Research Paper: The Effect of 12-Week Aquatic Exercises on Core Stability of Women With Low Back Pain

Hamideh Khodaveisi[1*], Akbar Sazvar[2], Mehrdad Anbarian[3]

1. Department of Physical Education and Sport Sciences, Faculty of Human Sciences, Hamedan Branch, Islamic Azad University, Hamedan, Iran.
2. Department of Physical Education and Sport Sciences, Faculty of Literature and Humanities, Malayer University, Malayer, Iran.
3. Department of Sport Biomechanics, Faculty of Physical Education and Sport Sciences, Bu-Ali sina University, Hamedan, Iran.

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ABSTRACT

Purpose: The current study investigated the effect of an aquatic training program on balance in women with low back pain.

Methods: This was a quasi-experimental study with a pre-test and post-test and control group design. The study population included all patients with low back pain who referred to orthopedics s offices. In total, 30 women suffering from back pain were purposefully and voluntarily selected; then, randomly divided into two experimental (15 patients) and control (15 patients) groups. The subjects of the aquatic exercise group received a 12-week aquatic exercise program of 3 sessions per week for 60 minutes. The control group received no physical activity program. At the beginning and end of the experimental period, the patients' balance was assessed using Berg Balance Scale. The obtained data were analyzed using t-test and the Analysis of Covariance (ANCOVA) at the significance level of $P<0.05$, by SPSS.

Results: We observed a statistically significant improvement in the scores of the experimental group, compared to the control group prior period balance ($P<0.05$). However, no significant change was observed in the controls ($P\geq0.05$). Compared with the control group, the experimental group scores significantly increased after receiving the twelve weeks of aquatic treatment ($P<0.05$).

Conclusion: The obtained results suggested that aquatic exercise therapy can be a useful treatment method to improve balance and subsequently improve the daily performance of patients.

*** Corresponding Author:**
Hamideh Khodaveisi, PhD.
Address: *Department of Physical Education and Sport Sciences, Faculty of Human Sciences, Hamedan Branch, Islamic Azad University, Hamedan, Iran.*
Phone: *+98 (918) 8156787*
E-mail: *khodaveisi_hamideh@yahoo.com*

Highlights

- Aquatic exercise therapy plays an important role in the rehabilitation of people with low back pain.

- After three months of aquatic exercise with emphasize on core stability training, there was a significant improvement in the balance of people with low back pain.

Plain Language Summary

This study aimed to examine the effect of 3-month aquatic exercise on core stability of women with low back pain. The results demonstrated that these exercises could improve the balance in women with low back pain.

1. Introduction

Low back pain is among major public health problems. In respect of occupational health, it is the main cause of disability; it is also one of the main causes of disability in adults with a lifelong prevalence rate of 60% to 80% [1]. The prevalence of low back pain is over 30%; however, 70-85% of individuals experience this pain at least once in life. The cost imposed to communities due to back pain is estimated to be 50-100 billion dollars a year [2, 3].

Back pain has many causes mentioned in various sources, including heavy lifting and soft tissue disorders like muscle and ligament sprains; however, most back pains are caused by power cuts and poor body posture [4]. Numerous treatments are available for these patients, such as manual therapy, massage, tensile and flexibility exercises, stability exercises, hydrotherapy, and so on [5]. The active treatments are commonly used to prevent weakness and muscle atrophy. Aquatic exercise is an active treatment in which the subject can be active by reducing weight and the pressure from body [6].

In fact, aquatic exercises have been widely recognized as an important method in the rehabilitation of patients with rheumatology, orthopedics, and neurological disorders. Floating in water reduces the load on the spine axis and staying immersed in water facilities active movements. Thus, stabilization might allow training in the water to gain power, flexibility and most importantly, balance improvement [7].

The higher viscosity of water than air provides a higher resistance; therefore, it increases sensory feedback and body awareness [7]. For these reasons, the water environment can be fairly effective for balance training. Olson et al. and Bello stated that aquatic exercises can be more useful for patients with low back pain than dryland exercises, and reduce symptoms in these patients [8, 9]. Studies revealed that people with low back pain are more likely to experience instability and imbalance, compared to healthy subjects [10].

Many studies have focused on the effect of exercising on pressure and balance center alternations in patients with low back pain. Carpes et al. argued that increased central muscle strength improves balance in people and prevents low back pain [11]. Training in water (due to its physical properties) is a therapeutic approach to improve balance and reduce pain. Due to the lack of static rest and floating weightlessness, water provides comfortable mobility for the patient. Therefore, it assists the individual to increase strength, flexibility and, most importantly, improve balance [12, 13].

Clark et al. reported that core stability with postural maintenance, as well as maintaining a good body posture during functional activities prevent the occurrence of faulty movement patterns; thereby, improve athletic performance [14]. Eric and Johnson examined the effect of Pilates exercises (that strengthen the trunk muscles in the lumbar and pelvic regions) on dynamic balance in healthy individuals. They concluded that dynamic balance can be improved by performance attainment tests [15]. The low back pain is highly prevalent and aquatic exercises are important in the treatment of patients with chronic low back pain. Therefore, accessing treatment and rehabilitation programs to improve chronic low back pain has always been an important issue.

There is a great body of literature on the effects of aquatic exercises in patients with low back pain. However, the effects of aquatic exercises emphasizing on core stability exercises on balance, as well as balance training effects on pain severity have been less explored. Moreover, the effects of these treatments in an environ-

ment other than water or on other diseases have been investigated. Pain is a significant problem in patients with chronic low back pain. Moreover, increasing the shifting range of the center of gravity and reducing the balance are important issues. Proper balance is an essential indicator in the daily activities of patients, and women suffer more from low back than men. Thus, it is necessary to explore this matter in women.

The present study examined the effect of twelve weeks of aquatic exercises on the balance and pain of women with low back pain.

2. Materials and Methods

The samples included 30 women with chronic back pain who were randomly assigned into two control (15 patients) and experimental (15 patients) groups. The present experimental study included all women with idiopathic chronic low back pain who referred to Mehr Orthopedic Clinic in Tehran City, Iran.

The inclusion criteria consisted of no history of surgery, fractures, burns, injuries or serious injuries in the lower extremities and the use of prostheses in hip, knee, and ankle, no use of insoles, not having diabetes or certain diseases [4, 8]. To find the study participants, some forms were prepared and provided to orthopedics offices. After performing examination by a physician and determining the type of low back pain (idiopathic), patients were invited to participate in the study.

Prior to participation in the study, all subjects provided informed consent forms. The control group practiced no regular exercises. The experimental group received a 12-week training program under the supervision of a coach for 3 sessions per week (each session lasted for approximately 90 minutes). The program included balance training, core stability exercises with an emphasis on endurance and strength (Table 1).

Some warm up exercises and 11 activities for the main program focusing on strengthening the central spinal stabilizing muscles were selected from reliable sources and provided to the experimental group. The subjects performed exercises until reaching the pain threshold and repeated exercises or increased the time of exercises with regards to their ability. In this study, the Berg Balance Scale (BBS) was used [16].

To measure pain, Visual Analog Scale (VAS) was used. VAS is the most reliable system of grading pain for comparing different courses and has been widely used in pain-related research; its reliability and validity have been previously reported (Icc=0.91) [17]. The data were analyzed using descriptive and inferential statistics. The collected data were analyzed by SPSS. The Kolmogorov-Smirnov test was used to determine the normal distribution of data. The obtained results confirmed that the normal distribution of study variables. Statistical tests were performed at the significance level of 0.05.

3. Results

Table 2 presents the subjects' characteristics after conducting the necessary examinations. There were no significant differences between the study groups in terms of age, height, weight, and Body Mass Index (BMI). In other words, both groups were homogeneous (in 0.01) Table 3 lists the obtained results of BBS, and pre-test and post-test Paired t-test. As indicated, the mean scores of BBS did not significantly improve in the experimental group.

The results of Independent Samples t-test are presented in Table 4. As per Table 4, aquatic exercises improved the balance of subjects in the experimental group, compared with the controls (P<0.05).

Table 5 indicates the Paired t-test pre-test and post-test results for the experimental and control groups. According to the Correlated Paired t-test results, there was a significant decrease in the amount of pain in the experimental group (P=0.001); while there were no significant changes in the control group (P=0.230). The results of

Table 1. The aquatic exercises program

Stage	Exercises
Warm up	Stretching exercises inside and outside water
Balance exercises	Walking while stiffening or relaxing the abdomen muscles, walking forward, backward, and to the sides, opening and closing hands harmonically, walking while deeply inhaling, walking on the toes and heels, single-leg standing, lying in water, jumping into water using pool wall edge, fast walking, zigzag walking, back extension and flexion, walking with long gaits.
Cool down	Stretching exercises inside and outside water

Table 2. The Mean±SD scores of age, height, and weight of the control and experimental group

Variables	Control	Experimental	P
Age (yr)	35.16±1.80	36.25±6.57	0.54
Height (cm)	158.57±3.91	161.14±5.79	0.17
Weight (kg)	57.50±6.17	65.02±7.96	0.011
BMI (kg/m^2)	22.64±2.80	24.51±3.16	0.11

PHYSICAL TREATMENTS

Table 3. The pre-test and post-test scores of BBS in the experimental group receiving aquatic exercises

Groups	Pre-Test	Post-Test	P
Control	41.5±3.3	43.1±5.2	0.021
Experimental	40.6±4.1	49.7±3.7	0.001

PHYSICAL TREATMENTS

Independent Samples t-test are presented in Table 6. Table 6 suggests that aquatic exercises affected the amount of pain among the subjects of the experimental group, compared with the controls (P<0.05).

4. Discussion

The present study investigated the effects of an aquatic exercises training program on balance in patients suffering from low back pain. The stabilization exercises in water reduced pain and improved the patients' balance.

The results of previous studies are consistent with those of the current study in respect of pain relief, such as Olson et al., Bello, Waller et al., and Dundra and associ ates [8, 9, 18, 19]. They concluded that aquatic training improved the mobility and quality of life, and reduced pain, disability, and quality in patients with chronic low back pain, which was consistent with the present study. In rehabilitating patients with chronic back pain, restoring power and the central balance of damaged soft issues are of great importance. Increasing the activity level of spinal muscles, as well as power by aquatic exercises improve patient's performance and reduce pain.

The current study differed from the previous studies in terms of the type of aquatic exercises. In fact, the protocols applied in the previous studies were based on general practice for low back pain; however, we applied specific exercises with an emphasis on stability and balance in low back pain patients. Additionally, the number of the weeks for performing the exercises was greater than that of other studies. Lee et al. reported that a one-month aquatic exercise program does not reduce pain intensity in patients with low back pain, which was not inconsistent with our results [20].

Table 4. Comparing the BBS scores in the experimental and control groups by Independent Samples t-test

Groups	t	P
Pre-test (control vs. experimental groups)	0.662	0.520
Post-test (control vs. experimental groups)	-4.01	0.001

PHYSICAL TREATMENTS

Table 5. Correlated Paired t-test results for the experimental and control groups at the pre-test and post-test stages

Variable	Groups	Pre-Test	Post-Test	t	P
Pain	Experimental	5.8±1.211	2.80±1.06	16.12	0.001*
	Control	6.01±1.17	5.81±1.13	2.41	0.230

* Significance level=0.05

PHYSICAL TREATMENTS

Table 6. Independent Samples t-test results for the experimental and control groups at the pre-test and post-test stages

Variable	Groups	t	P
Pain	Pre-test (control vs. experimental)	-0.48	0.639
	Post-test (control vs. experimental)	-7.52	0.000

PHYSICAL TREATMENTS

Some studies have suggested that increasing pain improved variation range and disturbing balance in patients with low back pain [21, 22]. In patients with low back pain, delayed muscle contraction, especially deep muscles as well as a change of the status of compliance of painful muscles impaired balance and stability [23, 24]. The rehabilitation programs are essential to improve balance. Carpes et al. and Rhee et al. studied the effects of stabilization exercises on balance in patients with low back pain. They concluded that these exercises increase balance and stability in these patients [11, 25].

Kawasaki et al. investigated the effects of aquatic stabilization exercises on diseases other than back pain. They argued that aquatic stabilization training increased balance in patients with Parkinson's disease [26]. This finding is consistent with the results of this study. Chu et al. observed no changes after performing 8 weeks of training partners in the water for the balance of heart disease - cardiovascular not in match with that of ours [27].

In patients with low back pain, physiological mechanisms undergo changes in balance; also, some errors in connection with the atmosphere of the body will be sent to the brain stem. Such information sends inappropriate gesture commands and subsequently leads to the removal of the natural state of body [28]. The hydrostatic pressure of water is followed by equal strength in all active muscle groups. Therefore, the water environment provides resistance to program conditions. The higher density of water than air helps the resistant force against the increased movement power by engaging the muscles; this process improves the balance of patients. In this study, other causes of increased balance can be attributed to the physical properties of water [13].

Floating body and immersion in water enhance the inputs from deep receptors, resulting in improved balance and stability with more stability and regulation. Moreover, because of viscosity properties, water has greater resistance, compared to air; thus, sensory feedback increases in water and improves the sense of body awareness [12]. Other impacts of aquatic exercises consist of improved balance, the vestibular stimulation of vestibular apparatus and facilitated entry. Exposure to water can irritate and raise skin inputs and increase afferent nerve stimulation, consequently. Therefore, multisensory activities like aquatic exercises may stimulate the senses involved in water balance to provide challenging conditions for the balance system; thus, that could be effective in improving balance [29].

Some researchers also believe that due to improved posture control in aquatic activities, water allows individuals to have a wide range of movements without increasing the risk of falling or injury. Also, protective environment allows water to maintain a straight posture and smooth independently of the [29]. The disruptive forces of stability and balance in water balance and challenging environment for activities involves extraction systems with balance. Furthermore, due to the increase in reaction time, such activities are appropriate for persons with impaired balance. Given the properties of viscosity Water Slow motion) More done and as a result of people More time for responses and reactions At their disposal. Repetition and movement speed may increase strength and endurance, and improve flexibility and reaction time [29].

The present study evaluated the effects of an aquatic exercise program on balance control in patients with low back pain. The obtained results highlighted the importance of aquatic physical activities for balance improvement in patients with no history of regular exercising. Moreover, aquatic exercise programs in combination with the medical treatments can have desirable effects on the balance of patients with low back pain. Aquatic exercises can be effective in balance improvement and subsequently fall prevention among patients. This is because of the low-risk nature of water, as a disruptive environment of balance, which provides challenging conditions to the balance system. Given that the training program was inexpensive and works there was no negative side of them, aquatic exercises are recommended for these patients.

Ethical Considerations

Compliance with ethical guidelines

All ethical principles were considered in this article. The participants were informed about the purpose of the

research and its implementation stages; they were also assured about the confidentiality of their information; Moreover, They were allowed to leave the study whenever they wish, and if desired, the results of the research would be available to them.

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Authors' contributions

All authors contributed in designing, running, and writing all parts of the research.

Conflict of interest

The authors declared no conflict of interest.

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