

The Effect of Aquatic and Mental Trainings on Balance in Elderly Males

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Abstract: The aim of this research was to investigate the effect of aquatic and mental trainings on balance in elderly males. For this purpose, 120 men were selected from among healthy aged men who were in Zanjan province and then classified in 4 groups of balance aquatic training (n=30), mental training (n=30), concurrent (aquatic and mental training) (n=30) and a control group (n=30) randomly. In order to estimate subjects' balance, Y-Test was used in three directions. Result showed that there was significant difference in reaching distance between 4 groups, after applying training programs, which in three directions of Y-Test there was significant difference between aquatic training groups, mental training and concurrent ones and control group. Also, the highest increase in reaching distance after applying exercise belongs to concurrent training. In conclusion, it was proposed that in order to improve the balance in society of aged people, with considering specific conditions, all of three mentioned exercise programs are used.

Key words: Balance • Aquatic training • Mental training • Elderly males

INTRODUCTION

Observing principles of health and immunity has led to the increase in average lifespan, so 17% of the world's population in 2006 was aged people. It is predicted that this figure would increase to 25% in 2030 (SCB 2006). Aged people as senior citizens of society should enjoy deserved physical, psychological and social health, so prevention and overcoming on aged people's disabilities, understanding their hard problems and examining the effective factors on improving life quality are important things.

Main components of daily physical activities and exercise movements can be divided into two sections of maintaining balance for keeping body position and spatial navigation and interaction between anatomic components for movement [1]. Since balance maintenance is considered one of the indices determining aged people's independence, so examining and identifying the effective factors on balance changes to increase independence background in movement, to improve the immunity of components of daily physical activities and exercise movement and to prevent injuries resulted from falling are examinable topic that researchers are interested in [2]. Balance, as one of the argumentative concepts of sense-

movement system examines the complex interaction between sensors inputs and necessary movement responses required to maintain or change the position [3]. As regards the aim of study, position control was examined in three aspects of neurophysiology, biomechanics and performance. Neurophysiologic and biomechanics aspects consider different levels of mechanism of balance control and the ability of maintaining or returning the centre of gravity in steadiness domain, respectively. From performance point of view, balance has been divided into three dynamic, semi- dynamic and static domains; different methods such as performance test of star excursion balance test (SEBT) and Y-test, leaf balance scale and Tinetti scale and biodex plant and force plate have been used to evaluate it [4, 5].

Hydrotherapy has long been used as a method to care rheumatic, orthopedic and neuron -al diseases, but only recently scientists have been interested in it. Physical nature of water as well as training can realize many of the bodily aims which were assumed in rehabilitation programs [6]. With respect to this fact that symptoms like pain, balance drop, atrophy, fitness, diseases of rheumatism and disorders of gait among aged people make difficult doing training on the ground for them and moreover because of water's unique nature like

floatation, cohesion and hydrostatic pressure; so it is considered a perfect medium for increasing self-confidence and decreasing the effect of weight tolerance resulted from gravity, it allows aged people to do exercise in a painless medium, therefore water is a safe and effective medium for aged people's rehabilitation [7]. Recent studies have reported multiple health advantages, so aged people can obtain them by doing aquatic training. These advantages include increase in the maximum consumption oxygen, decrease in the blood lipids, increase in muscular strength and resistance, improvement of flexibility, decrease in posture swing and increase in reaching distance and independence of daily affairs. Also some studies have examined the effect of aquatic training on aged people's balance and move ability. In a study, Brawa *et al.* [8] have examined the effect of an exercise program in water on density of bones' mineral. Results of this study showed that intervention program had a positive effect on improving psychological status, but there was no increase in bone density [8]. One of the limitations of this study was the lack of control group. Results showed that exercise group on the ground obtained significant improvement in the amount of reaching distance forward during first week, but there was no improvement afterwards. In contrast, exercise group in water showed significant improvement in the point of performance reaching distance during first two intervention weeks and then between fourth and fifth weeks. By fifth intervention week, exercise group in water was able to present more reaching distance than any other groups [10].

In a study by Suomi and Kocaja [11], 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]. In a study by Douris *et al.* [12], an intervention program of aquatic training was directly conducted along with an intervention program of ground exercise in order to determine which one is better for balance. Results showed that whether exercise was performed in water or on the ground, there was significant improvement in balance.

In a recent study by Resende *et al.* [13] the effect of an intervention hydrotherapeutic program on balance and

prevention from falling in women was examined. These researchers reported that hydro-therapeutic program had a significant effect on aged women's balance improvement; also they reported a significant decrease in risk potential of subject's falling.

Mental training is a symbolic exercise, including frequent mental imaginations in absence of any observable main muscular movement, which is done to improve the performance. Researchers' studies have indicate that mental training like physical exercise lead s to developing of people's movement skills, on the other hand these studies have showed that the same neural mechanisms involved in learning with physical exercise, are activated in mental training too. Mental training is a simple, safe and economic method which dose not need any special equipment and facilities, is taught easily and doing it does not lead to any physical tiredness [14]. In opinion of Winberg, particularly in some steps of therapy which doing physical training is impossible or causes tiredness and increases the potential of injury, these training can be replaced by physical training to improve rehabilitation [15]. With respect to study sets have been conducted to date, the effective role of mental training in different aspects have just been proved in rehabilitation and performance improvement, so the improvement and necessity of examining and applying this method is only presented in healthy subjects since 1930. Many studies have been conducted in relation to the effect of mental training on improvement of movement skills, their results indicate that mental training have some effects on enhancing the performance. Studies about the athletes of kayak, tennis and volleyball skills are some of this kind of research [16]. A research with the topic of the effect of mental training on decreasing lordosis and curing backache, it's results indicate of the significant effects of performing a period of mental training on modifying waist abnormalities and decreasing subjects backache [17]. Also, researchers have reported in their study the positive effect of mental training on competitive athlete's movement skills [18]. Guillot and Lebon [19] in their study, which examined the muscular responses during mental imagination, showed the activity of invlved muscles in movement during doing mental training. Many studies have been conducted in relation to the comparison of neural activities involved mental training and physical training. Results of these studies show that in mental and physical training, similar neural structures are involved in control steps, but in performing mental training, output of final movement is not produced [20].

With respect to many advantages of mental training, using them are presented in many domains of sport activities and most of the research has examined the effects of this training on cognitive and movement activities, so the role of this phenomenon in rehabilitation requires more research. Therefore with respect to the low cost of performing mental training in the aged society, some of the exercise problems of this group of society will be solved.

Reviewing the studies of aquatic training and mental training reveals that there is no study which can compare the effects of aquatic training to mental training and their concurrent effects in the aged group. With respect to the mentioned topics, the aim of present study was to comparably examine the effects of aquatic training, mental training and concurrent training on balance in elderly males.

MATERIALS AND METHODS

For this study, 120 men were selected from healthy aged men who were inhabitant in Zanjan province and their health was confirmed based on the evaluation criteria of health (according to the consciousness test and vestibular performance). Then they were randomly classified in 4 groups of $n=30$. Each participant was asked to explain any records of potential joint dislocations and falling completely. Participants who had a record of falling in recent 12 months or suffered from any joint dislocation and were affected by chronic arthritis or dizziness were excluded from the study.

Groups were classified as follows: first group: group of balance aquatic training ($n=30$). Second group: group of mental training ($n=30$). Third group: group of concurrent balance training and mental training ($n=30$), fourth group: the control group ($n=30$). To estimate the balance of subjects, Y-test was used in three directions [21]. As regards group of balance aquatic training, aquatic training were done to increase the subjects' balance for six weeks, three sessions per week and one hour per session according to pervious conducted studies every training session in water was divided into three steps: step of accordance with water medium, step of doing traction movements and step of doing static and dynamic training, to reach balance as regards group of mental training, this group did training for six weeks, three sessions per week, 15 minutes per session. The program of group of training was that all subjects of training group participated in a

suitable and quiet room planned for this reason from 8 to 12 A.m. every subject lay on a soft and suitable bed closed his eyes. Duration of exercise was 15 minutes per session, which first 5 minutes of relaxation training were performed for increase in quietness, simplicity of concentration and subjects' readiness to do the mental training. Mental training was done after asking the subjects about their readiness to begin the program, then exercise activity was continued for 10 minutes in the same laying position with closes eyes the subject's. Mental training was imagining himself in the state of doing pre-test examinations. The subject was trying to imagine that he did this activity more skillfully in every period. For group of concurrent balance aquatic training and mental training, subjects did a combination of training of previous two groups for six weeks and three sessions per week and 1.5 hours per session. After doing the training, all subjects of every four group took post-test by using Y-test. Descriptive statistics was used to describe the subjects' personal characteristic and for determining the significant difference between the effects of three different exercise methods, ANOVA statistical test and Toki test were applied.

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. (Figure1).



Fig. 1: Performance of Y balance test (21)

RESULTS

Table 1 shows the personal characteristics of the subjects in four exercise groups in aquatic, mental, concurrent and control ones. Results of analysis of one way variance showed no significant difference between variables of height, weight, age and foot length, which indicate the homogeneity of four groups in effective personal characteristics.

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 between reaching distance of four groups (Table 2).

With respect to the results of analysis of one-way variance and Toki- following test, significant difference is observed in reaching distance between four groups after applying exercise programs, that in every three direction

Table 1: Descriptive statistics of subjects' personal characteristics in 4 groups and results of their comparisons by analysis of one- way variance

Variable	Group	Mean	Standard deviation	F	P
Age (year)	Aquatic	65.07	14.14	0.647	0.588
	Mental	61.80	1.32		
	concurrent	64.87	14.17		
	Control	63	1.07		
Height (cm)	Aquatic	173.2	3.57	0.691	0.562
	Mental	174.53	3.91		
	concurrent	172.73	3.43		
	Control	173.87	3.72		
Weight (kg)	Aquatic	71.87	3.37	0.514	0.674
	Mental	72.93	3.31		
	concurrent	71.60	3.13		
	Control	72.27	2.74		
Foot length	Aquatic	85.60	2.11	0.35	0.56
	Mental	86.72	2.27		
	concurrent	88.64	3.10		
	Control	84.2	2.80		

Table 2: 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	pre	72/23± 6/43 *	76/54± 3/56 *	73/38± 4/52 *
	post	82/45± 4/53 * †	89/76± 5/64 * †	85/72± 6/28 * †
Mental	pre	70/09± 5/64 *	76/6± 3/09 *	73/47± 7/63 *
	post	80/43± 6/53 * †	90/41± 6/39 * †	86/28± 4/67 * †
Concurrent	pre	69/27± 4/75 *	74/38± 5/87 *	73/57± 7/06 *
	post	84/65± 7/03 * †	91/07± 7/25 * †	89/53± 8/32 * †
Control	pre	71/46± 4/2	77/46± 4/75	75/69± 4/39
	post	70/49± 7/61 †	78/58± 7/83 †	77/32± 6/72 †

*: symbol of significant differences of reaching distance between pre and post in groups

†: symbol of significant differences of reaching distance between groups in post training period

of Y-test there is significant difference between aquatic training, mental and concurrent groups after exercise. In comparison of groups with each other based on the amounts of range, there was difference between reaching distance before and after applying training which presented exact size of the effects of training on balance, it is observed that in every three direction of Y-test the most increase in reaching distance after applying exercise programs belongs to group of concurrent training.

DISCUSSION

The aim of this research was to investigate the effect of balance aquatic training, mental training and concurrent training (aquatic and mental training) on balance in elderly males. The results of present research are in accordance with the findings of Brawu *et al.* [9], Soumi and Kocaja [11], Douris *et al.* [12] and Resende *et al.* [13] and indicate of the significant effect of doing aquatic training on improving the performance. Also the results of the present research are in accordance with the findings of Guillot and Lebon [19] and indicate of significant effects of applying mental training on improving the performance of neuromuscular mechanism.

Potential reasons of increasing balance due to training include the increase in strength of subjects' lower limbs after participating in exercise programs, facilitation in the work of great, quick- contraction movement organs, increase in conformity of muscles, applying pressure on neuromuscular systems and the process of removing disinheriting.

Many studies have been conducted in relation to the neural mechanisms involved in mental and physical training. The results of these studies showed that mental and physical exercise has similar and common neural mechanisms in all steps of movement of control, but the output of final movement is not created during mental exercise. In mental exercise, the imagined movements follow the physical rules, movement control and physiologic and pathophysiologic conditions which are similar to real movement of control and physical exercise. Different studies have confirmed that mental training of neural mechanism cause the involvement of the brain structures which have some roles in cognitive control and movement planning. In other word all steps of control cognitive movement including planning and movement readiness are involved similar to real movement. But in mental exercise, executive phase of movement is inhibited. Reasons of confirming this theory which are based on the existence of neural mechanisms in common with mental and physical exercise are:

Many studies have shown that the time of doing an activity mentally is the same as its real doing. So the similarity of process time of information in mental and real doing activities indicate that mental and real movements are controlled with the similar movement. Also some studies have confirmed that the activity of automatic system during mental training is similar to physical exercise and has similar neural mechanisms. Many of the brain structures which are activated in movement control, readiness and movement planning of physical movements are activated in mental training too. Among these structures we can refer to secondary movement area, pre-movement cortex, elementary movement cortex, cerebellum, rule cores of brain and parietal lobe [22]. Also, several theories have been introduced in relation to the manner of effect of mental training on movement acquisition and progress of movement skills. Among these, we can use neuron-muscular psycho logic theory and symbolic learning theory to explain the development of movement skill and balance keeping in subjects of study. According to neuro- muscular theory, mental training of movement causes the activity potential and little contraction of muscles and movement feedback of this little muscular movement is sent to brain centers and affects the activity of these areas and improves the conformity of neuron-muscular system and causes the movement acquisition [23]. This theory is accordance with Jacobsen's theory that mental activity is the weak form of physical activity.

As a consequence according to this theory we can say that probably mental training causes improvement of neuron- muscular conformity of pro and anti muscles, so enhances the movement strategies and maintains balance [24]. With respect to obtained results we can say that the mental training is a pragmatic and effective method to improve the balance of aged people; we can apply this method to improve the balance keeping and enhance people's movement skills especially in group of aged people.

Rissel [25] 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 [26] 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 [27].

The effect of exercise on performance depends on different factors namely creating neuron- muscular conformity due to exercise, the amount of pressure resulted from the effect of exercise on performance, special effects of exercise on performance and effects of exercise on performance acquisition. In explaining the effects of mental training, concurrent and water training on balance we can use mentioned principles. Since exercise in water, places more pressure on neuron-muscular 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 aged people (because of placing more pressure and creating better neuromuscular conformity.). Also concurrent exercise, because it has some variety for the subject, can use for increase in performance.

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