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## RESEARCH ARTICLE

# EFFECT OF BREATHE HELD AT MAXIMUM EXPIRATION ON PAIN, RANGE OF MOTION, QUALITY OF LIFE AND BREATHING FUNCTION ON PATIENTS WITH LOW BACK ACHE

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**ABSTRACT**

**Study Objectives:** To check whether Does breathe held at maximal expiration could decrease pain and improve the range of motion, QOL and breathing function in non specific low back ache patients. Low back pain is a very common problem in general population. 70-85% of people have back pain at some time in their life. (Andersson, 1997) Low back pain is defined as pain localized between the 12th rib and the inferior gluteal folds, with or without radiation to legs. (Thompson *et al*., 2000) The mechanism of low back pain may be due repetitive loads on back causes decrease in the elasticity of disk. (Thompson *et al*., 2000; Andreas Prescher, 1998) Fissures and tears occur within annular fibers, which decrease the ability of the disk to provide stiffness during movement. Available literature demonstrate the definite impact of low back pain on psychological and functional status affecting health related quality of life of patients. (Kovacs Francisco *et al*., 2004) Some authors have evaluated the cause or effect relationship between the altered biomechanics of spine leading to back pain. (Lane *et al*., 1993; O'Neill *et al*., 1999) 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. (Hodges *et al*., 2005) Diaphragm plays two roles - acts as trunk stabilizer and help in respiration. (Hodges and Gandevia, 2000) Valsalva maneuver has several effects that improve spinal stability.

**Design:** An Experimental Study.

**Methods:** A total of 40 subjects were recruited for the study on the basis of inclusion and exclusion criteria after obtaining informed consent. The subjects were divided into two groups Group A (Breathe Held at Maximum Expiration n=20), and Group B (Traditional Core Stability Exercises n=20).

**Outcome Measure:** Pain using Visual Analogue Scale, ROM using SLR and Breathing function using SEBQ and Quality of Life using WHO QOL-Bref Scale.

**Results:** Analysis of Pain, ROM, Breathing Function and QOL showed that both the group proved to be effective in decreasing the Pain, ROM, Breathing Function and QOL level independently. When results were compared between the groups, Group A showed better improvement than Group B. However the results were statistically insignificant.

**Conclusion:** This study depected that breathe held at maximum expiration technique is effective on decreasing pain, improving ROM and breathe function along with QOL in patients with LBA.



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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 (Andersson, 1997). It affects both the gender equally but is more common in women than in men affecting developed than developing countries (Peter M Kent and Jennifer Keating, 2005). 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 (Andersson, 1997). 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 (Pavel Kolar, 2011), jobs requiring repetitive heavy lifting, the use of machine tools and the operation of motor vehicles (Frymoyer *et al.,* 1983). Excessive mechanical stress on the inter-vertebral disc (Yoganandan *et al.,* 1988). Cigarette smoking and tobacco consuming (Frymoyer *et al.,* 1983) along with psychological factors of patients (Andersson, 1997). 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 (Magee, 2011).

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The mechanism of low back pain may be due repetitive loads on back causes decrease in the elasticity of disk (Andreas Prescher, 1998; Thompson, 2000). Fissures and tears occur within annular fibers, which decrease the ability of the disk to provide stiffness during movement (Thompson, 2000). 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 (Andreas Prescher, 1998). 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 disc disease, there is a loss of disk height. This increases weight bearing on zygapophyseal joints and causes its degeneration (Andreas Prescher, 1998). Available literature demonstrate the definite impact of low back pain on psychological and functional status affecting health related quality of life of patients (Kovacs Francisco *et al.,* 2004). Some authors have evaluated the cause or effect relationship between the altered biomechanics of spine leading to back pain (Lane *et al.,* 1993; O'Neill *et al.,* 1999). 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 (Hodges *et al.,* 2005). Diaphragm plays two roles - acts as trunk stabilizer and help in respiration (Hodges and Gandevia, 2000). Along with diaphragm transversus abdominis, pelvic floor muscle and multifidus also stabilize the trunk. 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 (Carolyn Kisner, 2007). It has been found that there is delay in contraction of transversus abdominis resulted in inefficient muscular stabilization (Richardson *et al.,* 1996) 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 (O'Sullivan and Beales, 2007). Therefore these changes in kinematics of trunk stabilizer may be responsible for low back pain. Valsalva maneuver has several effects that improve spinal stability. Core stabilization exercises links to the most effective abdominal training and increases one's strength and stamina. Core strengthening exercises programme aims to improve stabilization and support to the spine. The muscles mainly involved in maintaining the trunk stability are multifidus and transversus abdominis. This therefore helps in improving the endurance of trunk extensors and preventing future back ache. (Gauri Shankar, 2012) In breathe held at maximum expiration technique the subject is instructed to hold his/her breathe after the maximum expiration. Kaneko *et al.* (2005) found that the percent change in transverus abdominis muscle thickness with maximum expiration was 86%. Misuri *et al.* (1997) showed that the mean thickness of the tranversus abdominis muscle was 10 mm in maximum expiration and 13 mm during maximal expiratory effort against a closed airway. As it has been proved that the strengthening of transversus abdominis decreases LBP (Carolyn *et al.,* 2002).

## MATERIALS AND METHODS

An experimental study was conducted on total of 40 subjects who were enrolled from Civil Hospital Gandhi Nagar Gujarat, on the basis of inclusion and exclusion criteria. This study was approved by ethical commity of Dolphin (PG) Institute of Biomedical and Natural Sciences, Dehradun. Subjects were divided into 2 groups after informed consent was informed. Group A (Breathe Held at Maximum Expiration n=20), and Group B (Traditional Core Stability Exercises n=20). Pre intervention readings of pain using Visual Analogue Scale, ROM using SLR and Breathing function using SEBQ and Quality of Life using WHO QOL-Bref Scale were carried out for each patient. For both the group interventions was given five times in a week for 4 weeks. Post intervention reading was calculated in the same manner as pre intervention after the end of 4 weeks. Protocol for Group A (BREATHE Held at Maximum Expiration): All the patients in this group received Held at Maximum Expiration. In this training First evaluate the breathing pattern dysfunction was evaluated which started with the subjective examination of the patient was used. Formal assessment of the breathing pattern was performed in the standing, seated and supine position. Once the breathing pattern was evaluated the patient started the exercises if the pattern was correct. If dysfunctional breathing pattern was observed, patient was explained the proper breathing pattern and trained for same by therapist or visual feedback. Subjects were positioned in the crook lying position. The verbal instruction for the maximum expiratory task was "breathe out maximally and hold your breathe for 5 seconds (Ishida *et al.,* 2012). Maximum expiration was performed with "almost maximal" effort which is equivalent to a rating of 10 on the burg scale. All the subjects performed 3 sets of 10 repetitions a day, 5 days a week for 4 weeks. Protocol for Group B (Traditional Core stability exercises): All the patients in this group received traditional core stability exercise which included curl ups and back extension exercises for 5 days a week, for 4 weeks 5 repetitions 2 times a day. Each exercise was performed with a hold period of 10 seconds (Gauri Shankar, 2012).

### Data analysis

Data was analysed using software SPSS version 16.0. Descriptive analysis was done to calculate the mean of age, weight, and height of all subjects. Independent t-test was done to compare data between the groups. Paired t-Test was used for analysis of the data comparison within the groups. The statistical significance was set as 95%, confidence interval with p value $<0.05$ considered to be significant.

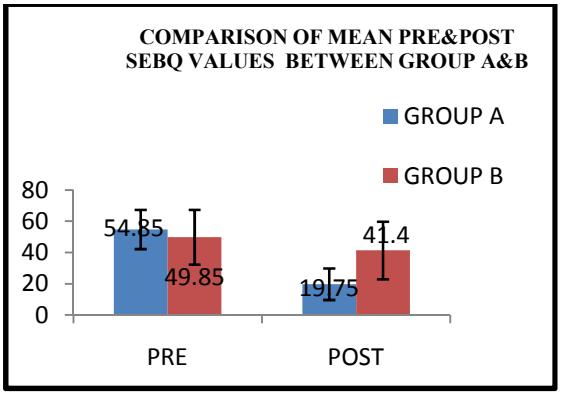
## RESULTS

Analysis of Pain, ROM, Breathing Function and QOL showed that both the group proved to be effective in decreasing the Pain, ROM, Breathing Function and QOL level independently. When results were compared between the groups, Group A showed better improvement than Group B. However the results were statistically insignificant.

## DISCUSSION

The results of the present study on 40 patients with LBP, who underwent a residential intensive training program for 4 weeks, showed that there was better improvement in quality of life in all domains; VAS scale and SEBQ score in Breathing Pattern

Rehabilitation group than the control group. The present literature suggests a lot about the relationship of dysfunctional breathing and backache. (Abe *et al.,* 1996; Katherina *et al.,* 2004) When the results for VAS were evaluated both the groups showed significant improvement; although Group A proved to be more effective when between



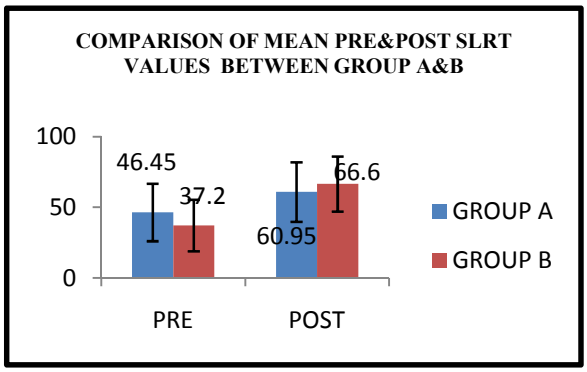




**Fig. 1. Comparisons of mean slrl values between groups**

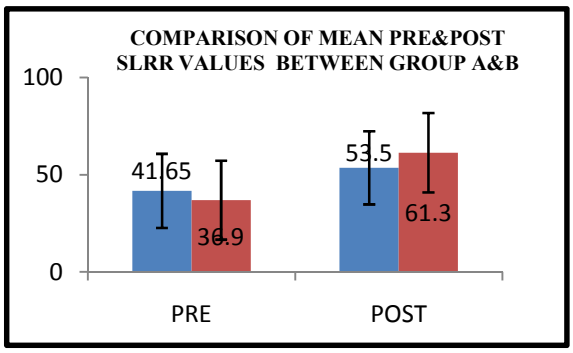



**Fig. 2. Comparison of mean slrr values between groups**

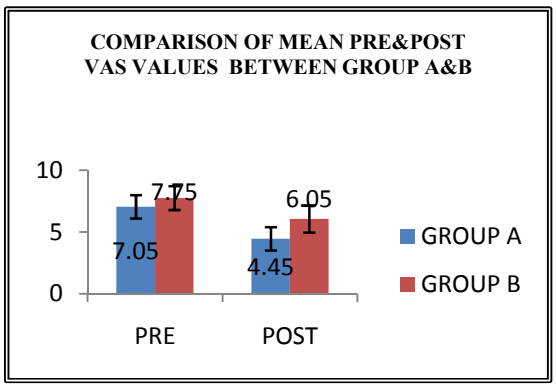



**Fig. 3. Comparison of mean vas values between groups**

roups analysis was evaluated. The results could be the increase in function of breathing which in turn could have shown a positive effect on decreasing back pain. (Courtney *et al.,* 2005)

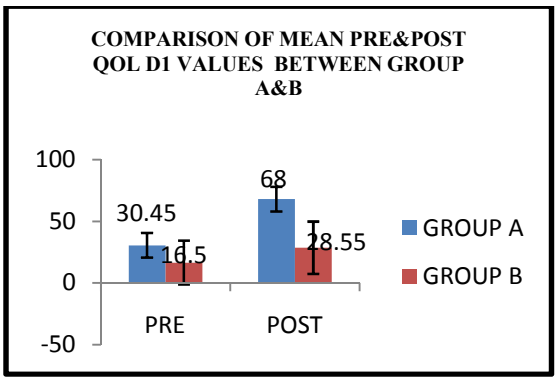



**Fig. 4. Comparison of mean sebq values between groups**

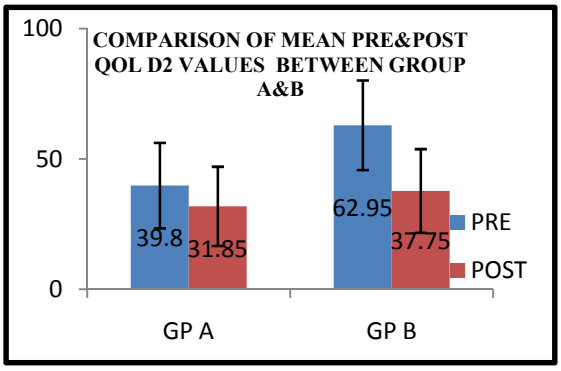



**Fig. 5. Comparison of mean qold1 values between groups**

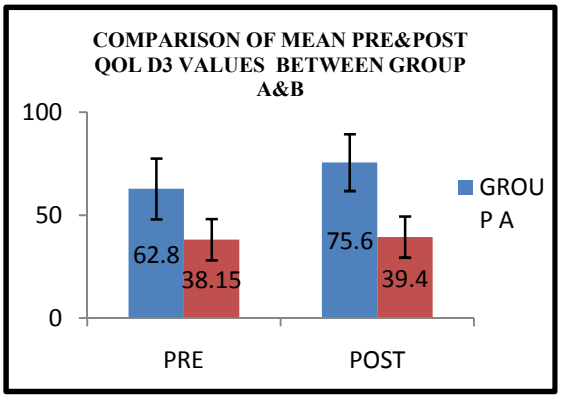



**Fig. 6. Comparison of mean qold2 values between groups**

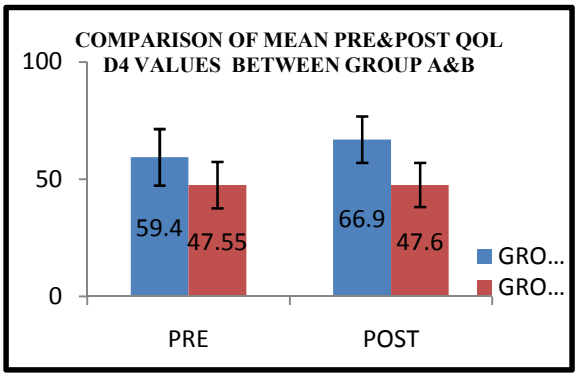



**Fig. 7. Comparison of mean qold3 values between groups**

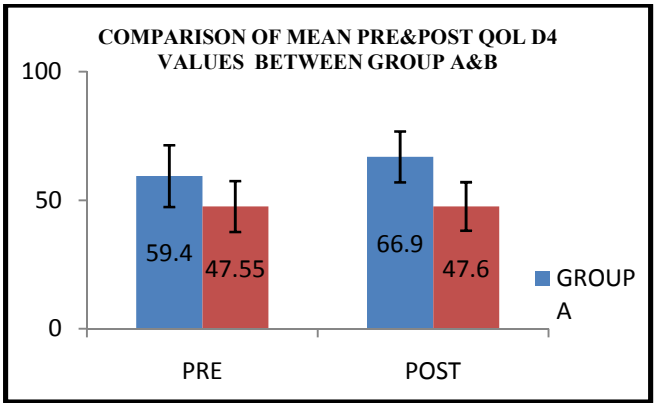



**Fig. 8. Comparison of mean qold4 values between groups**

Muscles such as the diaphragm, transverse abdominis and pelvic floor muscles are important for motor control and postural support as well as for breathing. If their function is compromised there is an increased susceptibility to back pain and injury. As Abdominal muscle weakness aggravates diaphragm dysfunction. Both tonic and phasic contraction of abdominal muscles assist the function of the diaphragm during inspiration and expiration and can to some extent compensate for diaphragm dysfunction (Courtney Rosalba, 2009). Which in turn can aggravate back pain. When the results for SLR were evaluated on both the sides there was non- significant difference between the effects of both the groups. Although both the groups proved to have significant improvement in SLR but we can't depict which one is better. The result behind it can be the positive effect of both the exercises on pain. It could be explained that both the techniques decreases pain hence increased range of motion equally. When the results for SEBQ were evaluated both the groups showed significant improvement; although Group A proved to be more effective when between groups analysis was evaluated.

Contraction of the abdomen during inspiration prevents the diaphragm from shortening excessively during standing posture and during rapid and large volume respiratory maneuvers (Courtney Rosalba, 2009). During expiration contraction of the abdomen assists diaphragm doming, increasing its length and curvature in preparation for effective contraction during inspiration (Courtney Rosalba, 2009). The result of the present study depicted that breathe held at maximum expiration could be a useful technique to train abdominal muscles and improve breathing function. The results are supported by Hiroshi Ishida *et al.,* 2012, who founded that breathe held at maximum expiration significantly increases the thickness of the transversus abdominis and Internal Oblique muscle compared to the abdomen drawing in maneuver. Hence we could suggest that strengthening of transversus abdominis in the present study could have improved the function of diaphragm and hence improved the breathing function. The results of analysis of WHOQOL proved that Group A is more effective in improving the quality of life of the subjects with LBA; although the results were not statistically significant except the psychological variable. There are many available interventions for alleviating back pain. Appropriate management of chronic back pain has been reported to have a positive effect on patients (Bronfort *et al.,* 2011). A study of the neuromuscular control unit (neural subsystem) and the spinal muscles (active subsystem) in patients with back pain showed delayed recruitment of the MF and reduced cross-sectional area of this muscle compared to healthy individuals (Silfies *et al.,* 2009; Hides *et al.,* 1996). One study also demonstrated that pain was not resolved without performing specific exercise (Hides *et al.,* 1996). Another study compared the neuromuscular responses of the TrA in patients with back pain with those of healthy individuals (Hodges and Richardson, 1996). It showed that the patients with back pain had delayed neuromuscular responses, which caused instability of the spine. Other than the study by Panjabi, who reported that deformed neuromuscular control influences the spinal muscles (Panjabi, 2006) few studies have evaluated the active subsystem of the TrA, which plays an important role in lumbar stabilization. Recently, a maximum expiration exercise was introduced as a training method for maintaining trunk stability while increasing the activity of the expiratory muscles of the TrA (Ishida *et al.,* 2012). The exercise is aimed at increasing TrA activity more than that of the internal oblique (IO), and external oblique (EO), global trunk muscles, and it is easier to perform than the abdominal hollowing method (Ishida *et al.,* 2012). Maximum expiration increases the activity of the TrA. According to Hiroshi Ishida *et al*. the maximum expiration may be an effective method for training of co-activation of lateral abdominal muscles too (Ishida *et al.,* 2012). Abe *et al.* (1996) reported that abdominal muscles are activated differently, the transversus abdominis is the most active followed by the Internal Oblique and External Oblique (Abe *et al.,* 1996).

According to Shankar and Chaurasia (2012), poor endurance of trunk muscles may induce strain on passive structure of lumbar spine and hence result in LBA. (Gauri Shankar, 2012) The present study breathe held at maximum expiration was found to have a significant decrease in LBA. The possible cause can be explaied on the basis of the relationship between the presence of LBP and delay in the activation of transversus abdominis muscle suggesting that the transversus abdominis muscle is important for normal motor control during active movement. (Hodges, 1999) Exercise techniques that promote independent contraction of the transversely oriented abdominal muscles have been demonstrated to have beneficial effects in relieving pain and disability in patients with chronic non specific low back pain and lowering recurrence rates after an acute pain episode (Monica Unsgaard *et al.,* 2012). Mean Baseline scores for this domain in breathing pattern rehabilitation group was 30.45 (mean of transformed score) increased to 68 after breathing pattern rehabilitation. This domain of WHOQOL Bref deals with features such as mobility, fatigue, pain, sleep, work capacity etc The observed improvement can be attributed to reduction in pain and disability with improvement in spinal flexibility (Tekur, 2008). Which was better than physical therapy exercises group which was 16.5 and 28.55 pre and post intervention.

When psychological health was considered group A proved to be more effective. The reason behind it could be improvement in their function and decrease in pain. Mean Baseline score for social and environmental health domains in breathing pattern rehabilitation group was better than physical therapy exercises group which could be easily related to their psychological and

social domains. Trunk flexor and extensors endurance training has been recommended as means of increasing fatigue threshold and improving performance and reducing disability (Kurt Jorgensen and Tom Nicolaisen, 1997). This maneuver-breathe held at maximum expiration might be considered a useful way of progressing toward more challenging exercises including co-activation of deep and superficial muscles in dynamic and functional tasks. It could be effective for multi-purposes like pain and range of motion, with improvement in dysfunctional breathing which will itself have a positive effect on low back pain. The overall effect of pain, range of motion in addition with function will indeed improve the QOL of patients.

**Conclusion**

Based on the findings of the present study, it can be depected that breathe held at maximum expiration technique is effective on decreasing pain, improving ROM and breathe function along with QOL in patients with LBA.

**Clinical Significance**

Breathe held at maximum expiration technique is easy to perform and strengthens transverses

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