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**THE IMPACT OF ANAQUATICPHYSICAL BALANCE TRAINING COURSE ON THE
STATIC BALANCE OF NOVICE DAMAGED ATHLETES**

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ABSTRACT

The present semi-experimental study has been done to evaluate the impact of anaquatic physical balance training course, and it has a two-group pretest-posttest design. Sixty volunteers damaged and novice athletes from different sports fields were randomly assigned to two experimental and control groups. Independent t-test was used to determine significant differences between active and passive groups, and dependent t-test was used to determine the difference between pre-test and post-test. Data analysis was performed using software Spss19. The values of $P < 0.05$ were considered significant. All individuals were evaluated at the beginning and end of the period to determine the balance time. The results were analyzed and the exercise group had significant improvements compared with the control group. The results showed that all types of exercise improve the balance. Thus, it can be concluded that aquatic balance training temporarily is a good alternative for physical exercise in individuals, who do not have the ability to perform physical balance exercises due to rest, or any nerve-skeleton damage that these exercises are prohibited.

Keywords: Proprioception sense, balance, static balance, balance training, aquatic environment.

INTRODUCTION

Physical balance of the body is one of the important topics in the human life. Balance is considered as an important element in motion activities (Abernityet al, 2005). Balance can be defined as the ability to keep the gravity center of the body towards the backrest position without fluctuations (Bakhtiari et al, 2013). Controlling balance and body posture in daily life is a complex operation that involves several receiver organs and nerve centers, and it requires mutual receiving and understanding sensory signals in various centers of the brain in an accurate form (Candeloro & Caromano, 2007). Various factors, including musculoskeletal disorders, sensory disorders, and etc. cause disorder and problem in balance and stability of the body in the upright position (Costill, 1971). Each of the primary sensory systems in the human body provides basic information for the central processing system that initially goes to a central processor that provides signals for eye movement and startle reflex (Costill, 1971). In fact, vestibular, visual, and sensory reflexes receptors play an important role in maintaining body balance (Cunningham, 2006). Recent evidence indicates that reducing the balance of the central part of the body can make the body more susceptible to damage and proper exercise can reduce the

injuries. The impact of exercise training on balance has been studied in various studies (Douris et al, 2003). Having high levels of balance in sport activities depends on neuromuscular and mechanical factors (Genuario & Vegso, 1990). Aquatic environment due to having features such as hydrostatic pressure (Guideline, 2001), floatation (Guskiewicz, 1999), adhesion as well as the possibility of increasing sensory feedback (Hoshikawa, 1999), and proprioception sense (Physiology Behave, 1999) can be a suitable environment to do physical exercises to improve balance. Proprioception sense is one of the important body senses that hurt in a variety of soft tissue injuries. Damage to the joint capsule causes malfunctioning in proprioception sense (Kronhed et al, 2001) and consequently, instability of the joint dynamics (Lord et al, 1993). Totally, balancing requires several key components, including muscle strength, visual strength, proprioceptive, vestibular and somatosensory receptors (Malina et al, 2004). These devices must operate to make the body stand, walk, and move without falling. Age is one of the other factors in the balance (Nagy et al, 2007). Therefore, all these factors may play a role in balance results achieved by

individuals by the effect of exercise and they should be considered. In the recent years, aquatic exercise has been added to training programs used by researchers to improve balance in older individuals (Nitz & Choly, 2004), but no similar research has been done on younger athletes. Since, performing many of exercises that are done hardly on land is easier in water, and individuals are able to perform those movements with less intensity, this exercise method has been welcomed in the elderly population (Norasteh et al, 2010). However, the impact of these exercises on the balance of young, athletes, and damaged individuals has been less studied. The purpose of this study, given the effectiveness of exercise programs in water, is determining the impact of an aquatic physical balance training course on the static balance of novice damaged athletes.

RESEARCH METHOD

The semi-experimental study is an applied and prospective research, in which the variables have been evaluated in two experimental and control groups with pre-test and post-test. In this study, 60 women aged between 14 and 35 were selected voluntarily and they were randomly divided into two groups of 30 individuals. All of them had an injury in some lower or upper limbs, and sometimes they had pain in the affected

member, and they were a member of different sports. None of the subjects entering the study had not any problem to participate in the training program and their fitness level was almost similar and none of them was a professional athlete. The research method was explained to volunteers and they completed the consent form in full consciousness.

Training protocol: the training group participated in aquatic training for three consecutive weeks. The content of each training session, which lasted 60 to 70 minutes, respectively was 10 to 15 minute warm-up, 50 minutes regular exercises designed to improve balance and strengthen damaged organs and 5 minutes for cooling. In the considered time for warm up, walk forward, walk backward, walk to the parties were performed. In this way that initially, 8 minutes walking was toward forward and then, alternately, walking forward, backward, and left and right were performed. The main exercises include hip adduction, hip flexion (knee extension), triple flexion of the lower limbs (both hip flexion, knee and ankle), anterior and posterior muscles of the leg (standing or walking on the toe and heel), the stork movements, half sitting squat on one leg, upper body rotation on one foot and hopping with hands to cross the resistance

against the water. The number of exercise repetitions was equal to 60 percent of the maximum average that the subjects could do the desired movement until exhaustion. For this purpose, in the first session of the training, the maximum number that could do the desired movement until exhaustion were obtained by taking a test, and the maximum average of the number of repetitions for all the subjects in the experimental group was considered as the maximum number of repetitions for each movement.

The applied balance screen was a multiple screen with weight radial direction slip. In order to determine the non-dominant leg, the subjects were asked to do three movements with the lower limbs and the organ that was used in at least two, preferably move as the dominant lower limb and the other limb was identified as the non-dominant leg. The three mentioned movements were shooting ball, hopping, going on a wobble board. The initial and final test were taken from all subjects in groups. In order to determine the average balance time in the first test, subjects were allowed to experience this movement experimentally to understand how to work with the device and how to maintain balance. After familiarizing, the athlete was asked to go three times on the screen with the non-dominant foot and try to maintain

balance with closed eyes and folded hands. This balance training method is for more involving in a proprioceptive sense (Roure et al, 1997). The maximum error was 0.04 second. This time was calculated from the moment of separating the dominant leg from the ground until the person put that leg on the ground again or until the edge of the balance screen was distracted from the horizontal level that crashed the earth or the person opened his\her eyes. The average of the obtained three times was calculated, and the result was considered as the first test. The experimental group started their training after the day of the first test. After twenty-one days of training, in the twenty-third day, the final test was conducted the same as the first test. During this period, the control group had no activity in relation to the issue of balance. All individuals in the experimental group were asked to avoid thinking and talking about training and also, doing it apart from the training time in the pool. Given the normal distribution of samples, independent t-test was used to determine significant differences between active and passive groups, and dependent t-test was used to determine the difference between pre-test and post-test. Data analysis was performed using software Spss19. The values of $P < 0.05$ were considered significant.

FINDINGS

Descriptive statistics for age, height, and weight of participants are available in Table 1.

The average and standard deviation of height and weight of the subjects have been presented in Table 1.

As Table 2 suggests, there is a significant difference between the pre-test and post-test in the experimental group, while no significant difference was observed between the pretest and post-test of static balance in the control group.

According to Table 3, there is a significant difference between the post-test results of the control and experimental groups.

As the chart suggests, after doing the mentioned training and running post-test, the static balance average increased from 10.79 to 13.01, but the average time decreased from 10.41 to 10.09 that this reduction may be due to the lack of physical activity and inactivity and the relationship between exercise and the amount of balance time.

Table 1: The average and standard deviation of individual characteristics of subjects

Variable	Group	Standard deviation± Average
Age (year)	Control	25/03± 7/09
Age (year)	Aquatic training	24/63± 6/12
Height (cm)	Control	166/83± 2/85
Height (cm)	Aquatic training	165/33± 3/40
Weight (Kg)	Control	61/90± 6/48
Weight (Kg)	Aquatic training	61/70± 7/70

Table 2: Comparison of the pre-test and post-test values for static balance in both control and experimental groups

Group	Standard deviation± Average of Dependent t			
	pre-test	post-test	(%) Variations	t
Experimental	2/75±10/79	2/43±13/01	-2/21	-10/24
Control	2/61±10/41	2/45±10/09	0/27	-1/72

Table 3: Comparison of post-test for static balance in the experimental and control groups

Variable	Average	Standard deviation	Average	Standard deviation	t
Static balance	10/09	2/45	13/01	2/43	-7/03

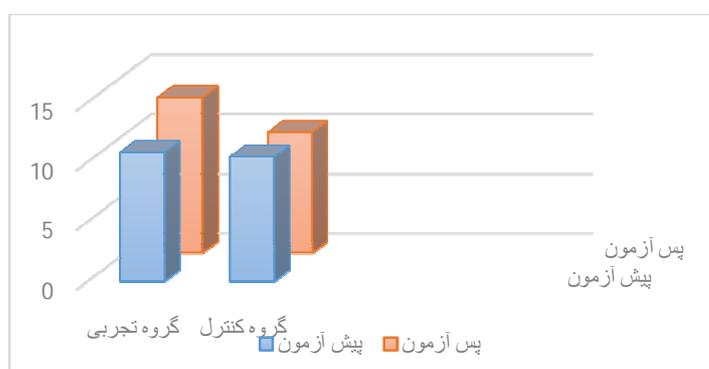


Chart 1: The average of balance time in preliminary and final assessment of the two groups

CONCLUSION

The purpose of the present study was to evaluate the impact of a short-term physical aquatic balance training course on the static balance of a group of novice athletes with minor injuries. In this program, some exercises were used, which could be implemented and repeated by other researchers, and also, the number and frequency of each exercise were designed to suit the individual's ability. This study showed that all types of aquatic exercises affect the balance skills of the subjects and improve them. Doing physical activity causes improvement probably by providing training opportunities and creating challenges for balance mechanism (Ruoti et al, 1997). Destabilizing forces and the water balance provide a suitable environment for balance activities and challenging systems involved in balance. Also, due to increasing the reaction time, these exercises are suitable for damaged athletes, because movements are done slowly because of the viscosity property of water, and consequently, they have more time for responses and reactions (Ryan & Simons, 2010). Having a density about 700 times more than air, water increases the energy cost a certain amount of done work to the land, while it reduces the loading pressure on the joints (Era & Heikkinen,

1985), and therefore, it provides a suitable environment for the activities of the affected athletes. According to Ruthie (1996), the main factor that seems to be related to improvements in balance is combining exercises in order to stimulate the vestibular system (Ryan & Simons, 2010), because an aquatic sport facilitates vestibular inputs (Saghazadeh, 2010). Moreover, this proprioception sense can be put under pressure in an aquatic environment (Ryan & Simons, 2010). Ruthie et al. (1996) reported that exposure to water can increase the nerves stimulation using data from the skin input (Sato et al, 2011). Thus, these exercises can be used to increase sensory message transmission to the related level of the central nervous system. Doing exercises may improve and facilitate the transfer of inputs in each of the senses, involved in maintaining balance. In the vaster picture, a better balance is the result of experience training affects the abilities of individuals to achieve a better balance. For example, swimmers use the outputs of the vestibular system to maintain their balance in the water, while gymnasts and footballers often use perceptual-motion systems and basketball players use the outputs of the visual system to maintain their balance in their training. In addition, individuals who have good muscle strength

in the lower part of their bodies, have a better balance compared to others (Sattin et al, 1990). Other factors that affect the balance include motion response, which are created by coordination, joint range movements and muscle strength (Schutte & Happel, 1990). Incidentally, since most of the exercises were done in such a way that the person stood on one leg and did not move the other leg, the involved devices may be challenged in maintaining the static balance on one leg while doing these exercises. Therefore, if these devices be strengthened and consequently, the individual's balance improves in this situation, because proprioception sense becomes greater during training (Skills, 1982). There is also this thinking that the proprioceptive sense inputs increase due to increasing stability and alignment of the body in an aquatic environment, which cause balance improvement (Skills, 1982). Hydrotherapy may be involved in neuromuscular coordination, proprioception sense, and proper operation of balance. Hydrostatic pressure increases the resistance to all the muscles involved in activity while immersing in water, and by the action of these muscle groups, the individual's balance is maintained, and it creates more stability sense (Guideline, 2001). That is why there is

no static rest situation in water, and muscles continually work to sustain the body condition (Guideline, 2001). This stability may make the achievement of the damaged individual easier to more power and flexibility and also, it makes possible to improve the balance. While walking in the water, the individual should maintain his/her balance against water turbulence, and also, provide the necessary force to with water resistance to advance forward. Therefore, the individual's balance is improved by doing this training. In an aquatic environment, individuals can do a vast range of movements without increasing the risk of falling or hurting by eliminating the weight of the different parts of the body. Also, an aquatic environment gives the permission to maintain a direct and smooth situation independently to the affected individuals (Sohbatihha & Aslankhani, 2011). Thus, the body can be aware of the related inputs related to a correct answer. Finally, all these factors can be involved in improving the balance caused by aquatic training. Also, the results of this research about the impact of aquatic training on the dynamic balance with open and closed eyes are consistent with the results of Lord et al. (Suomi & Kocejka, 2000), Yennan et al. (Thein & Brody, 1998), Suomi and Kocejka (Whipple et al, 1978). Based on these

results, if balance physical exercises were not possible somewhere and doing these exercises seemed to be useful, special aquatic training can be replaced. Coaches and sports teachers in schools can use this method to improve the physical condition of athletes, who have not a severe injury and there is a short time to hold the tournament (according to the results of the exercises in a short timeframe) for more efficiency and gaining a better result.

RECOMMENDATIONS

For future research in this field, we recommend to study on a specific population with a different average age compared with this study and conducting a similar research on professional damaged athletes, who do not have the possibility to do sport activities under normal circumstances with other athletes, and if possible, using more accurate tools like Motion Analyzer to assess the movements and advanced imaging system to assess the quality of movements. According to obtained results, it is worthy that physical education specialists and sports instructors have a particular attention to the use of aquatic environment to improve the body balance situation of athletes and raising the balance time in the body of athletes in different fields, and increase their abilities to

use this method effectively to obtain better results by appropriate and scientific using of it.

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