Original Article

BREATHING PATTERNS IN PATIENTS WITH LOW BACK PAIN

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ABSTRACT

Background: Low Back pain is common clinical condition encountered in a day to day Physiotherapy practice. Very few authors has so far documented changes in breathing patterns in low back pain while performing certain motor control tests.

Purpose: The aim of the study was to observe the breathing pattern in individuals with low back pain (LBP) both at rest and during motor control tasks.

Material and Method: 150 patients with LBP participated in this study and they were subcategorized further in acute, sub-acute and chronic low back pain patients. The breathing pattern was evaluated at rest (standing and supine position during both relaxed breathing and deep breathing) and while performing clinical motor control tasks, i.e. bent knee fall out, knee lift abdominal test and active straight leg raise. Breathing patterns in patients with LBP were assessed by therapist both visually and via palpation and observational findings were noted. Costo-diaphragmatic breathing was considered as normal breathing pattern.

Result: Observational findings of this study demonstrates altered breathing pattern in patients with LBP during motor control tasks.

Conclusion: At rest, no significant differences were observed in breathing patterns of LBP patients, whereas around 71% patients revealed abnormal breathing pattern during motor control tests.

KEYWORDS: Breathing pattern; Low back pain; Motor control tasks.

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INTRODUCTION

Low back pain is a very common problem in general population. 70-85% of people have back pain at some time in their life.[1] It affects both the gender equally but is more common in women than in men affecting developed than developing countries.[2] Prevalence of low back pain increases with increase in age up to 65 years and consider as a negative factor on recovery of low back pain.[1]

Low back pain is defined as pain localized between the 12th rib and the inferior gluteal folds, with or without radiation to legs. The common causes of back pain includes – degeneration of spine and discs, trunk stabilizers [3], jobs requiring repetitive heavy lifting, the use of machine tools and the operation of motor vehicles [4], excessive mechanical stress on the intervertebral disc[5], Cigarette smoking and tobacco consuming[4] along with psychological factors of patients.[1] Low back pain may be classified as acute, sub acute and chronic. Patient having chronic low back pain i.e. symptoms more than 3 months also presented with decreased muscle strength, impaired motor control, and decreased co-ordination and postural control which interferes with functional activities of patients.[6]

The mechanism of low back pain may be due repetitive loads on back causes decrease in the elasticity of disk. [7, 8] Fissures and tears occur within annular fibers, which decrease the ability

of the disk to provide stiffness during movement.[7]The vertebral end plates may become ossified. The adjacent spongy bone of the vertebral body can begin to sclerose. Blood vessels grow into disks and trigger ossification.[8] The disk can prolapse or protrude as a result of pressure of nucleus and lack of ability of annulus fibrosus to sustain it. In this case of degenerative disk disease, there is a loss of disk height. This increases weight bearing on zygapophyseal joints and causes its degeneration.[8]

Available literature demonstrate the definite impact of low back pain on psychological and functional status affecting health related quality of life of patients.[9]

Some authors have evaluated the cause or effect relationship between the altered biomechanics of spine leading to back pain.[10,11] In addition, recent evidences suggest that diaphragm contribute biomechanically to maintain trunk stability. It has been found that diaphragm by activation of the phrenic nerve resulted in an increase in intra-abdominal pressure with subsequently enhanced spinal stiffness.[12] Diaphragm plays two roles - acts as trunk stabilizer and help in respiration.[13] Along with diaphragm transversus abdominis, pelvic floor muscle and multifidus also stabilize the trunk.[14] The tonic activities of the transversus abdominis and diaphragm are modulated to meet respiratory demands during both inspiration and expiration and provide stability to the spine when there are repetitive limb movements.[15]

It has been found that there is delay in contraction of transversus abdominis resulted in inefficient muscular stabilization [16], impaired kinematics of diaphragm and pelvic floor muscle and changes in respiratory pattern were observed in patient with back pain during a motor control tasks.[17] Therefore these changes in kinematics of trunk stabilizer may be responsible for low back pain. Valsalva maneuver has several effects that improve spinal stability. Valsalva maneuver is a technique frequently used by individuals lifting heavy loads. Some research suggests that breathe holding increases lumbopelvic stability.[15] Also the effect of breath therapy to improve the lumbar stability has been found to be positive in patients with low back pain.[18]

In some studies it has been seen that there is alteration in breathing pattern in patients with chronic back pain.[19] Here an attempt is made to observe the various breathing patterns in patients with different types of low back pain classified on the basis of onset of symptoms.

As limited research available, the present study has been carried out to provide evidence of abnormal breathing pattern in low back pain patients. By confirming abnormal breathing patterns in patients with acute, sub acute and chronic low back pain, future more studies can be conducted to find out the effect of teaching correct breathing pattern techniques as an adjunct to overall management of low back pain.

METHODOLOGY

An Observational study with purposive sampling was conducted at Musculoskeletal department of Physiotherapy OPD, MGM's Institute of Physiotherapy Aurangabad, Maharashtra (India). Total 150 low back pain patients were observed for any alteration of breathing pattern . Before implementing the study an approval from college ethical committee was taken. Patients were explained procedure related to present study. The verbal and written concern was taken from all participants.

Both genders with the age group ranging from 18-65 years who are medically diagnosed patients with low back pain of_postural (i.e. mechanical back pain); degenerative origin (lumbar spondylosis) with or without radiation or discogenic back pain were included in the study.

Patients with Lumbar canal stenosis, Lumbar myelopathy, low back pain secondary to congenital or acquired spinal deformity, low back pain of neurological origin, patients with history of vertebral fractures, patients with neurological deficits such as altered sensation, muscle weakness or altered deep tendon reflexes were excluded.

PROCEDURE:

All the participants meeting inclusion criteria were interviewed for subjective assessment including history and pain evaluation.

150 Participants were then divided equally into three groups according to their duration of

symptoms as:

- Group A : Acute LBP: 3 to 4 weeks
- Group B : Sub-acute LBP: last upto 12 weeks
- Group C : Chronic LBP: more than 3 months [6]

Breathing patterns in patients with LBP were assessed by therapist both visually and via palpation and observational findings noted in master chart. Breathing patterns were assessed in both standing and supine positions under the following conditions:

- Spontaneous breathing – no specific instructions given
- During the performance of these four **motor control tasks**:

1. Active straight-leg raise (ASLR): With the patient lying supine, one leg at a time was lifted 20 cm off the table and held for 10 seconds.

2. Knee-lift abdominal test (KLAT): With the patient supine in crook-lying position, they were instructed to lift one foot off the table with both the hip and knee in 90 degrees of flexion while keeping the lumbar spine stable.

3. Bent-knee fall out (BKFO): With the patient supine in crook-lying position with one leg straight and one bent, they lowered the bent leg to approximately 45 degrees of abduction / lateral rotation while keeping the foot against the straight leg – then they returned to the starting position.[19] A pre-testing trial was organized to familiarize the subjects with motor control task.

The various normal and abnormal breathing patterns commonly observed are explained as follows:

1. Costodiaphragmatic breathing: defined as a displacement of the ribcage in cranial, lateral outward and ventral directions, and outward abdominal movement reversed on expiration, was considered the ideal pattern.

2. Paradoxical breathing: Chest wall moves in on inspiration and out on expiration (reverse of the normal movements).

3. Upper costal breathing: Upper chest moves with inspiration and expiration while the diaphragm is not properly engaged.

4. Mixed pattern breathing: Any of the above patterns mixed together.

5. Breath holding: Holding the breath for few seconds.[19]

In the present study, paradoxical breathing, upper- costal breathing, mixed patterns, and breath holding were all considered as impairments or abnormal breathing patterns in patients with low back pain. These patterns have been shown to adversely influence alveolar ventilation.[19]

RESULTS AND TABLES

All data were analyzed using appropriate descriptive statistics including tables and graphs. We expected that 50–60% of the patients (based on a previous research [22]) would display an asynchronous breathing pattern during motor control tests.

Demographic characteristics:

Table 1: Gender wise distribution of patients based on stage of LBP.

	Gender		
Stage of LBP	Male	Female	Total
Acute	23	27	50
Subacute	19	31	50
Chronic	27	23	50

Table 2: Mean and SD of age and duration of symptoms of patients in various groups.

	Age (in years) Mean ± SD		Duration of symptoms (in weeks)	
Stage of LBP	Male (n=69)	Female (n=81)	Male (n=69)	Female (n=81)
Acute	54±10	48±11	2 ± 1	1.5 ± 1
Subacute	50±14	54±13	8 ± 2	8 ± 2
Chronic	54±14	46±9	94 ± 77	108 ± 61

- During spontaneous breathing we found altered breathing pattern in 34% i.e.17 out of 150 patients with low back pain (n=150) in supine lying position.
- During active straight leg raise we found altered breathing pattern in 84% i.e.127 out of 150 patients with low back pain (n=150).
- During knee lift abdominal test we found altered breathing pattern in 88% i.e.137 out of 150 patients with low back pain (n=150).
- During bend knee fall out test we found altered breathing pattern in 91% i.e.136 out of 150 patients with low back pain (n=150).

Observational findings of respiratory patterns in acute, subacute and chronic low back pain patients during various clinical test

Table 3: Breathing pattern during spontaneous breathing in patients with low back pain.

During spontaneous breathing					
Breathing patterns					
LBP	CD	PB	UC	M	BH
Acute	44	0	3	2	1
	88%	0%	6%	4%	2%
Subacute	45	0	1	2	2
	90%	0%	2%	4%	4%
Chronic	44	0	2	2	2
	88%	0%	4%	4%	4%

During spontaneous breathing 88% acute LBP patients, 90% subacute LBP patients, 88% chronic LBP patients displayed costadiaphragmatic breathing pattern.

Table 4: Breathing pattern during active straight leg raise in patients with low back pain.

During ASLR					
Breathing patterns					
LBP	CD	PB	UC	M	BH
Acute	8	0	5	8	29
	16%	0%	10%	16%	58%
Subacute	9	0	24	7	10
	18%	0%	48%	14%	20%
Chronic	6	0	9	27	8
	12%	0%	18%	54%	16%

During ASLR 58% acute LBP patients displayed breath hold, 48% subacute LBP patients displayed upper costal, 54% chronic LBP patients displayed mixed breathing pattern.

Table 5: Breathing pattern during knee lift abdominal test in patients with low back pain

During KLAT					
Breathing patterns					
LBP	CD	PB	UC	M	BH
Acute	5	0	27	10	8
	10%	0%	54%	20%	16%
Subacute	7	0	8	26	9
	14%	0%	16%	52%	18%
Chronic	5	0	30	9	6
	10%	0%	60%	18%	12%

During KLAT 54% acute LBP patients displayed upper costal, 52% subacute LBP patients displayed mixed, 60% chronic LBP patients displayed upper costal breathing pattern

Table 6: Breathing pattern during bend knee fall out test in patients with low back pain.

During BKFO					
Breathing patterns					
LBP	CD	PB	UC	M	BH
Acute	4	0	8	26	12
	8%	0%	14%	52%	24%
Subacute	6	0	27	7	10
	12%	0%	54%	14%	20%
Chronic	6	0	8	8	28
	12%	0%	16%	16%	56%

During BKFO 52% acute LBP patients displayed mixed, 54% subacute LBP patients displayed upper costal, 56% chronic LBP patients displayed breath hold breathing pattern.

FIGURES:

Fig. 1: Gender wise distribution of patients based on stage of LBP.

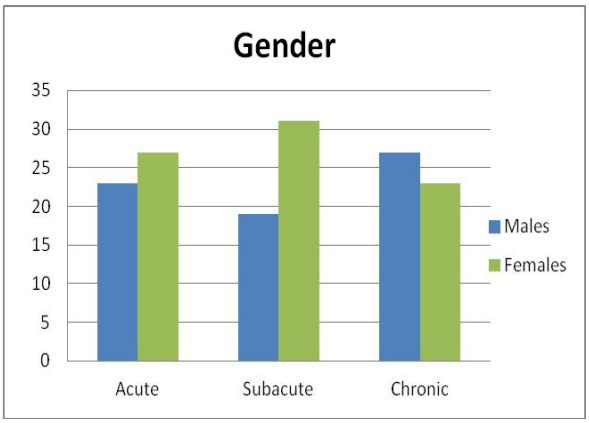


Fig 2: Mean and SD of age of patients in various groups.

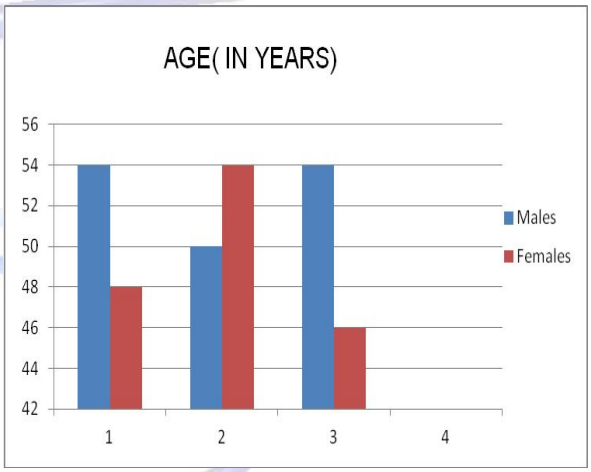
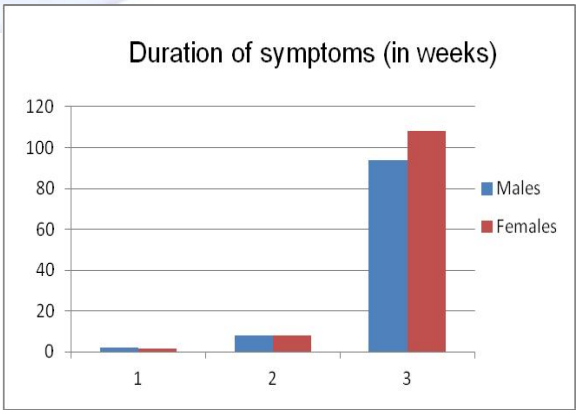


Fig 3: Mean and SD of duration of patients in various groups.



DISCUSSION

The results of present study demonstrated abnormal breathing pattern exists in patients with low back pain while performing various motor tasks. Our findings were supported by the research carried out by Roussel et.al. in 2009.[19] Biomechanically, diaphragm is a principle muscle for respiration and trunk stabilizer.[13] In addition, transversus abdominis muscle is invo-

lved in both postural control[16] and respiration.[23] The coordination of both postural control and respiration seems to be complicated, particularly when either postural control or respiratory demand is increased.[24] Patients with back pain reported altered postural control due to altered activity of tranversus abdominis [21] and diaphragm.[3] Therefore due to increased chances of alterations in normal breathing pattern in low back pain ,the present study was carried out to observe changes in breathing pattern.

In this study patient's breathing pattern was evaluated by visual inspection as well as palpation. Costo-diaphragmatic breathing was defined as normal breathing pattern [25,26] as it allows maximal lung expansion and therefore maximal gas exchange. Paradoxical breathing pattern, upper costal breathing, mixed breathing pattern and breath holding were all considered as abnormal breathing patterns [27], as these are likely to prevent effective alveolar ventilation.[28]

In our study, costo-diaphragmatic breathing pattern in supine position during quiet breathing was observed in almost all participants. But in LBP patients altered breathing patterns expected during various functional tasks may be due altered postural function of diaphragm and transversus abdominis.

To verify this hypothesis, motor control tests were performed during observation of breathing patterns. In this study out of 150 LBP patients more than half of the patients showed an abnormal breathing pattern during the motor control tests, i.e. ASLR, KLAT and BKFO while almost all had normal breathing pattern at rest when supine. It is therefore reasonable that several patients utilize their diaphragm to influence trunk stability and more specifically segmental stability of the lumbar spine, which interfere with their breathing pattern. This result of our study is in accordance with the findings of Hodges P.et.al. that respiratory movements represent a greater disturbance to posture in LBP-patients compared to healthy subjects.[20] Also in one of the study, impaired kinematics of diaphragm and pelvic floor were observed during a motor control test in patients with sacro-iliac joint pain .[29] Further this study demonstrated the type of abnormal breathing pattern in among all participants classified on the basis of duration of LBP as acute, subacute and chronic for comprehensive evaluation.In the present study costadiaphragmatic breathing pattern i.e. normal breathing pattern was observed in 88% acute, 90% in subacute and 88% in chronic low back pain patients during spontaneous breathing. Abnormal breathing patterns in almost all participants in all stages of disease during various functional tasks was seen.

During ASLR breath hold was observed in 58% acute low back pain patients, upper costal in 48% subacute low back pain patients, mixed breathing pattern in 54% in chronic low back pain. During KLAT upper costal breathing was observed in 54% acute low back pain patients, mixed breathing pattern in 52% in subacute low back pain patients, uppercostal in 60% in chronic low back pain patients. During BKFO mixed breathing pattern was observed in 52% in acute, upper costal breathing in 54% in subacute, breath hold in 56% in chronic low back pain patients.These findings of this study are also supported by number of authors. More than half of the patients displayed complete breath hold during ASLR performance. Normalization of this breathing pattern and diaphragmatic kinematics were found in the patients after following an individualized motor learning intervention. [17]

In some studies it has been seen that there is alteration in breathing pattern in patients with chronic back pain[19] as respiration has a continuous fluctuating effect on intradiskal pressure.[30] These respiration-induced intradiskal pressure changes may play a role in the nutrition and consequently in the mechanical behavior of the intervertebral disk.[31] A correct breathing pattern could therefore be very important in LBP-patients, as many of them show degenerated or impaired disks.

One of the studies has found that correct breath therapy is more effective than physical therapy in case of low back pain.[18] Therefore proper breathing exercises, back strengthening exercises, basic stretching exercises, relaxation techniques and ergonomic advice can resolve low back pain problems in patients. Furthermore research is required to add evidence of presence of abnormal breathing patterns in individuals with low back pain including large sample. In addition, the studies can be done to confirm the

effectiveness of correct breathing pattern techniques adjunct to routine treatment to correct the pattern and to reduce the symptoms of LBP.

LIMITATIONS:

· Small sample size.

· Inter or intra observer reliability for confirming the breathing pattern was not done.

· We have not use any device to observe abnormal breathing pattern like pressure biofeedback unit.

· Only manual palpation and/or visual inspection were used to assess the breathing patterns, which is a rather subjective evaluation method.

· Did not try to find out the association between the intensity and duration of LBP pain and the presence of altered breathing pattern.

CONCLUSION

The results of this study suggest that approximately 71% patients with low back pain irrespective of their stage of disease have abnormal breathing pattern while performing various motor tasks.

ABBREVIATIONS

LBP- Low back pain.
ASLR- Active straight leg raise.
KLAT- Knee lift abdominal test.
BKFO- Bend knee fall out.
CD- Costodiaphragmatic
PB- Paradoxical Breathing
BH- Breath Hold
M- Mixed
UC- Uppercostal

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