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The Effect of Water Walking on Pain Intensity and Motor Function in Men with Non-Specific Chronic Back Pain

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ABSTRACT

Background: Chronic low back pain (LBP) has been one of the most challenging medical problems in worldwide which has led to many disabilities and physical problems. The purpose of this study was comparison of the effect of walking forth, back and side in the water for 8 weeks on pain intensity, endurance of spinal muscles and motor activity in men with chronic low back pain.

Methods: In this quasi-experimental study, 30 men with chronic LBP were selected by purposive sampling method and randomly divided into three groups: walking forward, walking backwards, and walking sideways. Exercises were performed for 8 weeks with a frequency of 3 sessions per week and each session lasted 30-45 minutes. Pain intensity was measured by the Quebec pain scale and motor function with temporal rise and move test (TUG) and stork stand test (Stork test).

Results: The results of paired t-test showed that walking in water backwards, forwards and sideways significantly reduced the pain intensity and increase in motor function of the subjects in the post-test compared to the pre-test (p=0.001). Examination of the results of group comparison with one-way analysis of variance showed that there was no significant difference between walking methods on subjects' pain intensity and motor function with stork test (p> 0.05).

Conclusion: This article showed that 8 weeks of walking exercises in water reduced pain intensity and increased motor function in chronic LBP. It can be suggested that these exercises are effective for treatment of chronic LBP.

1. Introduction

Back pain is one of the most common chronic pains and is a symptom rather than a disease and people call it a disease because of the damage and suffering they suffer from it (Ogden et al., 2018). Back pain is defined as kidney pain from the second vertebra of the back to the sacral-iliac joints, which causes health problems. Most back pain is usually caused by lifting heavy objects as a result of joint injuries or soft tissue disorders, which are usually due to weak bone structure, flexibility, changes in muscle strength and loss of strength, and become more common with age increasing (Lotfi et al , 2015). Patients with back pain are divided into three groups, patients with acute back pain in which back pain lasts less than 6 weeks. Patients with local back pain in an area that lasts 12-12 weeks and patients with chronic back pain (CBP) who suffer from back pain for more than 12 weeks (Airaksinen et al., 2006). Unlike acute and regional back pain, CBP is a complex and problematic disease that is associated with complications and functional disorders (Kargarfard, Fayyazi Bordbar, & Alaei, 2012). So far, no specific treatment has been introduced for spinal disorders and back pain. In the past, physical therapy included treatments such as hyperthermia, electrical therapy, and stretching techniques, but today, exercises that involve the lumbar muscles are recommended as an optimal solution (George et al., 2012). Of course, the effects of exercise on the lumbar muscles vary depending on the time of exercise, frequency and types. Researchers suggest that a combination of rest, physiotherapy, medication, massage therapy and surgery may be effective for patients with chronic low back pain (LBP). Many studies have examined the effect of various therapeutic interventions on back pain. The focus of these studies has been on the exercises of the abdominal and lumbar muscles and increasing the endurance of these muscles, which has led to fatigue of these muscles (Airaksinen et al., 2006). Exercise in water as one of the treatment methods for back pain has low to moderate effects on performance and quality of life as well as a minor effect on the severity of pain in patients with chronic LBP. Exercising in water is effective in reducing pain and improving the quality of life of these patients by strengthening the muscles around the joint and reducing the pressure on it (Wang et al., 2011). Walking back and forth in the water strengthens the muscles of the back, pelvis and abdomen and is also effective in treating chronic low back pain, which leads to increased self-confidence, reduced anxiety, strengthened physical strength, and improved quality of life (Farajzadeh, Karimi-Gharigh, & Dastmalchi, 2017), and increases spinal flexibility (O'Sullivan, 2005). Electromyographic activity of the lower extremity muscles while walking backwards is more than forwards, so energy consumption is higher, which can be said to have benefits of walking backwards because it produces more muscle activity due to the person's effort than walking forward. Mood, oxygen demand, metabolic and cardiorespiratory response are higher than walking forward (Panjabi, 1992). Results shows muscle endurance in women with chronic idiopathic back pain increased significantly after 8 weeks of prolonged therapy and sitting, and the rate of back pain and functional disability improved (Momeni, Moghaddasi, Farahpour, Golpayegani, &

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Darehbidi, 2012). Also, 24 sessions of hydrotherapy reduced pain intensity in men with chronic nonspecific LBP (Mahjur, Javaheri, Soltani, & Yazdi, 2016). Also, Lotfi et al. (2015) showed that 24 sessions of water exercise could reduce the severity of pain in this patient (Lotfi et al., 2015). Hydrotherapy has been recognized as an effective and useful treatment especially for people with back pain who have difficulty bearing weight while exercising on the ground (Eitner, 1982). However, patients are not given a specific training method to practice in the water. Also, the present study is necessary to compensate the lack of research on the effect of hydrotherapy on people with CBP and the lack of research that examines the effect of walking in water on pain intensity, and motor function in patients with CBP. Accordingly, the present study intends to investigate the effect of various sedentary techniques in water back and forth on pain intensity, and motor function in men with chronic nonspecific LBP.

2. Materials and Methods

2.1. Subjects

The method of the present study was quasi-experimental with pre-test and post-test design. First, with the presence of the researcher in the orthopaedic ward of Ghaem Hospital in Mashhad, the details and how to implement the plan and research method were explained to the ward physician. After selecting the subjects based on entry and exit criteria and completing the consent form and personal information, 30 men were selected by purposive sampling method based on previous studies and randomly divided into three groups of walking forward, walking backwards, and walking sideways (left and right) in water (n=10 for each group).Inclusion criteria were; People with CBP for at least 3 months, subjects have no structural abnormalities and do not have regular exercise in the last six months, do not use painkillers 3 days before the pre-test and during the course, and finally no Have a history of surgery on the spine. Exclusion criteria were recurrence of the disease during training, voluntary withdrawal from cooperation, failure to complete pre-test and post-test research tests, irregular attendance at training (3 consecutive absences or 5 absences during the course), performing parallel activities during the research period and intensifying the subject's pain with the opinion of a specialist physician. The code of ethics of the present study is IR.UI.REC.1397.072.

2.2. Apparatus and task

2.3.1. Pain assessment

Patients' pain level was measured using the Quebec pain intensity questionnaire (QPIQ). The QPIQ contains 20 6-choice questions and assesses the amount of pain in daily activities. The scoring and interpretation method of QPIQ was based on a five-point Likert rating. Each question rates the pain from zero (no pain or not hard at all) to five (I cannot do it), respectively. Finally, the severity of back pain is estimated between 0-100. Zero indicates a person's complete health, 25 as moderate pain, 50 as severe pain, 75 as severe pain and higher as severe pain that the person is unable to perform any movement. The validity of QPIQ was confirmed using face and content validity and its reliability was reported to be 0.84 using Cronbach's alpha (Ilbeigi, Nikbin, & Afzalpour, 2014).

2.3.2. Motor function

Motor function was performed by two tests of standing up and moving timed and stork standing test.

Timed Rise-Move Tests: The modified Timed Rise-Move (TUG) Test is a stand-and-move test that is a simple way to examine the static and dynamic balance of individuals (Shamshiri, 2015). This test is frequently used by the elderly because of its simplicity (Hungerford, Gilleard, Moran, & Emmerson, 2007). The duration of this test, which examines the balance of individuals, is 10-15 minutes and predicts the risk of falls due to their age (Mahjur et al., 2016). The method of performing this test is that the subject is sitting on a standardized chair (with a height of 46 cm and a height of 63 cm) and after hearing the movement command from the examiner, he stands and traverses a length of 3 meters with Move normally in front of you and then turn and return to the seat and sit on the chair. During this process, the time was recorded using a stopwatch, the score of which was less than 10 seconds, which means high and normal mobility, a record of 19-10 seconds, indicating normal movement and independence in walking. Achieving a record of 20-29 seconds means slower movement, imbalance and the need to help walk and record more than 30 seconds means reduced mobility and prone to falling over people (Shamshiri, 2015).

Stork Stand Test: The stork stand test (Strok Test) is a test for measuring static balance designed by Johnson and Nelson (1979). The test is performed in two modes with eyes open and closed. Subjects were asked to stand on one foot with their hands on their waists, with the sole of the other foot (free foot) attached to the inside of the knee of the foot. In this case, the subject stood on the toe of the support and his endurance time in this position was recorded in seconds. Conditions that cause the test to end are: contact of the heel of the support with the ground; Remove the arms from the waist and separate the free foot from the knee of the foot. The test was repeated 3 times and the superior time was recorded (Hungerford et al., 2007).

2.3. Procedures

The training protocol in the present study included eight weeks of training to walk forward, backward and sideways in the shallow part of the pool of Samen Al-Aimeh water complex in Mashhad, which lasted three sessions per week and each session lasted about 30 minutes. The training protocol in the water walking groups was for the walking group only to move forward, for the walking group it was only to walk backwards in the water, and in the side walking group to move to the sides (left and right). The group rehearsals were held over a period of one and a half hours. Due to the limited time to use the pool, the research groups practiced at different hours. The first 5 minutes of the training session were related to warming up with light stretching movements in the pool. Exercise intensity was performed based on the reserve heart rate of the first eight sessions of 50%, the second eight sessions of 60% and the third eight sessions of 70%. The height of the water for all groups was up to the chest and it was emphasized that due to the slope of the pool in a shallow place, people should be in a place where the height of the water was up to the chest. People's heart rate was monitored every 10 minutes and the intensity of exercise was adjusted based on the reserve heart rate for each session. The resting heart rate (HRR) method used the patient's resting heart rate and the maximum heart rate (age-based method). To measure resting heart rate, individuals were asked to take their heart rate in one minute when they woke up and were still in bed, and based on that, the intensity of exercise was calculated for each person. After 8 weeks, post-test measurements (48 hours after the last training session) were performed out of water at the gym.

2.4. Data analysis

After measuring the variables, data analysis was performed in SPSS software version 23 in two parts: descriptive and inferential statistics. Mean and standard deviation, were used to describe the data. Then, the hypothesis of normal distribution of research variables was evaluated using Shapiro wilk test and the results showed that all variables have a normal distribution ($p>0.05$). Then paired t-test and one-way analysis of variance was used at a significant level ($p\leq0.05$).

3. Results

The results of descriptive statistics of anthropometric indices of research subjects are shown in Table 1.

Table 1. The anthropometric indices of subjects (M ± Sd).

Groups	n	Age (Year)	Height (cm)	Weight (kg)
Backwards walking	15	40.70± 6.45	179.80± 6.14	76.10± 8.99
Forwards walking	15	39.60± 5.38	177.80± 4.94	77.40± 7.47
Sideways walking	15	43± 6.8	175.60± 4.195	73.10± 7.97

Paired t-test was used to compare the variables of pain intensity, and motor function, and one-way analysis of variance with Tukey post hoc test was used for group comparison. The results of paired t-test showed that walking in water backwards, forwards and sideways significantly reduced the pain intensity in the post-test period compared to the pre-test (p=0.001) and significantly reduced TUG (p=0.001), and a significant increase in motor function was observed with the Stork test in the post-test compared to the pre-test (p=0.001, 0.008 and 0.001 respectively for each group) (Table 2).

One-way analysis of variance at the post test showed that there was no significant difference between walking methods on subjects' pain intensity (F (2, 27) = 1.73, p= 0.19) and stork test (F (2,27) = 1.62, p=0.21). However, there was a significant difference between groups of walking backwards and forwards in water (p= 0.027) in TUG, and results of pairwise comparison showed that there is a significant difference between backward and forward walking, and backward walking is better than forward walking in TUG (p=0.02), but there are no significant differences between other groups of study in TUG.

Table 2. Results of correlated t-test and in pre-test and post-test turns of the studied groups.

Variable	Group	M± Sd		paired t-test	
		Pre test	Post test	t	p
Intensity of pain	Backwards walking	67.10± 6.19	33.40± 5.96	18.517	0.001*
	Forwards walking	61.80± 5.45	33.30± 3.74	14.783	0.001*
	Sideways walking	63.40± 6.92	36.90± 4.74	9.949	0.001*
TUG	Backwards walking	14.74± 0.98	10.48±0.77	10.236	0.001*
	Forwards walking	13.90± 0.87	10.61± 0.87	8.209	0.001*
	Sideways walking	14.44± 0.91	11.45± 0.68	14.897	0.001*
Stork Test	Backwards walking	24.20± 4.52	38.50± 6.33	-5.280	0.001*
	Forwards walking	22.90± 4.79	32.90± 7.49	-3.406	0.008*
	Sideways walking	21.50± 4.99	36.70±7.39	-4.988	0.001*

* Intragroup significance (p<0.05).

4. Discussion and Conclusion

The results of the present study showed that the intensity of pain in the post-test turn decreased in all three exercise groups of walking in water (backward, forward and side) and the highest decrease was in the group of walking backwards in water, but in terms of the difference between the groups was not statistically significant.

Findings consistent with this research include the results of Baena-Beato et al. (2014) and Sedaghati et al. (2017). In the study of Baena-Beato et al. (2014), the effect of hydrotherapy methods on pain, disability, quality of life, body composition and fitness in adults with CBP was investigated and the findings indicate a significant improvement in pain in the water exercise group. But no significant difference was found between the groups (Baena-Beato et al., 2014). Previous study investigated the effect of three methods of hydrotherapy, exercise with extension and flexion pattern on trunk muscle endurance and pain intensity in women with non-specific chronic low back pain. Findings showed a significant reduction in pain intensity in both hydrotherapy and Williams's programs (Sedaghati, Sedaghati, & Ardjmand, 2017). In another study, Lee and Kang (2016) found that strength training and walking reduced pain intensity in patients with chronic low back pain (J.-S. Lee & Kang, 2016) which was somewhat consistent with the findings of the present study.

People with CBP experience weak strength and endurance of the trunk muscles. Having pain prevents the use of intense force and power movements, and sometimes restricts the person's movements in general. As a result, insufficient use of muscles causes atrophy, reduced flexibility and muscle weakness (Moon et al., 2013). The effectiveness of water therapy exercise in this study can be due to exercises that increase the bearing capacity of the extensor muscles increasing stability and stability of the trunk and by increasing the fatigue threshold of the trunk muscles, pain and inability to function to a large extent in patients. Has improved with CBP (Mitchell & Carmen, 1990).

Lee et al. (1995) found that one month of water exercise had no effect on pain intensity and disability in people with chronic LBP (J.-H. Lee, Ooi, & Nakamura, 1995). The difference in the number of subjects, the small number of treatment sessions was one of the possible reasons for the inconsistency of the findings of this study with the present study (J.-H. Lee et al., 1995; J.-S. Lee & Kang, 2016). Therefore, in general, about the possible mechanisms effective in reducing the pain intensity of patients with chronic low back pain, we can mention the two characteristics of buoyancy and resistance to movement (viscosity) of water. Floating in the water helps the patient to allow comfortable and easy movements to the joints of the body while reducing the load, in such a case the body weight is not tolerated in water and is a suitable treatment method to reduce the severity of back pain (Rutledge, Silvers, Browder, & Dolny, 2007).

The buoyancy of the water also reduces the pressure on the painful joints and muscles and allows the joints to move freely. Water, like the belt, also supports the pelvic girdle area and allows the person to be in a comfortable position without any increase in pain (Brady, Redfern, Macdougal, & Williams, 2008). The stickiness and viscosity of water can also affect the central muscles and stabilize the lumbar spine, as well as modify movement patterns resulting in reduced pain in patients (Rutledge et al., 2007). Another mechanism that reduces the severity of pain in hydrotherapy is that the float acts against gravity, reducing the weight of the body by reducing the pressing forces on the joint, and supporting the injured limb in such a way that without Increase the pain to a comfortable position and the pain cycle is broken. The stimulating effects of hot water increase the release of stiff muscles, which reduces muscle stiffness. Hot water diverts pain by bombarding the nervous system, bombarding within the sensory ten fibers that are larger and faster and more conductive than pain fibers. When immersed in water, sensory receptors compete with pain receptors, thus controlling and eliminating the patient's pain sensation, which is perhaps the most prominent therapeutic benefit of water (Chiquoine, Martens, McCauley, & Van Dyke, 2018) .

According to the effective mechanisms of hydrotherapy on pain intensity, it can be said that hydrotherapy and walking to the sides (front, back and side) in water can increase the blood flow in addition to relieving stimuli, increase the likelihood of stimulation and secretion of endorphins and reduces pain intensity in patients with LBP.

Consistent with this finding, the results of study of Bicalho et al. (2010) showed that rehabilitation exercises in an arid environment, such as spinal manipulation and stability exercises, had no effect on the

activity of para spinal muscles in patients with LBP (Bicalho, Setti, Macagnan, Cano, & Manffra, 2010). Differences in the characteristics of the land environment compared to the aquatic environment may be one of the possible reasons for the inconsistency of the findings of previous research with the findings of the present study. According to previous studies, disorders in both superficial and deep muscular systems play a role in causing LBP, but disorders in deeper lumbar muscles such as multifidus, intercostal and transverse muscles play a greater role in causing back pain (Panjabi, 1992). Also, Ansari et al. (2014) found that 8 weeks of hydrotherapy exercises caused improved performance in patients but the difference between control and experimental groups was not significant (Ansari, Elmieh, & Hojjati, 2014).

Contrary to this finding, results showed that there was a significant difference between lumbar function- which was performed using the reverse intensity test over time- in the groups of strength, combination (strength and walking) and control (J.-S. Lee & Kang, 2016). One of the reasons for the discrepancy between the findings is the difference between the protocol and training groups in Lee and Kang's research with the present study. Exercise therapy in water can improve physiological disorders associated with pain such as muscle weakness, profundity, balance, cardiovascular fitness, and limited range of motion of the lumbar spine. Exercise therapy in water also improves mobility, mental state, reduces metabolic disorders and reduces the risk of falls and weight loss (Wang et al., 2011). Consistent with the present results showed that after 6 weeks of hydrotherapy, motor function, level of physical activity, quality of life and muscle strength increased and pain intensity decreased and, reducing pain intensity was one of the effective factors in improving motor function in patients with chronic LBP (Hinman, Heywood, & Day, 2007). Reducing the pressing forces on the weight and joints and improving blood circulation due to hydrostatic pressure of water on the body all provide therapeutic movement in water, with less fatigue, pressure and sweating for patients with LBP, which together improve performance and improve life. Therefore, for these reasons can be said that there was no difference between the way they walk in the water and the extent of the effect on patients' motor function (Brown & Kraft, 2005) .The results of the present study showed that there was no significant difference between the effect of forward, backward and lateral walking exercises in water on pain intensity and motor function in people with chronic LBP, but there was a difference between walking in water in pre-test and post-test sessions. It has been meaningful. According to the research findings, it seems that among the methods of walking in water, performing more backward walking movements can be prescribed as one of the best therapies in patients with chronic low back pain.

Conflict of interests

The authors declare no conflict of interest.

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