International Journal of Health Sciences and Research
Volume 14; Issue: 3; March 2024
Website: www.ijhsr.org
Original Research Article *ISSN: 2249-9571*

Effect of Chronic Low Back Pain on PEFR and Chest Expansion

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DOI: https://doi.org/10.52403/ijhsr.20240304

ABSTRACT

Background: Chronic low back pain (cLBP) is when symptoms last more than 12 weeks. In cLBP, there is weakness of core muscle which in turn reduces the respiratory effort. The strength of the abdominal muscle is found to assist in prolonging as well as forceful expiration. Diaphragm also plays a role in spinal stability.
Aims: To evaluate the PEFR and chest expansion in patients with cLBP.
Settings and Design: An observational study was conducted in individuals of 18-65 years of both genders having backpain for more than 3 months of Ahmedabad. Patients with history of pulmonary diseases, any history of trauma or lumbar spine pathology such as infection or tumour were excluded.
Methods and Materials: Test procedure of PEFR and Chest expansion were explained and were taken by peak flow meter and non-stretchable inch tape respectively.
Results: Paired t-test was done to compare the predicted values of PEFR and Chest expansion values to actual PEFR and Chest expansion of cLBP patients.
Results: Mean age, BMI, PEFR, CE at 2nd, 4th ICS and xiphoid of males are (44.61±13.24), (22.26±1.31), (380.55±52.86), (1.78±0.48), (2.29±0.38) and (2.59±0.26) & females are (45.09±12.73), (22.67±1.66), (277.812±40.38), (1.58±0.42), (1.77±0.36) and (2.00±0.32). Predicted values of PEFR and CE for males are (463.222±35.95), (2.69±0.38), (2.7±0.41), (3.03±0.36) and for females are (306.13±26.32), (2.02±0.28), (2.03±0.21), (2.22±0.15). Values of PEFR and chest expansion have shown statistical difference ($p<.05$) from predicted values in both males and females.
Conclusions: There is reduction of PEFR and chest expansion values in the patients with cLBP. It may be due to the abdominals weakness and greater diaphragm fatigability in cLBP.

Keywords: PEFR, chest expansion, chronic low back pain, diaphragm fatigability

INTRODUCTION

The LBP is classified on the basis of the duration of the symptom into acute (no more than localised weeks), subacute (6-12 weeks) and chronic (more than 12 weeks).[(1)] When the origin of back pain can't be determined, the diagnosis given is nonspecific low back pain. [(2)] It is well documented that in chronic low back pain (cLBP) there is weakness of core muscle which in turn reduces the respiratory effort.[(3)]

The strength of the abdominal muscle is found to assist in prolonging as well as forceful expiration. [(4)]

While the first function of the diaphragm is respiration, it also plays a role in spinal stability. [(5)] During inspiration, the diaphragm contracts concentrically, whereas the transversus abdominis contracts eccentrically. The muscles function in reverse during exhalation with the diaphragm contracting eccentrically while the transversus abdominis contracts concentrically. [(6)]

Peak expiratory flow measurement (peak flow) is a simple measure of the maximal flow rate that can be achieved during forceful expiration following full inspiration. Patients can learn the technique quickly, and the equipment necessary is affordable and widely available. Major societies and advocacy groups have published patient-facing websites with clear videos that demonstrate proper technique, which can help clinicians electing to start home measurements for their patients. [7]
Movements of the ribs occur at the costotransverse and the costovertebral joints. The orientation of these joints varies in the upper and lower ribs. Due to this pump handle movement is seen in upper ribs where as bucket handle movement is seen in lower ribs. Therefore, both the upper, middle and lower chest movement should be assessed. [8] Chest expansion, defined as the difference in thoracic girth after maximum inspiration and maximum expiration, is one indicator of chest wall mobility. As it is measured using a measuring tape, it is a simple, inexpensive, and non-invasive tool for assessing chest mobility. [9]
There are very few studies on assessment of alteration of PEFR and chest expansion on individuals with chronic low back pain. The function of the diaphragm muscle deteriorates if non specific low back occurs. [10] So the aim of this study is to find out the effect of chronic low back pain on PEFR and Chest expansion.

MATERIALS & METHODS

Study Design – Cross-sectional study
Study setting – Ahmedabad, Gujarat
Sample size - 50
Sampling Method – Purposive sampling
Study population – Patients with chronic low back pain
Study duration - 3 months
Selection criteria:

- ***Inclusion criteria*:**

I. Patients who were willing to participate.
II. Patients of 18-65 years of age
III. Patients of both genders
IV. Patients having nonspecific low back pain for at least three months of duration

- ***Exclusion criteria:***

I. Any history of trauma of lumbar region. History of lumbar spine pathology such as infection, tumor. Known medical problems like osteoporosis and Tuberculosis of spine, bones or joints.
II. Obese or overweight individual
III. Postural abnormalities like scoliosis and any abnormal structural deformity
IV. Patients with history of pulmonary diseases such as pulmonary fibrosis, emphysema, bronchial asthma, cardiothoracic surgery, chronic bronchitis, lung cancer was excluded.

- ***Materials:***

I. Pen
II. Paper
III. Pencil
IV. Peak Flow Meter (Cipla Breathe O Meter)
V. Cloth tape measuring tape

PROCEDURE

Patients of chronic low back pain were screened as per the inclusion and exclusion criteria and the procedure was explained. A written consent was obtained from the patients. Initially the demographic data that is Name, age, gender were assessed.
Peak Flow Meter (Cipla Breathe O Meter) was used to measure Peak Expiratory Flow Rate (PEFR). Before starting the procedure, the disposable mouthpiece was fixed to the apparatus and was confirmed that the indicator was moved to the lowest end of the numbered scale. The patients were instructed to sit straight and comfortable. The patients were advised to take a deep inhalation and blowout forcefully and quickly through the mouthpiece which was hold tightly by their lips. Patients were informed to repeat the same procedure for two more times and the highest reading was noted.

Study procedure for chest expansion was carried out with study patients in straight and comfortable sitting position. With the help of non stretchable inch tape, the chest expansion was measured at three levels that is 2nd Intercostal Space, 4th Intercostal Space and Xiphoid process. Patient was asked to exhale the air as much as possible and then take a maximal deep inspiration. The difference between the full expiration and full inspiration was noted. Three trials were given at each level and average of three readings was noted.

STATISTICAL ANALYSIS

Statistical Package for the Social Sciences (SPSS) version 20 was used for analyzing the data. Descriptive statistics were documented as mean±standard deviation. Paired t-test with p-value of 0.05 as cut-off were used to compare the predicted values of PEFR by regression equations given by Kodgule, R. R., et al.(2014) [11] and predicted Chest expansion values[12] and actual PEFR and Chest expansion of chronic low back pain patients. The descriptive statistics was done for both gender groups.

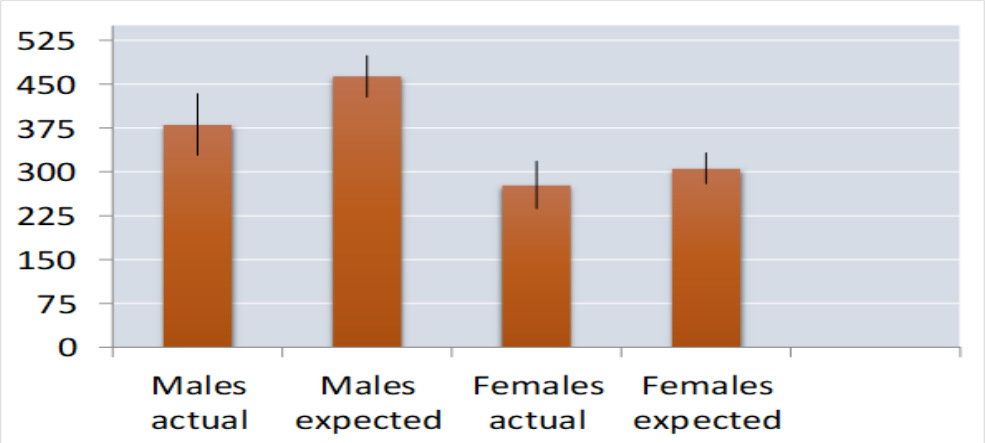
RESULT

Descriptive characteristics of males and females of chronic low back pain patients in table 1 (n = 50)

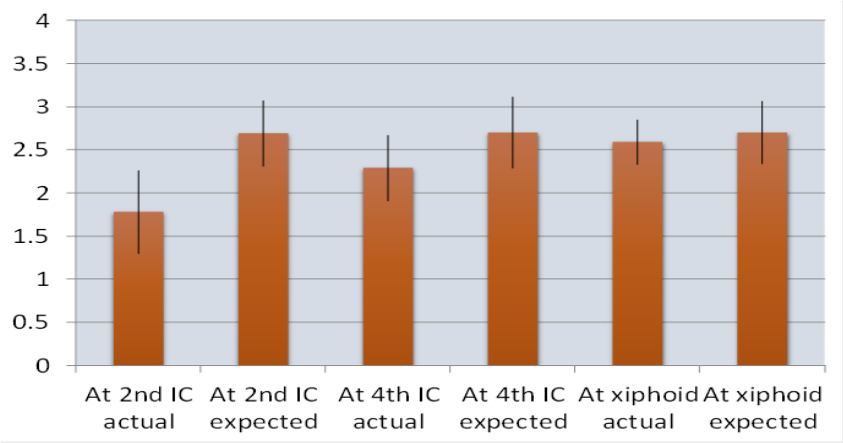
Table 1 Descriptive characteristics

Demographic Data	Males (n = 18)	Females (n = 32)
Age (y)	44.61±13.24	45.09±12.73
BMI (kg/m^2)	22.26±1.31	22.67±1.66
Duration of cLBP (months)	13.55±8.88	13.38±11.15

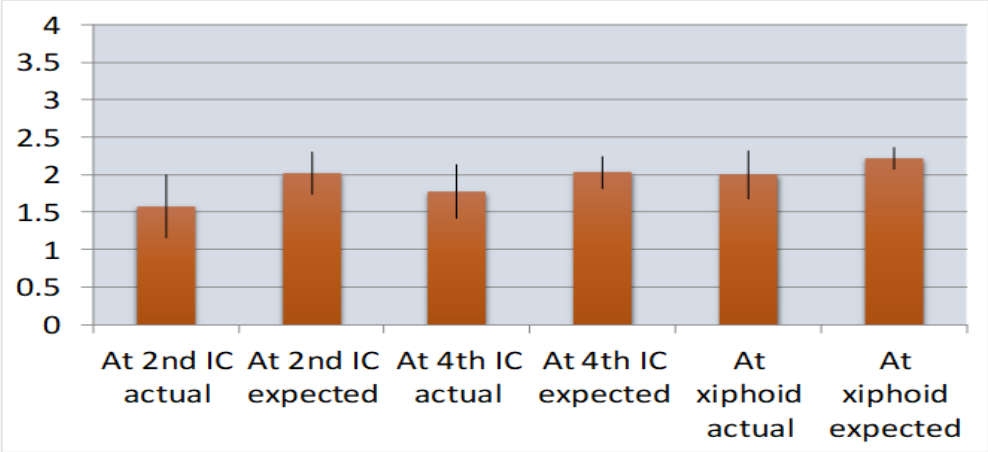
Graph 1 - PEFR values (ml/min) of both males and females



Graph 2 - Values of Chest expansion of Males (in inches)



Graph 3 - Values of Chest expansion of females (in inches)



Values of PEFR and chest expansion have shown statistical difference (p<.05) from predicted values in both males and females.
Student's T-tests showed statistical significance in males having *p value = 0.0002* And females having *p value = 0.0009* for PEFR.
It also showed significant difference in all chest expansion values especially at 2nd and 4th ICS (p<.005) in both males and females

Table 2: Chest expansion for males

CHEST EXPANSION AT	ACTUAL VALUE	PREDICTED VALUE	p VALUE	SIGNIFICANCE
2ND ICS	1.78±0.48	2.69±0.38	0.000001	Significant
4TH ICS	2.29±0.38	2.7±0.41	0.001	Significant
Xiphoid	2.59±0.26	3.03±0.36	0.04	Significant

Table 3: Chest expansion for females

CHEST EXPANSION AT	ACTUAL VALUE	PREDICTED VALUE	p VALUE	SIGNIFICANCE
2ND ICS	1.58±0.42	2.02±0.28	0.00006	Significant
4TH ICS	1.77±0.36	2.03±0.21	0.001	Significant
Xiphoid	2.00±0.32	2.22±0.15	0.03	Significant

DISCUSSION

The present study was conducted with the aim to evaluate the PEFR and chest expansion in patients with cLBP.
This study used the PEFR regression equations for predicted values:

Females: PEF = 168.551 – 1.776*age + 1.354*height(cm)
Males: PEF = 69.259 – 2.290*age+ 2.888*height(cm) [11]
Chest expansion at 2nd,4th intercostal and xiphoid were predicted on the basis of age and gender [12]:

Sr. No.	Level Of Expansion	Age Group (in Years)	Values (in inches)	
			Male	Female
1	2nd ICS	18-24	3.18	2.72
		25-34	2.98	2.38
		35-44	2.9	1.95
		45-54	2.68	2.01
		55-64	2.19	1.75
		65 and above	2.13	1.69
2	4th ICS	18-24	3.12	2.61
		25-34	2.93	2.32
		35-44	3.01	1.93
		45-54	2.51	1.95
		55-64	2.2	1.88
		65 and above	2.09	2.13
3	Xiphoid Process	18-24	3.15	2.41
		25-34	3.23	2.46
		35-44	3.33	2.27
		45-54	2.86	2.17
		55-64	2.63	2.05
		65 and above	2.59	2.01

The diaphragm is an important muscle for breathing; however, it also has a role in preserving the segmental stability of the lumbar spine by maintaining and increasing the intra-abdominal pressure during postural tasks. [10] A mechanism by which greater diaphragm fatigability in LBP patients may contribute to a decreased spinal control in this population, is via the responses evoked by activation of the inspiratory muscle metaboreflex. [10] Thus the fatigue of diaphragm in chronic low back pain patients could be the reason for reduced chest expansion values at 2nd and 4th ICS.

Britto RR et al.(2011), described that the decrease in respiratory function may be due to the weakness of the respiratory muscle and postural dysfunction in the trunk. [13]

A study done by SOUNDARARAJAN, LEO RATHINARAJ ANTONY, et al. (2021) concluded that the pulmonary dysfunction in cLBP is predominantly a result of core muscle weakness but may also due to the intensity of pain and kinesiophobia (fear of movement) associated with it. [3]

The limitations of our study include small sample size, number of males (n = 18) and females (n = 32) not equal. Also, complete Spirometry was not done as only PEFR was calculated. Future studies can include large sample size and can include other parameters of spirometry i.e. FVC and FEV1 and can also include prevalence study of alteration of PEFR and Chest expansion among cLBP patients according to their duration and severity of back pain.

CONCLUSION

We conclude that there is reduction of PEFR and chest expansion values in the patients with chronic low back pain. It may be due to the weakness of abdominals and greater diaphragm fatigability in cLBP.

Declaration by Authors

Ethical Approval: Approved

Acknowledgement: The authors would like to thank the patients of chronic low back pain who participated in this study.

Source of Funding: None

Conflict of Interest: The authors declare no conflict of interest.

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How to cite this article: Sweety Shah, Namya Anandkumar Shah. Effect of chronic low back pain on PEFR and chest expansion. *Int J Health Sci Res.* 2024; 14(3):20-25. DOI: *https://doi.org/10.52403/ijhsr.20240304*

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