Original Research Article

Correlation between abdominal muscle strength and pulmonary function in subjects with low back pain

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Abstract

Introduction: The diaphragm is man's main respiratory muscle. The role of the abdominal muscles is seen in both quiet and forceful breathing. Abdominal muscle function could be affected in subjects with back pain. Few studies are done about the relation between expiratory muscle strength and pulmonary function. So the aim of this study was to evaluate the correlation of abdominal muscle strength with pulmonary function in patients with low back pain.

Materials and methods: Sixty subjects with low back pain were included in the study. Subjects with history of acute or chronic respiratory disorders were excluded. Abdominal muscle strength was measured by curl up test and FEV_1/FVC and peak expiratory flow rate (PEFR) was measured to assess pulmonary functional.

Results: Using Spearman test for correlation between abdominal muscle strength and FEV_1/FVC (r= -0.27, p=0.03), and between abdominal muscle strength and PEFR (r=0.34, p=0.007) was seen.

Conclusion: There was a weak correlation between abdominal muscle strength and pulmonary function in subjects of low back pain.

Key words

Abdominal muscle strength, FEV_1/FVC ratio, PEFR, Low back pain.

Introduction

Low back pain is pain, muscle tension, or stiffness localized below the costal margin and above the inferior gluteal folds, with or without sciatica [1]. Many people have low back pain and this may be partly caused by weak abdominal

muscles. Developing strong abdominal muscles may help prevent back pain by making one less prone to back injuries [2].

The diaphragm is man's main respiratory muscle. The role of the abdominal muscles is in both quiet and forceful breathing. It is believed that the abdominal muscles could be strengthened in order to assist the ventilatory process. The strength of the abdominal muscles can assist prolonged and forced expiration [3]. Few studies have been done to find out the relation between expiratory muscle and pulmonary function. So the need of this study was to find the correlation between abdominal muscle strength and pulmonary function in subjects of low back pain.

Materials and methods

A correlational study was conducted at a Physiotherapy College of Ahmedabad. A total of 60 healthy subjects, both males and females, aged between 19-25 years who had low back pain were included in the study by convenience sampling. The subjects who had a history of acute or chronic respiratory disorders were excluded.

Information about the purpose and procedure of the study was provided to the participants. Informed consent was taken from them prior to participation. Outcome measures were abdominal strength by curl up test and FEV_1/FVC and PEFR for pulmonary function using a spirometer.

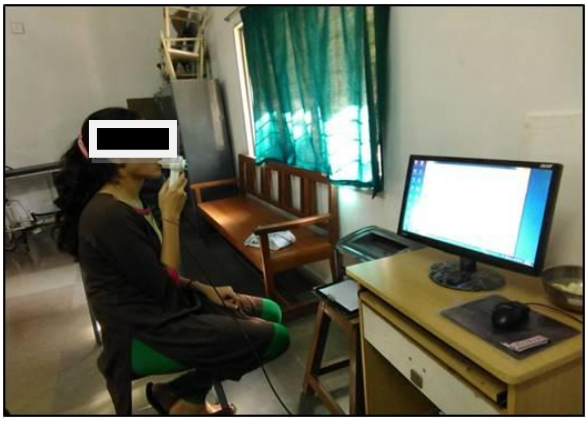
Abdominal muscle strength [4]
Curl up test was performed on plinth. Subject was kept in crook lying position. A tape was placed on a mat 3 inches from his/her fingertip. The subject did a curl up, to touch the tape each time. The pace of the curl ups was one every three seconds. When the subject slowed down, the test was over and count was noted. Starting position of curl up test was as per **Figure - 1** and end position of curl up test was as per **Figure – 2.**

FEV1/FVC ratio and PEFR [5]
Pulmonary function test was performed by using an office spirometer RMS Helios 401.The subject was placed in a comfortable high sitting position. The subject was instructed to put the mouth piece of the spirometer into the mouth and hold tightly by his/her lips. They were asked to inhale as much as possible and then exhale rapidly and forcefully for as long as flow can be maintained. The values of FEV_1/FVC ratio and PEFR were noted from the reports. Position of performance of PFT was as per **Figure - 3**.

Figure - 1: Starting position of curl up test.

Figure - 2: End position of curl up test.

Figure - 3: Position of performance of PFT.



Statistical analysis

SPSS windows version 16 was used. Descriptive statistics of mean and standard deviation were calculated for age, abdominal muscle strength, FEV_1/FVC and PEFR. Spearman test was applied to analyze the correlation between abdominal muscle strength and FEV_1/FVC and correlation between abdominal muscle strength and PEFR. Level of significance was kept at 5%.

Results

Mean/ median of age, Abdominal muscle strength, FEV1/FVC ratio and PEFR were as per **Table - 1**. Correlation between Abdominal muscle strength and FEV1/FVC ratio, r = -0.27, p = 0.3 showed a negative weak correlation between these two parameters which was statistically significant (**Table – 2**). Correlation between Abdominal muscle strength and PEFR, r=0.34, p= 0.007 showed a positive correlation between these two parameters which was statistically significant.

Scatter plot between abdominal muscle strength and FEV1/FVC was as per **Figure - 4** and scatter plot between abdominal muscle strength and PEFR was as per **Figure - 5**.

Table – 1: Mean Age, Abdominal muscle strength, FEV1/FVC ratio and PEFR.

	Age (years)	**Abdominal muscle strength**	**FEV_1/FVC**	**PEFR (L/min)**
Mean/ Median	21.72±1.6	20	92.65±7.7	4.55±1.22

Table – 2: Correlation between Abdominal muscle strength and FEV_1/FVC, PEFR.

	Type	**r value**	**p value**
Abdominal muscle strength andFEV_1/FVC	Negative	0.27	0.03
Abdominal muscle strength and PEFR	Positive	0.34	0.007

Discussion

The study showed a positive weak correlation between abdominal muscle strength and PEFR and a negative weak correlation between abdominal muscle strength and FEV1/FVC in individuals with low back pain.

Figure – 4: Scatter plot between abdominal muscle strength and FEV1/FVC.

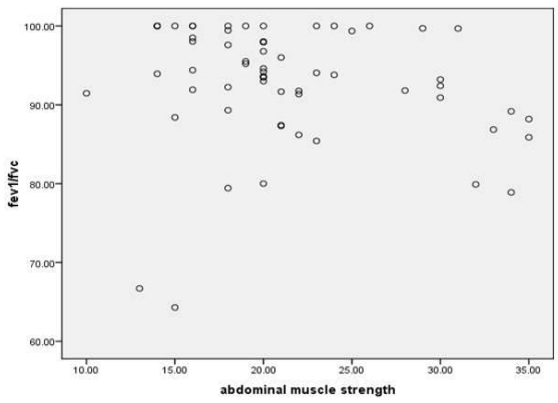
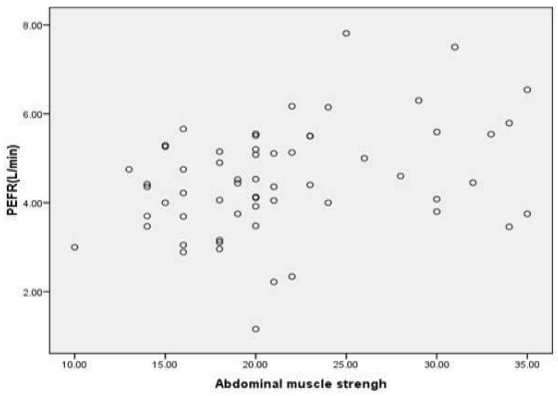


Figure – 5: Scatter plot between abdominal muscle strength and PEFR.



The diaphragm, the main muscle of inspiration, and with the trunk muscles, is involved in trunk stability and posture control [6]. Abdominal muscles (Transversus abdominis, Internal oblique abdominis, External oblique abdominis, and rectus abdominis) are trunk flexors and

rotators as well as expiratory muscles. Abdominal muscle fibers pull the ribs and costocartilage caudally, into a motion of exhalation. By increasing intra-abdominal pressure, the abdominal muscles can push the diaphragm upward into the thoracic cage, increasing both the volume and speed of exhalation [7]. One study noted that the co-contraction of the abdominal muscles and the diaphragm increases intra-abdominal pressure, fixes the trunk, and reduces the stress on the spine, especially the lumbar region [6]. Expiratory muscle recruitment might also aid inhalation by causing lengthening of the diaphragm, which improves its length tension relationship [8].

Weak abdominal muscles cause hip flexor muscles to tighten causing an increase in the curve of the low back and excessive anterior pelvic tilt. Unhealthy posture and muscle imbalance can lead to low back pain [9]. One study looked into the changes in breathing patterns experienced by chronic lower back pain patients [6]. The result of their study showed positive correlation between abdominal muscle strength and peak expiratory flow rate which is not similar to the present study. It suggests that good abdominal muscle strength maintain the pulmonary function and vice-versa, thereby reducing low back pain.

Hagins and Lamberg recently revealed that patients with chronic low back pain over a period of time tend to develop a dysfunction in their respiratory ability due to weakness of low back and abdominal muscles [10]. This is because when a person inhales more air, a pressure is created within the abdomen – this pressure is supported by the abdominal and lower back muscles, and when the muscles are weak the support system cannot function properly leading to problems in breathing. Diaphragmatic function achieved via deep abdominal muscle strengthening exercises not only increased respiratory volume but also played a role in stabilizing the lumbar spine through the co-contraction of the transversus abdominis [6]. According to Sanya AO and Ramayide AO it is believed that the abdominal muscles could be strengthened in order to assist the ventilator process [11]. The recruitment of the deep abdominals increases intra-abdominal pressure and coactivation of the entire abdominal wall has a fundamental role in providing adequate support for spine and trunk stiffness [12]. Breathing properly leads to relaxation of the body and the muscles in the mid and the lower back. So, breathing exercises can be a way to target the treatment of chronic low back pains [10].

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Mehling WE, et al. studied the effects of breathing therapy on chronic low back patients. Patients improved significantly with breathing therapy. The changes in standard low back pain measures of pain and disability were comparable to those resulting from high-quality, extended physical therapy [13]. Kim E, et al. studied the effects of deep abdominal strengthening exercise on respiratory function and lumber stability, he concluded that the deep abdominal muscle strengthening exercises enhance the respiratory function and effective for lower back pain patients in need of lumbar stabilization [6]. However, the effect of breathing exercises or strengthening exercise was not seen in the present study.

Limitation of the study was that intensity of pain and chronicity of pain were not assessed and analyzed. Further studies can be performed with a larger sample including a wider age group and seeing the effect of exercises in low back pain subjects.

Conclusion

There is a weak correlation between abdominal muscle strength and pulmonary function in subjects of low back pain.

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