Effects of lumbopelvic sling and abdominal drawing-in exercises on lung capacity in healthy adults

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Abstract. [Purpose] To examine the effects of lumbopelvic sling and abdominal drawing-in exercises on the lung capacities of healthy subjects. [Subjects and Methods] Twenty-nine healthy subjects with no orthopedic history of the back were recruited. Subjects were randomly assigned to an experimental group and control group. Subjects were allocated to one of two groups; an experimental group that underwent lumbopelvic sling and abdominal drawing-in exercises and a control group that underwent treadmill and abdominal drawing-in exercises. Lung capacities were evaluated 4 weeks after exercises. [Results] The experimental group showed significant increments in EV, ERV, IRV, VT vs. pre-intervention results, and the control group showed significant increments in the EVC and IRV. Significant intergroup differences were observed in terms of post-training gains in EVC, IRV, and VT. [Conclusion] Combined application of lumbopelvic sling and abdominal drawing-in exercises were found to have a positive effect on lung capacity.

Key words: Abdominal drawing in maneuver, Lung capacity, Sling exercise

INTRODUCTION

Cardiorespiratory fitness (CRF) is a measure of the capacity of the cardiovascular system to transport oxygen and the ability of the muscles to use this oxygen. In addition, CRF reflects the ability of the circulatory, respiratory, and muscular systems to supply oxygen to skeletal muscles during sustained physical activity1), and thus, CRF is associated with health outcomes. Furthermore, accumulating evidence demonstrates CRF is independently associated with morbidity and mortality in the general population2-4). Sling exercise is a new training method for athletes and orthopedic patients5). Because of its convenience and practicality, sling exercise has become more and more common in rehabilitation clinics and fitness training centers6). Recently, researchers have reported that lumbopelvic sling exercises are effective for strengthening respiratory muscles7), and Lukens et al.8) advised that these exercises effectively strengthen transverse abdominis muscle, which is an important respiratory muscle. However, few studies have been performed on the clinical effects of combined lumbopelvic sling and respiratory muscle strengthening exercises. Therefore, in the present study, we studied the effects of combined lumbopelvic sling and respiratory muscle strengthening exercises on vital capacity.

SUBJECTS AND METHODS

This study was conducted on 29 healthy individuals without an orthopedic history after obtaining informed consent. All
procedures were reviewed and approved by the Institutional Ethics Committee of Eulji University Hospital. The subjects were randomly assigned to an experimental group of 15 subjects or a control group of 14 subjects. Both the experimental group and the control group received ADIM (abdominal drawing-in maneuver) exercise for 20 minutes per session. Members of the experimental group also received a lumbopelvic sling exercise for 20 minutes per session, whereas control group members received 20 minutes of additional treadmill training. Exercises were performed 40 minutes per session once per day, five times per week, for four weeks, which is referred to as the intervention period.

The study selection criteria were as follows: 1) had not performed any trunk muscle-related exercise during the three months prior to selection; 2) no history of surgery in the waist region; and 3) the absence of lower back pain. In experimental and control groups average ages, heights, and weights were 20.93 ± 1.33, 20.64 ± 1.15 years, 173.45 ± 5.56, 170.69 ± 4.27 cm, and 64.05 ± 10.19, 60.11 ± 6.82 kg, respectively. The experimental group showed significant increases in EVC, ERV, IRV, and VT (p<0.05), and the control group showed significant increases in EVC, IRV, and VT (effect sizes 1.28, 0.82, and 0.96, respectively). Significant intergroup differences in post-intervention gains were observed for EVC, IRV, and VT (p<0.05). The effect sizes of gains in the experimental and control groups were high for EVC, IRV, and VT (effect sizes 1.28, 0.82, and 0.96, respectively).

RESULTS

Twenty-nine subjects (experimental group=15, control group=14) completed the experiment. The characteristics of the two groups (n=29) before and after intervention are shown in Table 1.

The experimental group showed significant increases in EV, ERV, IRV, and VT after intervention (p<0.05), and the control group showed significant increases in EVC and IRV (p<0.05). Significant intergroup differences in post-training gains were observed for EVC, IRV, and VT (p<0.05). The effect sizes of gains in the experimental and control groups were high for EVC, IRV, and VT (effect sizes 1.28, 0.82, and 0.96, respectively).

DISCUSSION

The present study was conducted to examine the effects of combined lumbopelvic sling and ADIM exercises on the respiratory competences of normal, healthy adult males. Significant intergroup post-intervention gains were observed for EVC, IRV, and VT. The respiratory rate of an adult male at rest is 13–18 breaths/min, the amount of air inhaled per breath is 400–600 ml, and the amount of air inhaled per minute is 4–15 l. During exercise the amount of air inhaled is proportional to oxygen uptake and to the CO₂ yield of active muscles. Accessory muscles act during forced inhalation or extended active inhalation. Accessory muscles for exhalation are core muscles, such as, the rectus abdominis, the internal/external oblique, and the transverse abdominis, and when these muscles contract, pressure in the thoracic cage increases and air is forced out of the lungs. During inspiration, respiratory muscles expand the ribs, increase diaphragm movement, and draw air into the lungs, and during expiration, these muscles are relaxed and air is discharged.
Exercise to improve respiratory competence are diverse. Recently, exercises based on the use of slings, intended to stabilize trunk muscles, have been used. Sling exercises are performed using the subject body weight and antigravity, and have the advantages of requiring little space, being straightforward, and of enabling diverse exercises. As a result they are widely used to strengthen respiratory muscles. In addition, unlike other exercise methods, sling exercises are effective for muscle strengthening because changes in body axis allow different movements. Respiratory competence improvement by sling exercise is due to increases in the activities of core respiratory muscles that are required to maintain neutral posture during trunk movements caused by the external resistance applied by the sling. According to our results, the sling exercise activates the diaphragm which acts as an agonist for inspiration and accessory muscles for expiration to enhance respiratory competence. The effects of core exercises using slings include dynamic stabilization of the trunk and lumbar vertebrae, neutral control of the spine, and enhanced coordination of muscles that positively affect respiratory muscle strength.

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