Effect of Core Training on Inspiratory Muscle Strength in well-trained Men

D.O.I: http: doi.org/10.4127/jbe.2016.0098

MUSTAFÄ ÖZDAL
Asst.Prof.Dr., Gaziantep University, Department of Physical Education and Sport, Lab: Gaziantep University Performance Laboratory, Gaziantep, Turkey.

ABSTRACT

The aim of this study was to examine the effects of core strength training program (CT) on inspiratory muscle strength (IMS) in well-trained men. Twenty four well-trained male athletes participated in the present study as subject, and they divided randomly two groups as the experimental (Ex), and control (Con). Ten-weeks CT program was administered on the Ex. The subjects were recruited to perform 2 times maximal inspiratory pressure (MIP) pre- (T1) and post- (T2) 10-weeks program. Significant increase was found in the MIP (10.92 cmH₂O) of the Ex group after 10-weeks CT program (p < 0.05). The Con did not show statistically important difference (2 cmH₂O) between the T1 and T2 (p > 0.05). Percent change in the MIP of the Ex was by 6.13%, and in the MIP of the Con was by 1.38%. When compared percent change in the MIP of groups, the increment of the Ex was found significantly higher than the Con (p < 0.05). In summary, respiratory muscle strength significantly increased after 10-weeks CT program. As a conclusion, it could be said that core strength training causes improvement of respiratory muscle strength.

Key Words: Respiratory muscles; Maximal inspiratory pressure; Fatigue; Core strength; Exercise
INTRODUCTION

The respiratory muscles are vital, and their strength affects exercise tolerance (3, 22, 33). Inspiratory muscle strength (IMS) impairments may contribute to the respiratory pump dysfunction, dyspnea, altered breathing patterns, inspiratory fatigue, and ultimately exercise intolerance (2, 9, 10, 13, 14, 15). Maximal inspiratory pressure (MIP) measurement is one of valuable method for evaluation of inspiratory muscle strength (6, 20).

Core training (CT) is commonly used for the core strength, and conditioning field (24). The CT has positive effects to strength of body core area (24, 28). The core area of body is considered with the abdominal muscles, paraspinals, gluteals, obliques, pelvic/hip girdle musculature and diaphragm (27) that is serves as the roof of the core (1) and is most important muscle of inspiration (21).

There is no study about of the CT and the IMS. It is not known that the effect of the CT program on the IMS. It could be hypothesized that the CT may positively affect the IMS. Aim of the present study was to investigation of effect of the core training program on the inspiratory muscle strength in well-trained men.

METHODS

Experimental Approach to the Problem

The present study was including 10-weeks training program, and test-retest design with control group was used in order to identify effect of the CT. The subjects visited the laboratory three times. During first visit, they were familiarized the MIP measuring, and the CT exercise moves. During second (T1) and third visit (T2), maximal inspiratory pressure was determined as “inspiratory muscle strength”. Measurements were applied same time (between 10:00 - 12:00). Exercise and high-intensity physical activity were not allowed before visits. Between second and third visit (T1 and T2), 10-weeks core training program and their own sport training program were applied to the experimental group. At the same time, the control group was only regularly participated in their own sport training routine.

Subjects

Twenty four well-trained male athletes voluntarily participated in the present study as subject (Table 1), and they were divided randomly two equal groups as the experimental (Ex) and the control (Con). We received written consent from
subjects, and also ethical approval from Gaziantep Clinical Researches Ethical Committee.

Table 1.
Descriptive information of subjects (Means ± SD)

<table>
<thead>
<tr>
<th></th>
<th>Ex, n = 12</th>
<th>Con, n = 12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>24.33 ± 2.42</td>
<td>23.08 ± 3.15</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>188.83 ± 8.80</td>
<td>184.50 ± 5.07</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>83.33 ± 11.30</td>
<td>80.50 ± 5.98</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>23.25 ± 1.29</td>
<td>23.63 ± 1.25</td>
</tr>
<tr>
<td>MIP (cmH₂O)</td>
<td>157.08 ± 15.85</td>
<td>151.25 ± 7.20</td>
</tr>
</tbody>
</table>

There was no significant difference between groups, BMI = Body mass index, MIP = Maximal inspiratory pressure, Ex = Experimental group, Con= Control group

PROCEDURES

Maximal Inspiratory Pressure (MIP) Measurement

The MIP was measured with mouth pressure meter (MicroRPM, CareFusion Micro Medical, Kent, UK). MIP measure started from residual volume. The nose was occluded throughout effort. In order to obtain best value, all subjects performed five attempts for not higher than 10% difference between two attempts. Average of acceptable attempts was used for the MIP value (4).

Core Training Program

The Con did not receive the CT program. They were instructed to maintain their own sport training routine. The Ex received the CT program that consisted of 10 core-related exercises performed for 10 weeks. The CT frequency was 5 times per week. Intensity of the program presented in Table 2. The following 10 exercises were practiced in all training sessions for CT (23, 30): [1] push up, [2] abdominal crunch, [3] vertical leg crunch, [4] jack knife, [5] supine knee drop side-to-side, [6] reverse crunch, [7] superman, [8] plank with alternating arm and
leg raise, [9] cat-camel stretch, [10] plank jack. Before and after the exercises, 5 minutes walking or jogging and 5 minutes static stretching for major muscles were practiced in order to warm-up and cool-down (5). The exercises were fully instructed and demonstrated by strength and conditioning specialist. All subjects of the Ex received a hard copy that included instructions, pictures, and key points of the exercises.

Table 2.

Intensity of core training program

<table>
<thead>
<tr>
<th>Weeks</th>
<th>Sets</th>
<th>Repetitions</th>
<th>Rest</th>
</tr>
</thead>
<tbody>
<tr>
<td>First 2 weeks</td>
<td>2</td>
<td>8</td>
<td>15 sec after repetitions</td>
</tr>
<tr>
<td>Second 2 weeks</td>
<td>2</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Third 2 weeks</td>
<td>3</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Fourth 2 weeks</td>
<td>3</td>
<td>15</td>
<td>60 sec between each set</td>
</tr>
<tr>
<td>Fifth 2 weeks</td>
<td>4</td>
<td>12</td>
<td></td>
</tr>
</tbody>
</table>

Statistical Analyses

For statistical analysis SPSS 22.0 program (SPSS Inc., Chicaco, Ill) was used. Data were presented as mean, standard deviation and mean percent of difference. Shapiro-Wilk test was used for normality. Paired and independent samples T tests were performed to determine significant effects of the CT on the IMS. Significance was defined as p≤0.05.

RESULTS

Descriptive information of subjects was shown in Table 1. There was no significant difference between the Ex and the Con in descriptive information in the present study (p > 0.05).
Table 3.

Differences in the MIP between T1 and T2 of groups

<table>
<thead>
<tr>
<th></th>
<th>Ex, n = 12</th>
<th>Con, n = 12</th>
</tr>
</thead>
<tbody>
<tr>
<td>MIP (cmH₂O)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>T1</td>
<td>157.08 ± 15.85</td>
<td>151.25 ± 7.20</td>
</tr>
<tr>
<td>T2</td>
<td>168 ± 19.36*†</td>
<td>153.25 ± 7.79</td>
</tr>
<tr>
<td>Difference (T2 - T1)</td>
<td>10.92</td>
<td>2</td>
</tr>
<tr>
<td>Percent change</td>
<td>6.13%†</td>
<td>1.38%</td>
</tr>
</tbody>
</table>

*significance between T1 and T2 of group
†significance between Ex and Con

MIP = Maximal inspiratory pressure, T1 = Measurement of MIP before 10-weeks training program, T2 = Measurement of MIP after 10-weeks training program, Ex = Experimental group, Con = Control group

Changes of maximal inspiratory pressure between T1 and T2 of groups were presented in Table 2. In the Ex, the MIP was observed 157.08 ± 15.85 cmH₂O at T1, and observed 168 ± 19.36 cmH₂O at T2. The MIP difference (10.92 cmH₂O) between T1 and T2 of Ex was found statistically significant (p = 0.002). The MIP change of the Con was recorded as 151.25 ± 7.20 cmH₂O at T1, and 153.25 ± 7.79 cmH₂O at T2. The difference (2 cmH₂O) of the Con was not found significant (p > 0.05). There was significant difference between the Ex and the Con in T2 measurement (p = 0.023). Percent change in the MIP between T1 and T2 of the Ex and the Con was shown in Figure 1. While the Ex showed high increase in the MIP by 6.13% between T1 and 2, the increase of the Con was not similar (1.38%). When compared percent changes of the Ex and the Con, significant difference was observed between the Ex and the Con (p = 0.015).
The increase between T1 and T1 was significant in the Ex (p < 0.05). This result showed that the 10-weeks CT program had strengthening effect on respiratory muscles. But, this effect did not occur before and after 10-weeks in Con (p > 0.05). Additionally, the Ex had significant increment by 6.13% after 10-weeks CT program (p < 0.05). On the other hand, the Con did not have significant increment (p > 0.05).

The core training emphasizes strength and conditioning of muscles of trunk (25). Diaphragm that is serves as the roof of the core (1; 27) is most important muscle of inspiration (21). Besides, upper body trunk muscles are responsible for supporting to rising demands of breathing (18), and have responsibility to respiration for stabilization of the rib (1). The respiratory muscles and trunk muscles can affect each other as strengthening and fatiguing (18). At this point, it could be believed that the positive effects of the CT program may have occurred from strengthen the diaphragm and trunk muscles in the present study.

Previous studies showed that positive effect of core strength training on trunk muscle strength and force development (7, 8, 11, 12, 16, 19, 26, 28, 31, 32,
There are a number of neural adaptations following core strength training that included more efficient neural recruitment patterns, faster nervous system activation, improved synchronization of motor units and a lowering of neural inhibitory reflexes (29). Besides, core strength training results in hypertrophy of the muscles and neural adaptations of muscles which benefits performance by increasing the possible force generation, improved intrinsic muscle stiffness and improved tissue mobilization (1). Physiologically, the core strength training is believed to lead to the greater maximal power and more efficient use of the muscles of the shoulders, arms, and legs (17). It could be considered that increase in the inspiratory muscle strength after 10-weeks CT program resulted from physiological and neural adaptations of trunk and respiratory muscles.

In summary, in the present study, respiratory muscle strength significantly increased after 10-weeks CT program. As a conclusion, it could be said that core strength training causes improvement of respiratory muscle strength.

REFERENCES


Address for correspondence:

Mustafa ÖZDAL
Gaziantep University, BESYO, Gaziantep, Turkey
e-mail: ozdalm@hotmail.com,
Mobile Phone: +905065150159, Fax: +903423600751