

ORIGINAL ARTICLE

IJPHY

COMPARISON OF EFFECTIVENESS OF DIAPHRAGMATIC BREATHING AND PURSED-LIP EXPIRATION EXERCISES IN IMPROVING THE FORCED EXPIRATORY FLOW RATE AND CHEST EXPANSION IN PATIENTS WITH BRONCHIAL ASTHMA

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ABSTRACT

Background: Asthma is growing problem in India and throughout the world. Breathing exercises are commonly incorporated in overall pulmonary rehabilitation program of patients with bronchial asthma. However there is a lack of awareness regarding following a specific exercise prescription which is based on individual's requirements. Physiotherapist can help in designing an exercise prescription specific to an individual possibly to achieve more control over bronchial asthma.

Methods: Thirty patients both male and female aged between 20 and 40 years diagnosed with bronchial asthma by the physician were assigned in two groups. Group-1 patients were given diaphragmatic breathing exercises and group-2 patients were given pursed-lip expiration exercises. Both groups received selected intervention for 6 weeks, 5 days in a week, 2 times in a day, and 20 minutes per session. Pre and post-test measures of forced expiratory flow rate were taken by peak expiratory flow meter and chest expansion was measured by inch tape. Data were analysed using Statistical Package for Social Sciences (SPSS) version 17.0 software. The analysis was performed by using students paired t-test.

Results: The study shows statistically significant improvement in diaphragmatic breathing exercise group when compared to pursed-lip expiration exercise group. The value of chest expansion has shown 2.04 % improvement in group 1 and 1.01 % in group 2 whereas peak expiratory flow rate (PEFR) showed 16.9 % improvement in group 1 and 2.27 % in group 2.

Conclusion: Diaphragmatic breathing exercises play a vital role in rehabilitation of asthmatic patients to gain functional improvement and independence.

Keywords: Bronchial asthma, Diaphragmatic breathing exercise, Pursed-lip expiration exercise, Forced expiratory flow rate, Chest expansion

Received 01st December 2015, revised 19th January 2016, accepted 04th February 2016



www.ijphy.org

10.15621/ijphy/2016/v3i2/94871

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INTRODUCTION

Bronchial asthma is a growing problem throughout the world. It is one of the commonest respiratory diseases occurring in younger age group as well as older population [1-12]. In bronchial asthma smooth muscles of bronchial wall become hyper responsive to a wide range of stimuli resulting in coughing, wheezing, chest tightness and dyspnea [2]. This can be treated prophylactically and physiotherapeutically. Prophylactic measures aim at reducing bronchospasm, whereas physiotherapeutic measures aim at relaxing the patient improving lung function, gaining breathing control (breathing control consist of normal breathing using the lower chest with the upper chest and limbs relaxed), reducing severity of attacks and rehabilitation [3].

Incidence of asthma is increasing and demands more effective treatment procedures. It is known fact that exercise has a positive effect in controlling bronchial asthma, but there is lack of awareness on following a specific exercise prescription which is based on individuals' requirements. Physiotherapist can help in designing an exercise prescription specific to an individual possibly to achieve more control over bronchial asthma [4,5].

Even though the diaphragmatic breathing and pursed-lip expiration exercises are the two available forms of treatment, a thorough understanding of the procedure will enable the therapist to advice the patient and improve the pulmonary function and chest expansion. [6] Hence the study is undertaken to throw more light on the two physiotherapy techniques (diaphragmatic breathing and pursed-lip expiration) and their effect on forced expiratory flow rate (FEFR) and chest expansion in patients with bronchial asthma.

MATERIALS AND METHODS

The present study is a pre-test post-test experimental study, conducted in bronchial asthma patients (both male and female) between the age group of 20-40 years. The bronchial asthma patients referred from the Department of Medicine by the physician reporting to Yenepoya Medical College Hospital, Mangalore, Karnataka, India, constituted the population of the study. A total number of 50 patients were screened using the following proforma out of which 30 met the inclusion criteria. The patients were required to fulfil the following criteria to be included in the study: (i) mild (daytime symptoms more than once a week, (ii) nocturnal symptoms more than twice a month, peak expiratory flow rate/ force expiratory flow volume in one second (PEFR / FEV1 > 80%) and (iii) moderate (day time symptoms daily, nocturnal symptoms more than once a week, PEFR / FEV1: 60 – 80%) persistent bronchial asthma patients. Subjects were excluded from the study if they had the following problems: (i) non co-operative patients, (ii) status asthmatics patients and (iii) patients of asthma associated with other respiratory and cardiac diseases.

Ethical clearance from the Yenepoya University Ethical Committee was obtained prior to the commencement of the study. The purpose of the study was explained to the

patients in their language. All patients signed an institutionally approved informed consent statement prior to data collection. Thirty patients were assigned into two groups (group-1 and group-2). Each group consisted of equal number (15) of patients.

(a) Group - 1

Patients were given diaphragmatic breathing exercise for 6 weeks (5 days in a week, 2 times in a day for 20 minutes per session). The patient was asked to relax and positioned in a comfortable position so that his/her back and head are fully supported and his/her abdominal wall relaxed (fowler's position). The researcher places his hands on the rectus abdominals just below the anterior costal margin. Patient was asked to breathe in slowly and deeply through the nose. Patient was instructed to keep the shoulders relaxed and upper chest quiet, following the abdomen to rise. Then the patient was asked to slowly let all the air out using controlled expiration with pursed-lip. This was applied for three or four times and then rest. Care was taken not to hyperventilate the patient. Three or four sets were applied in a 20 minutes treatment session.

(b) Group - 2

Patients were given only pursed-lip expiration exercise for 6 weeks (5 days in a week, 2 times per day for 20 minutes per session). The patient was asked to relax his or her shoulder muscles and asked to breathe in (inhale) slowly through his or her nose for two counts, keeping mouth closed. Then he/she was asked to pursue their lips as if they were going to whistle or gently flicker the flame of a candle. Finally breathe out (exhale) slowly and gently through pursed-lips while counting to four. Periodic assessment was taken every week by the physiotherapist to find out whether the patients were doing the exercise daily or not.

Mini wright peak flow meter was used to measure the peak expiratory flow rate. The meter was calibrated by hand to ensure consistent accuracy and reproducibility. The flow meter measures the speed at which air is exhaled from lungs, giving a measurement of how well airways are working. It has a clear, easy to read scale which measures from 30 to 400 L/min (low range) and from 60 to 850 L/min (standard range).

FEFR readings provide an objective measure of how well the lungs are functioning. An increase in an individual's FEFR value reveals lung function that has got better and, a decrease in FEFR highlights that the lung function has got worse. When asthma is well controlled, FEFR readings are at their highest, and do not vary from day to day; big changes in peak flow suggests that the disease is not fully under control. The patient was asked to take in deepest breath possible then to put the mouth piece in the mouth and to give a short sharp, fast explosive blow into the meter. The meter readings were kept at zero. The test was repeated twice and the best of the three attempts was recorded.

Standard inch tape was used to measure the chest expansion. The flat inch tape was placed around the chest and

then the patient was asked to breath out as far as possible in which the measuring tape was drawn taut, patient was then asked to breathe in as deeply as possible, at the same time allowing the tape measure to be released and the two measurements were recorded.

Data were analysed using Statistical Package for Social Sciences (SPSS) version 17.0 software. The analysis was performed by using students paired t-test and statistical significance was accepted for $p < 0.05$.

RESULTS

Table 1 compares the age of patients involved in the study. The mean age in diaphragmatic and pursed lip expiration group was 58.00 ± 8.28 and 53.33 ± 7.65 respectively. There was no significant difference between the two groups with respect to ages ($p = 0.121 > 0.05$). In group 1, 86.7 % were males and 13.3 % were females and in group 2; 93.3 % were males and 6.7 % were females (Figure 1 and Table 2). There was no significant difference between the groups with respect to male/female ratio as $p = 0.543 > 0.05$.

Table 1: Comparison of age of patients in the experimental groups

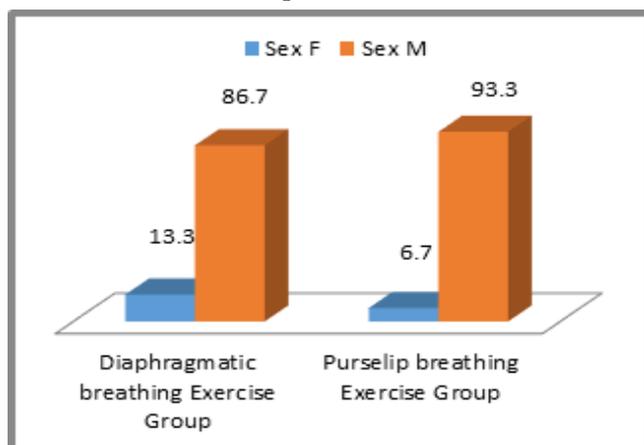
Age Group	No. of Patients (N)	Minimum age	Maximum age	Mean	Standard deviation	t value	p value
Diaphragmatic breathing exercise group	15	38	69	58.00	8.289	1.601	0.121 NS
Pursed-lip breathing exercise group	15	39	62	53.33	7.659		
Total	30	38	69	55.67	8.193	-	-

NS – not significant

Table 2: Gender wise distribution of patients in the study group

Sex	Group		Total
	Diaphragmatic breathing Exercise Group	Pursed lip breathing Exercise Group	
F	2 13.3%	1 6.7%	3 10.0%
M	13 86.7%	14 93.3%	27 90.0%
Total	15 100.0%	15 100.0%	30 100.0%

Figure 1: Bar diagram showing gender distribution of patients



The chest expansion and PEFR recorded before the treatment (pre-test) are shown in Table 3. The difference between the two groups was not significant (Table 3). The post-test results for group 1 are provided in Table 4. In diaphragmatic breathing group, chest expansion before the intervention was 81.67 ± 10.17 and it becomes 83.33 ± 9.98 after the treatment; resulted in 2.04 % improvement ($p < 0.001$). PEFR before the treatment was 96.67 ± 34.16 and after the treatment, it becomes 113.00 ± 36.34 (16.9 % improvement). The results hence showed that the treatment was effective for both chest expansion and PEFR. Figure 2 schematically shows the result.

Table 3: Comparison of chest expansion and PEFR before (Pre-) treatment

Parameter	Group	N	Mean	Std. Deviation	t value	p value
Chest expansion (cm)	Diaphragmatic breathing Exercise Group	15	81.67	10.168	1.162	0.255
	Pursed lip breathing Exercise Group	15	86.13	10.868		NS
PEFR (Lt/min)	Diaphragmatic breathing Exercise Group	15	96.67	34.157	0.528	0.602
	Pursed lip breathing Exercise Group	15	105.33	53.601		NS

Table 4: Pre- and post-comparison of chest expansion and PEFR in diaphragmatic breathing exercise group

Parameter	N	Mean	Std. Deviation	Mean Difference	Change (%)	t value	p value	
Chest expansion (cm)	Pre	15	81.67	10.17	1.67	2.04	13.23	$P < 0.001$ HS
	Post	15	83.33	9.98				
PEFR (Lt/min)	Pre	15	96.67	34.16	16.33	16.90	8.25	$P < 0.001$ HS
	Post	15	113.00	36.34				

HS –highly significant

Figure 2: Pre- and post-comparison of chest expansion and PEFR in diaphragmatic breathing exercise group

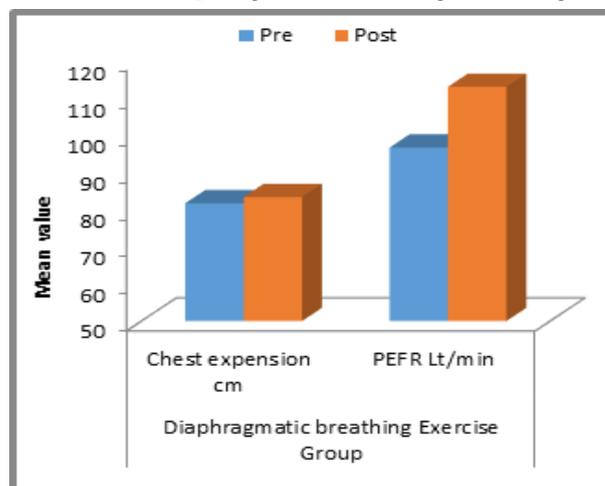


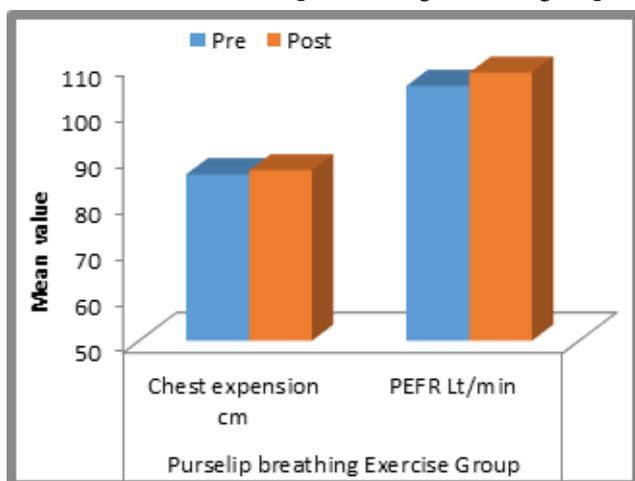
Table 5 shows the results of pursed-lip breathing group where the chest expansion before and after the treatments were 86.13 ± 10.87 and 87.00 ± 10.72 respectively (1.01 %

improvement). PEFR before the treatment was 105.33 ± 53.60 and after the treatment, it turned out to be 108.20 ± 53.45 with 2.72 % improvement. Hence the treatment is effective for both chest expansion as well as PEFR (Figure 3).

Table 5: Pre and post comparison of chest expansion and PEFR in pursed-lip breathing exercise group

Parameter	N	Mean	Std. Deviation	Mean Difference	Change (%)	t value	p value
Chest expansion (cm)	Pre	86.13	10.87	0.87	1.01	4.52	P<0.001 HS
	Post	87.00	10.72				
PEFR (Lt/min)	Pre	105.33	53.60	2.87	2.72	8.53	P<0.001 HS
	Post	108.20	53.45				

Figure 3: Pre- and post-comparison of chest expansion and PEFR in Pursed lip breathing exercise group

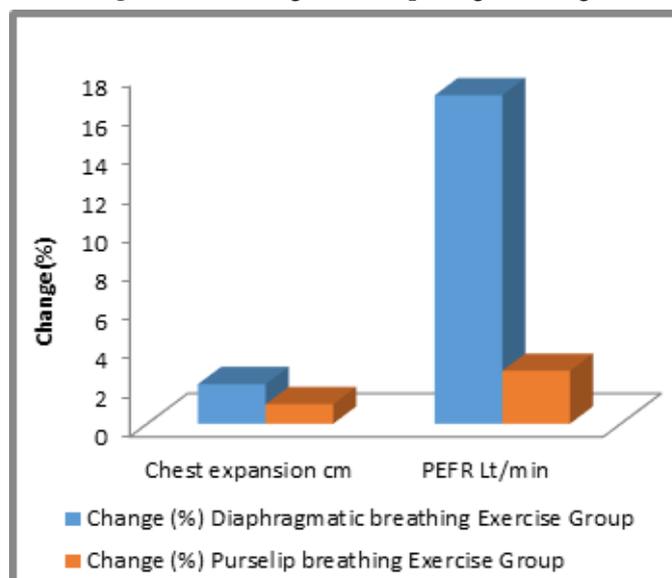


A comparison of % change between the groups is also provided (Table 6 and Figure 4). The value of chest expansion has shown 2.04 % improvement in group 1 and 1.01 % in group 2 whereas the PEFR showed 16.9 % improvement in group 1 and 2.27 % in group 2. The results hence clearly showed that the treatment performed in group 1 was significantly more effective than that performed in group 2.

Table 6: Comparison between groups

Parameter	Group	N	Mean Difference	Standard Deviation	Change (%)	t value	p value	p value
Chest expansion (cm)	Diaphragmatic Exercise Group	15	1.67	0.488	3.485	3.485	0.002	HS
	Pursed lip Exercise Group	15	0.87	0.743				
PEFR (Lt/min)	Diaphragmatic Exercise Group	15	16.33	7.669	6.705	6.705	P<0.001	HS
	Pursed lip Exercise Group	15	2.87	1.302				

Figure 4: Bar diagram comparing % change



DISCUSSION

The study was conducted on 30 bronchial asthma patients between the age group of 20 to 40 years. The result of the study in six weeks duration showed that there is significant improvement in FEFR and chest expansion in diaphragmatic breathing exercise group. The results are in agreement with the report of Holloway and Ram [13], where it was found that diaphragmatic breathing technique relieves the symptoms of bronchial asthma and also increases FEFR, chest expansion and a significantly improves the quality of life.

Literature on diaphragmatic breathing and pursed-lip breathing reveals that pursed-lip breathing is effective in decreasing dyspnoea, it improves gas exchange in people with moderate to severe, but stable chronic obstructive pulmonary disease. These positive effects appear to be related to the technique's ability to decrease air way narrowing during expiration, an effect attributed to decreasing the resistive pressure drop across the air way wall. Thus pursed-lip breathing could only be expected to be beneficial to those people with narrowing of larger air ways during expiration which would exclude people with mild disease. Only a few studies demonstrated positive effects during diaphragmatic breathing. These effects appeared to be associated with slowing the respiratory rate and not improving ventilation or volume of oxygen maximum. Pursed-lip breathing is often adopted naturally and diaphragmatic breathing requires skill and extensive training. Our interpretation of the evidence is that pursed-lip can be a valuable rehabilitation tool in selected cases and that there is no rationale for teaching diaphragmatic breathing to this patient population.

Traditionally, physical therapist classifies diaphragmatic breathing and pursed-lip breathing as breathing retraining techniques. To date, no studies were found that investigated patients' ability to use these techniques during functional activities, which may require use of the techniques over prolonged periods of time. This should be a focus of future

research. Future studies would include measures which may better clarify the mechanisms for dyspnoea reduction with pursed-lips breathing and diaphragmatic breathing such as inspiratory capacity, the duty cycle, pace, and thoraco abdominal changes during walking [14].

In recent years, asthma treatment has been focused on pharmacological protocols designed to control asthma and the inflammatory process of the disease. Other therapeutic approaches to help control asthma have been neglected. Studies on physical exercise, breathing exercises, and physiotherapeutic approaches have been performed to determine the clinical and physical benefits of these interventions on bronchial asthma. Specific inspiratory muscle training improves muscle strength and endurance which results in reduced asthma symptoms, hospitalizations for asthma, emergency department contacts, absences from school or work, and medication consumption.

The use of breathing exercise in the clinical treatment of older adults with asthma can be effective, and the improvements in muscle strength can help in dealing with asthma crisis. New randomised, double-blind, placebo-controlled studies with larger sample populations are needed, especially for older asthmatic patients. Future studies could examine both the outcomes used in this study and outcomes associated with airway hyper-reactivity and inflammatory markers to better understand the physiological mechanisms of these interventions [15].

CONCLUSION

The results of the study are in favour of diaphragmatic breathing exercise group as it has resulted significant improvement in FEFR and chest expansion. Thus it can be concluded that diaphragmatic breathing exercise plays a vital role in the rehabilitation of asthmatic patients to gain the functional improvement, independence and to reduce functional impairments and symptoms.

ACKNOWLEDGEMENT

The authors thank Dr. Veena Vaswani, Professor and Head, Department of Forensic Medicine, Yenepoya University for her valuable guidance and suggestions for the research study. We also thank Mrs. Neevan D'souza for her help in statistical analysis of the data.

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Citation

G. Shine, Shaikhji Saad, Shaikhji Nusaibath, Abdul Rahim Shaik, & S. Padmakumar. (2016). COMPARISON OF EFFECTIVENESS OF DIAPHRAGMATIC BREATHING AND PURSED-LIP EXPIRATION EXERCISES IN IMPROVING THE FORCED EXPIRATORY FLOW RATE AND CHEST EXPANSION IN PATIENTS WITH BRONCHIAL ASTHMA. *International Journal of Physiotherapy*, 3(2), 154-158.