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The Effect of Aquatic, Whole Body Vibration and concurrent (aquatic and Whole Body Vibration) Training on Dynamic Balance in Elderly females

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ABSTRACT

Diminished ability to maintain balance may be associated with an increased risk of falling. In older adults, falls commonly lead to injury, loss of independence, associated illness and early death. It has been suggested that the exercise efficiently maintains balance and reducing the risk of falling significantly. The aim of present study was to compare and examine the effects of aquatic, WBV and concurrent training on dynamic balance in elderly females. 40 females with average and standard deviation age of 55.91±2.25yr, weight 73.98±3.18kg and height 155.78±4.29cm who all lived at home and could perform their daily tasks without help participated in this study. They were randomized consecutively into four Groups: the group1 submitted for the aquatic training for the six week and with 3 session per week, consisting of 10 subjects, the group 2 submitted for the Whole Body Vibration Training for the six week and with 3 session per week (WBV Group), consisting of 10 subjects, the group 3 submitted for the aquatic training plus Whole Body Vibration Training for the six week and with 3 session per week (concurrent Group), consisting of 10 subjects and the Control group, consisting of 10 subjects without intervention. Dynamic balance was evaluated in all subjects, before and immediately after completion the exercise period by a physiotherapist who was blinded to the distinct group with using Y-balance Test. A one-way ANOVA and Tukey post-hoc used to analyze the data ($P \leq 0.05$). Results of this study showed that there are significant difference between aquatic, WBV and concurrent training with control group. However, there are not significant differences between aquatic, WBV and concurrent training groups. Due to results, using Aquatic, Whole Body Vibration and concurrent exercises are recommended to decrease likelihood of falling and improve the dynamic balance in elderly females.

Keywords: Aquatic Training, Whole Body Vibration Training, Concurrent Training, Dynamic Balance.

INTRODUCTION

Balance, stability and the prevalence of falls leading to injury are topics of great concern within the older-adult population. One-third of people ages 65 and over fall at least once each year, and falls are the leading cause of death from injury in this age group. Further, approximately 40% of falls that require hospitalization involve hip fractures, and half of these individuals never regain their previous level of functional ability [1].

Several studies have shown that training can improve balance in older persons. Most of these have included multidimensional exercise interventions directed towards strength, flexibility and aerobic capacity [2, 3]. Visual feedback training [4], aerobic dancing [5] and exercise balls [6] can also enhance postural control.

Aquatic exercise has been widely promoted as the optimal type of exercise for older people as it reduces weight-bearing stresses on the skeletal joints and provides therapeutic benefits for orthopedic conditions [7, 8]. In addition, aquatic exercise benefits are in agreement with current recommendations stating that aerobic power, muscle strength, and body flexibility are important factors in maintaining functional independence in older people [9, 10]. In a study by Suomi and Koceja, the effect of exercise in water on the amount of postural swing in women affected by lower limbs arthritis was examined. In group of aquatic training, the area of total swing and size of anterior, interior-external swing was decreased in sightless conditions compared to control group. Based on the findings, these researchers concluded that Women affected by lower limbs arthritis can improve their ability of balance by doing aquatic training [11].

Whole body vibration (WBV) is a mode exercise by which an individual stands on a vibration platform that may be oscillating and therefore creating vertical displacement. WBV, as a relatively recent data of exercise science research, requires further investigation since knowledge of effects and methods to elicit effects in various samples are relatively unknown [12]. To date, most investigations have reported WBV effects in young samples. For example Torvinen et al (2002) showed improvements in postural sway on a sway platform after 4 min of WBV training in young adults [13].

Reviewing the studies of aquatic training and Whole Body Vibration (WBV) training reveals that there is no study which can compare the effects of Aquatic training to WBV training and concurrent effects in the elderly group. With respect to the mentioned topics, the aim of present study was to compare and examine the effects of aquatic, WBV and concurrent training on dynamic balance in elderly females.

MATERIALS AND METHODS

Subjects

40 females with average and standard deviation age of 55.91±2.25yr, weight 73.98±3.18kg and height 155.78±4.29cm who all lived at home and could perform their daily tasks without help participated in this study. Moreover, they were free from any disease of the central nervous system and did not show any orthopedic disorder either of the trunk or the lower limbs The subjects were randomized consecutively into four Groups: the group1 submitted for the aquatic training for the six week and with 3 session per week, consisting of 10 subjects, the group 2 submitted for the Whole Body Vibration Training for the six week and with 3 session per week (WBV Group), consisting of 10 subjects, the group 3 submitted for the aquatic training plus Whole Body Vibration Training for the six week and with 3 session per week (concurrent Group), consisting of 10 subjects and the Control group, consisting of 10 subjects without intervention. All subjects read and signed a term of free informed consent that described the procedures which would be realized during the research**.**

Data collection

Dynamic balance was evaluated in all subjects, before and immediately after completion the exercise period by a physiotherapist who was blinded to the distinct group with using Y-balance Test.

Method of Performing Y-balance Test

In this test 3 directions (anterior, posteromedial, posterolateral) are in a central plate. Angles of these 3 directions are determined according to the instrumented bars, which are fixed in lateral sections of plate in three directions and an indicator is installed on every bar. Before beginning the test, the subjects' better foot is determined, so that if right foot is the better limb, test will be performed in clockwise direction and if left foot is the better limb, test will be performed in anti-clockwise. Subject stands up on the intersection plate of three directions with better foot (only one foot) and as long as he dose not commit any foul (foot does not move beyond the intersection plate of 3 directions, subject does not lean against the foot which performs access activity, or subject does not fall) performs the access activity by movement of indicators and indirection that tester selects randomly, then returns to normal states of two feet, therefore the distance to which indicator was moved by subject is recorded as his reaching distance. Subject does every direction three times and finally the mean of them is calculated and then is divided by foot length (according to cm) and is multiplied by 100 to reach the reaching distance in term of percent of foot length [14].

Training protocol

Aquatic training

The intervention consisted of 6 weeks of Aquatic training. The aquatic training session included adaptation to water medium, two stretches for 30 seconds each, and the main phase or training in water that included eight walking-related practices in various states and three strength practices to fortify walking ability and the strength of the lower limb muscle. The Aquatic training protocol took 30 min per session to complete [15].

Whole body Vibration training

The intervention consisted of 6 weeks of Whole Body Vibration training. The WBV group exercised on a vibration platform (WNQ): squat, deep squat, wide stance squat, toes-stand, toes-stand deep, one-legged squat and lunge. Subjects of WBV group participated in training sessions 3 times a week. The amplitude of the vibration platform was controlled at 0.5mm, while the frequency of the platform was increased in standard with procedures of other WBV studies [16, 17]. The frequency of the vibration platform for the first WBV session in week one was 15 Hz and increased to 25 Hz by the last WBV session in week six (table1). Participants were to maintain the posture as accurately as possible for the duration of the WBV bout. Also, participants were told to hold the handlebars for support if required with instructions not to lean on the handlebars so as not to reduce potential WBV effect. The WBV training protocol took 30 min per session to complete.

Table1: vibration platform frequency for the six weeks of WBV intervention

intervention	week1	Week2	Week3	Week4	Week5	Week6
Set × Frequency	5×15Hz	2×15Hz 3×20Hz	5×20Hz	2×20Hz 3×25Hz	5×25Hz	5×25HZ

Concurrent training

The intervention consisted of 6 weeks of combination of Aquatic and Whole Body Vibration training. Subjects of this group did a combination of training of previous two groups. The concurrent training protocol took 30 min per session to complete.

Statistical Analyses

Standard descriptive statistics were used to report means and standard deviation for baseline characteristics ($P \leq 0.05$). An ANOVA statistical test and Tukey post-hoc used to analyze the data. All data was analyzed by using SPSS for windows software version 16.0(SPSS Inc, Chicago, IL).

RESULTS

Table 2 shows the personal characteristics of the subjects in four exercise groups. Results of analysis of one way variance showed no significant difference between four groups in variables of height, weight, age and foot length, which indicate the homogeneity of four groups in personal characteristics.

Table2: Descriptive statistics of subjects' personal characteristics in four groups

group	N	Age(years)	Height(cm)	Weight(kg)
Aquatic training	10	56 ± (3/80)	155/85 ± (3/33)	74/07 ± (4/46)
WBV training	10	56/25 ± (3/13)	155/18 ± (5/25)	74/63 ± (5/55)
Concurrent training	10	56/41 ± (4/18)	155/92 ± (4/14)	73/5 ± (6/5)
Control	10	54/41 ± (3/75)	155/42 ± (4/87)	72/83 ± (3/43)

In order to compare the subjects of four groups in pre-test of Y-test, analysis of one way variance was used in 3 directions. Results did not show any significant difference in reaching distance between four groups in all directions (Table 3). But, results of analysis of one way variance, in post-test, show significant difference in reaching distance in 3 directions of Y-test between four groups. Also, results of tukey test showed that there are significant difference between aquatic, WBV and concurrent training with control group. However, there are not significant differences between aquatic, WBV and concurrent training groups (Table 3).

Table 3: Mean and standard deviation of reaching distance (centimeter divided by foot length multiply by 100) of subjects of four groups before and after applying exercise programs

groups	directions	Anterior	Posteromedial	Posterolateral
Aquatic training	Pre	50.95±2.54	61.07±2.90	58.30±2.68
	Post	58.92±2.64	67.91±3.01	63.90±2.51
WBV training	Pre	50.41±1.75	61.09±2.07	57.91±2
	Post	59±2.22	67.54±2.02	64.92±2.32
Concurrent training	Pre	51.02±1.66	60.58±2.16	58.33±2.37
	Post	59.24±1.79	68.42±2.01	64.53±2.41
control	Pre	51.22±2.19	61.41±2.44	58.41±2.50
	Post	51.2±1.70	60.81±2.56	58.5±2.38

DISCUSSION

The aim of present study was to compare and examine the effects of aquatic, WBV and concurrent training on dynamic balance in elderly females. Dynamic balance of the elderly females improved after six weeks Aquatic, WBV and concurrent exercise. The results of present research are in accordance with the findings of Soumi and Koceja [11], Douris et al [18] and

Resende et al [19] and indicate of the significant effect of aquatic training on improving the performance. Rissel [20] believed that improvement in control of body position is the result of this fact that water allows people to do great range of movements without increasing the risk of falling or being injured. Ruoti [21] believes that protective medium of water allows aged people to maintain a straight and flat posture independently. Also, existence of the forces which destroy the stability and balance provides a suitable medium for balance activities and for challenging the involved systems. Also, due to the increase in reaction time, these training are suitable for people with defect in balance, because due to the viscosity property of water, movements are performed slowly and so people have more time to create response and reaction. Combination of frequency and speed of movements may cause to increase in strength and improvement of flexibility reaction time [22]. Also exercise in water, places more pressure on neuromuscular systems to maintain balance, so during performing these training, people need dynamic balance. In conclusion, protocol of exercise in water is a special exercise to improve the balance in elderly people.

Also, dynamic balance of the elderly females improved after six weeks WBV exercise. These findings are similar to findings of Bosco et al 1999[23]; Torvinen et al 2002[13]; Rittwegar et al 2003[24]. Unlike from present study, those studies recruited young adults of varying athletic ability. Findings from this study, therefore. Suggested that WBV can be a useful tool to beneficially affect dynamic balance and decreased of fall risk in another population, specifically, older adult population. One possible explanation for the observed balance improvements was, increased synchronous motor unit recruitment. WBV increased muscular fatigue quantifiers (RPE and blood lactate levels) [24]. Such process caused enhanced neuromuscular excitability and greater motor unit recruitment [13]. Furthermore, the synchronous activity of synergist muscles of the lower limbs or increased inhibition of the antagonistic muscles caused by the activation of the stretch reflex may also explain the observed findings [13]. Also, the improvement in muscular strength [17, 23], after WBV training and the extensive stimulation of the proprioceptive pathways might be partly responsible for the improvement in dynamic balance found in the present study.

Also, dynamic balance of the elderly females improved after six weeks concurrent exercise. Reviewing the studies reveals that there is no study which can identify the effects of concurrent (Aquatic plus WBV training) effects in the elderly group. In addition possible explanations for improvement of dynamic balance following of Aquatic and WBV training, Concurrent exercise, because it has some variety for the subject, can use for increase in dynamic balance in elderly females.

Due to results, using Aquatic, Whole Body Vibration and concurrent exercises are recommended to decrease likelihood of falling and improve the dynamic balance in elderly females.

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