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EFFECT OF HYDROTHERAPY ON LOWER BODY STRENGTH AND BALANCE AMONG ELDERLY WOMEN

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ABSTRACT

Falling is one of the most epidemic problems related to aging process. To prevent falls, the preventive strategies including appropriate physical activity programs can be effective in falling prevention. The purpose of this study was to investigate the effect of hydrotherapy on lower body strength and balance among elderly women. Thirty-six elderly people were randomly divided into two groups including experimental and control groups. Experimental group participated in an aquatic exercise program that consisted of 40-minute sessions twice a week for 12 weeks while control group had no plan of exercise. Statistical analysis using t-test was used to analyze the data ($p<0.05$). Hydrotherapy training diminished total Fat mass (FM) compared with control group. Likewise, increased total fat free mass (FFM) was found in experimental group compared with control group. It was also suggested that static, dynamic balance and lower body strength were significantly improved after the exercise intervention. It was concluded that water-based exercises can be used as an important preventive strategy to improve effective factors of balance in elderly.
Keywords: *Aquatic exercise, balance, elderly, elderly people.*

1. INTRODUCTION

There have always been some important challenges related to health conditions in the older population including how to increase physical fitness, life expectancy. Nowadays, Falls is a major public health problem among elderly people as they can cause the irreversible health, social, physical and psychological consequences, and a large healthcare costs (Alikhajeh, Hosseini, & Moghaddam, 2012). Postural instability caused by visual deficits, Muscle weakness, psychotropic drugs,

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sensory- motor impairments, orthopedic constraints, is one of the main factors that limit older individuals' daily activities and lead to falling in the elderly, thereby making older adults more dependent (Gananca, Gazzola, Aratani, Perracini, Ganança, 2006; Taheri, Taheri, & Irandoust, 2014; Perracini, & Ramos 2002; Fried, Tangen, Walston, Newman, Hirsch, Gottdiener, …. &, McBurnie, 2001; Foldvari, Clark, Laviolette, Bernstein, Kaliton, Castaneda, …., & Singh, 2000).

It has been reported in a study that elderly women have a higher possibility for falls because of less lean body mass and muscle strength (Foldvari, *et al.*, 2000). A number of studies, however, have shown that with ageing both sensory inputs and motor outputs diminish leading to alterations in the strategies used in postural control (Hess, & Woollacott, 2005). Some examples of reduced motor function with ageing include decreased muscular strength and an alteration in the coordination of agonist/antagonist muscle activation patterns. There are some limiting factors such as arthritic diseases, pain, muscle weakness, obesity which make it difficult for elderly people to perform exercises on the ground while the situation is completely different in an aquatic environment due to joint overload reduction and consequently less risk of falls during the exercises (Booth, 2004). Although it seems that aquatic exercise may be an appropriate intervention for elderly persons, little is known about its effect to improve body composition such as fat free mass, percent body fat, muscle mass in older adults engaging regularly in these activities. Providing aged people with healthcare services in order to overcome their possible disabilities is of utmost important, therefore, intervening the effective strategies for improving the quality of life in the elderly must be taken into consideration. Since the improvement in static, dynamic balance and lower extremities strength are effective in balance maintenance in aged people's, so we investigated the effect of hydrotherapy on lower body strength and balance among elderly women. The aim of this research was to study the effect of hydrotherapy exercises on static, dynamic balance and lower Body Strength in the elderly women.

2. METHODS AND MATERIALS

2.1 Sample

Thirty-six healthy aged women were recruited from the health clinic of Dr. Irandoust in Qazvin. The research procedure was given to each subject; after acceptance, written consent was obtained. Eligibility criteria for the study included (a) older than 65 years; (b) walking independency; (c) lack of musculoskeletal disorders, cardiovascular disease, pulmonary impairments; (d)

lack of cognitive impairments; and (e) physical ability to participate in the exercise program.

2.2 Measurements

2.2.1. Timed Chair-Stand Test

Body strength of legs was measured with the Timed Chair-Stand Test (Toraman, & Ayceman, 2005). The subjects sat as far back as possible in the chair and then stood up from a seated position with arms folded across their chests as many times as possible within 30 seconds. Their scores were the number of times they stood up and sat down within 30 seconds. The mean score of two repetitions was calculated in frequencies. In the study by Jones et al. (1999), test-retest intraclass correlations (ICCs) of 0.84 for men and 0.92 for women indicate that the 30-second chair stand has good stability reliability (Jones, Rikli, & Beam, 1999). In this study, the ICC was 0.98.

2.2.2. The Timed Up and Down Stair Test

This Test is designed to measure dynamic balance (Leroux, 2005). Using an 8-in. high stair, the elders step on and off seven times at their naturally preferred comfortable pace. They step up with one foot and then the other and step down with one foot followed by the other foot. One time includes both ascending and descending the stair. The mean of two repetitions was calculated in seconds. In the study by McCarthy and Oldham (2004), the stair test had intra tester reliability with a high ICC statistic of 0.98 (McCarthy, & Oldham, 2004). In this study, interrater reliability was 0.97.

2.2.3. Stork Test

This test is designed to measure static balance. The elders lift one foot up without touching it to the support leg. The elders kept their eyes open during the test. The mean number of seconds of two repetitions on each leg was calculated. In a study by Gioretti, Harris, & Jette, (1998), the reliability coefficient was 0.75 for one-leg standing. In this study, the ICC was 0.93.

2.3 Procedure

Experimental group participated in an aquatic exercise program that consisted of 40-minute sessions twice a week for 12 weeks while control group had no plan of exercise.

Each exercise session included three parts: water adaptation phase, stretching phase and a phase of static and dynamic exercises for balance. The intensity of exercise was intervened from low to moderate, around 60% of maximum Heart Rate (controlled by Polar Electro, Kempele, Finland). The maximum HR was calculated using Cooper's formula (220 – age). An exercise therapist supervised all the exercise classes. The static and dynamic balance were respectively measured by stork and the timed up and down stair tests before and after exercise. Pre-test and post-test of Body composition variables (BMI, PBF, FM and FFM) were measured by ZENUS 9.9 PLUS Body Composition Analyzer.

2.3 Statistical Analysis

The analysis of data was done by SPSS v.20 software. The *t*-test was used to analyze the data ($p<0.05$). All variables were expressed as Mean ±SD and values less than 0.05 were considered statistically significant.

3. RESULTS

Table 1: Effects of hydrotherapy on body composition

Variable	Experimental Group M±SD		Control Group M±SD		Sig.
	Pre-test	Post-test	Pre-test	Post-test	
Age (yr)	71.2 ±4.7		71.8±3.9		-
Height (cm)	156.2 ± 5.5		156.1± 5.4		-
Weight (kg)	59.7 ± 4.9	57.7 ± 5.3	58.9 ± 5.5	58.8 ± 5.1	0.001*
Total FM	20.7	19.2	20.6	20.5	0.011*
Total FFM	46.6	47.4	46.5	46.7	0.009*

Abbreviations: BMI, body mass index; PBF, percent body fat; FM, fat mass; FFM, fat free mass.
*Significant difference between experimental and control groups

With regard to body composition, Aquatic Group diminished total FM compared with control group (p = 0.011). Likewise, increased total FFM was found in experimental group compared with control group (p = 0.009) (see table 1).

Table 2: Comparison of lower body strength and balance between the experimental and control groups at 12 weeks of intervention

Variables	Experimental group M±SD		Control Group M±SD		*t*
	Pre-test	Post-test	Pre-test	Post-test	
Lower Body Strength (Frequencies)	7.49±0.87	11±1.02	7.3±0.74	6.90±0.66	14.49*
Static Balance (S)	5.8±0.84	7.8±0.91	4.0±0.98	4.1±0.82	3.61*
Dynamic Balance (S)	17.2±5.2	12.6±2.4	15.31±2.6	15.2±2.2	-3.27*

* Significant at $p \leq 0.05$

Results are reported in Tables 2. As seen, all variables including lower body strength, static and dynamic balance were significantly improved after hydrotherapy training.

Figure 1: The effect of hydrotherapy exercise on lower body strength

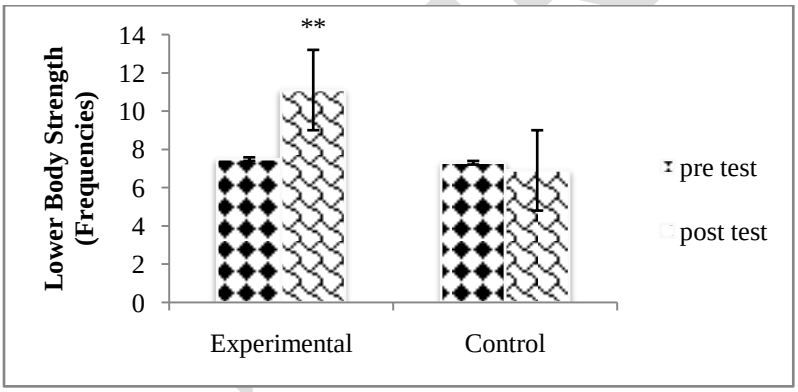


Figure 2: The effect of hydrotherapy exercise on static balance

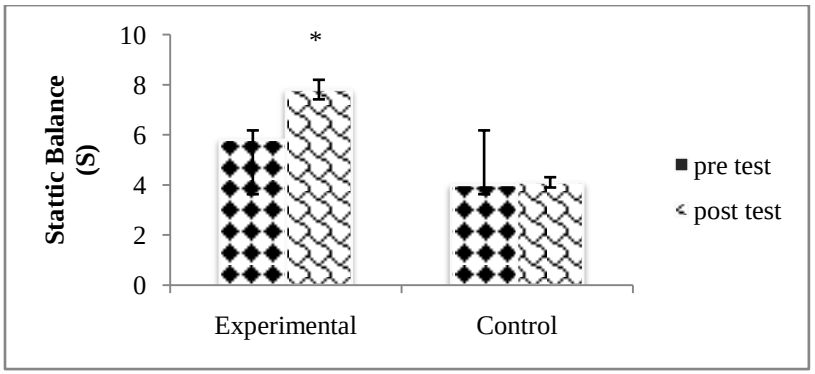
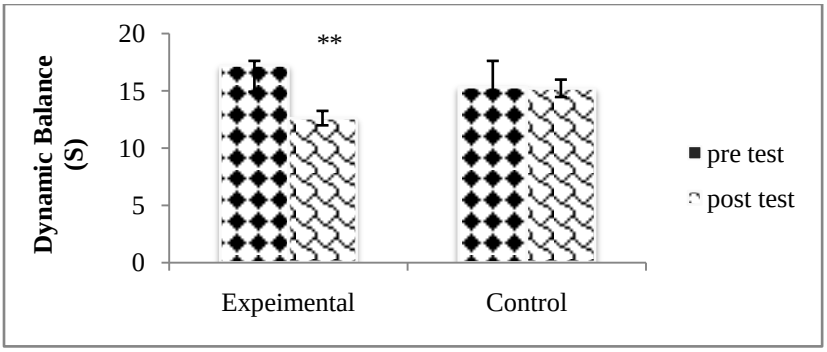


Figure 3: The effect of hydrotherapy exercise on dynamic balance



4. DISCUSSION

The aim of this study was to investigate whether a hydrotherapy program would be capable of improving older adults' static, dynamic balance and lower body strength in elderly women. We observed a significant improvement in the static, dynamic balance and lower body strength of the older adults who did the hydrotherapy exercises. Some studies suggested that aquatic exercises improved the balance and reduced the risk of falls among older people (Lund, Weile, Christensen, Rostock, Downey, Bartels, Danneskiold-Samsøe, & Bliddal, 2008; Lord, Matters, St Georges, Thomas, Bindon, Chan, Collings, & Haren, 2006). It was shown in this study that Total Fat mass were decreased significantly, while Fat Free Mass was increased significantly after aquatic intervention that is consistent with the previous studies (Bergamin, Ermolao, Tolomio, Berton, Sergi, Zaccaria, 2013). The optimal change of body composition as shown would assist the balance improvement of elderly (Bergamin, *et al.*, 2013). In other words, Simultaneous improvement in balance and lower body strength can be attributed to decreased fat mass and increased fat free mass of subjects in experimental group, likewise the improved neuromuscular coordination can be effective in this result. This result emphasizes the role of muscle strength, suggesting the hypothesis of a correlation between leg muscle density, muscle strength, and balance, as previously suggested by MacIntyre, Rombough, & Brouwer (2010). Although fall risk was not measured in this study, increases in movement efficiency as measured by lower body strength, static and dynamic tests, implies increased physical fitness of the elderly women which can be effective in fall prevention. The positive effect of physical exercise on improvement of static and dynamic balance in older adults has been reported by Ikezoe, Tsutou, Asakawa, and Tsuboyama, (2005) which is consistent with our study. The effect of hydrotherapy exercises on elderly performance depends on different factors namely the increase in strength of subjects' lower limbs, creating neuro-muscular

Conformity due to exercise and the amount of pressure resulted from the effect of exercise on performance (Hosseini, 2011). In explaining the effects of aquatic training on balance, it can be noted that exercise in water, places more pressure on neuromuscular systems to maintain balance. A novel approach of this manuscript is based on considering the effective factors in fall prevention of the elderly women, which focus on some selected exercise protocol for increasing lower body strength, balance.

5. CONCLUSIONS

Conclusively, the findings from this study have implications for health promotion strategies in healthy elders and suggest the need to develop fall prevention programs using hydrotherapy in the community setting so that health cost can be decreased and quality of life in older people can be improved.

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