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

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#### ABSTRACT

Low back pain is a broad term encompassing pain, muscle tension, or stiffness localized below the costal margin and above the inferior gluteal folds. Reviewing of previous studies shows that low back pain is partly caused by weak abdominal muscles. Developing strong abdominal muscles may help prevent back pain by making individual less prone to back injuries. Few studies have been done to find out the relation between expiratory muscle and pulmonary function. Pulmonary function test provide the clinician with information about integrity of the airways. Pulmonary disease are classified into 3 basic categories; Obstructive, Restrictive, Combined. To diagnose the respective pulmonary condition Forced Vital Capacity (FVC), Forced Expiratory Volume in One sec. (FEV<sub>1</sub>) Peak Expiratory Flow Rate (PEFR), "Curl up" was examined. Observational study was carried out with 60 samples by using convenient sampling in the duration of 6 months at Dr. Ulhas Patil College of Physiotherapy. After ethical committee consideration Subjects were enrolled according to selection criteria. With respect to the objective mentioned there is no correlation between Abdominal Muscle Strength and FEV<sub>1</sub>/FVC, as the r value is 0.04 and the P value was 0.72. It suggested that abdominal strengthening may help in good pulmonary function and may assist the ventilatory process along with maximum forceful exhalation with correct breathing techniques and posture.

**Keywords:** Forced Vital Capacity (FVC), Forced Expiratory Volume in One sec. (FEV<sub>1</sub>) Peak Expiratory Flow Rate (PEFR)

#### INTRODUCTION

Low back pain is pain, muscle tension, or stiffness localized below the costal margin and above the inferior gluteal folds. 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. 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. Few studies have been done to find out the relation between expiratory muscle and pulmonary function. Pulmonary function test provide the clinician with information about integrity of the airways. It shows function of respiratory musculature. Condition of lung tissue themselves involves several test that measures lung volume and capacities, gas flow rates, gas diffusion and distribution. Based on result of PFT, Pulmonary disease are classified into 3 basic categories; Obstructive, Restrictive, Combined. **Forced Vital Capacity (FVC):** It is the maximum values of gas a patient can exhale as forcefully and quickly as possible. It is measured by having a patient exhale as forcefully and quickly as possible in pneumotachometer, the patient should breath in maximum and exhale as quickly as possible. **Forced Expiratory Volume in One sec. (FEV<sub>1</sub>):** the volume of air exhale during one sec of FVC and reflex the airflow to large airways. The utility of FEV<sub>1</sub> measurement associated with degree of obstruction that is no or little obstruction. FEV<sub>1</sub>: Normal = 2 L/sec.; Mild obstruction = 1 - 2 L/sec.; Severe obstruction = < 1 L/sec. **Peak Expiratory Flow Rate (PEFR):** It is the maximal flow that occurs at any point during FVC. Normal

= 9 – 10 L/sec. The “Curl up” is also known as a crunch. This test measures abdominal strength and endurance. This test focuses predominantly on the main abdomen muscle, the rectus abdominis, and may not evaluate the core as a whole. It is performed on a mat. Very few studies suggested the correlation between abdominal muscle strength & Pulmonary Functions. Thus, the study needs to be carried out to find out the correlation between abdominal muscle strength & Pulmonary Functions in subjects with low back pain

## METHODOLOGY

Observational study was carried out with 60 samples by using convenient sampling in the duration of 6 months at OPD of Dr. UlhasPatil College of Physiotherapy

## PROCEDURE

Permission from ethical committee and inform consent was taken from patients. According to inclusion and exclusion criteria patient were taken in the study. 60 subjects with non-specific low back pain, Age between 19 – 25 years both male and female were included in the study. Than patient were asked to perform curl up test FIG 1, followed with pulmonary function test- FEV<sub>1</sub>/FVC, FIG 2



Fig: 1

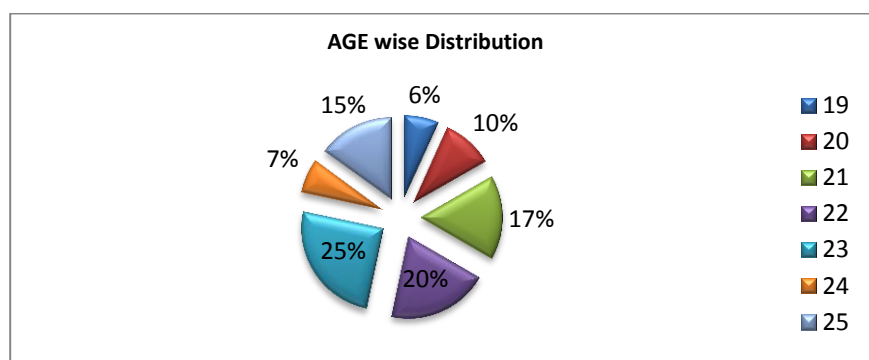


**Fig: 2**

### Statiscalanalysis and graph

**Table No. 1:** Age wise distribution among subjects.

Age (years)	19	20	21	22	23	24	25
No. of sub.	4	6	10	12	15	4	9

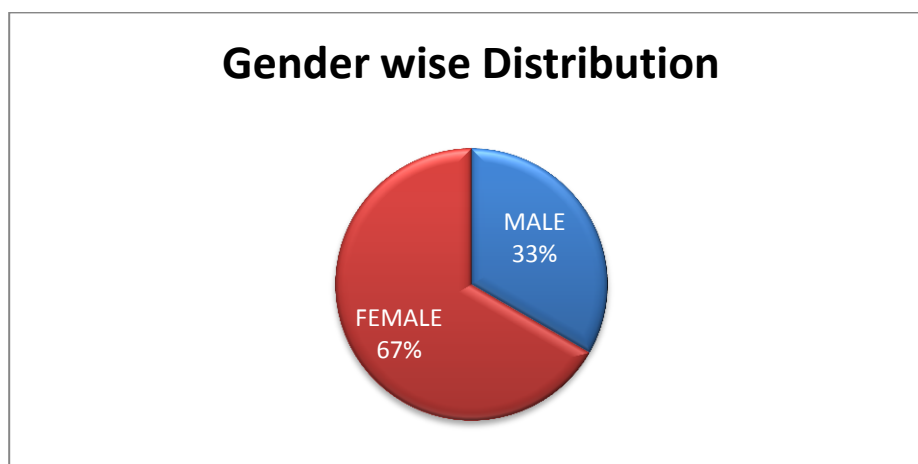


**Graph No. 1:** Age wise distribution among subjects.

**Table no.1** shows age wise distribution among subjects. In which was highest number of subjects were found in age group of 23 years,

**TABLE NO.2 :** Gender wise distribution among subjects.

[1] Gender	[2] No. of Subjects
[3] MALE	[4] 20
[5] FEMALE	[6] 40



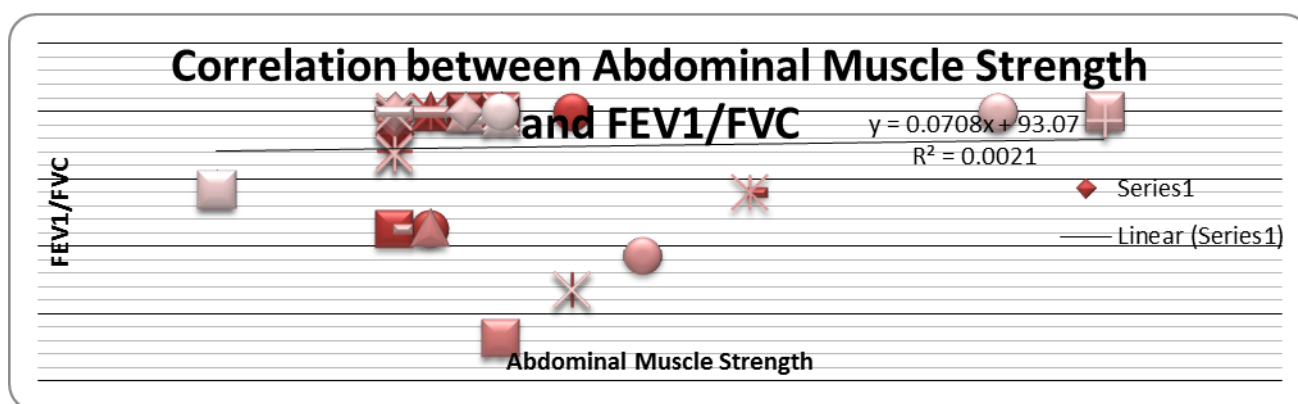
**Graph 2 :**Gender wise distribution among subjects.

**Table no.2** shows gender wise distribution among subjects which shows Percentage of female

participants were more as compared to males (M=33%, F=67%).

**TABLE NO.3: Correlation between Abdominal Muscle Strength and FEV1/FVC**

[7] Age	[8] Abs	[9] FEV1/FVC	[10]r value	[11]P value	[12]Correlation
[13]22.26 ± 1.73	[14]23.5 ± 5.81	[15]94.74 ± 9.2	[16]0.04	[17]0.72	[18]No Correlation



**Graph 3: Correlation between Abdominal Muscle Strength and FEV1/FVC**

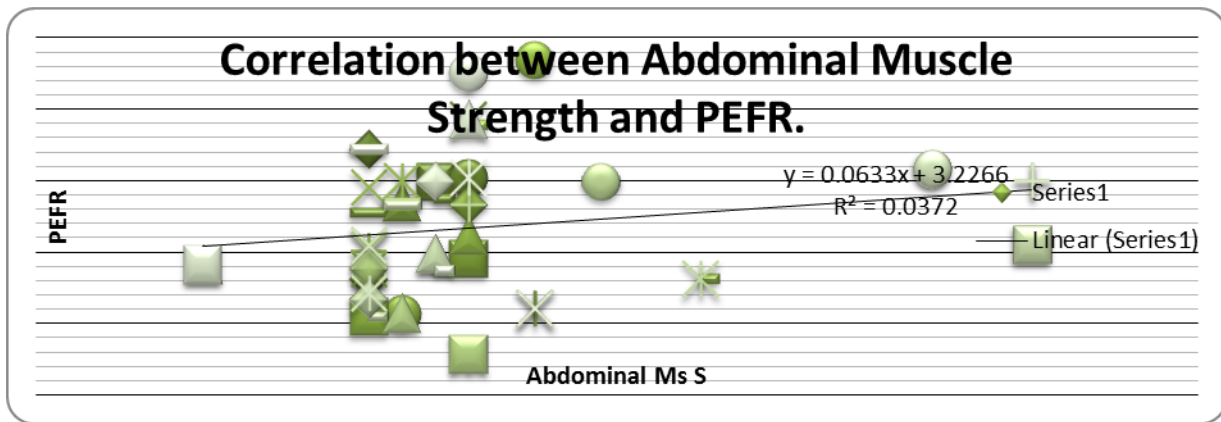
## RESULT

This graph shows that there is **no** correlation between Abdominal Muscle Strength and

FEV1/FVC, as the r value is 0.04 and the P value is 0.72.

**TABLE NO.4: Correlation between Abdominal Muscle Strength and PEFr.**

[19]Age	[20]Abs	[21]PEFR	[22]r value	[23]P value	[24]Correlation
[25]22.26 ± 1.73	[26]23.5 ± 5.81	[27]4.72 ± 1.91	[28]0.19	[29]0.14	[30]Partial Positive



## RESULT

This graph shows that there is **Partial positive** correlation between Abdominal Muscle Strength and PEFR, as the r value is 0.19 and the P value is 0.14.

## DISCUSSION

The study showed a partial positive correlation between abdominal muscle strength and PEFR and no correlation between abdominal muscle strength and FEV1/FVC in individuals with low back pain.

The diaphragm, the main muscle of inspiration, along with trunk muscles, is involved in trunk stability and postural control [6]. Abdominal muscles (transverse abdominis, Internal oblique, External oblique, rectus abdominis) are trunk flexors and rotators as well as expiratory muscles. Abdominal muscle fibres 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].

Weak abdominal muscles causes 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 experience by chronic low back pain patients [6]. The result of their study showed partial positive correlation between abdominal muscle strength and PEFR.

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 work properly leading to problems in breathing.

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 co-activation 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 pain [10].

Good abdominal muscle strength maintains good pulmonary function and thereby reduces the pulmonary complications. It is believed that when the ventilatory capacities of lungs are compromised, the respiratory functions are affected and the individual could utilize the abdominal muscles to effect forced expiration, thus getting room for improved inspiration action [14].

The deep abdominal muscle strengthening exercise is effective at increasing vital capacity. The contractility of the diaphragm and the transverses abdominis in particular influences the partial stabilization of the lumbar spine and functions as a type of regulatory mechanism, causing changes in breathing patterns [14].

To conclude, enhanced diaphragmatic function achieved via deep abdominal muscle strengthening exercises not only increases respiratory volume but also plays a role in stabilizing the lumbar spine through the co-contraction of the transversus abdominis [15]

To suspect maximum force expiration, there needs a strong abdominal muscle contraction to exhale forcefully and as quickly as possible to get the maximum force of exhalation[14]. Thus, as the study showed a partial positive correlation between abdominal muscle strength and pulmonary function. Abdominal strength could be increased in order to assist the ventilatory process along with maximum forced inspiration. And It was found that there was NO correlation between abdominal muscle strength and FEV1/FVC based on the results.

## CONCLUSION

- Thus, the study concludes that there is a partial positive correlation between abdominal muscle strength and PEFR.
- And there is no correlation between abdominal muscle strength and FEV1/FVC in individuals with low back pain. It is suggested that abdominal strengthening may help in good pulmonary function and may assist the ventilatory process along with maximum forceful exhalation with correct breathing techniques and posture.

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## Limitations

- 1) Intensity of pain and chronicity of pain were not assessed and analyzed.
- 2) Small sample size were taken [n=60]
- 3) Age group was limited i.e, 19-25 yrs.
- 4) Manual errors.

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