	posttest	4 weeks detraining	6 week detraining	8 week detraining
ABT	48.66 ± 1.91	52.13 ± 1.76 <sup>ac</sup>	52.53 ± 1.80 <sup>a</sup>	52.60 ± 1.76 <sup>a</sup>	52.00 ± 1.55 <sup>a</sup>
WBVT	48.40 ± 2.09	51.66 ± 1.87 <sup>bc</sup>	50.40 ± 1.80 <sup>d</sup>	50.13 ± 1.55 <sup>e</sup>	48.93 ± 1.79 <sup>f</sup>
CG	48.93 ± 1.75	49.13 ± 1.92	48.80 ± 1.42	48.86 ± 1.72	49.20 ± 1.69

Significant difference between (a: ABT and CG, b: WBVT and CG, c: pre-test and post-test, d: post-test and 4 weeks detraining, e: post-test and 6 weeks detraining, f: post-test and 8 weeks detraining), all at the  $p \leq 0.05$ .

## DISCUSSION

The aim of this study was to Comparisons of BBS following eight weeks WBVT and ABT in male elderly able-bodied individuals. The main hypothesis was that adults who participate in WBVT and ABT for eight weeks would significantly improve static and dynamic balance compared against the control group, which these effects will be preserved after four, six and eight weeks of detraining. The results of this study confirm the effect of these training programs on aforementioned factors on the adult samples. The score of BBS test for post-test in comparison with the pre-test increased 6.73 percent in WBVT and 7.13 percent in ABT group respectively. Increase in BBS score represent improvement in static and dynamic balance in training groups [23-25].

Our finding in WBVT group is similar to former studies that have reported improvement in neuromuscular performance and balance after WBVT [12-14, 27]. A possible reason for improvement in static and dynamic balance observed in the WBVT group in the present study is the increase in simultaneous recruitment of motor units. It is reported that WBVT increase all identifiable pressure indicators (RPE and blood lactate levels). This process can improve neuromuscular irritability as well as recruitment of more motor units [27, 28]. In addition, simultaneous activity of synergist muscles or increased inhibition of antagonist muscles in lower limbs due to activation of stretch reflex may also justify our results. In this study, subjects stood on the vibration platform with flexed knee (110 degrees); hence, activation in quadriceps muscles (agonist) and inhibition in hamstring groups (antagonist) through stretch reflex increases. This posture can lead to an increase in the recruitment of motor units of synergist muscles through increased involuntary contraction and improve neuromuscular performance.

The results of BBS tests showed significant improvement in static and dynamic balance, and walking ability in aquatic balance training group, which is similar to the results in former studies that examined effect of hydrotherapy among elderly subjects [1, 11, 16, 18, 20, 29]. However, functional tests and intervention programs in these studies were different and a little find it difficult to compare the results. Our findings indicate that resistive nature of water may have increased lower limb muscle strength and it has improved neuromuscular performance and static and dynamic balance in adult groups. On the other hand, water has viscous property that slows down the movement and delays falls in adult subjects; during failure in balance, it provides more time to restore balance. Floating property of water also acts as a supporting factor, which increases self confidence and reduces fear of falling. Using this exercise, we enable the adult subjects to exercise beyond their limit of support without fear of falling. These physiological properties of water have probably improved static and dynamic balance in adult subjects. Our findings, however, challenge the results of Chu and colleagues study (2004) [30]. They reported that eight-week training in water had no significant effect on balance in patients with heart attack, while significant improvements in cardiovascular preparation, walking speed and lower extremity strength were observed. However, in their study, balance system was not considered and researchers were of the opinion that the buoyancy of water and use of flotation devices have not challenged balance systems effectively [30].

Detraining is a period after the training intervention when no training is performed. As shown in tables, the score of BBS reached their initial and before training values in the WBVT group after

six weeks of detraining, and there were significant differences between posttest with six and eight weeks of detraining. While in ABT there were not any significant differences in amounts of post-test with four, six, and eight weeks of detraining. The findings imply that the effect of WBVT on static and dynamic balance has returned to its original levels after discontinuation of the training; however, these factors remained to their high levels after discontinuation of the training in ABT. Since the goal of athletic training programs are to maintain their effects on the body, it is likely to say that the effect of ABT is more enduring on static and dynamic balance in adult subjects.

From the physiological perspective, increases in strength due to resistance exercise occur in two phases. At the beginning of exercises, increase in strength is obtained through neuromuscular coordination in the muscles, and then the structural changes and hypertrophy occur in muscles that are considered as increase in strength [27, 31]. WBVT causes activation of vibration tonic reflex [32]; this reflex causes an increase in muscle strength by improving neuromuscular coordination, but the first factors which affect and reduce in detraining period are neuromuscular adaptations. This is the reason why muscle structural adaptations (e.g. muscle hypertrophy) decrease with less speed and lower rates during detraining period. It can justify the cause of fast reduction of static and dynamic balance in WBVT group as well as maintenance of training effects in ABT.

## CONCLUSION

The results of this study showed that ABT with an emphasis on several senses involved can improve static and dynamic balance. Multi-sensory trainings, which manipulate senses involved in balance, both in stable and unstable levels, may also be an effective tool to improve balance in adults. Meanwhile, the use of ABT, due to low-risk nature, providing challenging conditions for balance systems can be an effective way to improve balance and prevent subsequent falls among adults. According to the findings of this study, exercise in water can be recommended as a training method to improve static and dynamic balance and reduce the probability of falling in male adults with no history of regular exercise. WBVT can also be recommended as complementary training besides ABT.

## REFERENCES

- [1] Resende, S.M. and C.M. Rassi, *Revista Brasileira de Fisioterapia*, **2008**. 12: p. 57-63.
- [2] Lopes, K., et al., *Revista Brasileira de Fisioterapia*, **2009**. 13: p. 223-229.
- [3] Carter, N., P. Kannus, and K. Khan, *Sports Medicine*, **2001**. 31(6): p. 427-438.
- [4] Shumway-Cook, A., et al., *Physical Therapy*, **1997**. 77(1): p. 46-57.
- [5] Hobeika, C.P., *Ear Nose and Throat Journal*, **1999**. 78: p. 558-567.
- [6] Bernier, J.N. and D.H. Perrin, *The Journal of orthopaedic and sports physical therapy*, **1998**. 27(4): p. 264-275.
- [7] Frändin, K., et al., *Scandinavian journal of rehabilitation medicine*, **1995**. 27(4): p. 231-241.
- [8] Lord, S., et al., *Journal of the American Geriatrics Society*, **2003**. 51(12): p. 1685-1692.
- [9] Campbell, A., et al., *British Medical Journal*, **1997**. 315(7115): p. 1065-1077.
- [10] Lord, S., et al., *Journal of the American Geriatrics Society*, **1995**. 43(11): p. 1198-1206.
- [11] Booth, C.E., *Activities, Adaptation & Aging*, **2004**. 28(4): p. 45-57.

- 
- [12] Roelants, M., C. Delecluse, and S. Verschueren, *Journal of the American Geriatrics Society*, **2004**. 52(6): p. 901-908.
- [13] Luo, J., B. McNamara, and K. Moran, *Sports Medicine*, **2005**. 35(1): p. 23-41.
- [14] Dolny, D. and G. Reyes, *Current Sports Medicine Reports*, **2008**. 7(3): p. 152-157.
- [15] van Nes, I., et al., *American Journal of Physical Medicine & Rehabilitation*, **2004**. 83(11): p. 867-873.
- [16] Lord, S., D. Mitchell, and P. Williams, *Australian Journal of Physiotherapy*, **1993**. 39: p. 217-217.
- [17] Jones, C.J. and D.J. Rose, **2005**: Human Kinetics.
- [18] Simmons, V. and P.D. Hansen, *Journals of Gerontology Series A: Biological and Medical Sciences*, **1996**. 51(5): p. 233-238.
- [19] Rissel, C., *The Australian Journal of Physiotherapy*, **1987**. 33(4): p. 226-232.
- [20] Douris, P., et al., *Journal of Geriatric Physical Therapy*, **2003**. 26: p. 3-6.
- [21] Suomi, R., *Archives of physical medicine and rehabilitation*, **2000**. 81(6): p. 780-785.
- [22] Avelar, N.C.P., et al., *Revista Brasileira de Fisioterapia*, **2010**. 14(3): p. 229-236.
- [23] Conradsson, M., et al., *Physical Therapy*, **2007**. 87(9): p. 1155-63.
- [24] Donoghue, D. and E.K. Stokes, *J Rehabil Med*, **2009**. 41(5): p. 343-6.
- [25] Muir, S.W., et al., *Physical Therapy*, **2008**. 88(4): p. 449-59.
- [26] Lord, S., et al., *Australasian Journal on Ageing*, **2006**. 25(1): p. 36-41.
- [27] Torvinen, S., et al., *Medicine & Science in Sports & Exercise*, **2002**. 34(9): p. 1523-1528.
- [28] Rittweger, J., M. et al., *Clinical Physiology and Functional Imaging*, **2003**. 23(2): p. 81-86.
- [29] Devereux, K., D. Robertson, and N. Briffa, *Australian Journal of Physiotherapy*, **2005**. 51(2): p. 102-8.
- [30] Chu, K.S., et al., *Archives of physical medicine and rehabilitation*, **2004**. 85(6): p. 870-874.
- [31] Komi, P., *International Journal of Sports Medicine*, **1986**. 7: p. 10-15.
- [32] Rittweger, J., *European journal of applied physiology*, **2010**. 108(5): p. 877-904.