

# The Effects on Muscle Strength and Visual Analog Scale Pain of Aquatic Therapy for individuals with Low Back Pain

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**Abstract.** [Purpose] The purpose of this study was to investigate whether ten weeks of aquatic therapy exercise would increase low back muscle strength and reduce low back pain in 19 elderly subjects. [Subjects] Nineteen low back disorder patients were randomly assigned to one of two groups: an aquatic therapy exercise group (n=9), and a control group (n=10). [Methods] The aquatic therapy group participated five times a week for ten weeks in an aquatic exercise designed to strengthen the low back muscles. Data collection was done using a Cybex-770 system. [Results] The results show that the aquatic exercise significantly reduced visual analog scale pain by 52.1%. Significant improvements in low back muscle strength were found in the aquatic therapy group on peak torque of flexor in 180 °/sec by 48.31% and on peak torque of extensor in 180 °/sec by 152.85% . [Conclusion] Based on the results, we conclude that the ten weeks of aquatic therapy exercise can enhance low back muscle strength and reduce low back pain in elderly women.

**Key words:** Muscle Strength, Low Back Pain, Aquatic Therapy

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## INTRODUCTION

The world health organization has named low back pain as a 20st century epidemic, and indeed, low back pain is emerging as an increasingly significant medical issue<sup>1)</sup>. Walking erect causes human beings to put a heavy load on their lumbar region. As a result, 60–80% of people experience backache during their life<sup>2)</sup>. The cause of lower back pain varies in relation to physical, psychological and social functions<sup>3–6)</sup>. Furthermore, lower back pain is reportedly caused by neuropathy, obesity, fatigue, psychological pressure, heavy metal poisoning, lack of exercise, and lack of calcium when accompanied by a bad posture, weakened muscle, severe stress, and internal diseases including gastritis.

The major diseases closely related to low back pain are, compression fractures of vertebrae, disc herniation, spondylolysis, and scoliosis. Regardless of clinical causes, decrease of muscular strength and endurance, reduction of flexibility, and reduction of motion range of the lumbus and lower limbs have commonly been found in individuals with lower back pain. As an important factor of the etiology of

chronic backache, low back muscle strength has attracted attention from orthopedists and physiatrists<sup>7,8)</sup>. Therefore, many researchers have measured low back muscle strength in order to investigate the difference between healthy people and patients with low back pain.

Aquatic exercise can alleviate subjective pains because the turbulence, pressure, and temperature of water increases sensory input. Moreover, water's buoyancy, relaxation of muscles, increase of excessive muscle motion, and the decrease of weight bearing, reducing joint compression. Also, the increase of mental and social stimuli serves to alleviate pain. In addition, aquatic exercise increases cardiovascular respiratory endurance, muscular strength and endurance, and flexibility. The characteristics of water help to extend the range of joint motion and lessen the load on the spine, knee, and ankle joints, which enables patients joint-related disorders to easily participate in exercises with reduced weight bearing and continue exercises even with a slight injury<sup>9)</sup>. Study of this issue has seldom been conducted. Research conducted on 35 back pain patients demonstrated that following an aquatic exercise program, patients' physiological and psychological indices remarkably

**Table 1.** Baseline characteristics of the subjects

Group	Age (years)	Height (cm)	Weight (kg)	BMI
Exercise (n=9)	61.2 ± 3.3	152.2 ± 8.2	53.4 ± 6.6	25.3 ± 12.1
Control (n=10)	60.8 ± 5.0	154.9 ± 5.3	54.4 ± 9.0	26.5 ± 9.5

increased<sup>10)</sup>. Senior citizens' physical activity has an important role not only for its primary purpose, but also as a means of recovering in physical function and maintaining health. Therefore, women's physical activities can help to treat or cure a disease. Physical activity can also improve an individual's overall health, metabolic energy levels, and lifestyle. Aquatic exercise may also have positive effects on women's weight loss and fitness. Few studies have investigated the effects of aquatic exercise in the elderly, and much more research is needed to study its influence on muscle strength and endurance. It has been hypothesized that aquatic exercise would strengthen low back-muscle and decrease low back pain in elderly women. Therefore, the purpose of this study was to examine the influence of aquatic exercise on the low back muscle strength of patients with low back pain.

## SUBJECTS AND METHODS

### Subjects

A total of 27 low back disorder patients were considered for inclusion in this study. After receiving a conservative treatment for over 4 weeks, 19 of these patients were selected based on an orthopedist's findings. The patients were randomly assigned to one of two groups: the aquatic therapy exercise group (n=9) and a non-exercise control group (n=10). The aquatic exercise of the exercise group was implemented at D city's swimming pool for 10 weeks. The physical characteristics of both groups are shown in Table 1.

### Methods

Aquatic therapy was performed according to the program suggested by Robert (1996)<sup>11)</sup>. It was carried out for 50 minutes, 5 times a week, and it was divided into three parts: warm-up 10 minutes, main exercises 30 minutes, cool-down 10 minutes. The main exercises consisted of walking, chin twist, arm spreading, knee-up, floating against the wall, floating on the stomach, floating on the floor, breathing on the water, sedentary kick, walking in a row and walk-and-row. A visual analog scale (VAS) was used to measure the degree of low back pain. The VAS was developed in 1979 by Huskisson<sup>12)</sup>. Subjects check the degree of subjective pain on a 10 cm line, on which 0 cm indicates "no pain" at the left end and 10 cm indicates "very severe pain" at the right end. The VAS score is determined as the measurement from the left side, with a higher score meaning a more severe pain intensity of the low back.

Low back muscle strength was trained with a Cybex-770 isokinetic exercise device. The central femur and the lower tibia were fixed by a belt, the torso was tightened with the belt, and both hands were fixed by holding the handle. After exercising twice at 180°/sec followed by a 1-minute break,

**Table 2.** The results of visual analog scale

Group	Baseline	10 Weeks
Exercise (n=9)	6.52 ± 3.45	3.12 ± 2.32**
Control (n=10)	6.09 ± 4.33	5.89 ± 4.42

\*\* Significantly different from the baseline (p<0.01).

**Table 3.** The results of peak torque of flexion at 180°/sec

Group	Baseline	10 Weeks
Exercise (n=9)	33.12 ± 7.89	49.12 ± 11.15*
Control (n=10)	32.46 ± 12.75	36.80 ± 13.54

10 more repetitions were conducted at maximum strength. Data are shown as mean ± SD, student's t-test was used for statistical analyses of the data. Statistical significance was accepted for p values of less than 0.05.

## RESULTS

The mean and standard deviation of visual analog scale, pre- and post-task by group, is shown in Table 2. The results show that for the aquatic exercise group, the change in visual analog scale was statistically significant: 6.52 ± 3.45 pre-task and 3.12 ± 2.32 a post-task (p<0.01). However, there was no significant difference between the pre-task result and the post-task result (6.09 ± 4.33 and 5.89 ± 4.42) of the control group.

Table 3 presents the mean values of maximum peak torque of the flexors, pre- and post-task by group. The results indicate that the change in maximum peak torque of the flexor was statistically significant for the exercise group: 33.12 ± 7.89 Nm pre-task and 49.12 ± 11.15 Nm post task (p<0.05). No significant difference was found between the pre-task result and the post-task result (32.46 ± 12.75 Nm and 36.80 ± 13.54 Nm) of the control group.

The mean values of maximum peak torque of the extensors, pre- and post-task by group, can be found in Table 4. The results show that the change in maximum peak torque of the extensor was statistically significant: 12.98 ± 8.96 Nm pre-task and 32.82 ± 13.34 Nm post-task (p<0.05). However, there was no significant difference between the pre-task result and the post-task result (13.26 ± 6.43 Nm and 16.43 ± 11.46 Nm) of the control group.

## DISCUSSION

The causes of low back pain are varied and complicated. It can be the result of a spinal disorder, or psychological

**Table 4.** The results of peak torque of extension at 180°/sec

Group	Baseline	10 Weeks
Exercise (n=9)	12.98 ± 8.96	32.82 ± 13.34*
Control (n=10)	13.26 ± 6.43	16.43 ± 11.46

factors caused by stress, or somatological factors triggered by epidemiologic hypofunction of the musculoskeletal system<sup>1)</sup>. The imbalance between the muscles around the spine can lead to the malfunction of epidemiologic motion, which can add weight to joints consequently causing lower back pain. Intensified exercises of muscles around the back are essential to reduce low back pain of patients.

The back muscle strength of patients with back pain has become the main issue of therapy, as strengthening of these muscles can improve stability of the spine. As a conservative treatment, different types of exercises are carried out, as anti-back pain exercises. Studies suggest that these anti-back pain exercises are able to release neuromuscular pressure, intensifying support for overloaded spinal segments<sup>9)</sup>. To clarify the importance of the back muscle strength related to back pain, abdominal muscle strength was measured in this study. It was noted that there is a close relationship between back pain and the weakness of the back muscle strength<sup>5)</sup>. Hydrogymnastics are reported to be helpful in promoting proper posture by intensifying muscle strength and flexibility, which can prevent pain and re-currence<sup>5,13)</sup>. Studies have reported that aquatic activities are very helpful for the minimization of weight overload, which can relieve the burden on the joints or the back. Furthermore, these activities can increase cardiopulmonary endurance, muscular endurance, and  $Vo_{2\max}$ , and flexibility by extending the joint motion range, and decrease back pain by increasing abdominal muscle strength, intensifying lower extremity muscle strength, as well as being helpful in promoting weight loss<sup>14-18)</sup>.

One important characteristic of water is buoyancy, allowing women who are keen to the dangers caused by extreme exercises on the ground to maintain their workout without further overload of the joints. This enables individuals to participate in various training programs, such as support, assistance, or resistance<sup>19-21)</sup>, and be free from any possible danger of extreme motion. This type of aquatic exercise can be performed by patients with joint-related diseases, back pain patients, senior citizens whose joint motion ranges are restricted, and also individuals who suffer from obesity by modifying the intensity of the exercises and the motion.

The implementation of water workout programs can promote walking, and swimming, and strengthen the muscles of the abdomen, the leg, the back, the hip, the hamstrings, and the calf. One study has shown that the physiological and psychological index of individuals participating in an aquatic exercise increased significantly compared to the period when they did not participate in the program<sup>11)</sup>. Clearly, aquatic exercise has many therapeutic possibilities, including the

potential to relieve lower back pain. In the current study, the subjective pain scale of women experiencing low back pain was  $6.52 \pm 3.45$  in the exercise group, and  $6.09 \pm 4.33$  in the control group, pre-exercise. These pain degrees were higher than the average. For instance, Jin and Lim (2008) used the same method to investigate the level of pain reported by patients with chronic back pain, and they reported a pain scale level of  $5.8 \pm 2.22$ <sup>22)</sup>. When compared to their study, the pain reported of this study had a somewhat higher level, but the difference is due to occupational variation of the subjects. It should be noted that further study is needed to develop a deeper understanding of the degree of back pain among women using more subjects, and different exercise modes and intensities may be important factors to consider.

The analysis of maximum peak torque was generated by each speed of 180 °/sec on extensor and flexor to test the difference in isokinetic exercise capacity of the trunk between the aquatic exercise group and the control group. The aquatic exercise group showed a more meaningful difference than the control group in both extension and flexion at 180 °/sec. Therefore, it can be concluded that the aquatic exercise helps to maintain or intensify the muscle strength of patients with back pain. We conclude that the aquatic exercise program is beneficial for patients with low back pain, as it resulted in increase of low back muscle strength and a decrease in pain.

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