

Effects of exercise therapy on muscular strength in firefighters with back pain

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Abstract. [Purpose] The purpose of this study was to determine how an exercise program focusing on muscular strength could aid firefighters with chronic lower back pain. [Subjects] The research subjects were randomly assigned to two groups, the experimental group (n=8) and the control (n=8). [Methods] The experimental group performed two types of exercise programs four times per week for 8 weeks under supervision. Tests were performed before and after the 8 weeks of exercise in accordance with the Korea Occupational Safety and Health Agency's program. [Results] At the end of the 8 weeks of the rehabilitation program, abdominal muscular strength were significantly increased in the experimental group, and this indicates that the exercise therapy was effective for improvement of muscular strength. [Conclusion] We found that exercise therapy is an effective intervention that can reduce the pain of patients with chronic lower back pain. The firefighters with chronic lower back pain who participated in this study exhibited enhanced lower back muscular strength and obtained some additional benefits. They need regular exercise.

Key words: Firefighters, Lower back pain, Muscular strength

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INTRODUCTION

The activities of firefighters mainly include the use of firehoses, manual lifting, or tools for fire rescues. Factors that cause low back pain may include, ascending a ladder, lifting weights, moving the body, stretching the body, or excessive firefighting work. These awkward activities involve risks of musculoskeletal disorder¹⁾.

Musculoskeletal disorders of firefighter, in particular low back pain is believed to be originated from their emergency duties¹⁾. Low back-pain is a high-relapse rating chronic disease influenced compositively by strength, flexibility, balance, and posture²⁻⁵⁾.

Chronic low back pain is a pain syndrome appearing in the region from the lumbar area to the sacroiliac joint, regardless of lower extremity radiating pain^{6, 7)}.

Previous studies have attempted to reduce lower back pain using exercise programs and have also included several patient education sessions and many different types of

stretching and strengthening.

However, it has been still remained controversial that a few findings regarding the effect of exercises on fire fighter with low back pain who had experienced health risks due to exposure to various adult diseases and illnesses, but the number of studies on back strength are still rare. Thus, the aim of this study was to investigate the effect of conventional low back pain rehabilitation programs on firefighters who complained of low back pain by analyzing how the program affects their back strength.

SUBJECTS AND METHODS

All subjects of this study were the fire fighters. They were selected based on a body fat rate of over 30% obtained using a bioelectric impedance method. The subjects had not participated in physical activity or training for at least 6 months. They were randomly assigned to two groups, the experimental group, n=8, and the control group, n=8 (Table 1). All subjects were educated about the contents and purpose of the experiment prior to its beginning and were asked to provide written informed consent prior to participating. Our low back pain rehabilitation programs (Table 2) were based on the Korea Occupational Safety and Health Agency's program⁶⁾. The study of Park attempted to reduce lower back pain using exercise programs and included several patient

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Table 1. Characteristics of the subjects

Group	Age (yrs)	Height (cm)	Weight (kg)
Experimental	45.1±2.23	171.4±5.23	71.1±6.56
Control	41.6±4.27	171.0±3.23	69.3±2.87

Table 2. Low back pain rehabilitation program

Eight-week rehabilitation program	
Warming-up exercise	Riding a stationary bicycle-10 minutes Stretching-5minutes
Core exercise	Flexion reinforcement
	Sit-ups Knee chest Toe touch Squat training
Core exercise	Extension reinforcement
	Prone Push back arch back Back arch back
Four weeks	Times-10 seconds/3 times
Six weeks	Times-12 seconds/3 times
Eight weeks	Times-15 seconds/3 times
Finish exercise	Stretching-5 minutes

education sessions and many different types of stretching and strengthening¹⁾.

The experimental group performed two types of exercise programs for 8 weeks. The exercises focused on muscular strength (abdominal muscles, back muscles), flexibility, and balance. The exercise duration was 10 seconds per repetition with three for weeks 1–4, 12 seconds per repetition with three repetitions for weeks 5–6, and 15 seconds per repetitions with three repetitions for weeks 7–8, and the exercises were performed twice a day, four days a week. We ensured that the subjects performed all of the exercises before and after the 8 weeks of the exercise program. All the subjects underwent measurement of abdominal muscular strength, and back muscular strength was measured by sit-ups holding and sit-arch back holding. Subjects were each told their body to attach on the floor with knees at a right angle upright. They were then told to hold their pose with raise upper body and hands on their chest. For back muscular strength, subjects were told to lay face down and attach their body to the floor. They were then told to put their hands on their head with their pose hold with shoulders upward with maximally. We measured the elapsed time of each test. All subjects were given 1 trial for each test. All experiments were reviewed and approved by the Committee of the Ethics Kangwon National University. The pre-intervention and post-intervention data were examined using the paired t-test for comparisons within each group of subjects, and the independent t-test was used for comparisons between the groups. The level of significance was chosen as 5% for all statistical analyses.

Table 3. Comparison of abdominal muscular strength within groups (units: sec)

Group	Pre	Post
Experimental	24.2±3.4	27.9±3.1**
Control	22.6±1.9	21.9±1.2

Mean±SD, **: p<0.01

Table 4. Comparison of abdominal muscular strength between groups (units: sec)

Group	Changes in muscular strength
Experimental	25.6±4.8**
Control	22.2±1.6

Mean±SD, **: p<0.01

Table 5. Comparison of sit-arch back holding within group (units: sec)

Group	Pre	Post
Experimental	24.2±5.9	26.3±5.2*
Control	15.6±5.1	15.6±4.7

Mean±SD, **: p<0.01

Table 6. Comparison of sit-arch back holding between groups (units: sec)

Group	Changes in sit-arch back holding
Experimental	25.0±5.9**
Control	15.6±4.8

Mean±SD, **: p<0.01

RESULTS

There was an increase in abdominal muscular strength after the exercise, and also a change in muscular strength between the control and experimental groups.

For the experimental group, abdominal muscular strength increased from 24.3±3.4 sec before the exercise to 27.9±3.1 sec after the exercise (p<0.05). For the control group, abdominal muscular strength decreased from 22.6±1.9 sec before the exercise to 21.9±1.2 sec after the exercise (p>0.05).

In case of the experimental group, back muscular strength was increased from 24.2±5.8 sec before the exercise to 26.4±5.2 after the exercise (p<0.05). In the case of the control group, back muscular strength decreased from 15.6±5.1 sec before the exercise to 15.6±4.7 sec after the exercise (p>0.05) (Tables 3–6).

DISCUSSION

It is caused by mechanical, degenerative, and psychological factors. The mechanical factors of lower back pain are the spine, muscles surrounding the spine, ligaments, the sacroiliac joint, nerves, the periosteum, and discs⁸⁾.

It is essential for people with chronic low back pain to strengthen the low back muscles and to increase in lumbar flexibility.

The treatment for chronic low back pain can vary depending on the type and source of pain. Considering their job duties, low back pain in firefighters' low back pain may originate from injuries, job stress, or loading on different structures of the body. Weight training is a physical activity that raises contractible or extensible contraction by using fixed or adjustable resistance and utilizes free weight equipment including barbells or dumbbells, or contractible or adjustable resistance machines. The effect of training has been shown in precedent studies. Many researchers use a weight training program to investigate the effects of exercise on low back pain. Pollock and Gettman⁹⁾ reported that weight training was a significant method for people with low back pain. Similar to this finding, Lee¹⁰⁾ used a resistance exercise and lumbar stabilizing exercise to increase lumbar strength and to reduce pain. These two researchers found the effects of weight bearing exercise enhanced lower back muscle strength. The present study analyzed whether a rehabilitation program for firefighters with chronic low back pain would reduce muscle pain and enhance muscle function in subjects complaining of back pain for more than 6 months without surgical treatment and neurologic abnormalities. We measured muscle pain with the following question.

How do you think the results of the isometric strength test will relate to the muscular strength necessary for firefighting? It is well documented that isometric strength exercises only show an increase in strength within a 20 degree range on either side of the position at which it was measured.

In the present study, the experimental group showed significantly increased abdominal muscular strength compared with the control group. This finding indicated that the stretching type rehabilitation program would have some additional benefits for firefighters. Henchoz et al.¹³⁾ conducted a randomized controlled trial with a 3-month exercise program. They analyzed the effects of an exercise program on patients with chronic low back pain who had completed functional multidisciplinary rehabilitation. The participants underwent 12-weeks of exercise program and showed improvements in disability score and trunk muscle strength.

Compared with previous studies, weight training exercises were found to enhance isometric muscle function, which hints that there would be various factors relating to this finding.

The improvement of muscle strength can come with the increase of muscle size as a priority.

Although, weight bearing exercise programs have many additional health benefits for low back patients, our study focused on 8-types of back stretching exercise. An increase in low back muscle flexibility would maximize the low back muscular strength, preventing low back pain and reducing the risk of injuries¹⁰⁾. Therefore, muscular flexibility and balanced growth of muscular strength are the fundamental

elements for of building a correct posture⁹⁾. It is necessary to increase muscular strength and muscular endurance of the lumbar region including the abdominal muscular strength and back muscular strength to help maintain correct postures, and this will reduce the dynamic loads on the vertebra and tissues around the spine¹⁰⁻¹⁴⁾.

This current study used the exercise program conducted by the Korea Occupational Safety and Health Agency. Although the results indicated that patients improved their low back pain, further, more specific and diverse experiments and research are necessary with regard to how exercises can be integrated into an ideal physical activity program that is suitable for a person's own characteristics.

The results might indicate that low back pain suffers change their posture by increasing the strength of the back muscle. This could mean that those with increasing pelvic tilt are more at risk of having back pain. Further study is recommended to investigate this relationship in subjects with moderate to severe disabilities.

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