Biological Forum – An International Journal **7**(2): 18-21(2015)

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Effect of Eight-week Exercise in Water on Static and Dynamic Balance, Gait Parameters and Lower Extremity Strength among Elderly Women between 60 and 72 years old

Mirzaeian Elham, Kazemzadeh Yaser and Sokhanguei Yahya
Department of Physical Education and Sport Sciences,
Islamshahr Branch, Islamic Azad University, Tehran, IRAN

(Corresponding author: Kazemzadeh Yaser)
(Received 30 May, 2015, Accepted 02 July, 2015)
(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: The present study aimed to evaluate the effect of eight-week exercise in water on balance, lower extremity strength among elderly women. This was a quasi-experimental study with pretest-posttest in both control and experimental groups. The statistical population consisted of healthy elderly women in a geriatric center in Khorramabad City. In this study, 30 disabled elderly women between 60 and 72 years old were selected using a convenience sampling method and were randomly assigned to two homogeneous experimental and control groups. Prior to the exercise protocol, static and dynamic balance as well as lower extremity strength of the participants were measured and evaluated using standing stork test, timed get up and go test and 30-second chair stand test. The experimental group performed aqueous exercises (including balance and strength exercises) for eight weeks (three sessions per week). The control group did not perform any exercise during the study. Finally, the participants were retested to evaluate static and dynamic balance as well as lower extremity strength after the exercise protocol. Pre-test and post-test data was analyzed in the experimental group after eight weeks of training. Then, experimental and control groups were compared using the t-test for both dependent and independent groups. The results showed that eight-week exercise in the water significantly increased static balance up to 28%, dynamic balance up to 10%, and lower extremity strength up to 37%, step length up to 19% and step width up to 13% among the elderly women. The results showed that exercise in water as an environment with disruptive balance due to low risk nature provides the context for challenging both balance and muscular systems. Exercise in water is also an effective method in improving balance and lower extremity strength as well as preventing falls among the elderly.

Keywords: Balance, Elderly, Exercise in water, Strength, Women

INTRODUCTION

Elderly refers to age-related biological overall changes over time, which is not due to environmental factors or disease. Elderly is irreversible and inevitable (Nagy *et al.*, 2007). Balance control requires participation in the three areas of information processing by visual senses, atrial senses vestibular senses and sensory body system, central integration of the brain and motor response. Thus, any failure in the system can put the individual at the risk of falling down. Decreased balance (imbalance) is due to inactivity and severe reduction in muscular strength. Studies have reported that physical activity can improve posture control and reduce falls (Hughes and Frontera 2001).

In another study, the scholars showed that muscular weakness in the hip abductors, extensors and knee flexors and dorsey flexion at ankle are associated with the risk of falls. In addition, the strength or the ability to build muscle is effective in establishing balance. As the individual grows older, he will be less physically active and less affected by various diseases. Thereby, he will walk with less speed and mobility, which will increase the risk of falls and disrupt daily activities (Nashner, 1993). Doris *et al.* (2003) also compared the effect of exercise in land and water on balance in the elderly after a six-week exercise period and found no significant difference between the two groups. On the other hand, creating a safe and yet effective environment is challenging in development of the training exercises improving balance and muscular strength in the elderly. Some other studies have also noted that physical activity in water is useful for the elderly (Alirezai, 2007). Ruoti *et al.* (1997) stated that water has a supportive role and helps the individual to independently maintain his vertical and upright posture. Water increases stimulation of afferent neurons or sensory, which stimulates the muscles easily and freely, so that the individual may be no longer afraid of moving. In addition, exercise in water has major physiological and motor impacts, which have important role in preserving and improving range of joint motion as well as reducing muscular tension and relaxation. Exercise in water is used to either improve rehabilitation or prevent functional changes. In recent years, exercise in water was increasingly used to improve fitness and rehabilitation among the elderly.

Rasendi *et al.* (2008) examined the effect of one-period exercise in water on balance and prevention of falls in elderly women. A significant increase was reported in score of balance and reducing the risk of falls among the elderly (Resende and Rassi 2008). Although exercise in water is accepted as an inexpensive, accessible and low risk workout which maintains health and mobility and prevents falls in the elderly, the benefits of different types of exercise in terms of different physiological systems are not explored yet, particularly exercise in the water in those systems involved in balance. Such physical exercises and activities as strength training, tai chi, and balance yoga are cited as conventional training methods to resolve these problems among the elderly.

However, these types of trainings have several limitations due to physiological problems in process of aging, especially in those elderly people suffering from other diseases, such as arthritis and motor disabilities. Water environment is significantly suitable in terms of safety because water prevent of falls in those people with limitations in joint motion as well as elderly individuals, veterans and disabled individuals with difficulties due to reduced physical and mental abilities (Sohbatiha *et al.,* 2011). The movements performed with difficulty by middle aged and elderly individuals are performed easily in water. The elderly individuals can move more easily and less intensely in water than on dry land (Rezmovitz *et al.,* 2003). Hence, exercise in water and health values have been welcomed among the elderly population. Water provides resistance to the movement in order to control changes in speed of movement and retraining the muscles (Cromwell *et al.,* 2007).

Following issues encouraged further studies on the elderly individuals prone to falling and disability: lack of accurate standards for evaluation of elderly people prone to falling, no studies on changes in gait and muscular strength in this group of people as a result of aging, immobility, the impact of diseases, as well as the relationship of strength with speed and mobility and confounding results. Walking is an important component of an independent life; however, elderly individuals often suffer from falls and injuries. According to the above-mentioned materials, the present study examined the effects of eight-week exercise in water on static and dynamic balance as well as gait parameters and lower extremity strength among elderly women in a geriatric center in Khorramabad City.

MATERIALS AND METHODS

This was a quasi-experimental study with pretest and posttest in two experimental and control groups. The effects of eight-week exercise in water on balance and lower extremity strength among elderly women were evaluated. The statistical population consisted of 30 healthy elderly women in a geriatric center in Khorramabad City. Descriptive and inferential statistical methods were used to analyze the data. Descriptive statistics was used to calculate the mean and standard deviation of age, height and weight of the participants. Normal distribution of data was tested using Kolmogorov-Smirnov test and homogeneity of variances was examined with Levine test. The t-test for independent and dependent groups was used to determine the difference between the pre-test and post-test in both experimental and control groups. All statistical operations were performed using SPSS (version 20).

RESULTS

The participants were disabled elderly individuals from 60 to 72 years old. They were selected using a convenience sampling method and were randomly assigned to two homogenous experimental and control groups. The participants were divided into two homogeneous groups consisting of 15 individuals (control and experimental). The experimental group performed their exercises in water for eight weeks, for three sessions per week (24 sessions in total). Each session lasted an hour. During the study, the control group only performed their daily activities.

Table 1: Steps to exercise protocol in water.

The first stage (15 minutes warm-up)	The second stage (30 minutes exercise)	The third stage (15 minutes cooling)
Stretching in water	Transferring the weight from front to back	Stretching in water
Walking forward	Rotating around a square	Floating exercises, stretching and deep breathing
Walking backward	Standing on one leg	
Waking sideways	Transferring the weight from one side to the other side	
Walking on heal and toe	Step sideways	
Jogging in water	Scot	
	Receding hamstring	
	Opening the thigh	
	Trading water	
	Pendulum movements of hands and legs	

Descriptive and inferential statistical methods were used to analyze the data. Descriptive statistics was used to calculate the mean and standard deviation of age, height and weight of the participants. Normal distribution of data was tested using Kolmogorov-Smirnov test and homogeneity of variances was examined with Levine test. The t-test for independent and dependent groups was used to determine the difference between the pre-test and post-test in both experimental and control groups. All statistical operations were performed using SPSS (version 20).

Table 2: Descriptive characteristic of subjects.

Variable	Group	Mean	SD	t	P value
Age (year)	**Control**	64.2	3.7	0.283	0.857
	Experimental	64.5	4.3		
Height (cm)	**Control**	165.2	4.6	0.268	0.792
	Experimental	164.5	6.8		
Weight (kg)	**Control**	64.1	4.3	1.17	0.255
	Experimental	66.8	5.8		

As observed in Table 1, no significant difference was observed between the two groups in terms of age, height and weight and the two groups were homogeneous in all the above parameters.

DISCUSSION AND CONCLUSION

The results showed that an eight-week exercise in water significantly improved static balance in the elderly ($p = 0.001$). Due to lack of improvement in static balance in the control group ($p = 0.756$), it might be interpreted that exercise in the water improved static balance in the experimental group. The results also showed that quantitative value of static balance was equal to 3.85 seconds in the experimental group prior to implementation of the selective exercise. After implementation of the exercise protocol on water, the static balance was increased to 4.93 seconds. As a result, the static balance increased 28%. Thereby, the difference in static balance was significant between the control and experimental groups. The results showed that an eight-week exercise in water significantly increased dynamic balance in the elderly ($p = 0.006$). Due to the lack of improvement in dynamic balance in the control group ($p = 0.878$), it can be interpreted that exercise in water improved the dynamic balance in the experimental group. The results showed that quantitative value of dynamic balance in the experimental group was 12.01 seconds prior to implementation of the selective exercise. After implementation of the exercise protocol in water, dynamic balance increased to 10.83 seconds. Thereby, dynamic balance increased 10%. As a result, the difference in dynamic balance was significant between the control and experimental groups. Proprioception is vital in balance control.

The results showed that eight-week exercise in water significantly improved lower extremity strength in the elderly ($p = 0.0001$). Due to lack of improvement in lower extremity strength in the control group ($p = 0.469$), it can be interpreted that exercise in water improved strength in the experimental group. Implementation of the exercise protocol in the water significantly increased lower extremity strength up to 37% in the experimental group in the elderly. The findings confirmed the importance of physical activity in water in improving lower extremity strength in the individuals with no history of regular sport activities. Lower extremity muscular strength and balance are important gait parameters, which effectively prevent frequent falls in the elderly (Shumway-Cook *et al.,* 1997). Since muscles of the lower extremity (quadriceps muscles and hamstring) play a major role in static and dynamic balance and due to weak and reduced muscular strength in elderly, specific strength training methods can strengthen lower extremity muscles and minimize the above-mentioned problems (Buchner and Delateur 1999, Thomai and Athanasia 2006, Dong-Koog *et al.,* 2008).

The results also showed that step length significantly increased in elderly women who performed exercise in water for eight weeks compared to those who did no exercise. Increased muscular strength during taking a step increases the force needed during taking the step. As a result, the step length increases.

The results also showed a significant increase in step width among elderly women who participated in training in water for eight weeks. The present study aimed to investigate the effect of eight-week exercise in water on balance and gait parameters as well as lower extremity strength among elderly. The results showed an improvement in balance and an increased in balance during walking and an increase in muscular strength. Due to the lack of improvement in balance, balance during walking and lower extremity muscle strength in the control groups, it can be interpreted that exercise in water significantly increased balance, balance during walking and muscular strength in the experimental group. In addition, the results showed that compound exercises emphasize on involvement of multiple senses in balance and lower extremity strength. Thereby, compound exercises more effectively improve balance and lower extremity strength than exercises with solely involvement of balance, flexibility, aerobic, etc. (Zameni and Haghighi 2011, Sadeghi *et al.,* 2001).).

Thereby, exercise in water as an environment with disruptive balance due to low-risk nature can provide the context for challenging both balance and muscular systems and is an effective method to improve balance and lower extremity strength as well as preventing falls among the elderly.

REFERENCES

Alirezai F. (2007). The effect of a water exercise program on static and dynamic balance in elder women. [MSc Thesis].Tarbiat Moallem University, 2007.

Buchner DM, Delateur BJ. (1999). The importance of skeletal muscle strength to physical function in older adults. *Annals of Behav Med.* **13**: 1-12.

Cromwell RL, Meyers PM, Meyers PE, Newton RA. (2007). Tae Kwon Do: an effective exercise for improving balance and walking ability in older adults. *J Gerontol A Biol Sci Med Sci.* **62**(6): 641-6.

Dong-Koog N, Jae-Young Lim, Hyung-Ik S, Nam-Jong P. (2008). The effect of aquatic therapy on postural balance and muscle strength in stroke survivors. *Clinical Rehabilitation*. **22**: 966-976.

Douris P, Southard V, Varga C, Schauss W, Gennaro C, Reiss A. (2003). The effect of land and aquatic exercise on balance scores in older adults. *Journal of Geriatric Physical Therapy*. **26**: 3-6.

Hughes V, Frontera W. (2001). Longitudinal muscle strength changes in older adults: influence of muscle mass, physical activity, and health. *J Gerontol A Biol Sei Med.* **56**(5): 209-17.

Nashner LM. (1993). Practical biomechanics and physiology of balance. In: Jacobson G, Newman C, Kartush J. (1993). Handbook of Balance Function and Testing. Mosby Year Book; St Louis, MO. **6**: 261-279

Nagy E, Kiss AF, Barnai M. (2007). Postural control in elderly subjects participating in balance training. *Eur J Appl Physiol.* **100**: 97-104.

Ruoti R, Morrise D, Cole A. (1997). Aquatic Rehabilitation. Philadelphia. Pa: *Lipincutt.* 118.

Resende SM, Rassi CM. (2008). Effects of hydrotherapy in balance and prevention of falls among elderly women. *Revista Brasileira de Fisioterapia*. **12**: 57-63.

Rezmovitz J, Taunton JE, Rhodes E, Zumbo B. (2003). The effects of a lower body resistance-training program on static balance and well-being in older adult women. *BCMJ*. **45**(9): 449-55.

Sadeghi H, Prince F, Zabjec KF, Allard P. (2001). Sagittal hip muscle power during walking in old and young men. *J Aging and Physical Activity*. **9**: 172-183.

Sohbatiha M, Aslankhani MA, Farsi A. (2011). The effect of aquatic and land-based exercises on static and dynamic balance of healthy male older people. Salmand, *Iranian Journal of Ageing*. **6**(20): 54-63. [In Persian].

Shumway-Cook A, Gruber W, Baldwin M, Liao S. (1997). The effect of multidimensional exercises on balance, mobility, and fall risk in community-dwelling older adults. *PHYS THER.* **14**: 7746-57.

Thomai T. Athanasia B. (2006). The effecta of a twenty-four-week aquatic training program on muscular strength performance in healthy elderly women. *Journal of Strength and Conditioning Research.* **20**(4): 811-18.

Zameni Leila, Haghighi M. (2011). The effect of equality exercise on pain and postural control in women with low back pain. *International Journal of Sport Studies.* **1**(4): 153-157.