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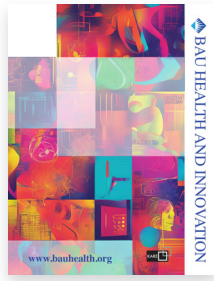

Original Article

The Effect of Breathing Exercises on Respiratory Function Test Parameters and Dyspnea in Patients with Chronic Obstructive Lung Disease and Asthma: A Retrospective Study

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Abstract

Objectives: Chronic lung diseases affect quality of life and are characterized by dyspnea and exacerbation. In addition to pharmacological treatments, pulmonary rehabilitation programs aim to reduce the impact of the disease. The aim of this study is to investigate the effectiveness of breathing exercises (BEs) on pulmonary function tests (PFTs) and dyspnea in patients with chronic obstructive pulmonary disease (COPD) or asthma.

Methods: In this retrospective study, a total of 60 patients diagnosed with COPD (n = 30) and asthma (n = 30) were included between August 2020 and March 2021. All participants performed BEs 4 days a week for 4 weeks, and their effects were evaluated. The functional status of the participants was evaluated with PFT (forced vital capacity [FVC], forced expiratory volume-1 (FEV1), FEV1/FVC, peak expiratory flow) parameters and dyspnea severity with the modified Borg scale. In addition, blood oxygen saturation and heart rate were also recorded and evaluated.

Results: After 4 weeks BEs program, it was observed that there was an increase in FEV1/FVC value among PFT parameters in patients diagnosed with asthma and no significant change in other values, while there was no change in pulmonary function parameters, blood oxygen saturation and heart rate results in patients diagnosed with COPD.

Conclusion: It was found that PFT parameters, blood oxygen saturation, and heart rate remained stable during the 4-week follow-up period in individuals with COPD and asthma who performed BE.

Keywords: Asthma, breathing exercises, chronic obstructive pulmonary disease, modified borg scale, pulmonary function test.

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Chronic obstructive pulmonary disease (COPD) is a chronic, progressive, irreversible lung disease characterized by airflow limitation. Airflow limitation in COPD develops as a result of parenchymal damage and inflammatory responses. While chronic inflammation causes remodeling, decreased elasticity of lung tissue, deterioration of its structure, and narrowing of the small airways, the decrease in elastic retraction force due to parenchymal damage makes it difficult to maintain airway strength and patency during expiration.[1] In reviewing the

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current classifications of COPD, an attempt has been made to divide it into two subcategories, with the predominant complaints being chronic bronchitis and emphysema. While chronic bronchitis reflects a clinical definition, emphysema includes a more pathological definition, and both definitions cause varying degrees of airflow limitation in patients. Chronic bronchitis is defined as the presence of complaints of cough and sputum production that persist for at least 3 months/year for at least 2 consecutive years, without causes such as tuberculosis, bronchiectasis, or lung abscess. Emphysema is defined as abnormal, permanent expansion and structural deterioration of the airways distal to the terminal bronchioles, together with tissue destruction, without significant fibrosis.[2] However, since this classification is distinguishable in very few patients with COPD and can be present at different rates, this distinction is no longer used.

People with COPD have muscle weakness in the diaphragm and other respiratory muscles. Respiratory muscle dysfunction is mainly due to mechanical effects caused by increased ventilation. Factors such as increased ventilation and airway resistance in COPD cause premature fatigue and weakness of the respiratory muscles. It is important to remove the chronic mucus produced in COPD from the lungs, maintain or increase limb muscle strength, and respiratory muscle strength to maintain quality of life in a patient with COPD. Therefore, respiratory muscle exercises are applied to this group of patients as part of respiratory rehabilitation.[3]

Asthma, a chronic and inflammatory airway hypersensitivity, is characterized by episodes of wheezing, dyspnea, and coughing. In asthma, the smooth muscles around the airways contract in response to triggers such as allergens, smoke, cold air, or exercise. In addition, the airways narrow due to increased mucus production. The causes of asthma may be genetic, working in jobs with inhaled dust and chemicals, exposure to allergens, or severe respiratory illness in infancy, maternal smoking, or exposure to cigarette smoke during pregnancy.[4] Breathing exercises (BEs) are a non-pharmacological treatment widely used around the world to treat people with asthma. The goal of BE is to control asthma symptoms and reduce the severity of attacks. BE can reduce dyspnea, improve ventilation, increase respiratory muscle strength and endurance, increase chest wall mobility, improve breathing patterns, and prevent atelectasis.[5]

Although there are studies investigating the effects of physical activity and BE in individuals with chronic lung diseases such as COPD and asthma, the evidence in the literature is insufficient. Furthermore, the timing, components, duration, and intensity of pulmonary rehabilitation are still unclear. The aim of this retrospective study was to evaluate the effectiveness of BE on parameters such as pulmonary function test (PFT), dyspnea, oxygen saturation, and heart rate in patients with COPD and asthma.

Materials and Methods

In this retrospective study, the data of patients admitted to the Respiratory Laboratory of the Chest Diseases Department of Istanbul Sisli Kolan Hospital were analyzed between August 2020 and March 2021. The inclusion criteria were as follows: having a diagnosis of COPD or asthma, being between 18 and 72 years of age, performing regular BE for 4 weeks (4 days/week) as prescribed by the physician, not changing the drug treatment program, being stable in terms of comorbidities and general health status, and having regular 4-week follow-up data. Exclusion criteria were as follows: COPD exacerbation or asthma attack in the previous 3 months, concomitant other respiratory diseases, and pregnancy. A total of 60 subjects were included in the study, including 30 patients with COPD and 30 patients with asthma who met the inclusion criteria. Ethics committee approval and study permission were obtained before data collection within the scope of the study in accordance with the Declaration of Helsinki (Date: April 07, 2021, Number: 2021-07/05). All parameters were evaluated twice, before and 1 month after BE.

Outcome Measures

Respiratory Function Test Parameters

The following PFT parameters were included and evaluated in the study. PFT was performed using the Masterscreen PFT device according to established standards.[6]

Forced vital capacity (FVC)

FVC is the volume of air that can be expelled with a rapid, forceful exhalation after a deep inhalation. Healthy people can usually exhale 80% of their lung volume in 4–6 s or less. In people with severe obstruction, the exhalation time can be as long as 20 s. FVC may be reduced in obstructive and restrictive diseases such as mucus plug, cystic fibrosis, bronchiectasis, asthma, chest wall deformities, and neuromuscular diseases.[7]

Forced expiratory volume-1 (FEV_1)

FVC is the volume of air exhaled in the 1st s from the start of the maneuver. It usually provides information about

large airway obstruction. A decrease in the FEV_1/FVC ratio indicates obstruction, and FEV_1 indicates the severity of the obstruction.[8]

FEV_1/FVC ratio

This is a parameter used to detect the presence of obstruction. It is low in obstructive diseases and normal or high in restrictive diseases.[8]

Peak expiratory flow (PEF)

It is measured by a maneuver of maximal inhalation followed by maximal exhalation. It provides information about obstruction in the large airways. It is usually correlated with FEV_1 measurements.[8]

Modified Borg Scale (MBS)

In addition to the PFT parameters mentioned above, the dyspnea level of the participants included in the study was evaluated using the MBS. The MBS is a scale between 0 and 10 and is a reliable tool in the evaluation of dyspnea in patients diagnosed with COPD and asthma.[9]

Heart Rate and Peripheral Oxygen Saturation

Participants' heart rate and blood oxygen saturation were evaluated using pulse oximetry.

BE Program

Patients were asked to perform the BE program 4 days a week for 4 weeks. The exercises were explained to the patients by physiotherapists and physicians trained in this field. Adherence to the program was monitored through weekly phone calls and verified based on documentation in the patient records. Only those patients who both reported and documented continued participation in the home-based program were included in the study. The details of the BE program for the patients included in this study are presented below.

Deep BE

This exercise was asked to be done while sitting in bed or on a chair. Patients were asked to take a deep breath through their nose and hold their breath for 3 s, and then exhale slowly through their mouth. A 30-s rest break was given after every 3 repetitions. This exercise was asked to be repeated 10 times, twice a day.[10]

Diaphragmatic BE

The patient is asked to lie supine with knees flexed 90°. The patient is asked to place one hand on the upper chest and the other hand on the abdomen just below the rib cage. It was explained that the patient should take the deepest breath possible through the nose slowly, while the hand on the chest should remain still and the hand on the abdomen should rise. In the exhalation phase, the patient was told to exhale slowly by tightening the abdominal muscles. This exercise was asked to be done in three sets of five repetitions, and 2 times a day. A rest period of 3 min was given between sets.[10]

Thoracic Expansion Exercises

With a belt-like object placed on the lower part of the costas, the patient is asked to breathe against the resistance while inhaling and to increase the mobility of the thoracic region by applying additional resistance while exhaling. This exercise is asked to be done 2 times a day, two sets of 5 times each.[11]

Statistical Analysis

IBM Statistical Package for the Social Sciences version 24.0 Software (IBM Corp., Armonk, NY, USA) was used for statistical evaluation. Destructive data were determined by the mean and standard deviation. Comparisons of these values before and after exercises were made with the Wilcoxon signed-rank test.

Results

A total of 60 patients with COPD (n=30) and asthma (n=30) were included in the study. Of the 30 patients with asthma included in the study, 16 were female and 14 were male. The ages of asthma patients in this group ranged between 18 and 41 years, with a mean age of 29±6.4 years. Eleven of the patients had a history of smoking, and 8 were active smokers. Of the 30 patients with COPD included in the study, 18 were female and 12 were male. The age range of the patients in this group was 44–72 years, with a mean age of 64±8.1 years. Four of the patients had no smoking history. The mean smoking history of patients in the COPD group was 62±18.5 pack-years.

In the participants in the COPD group, the mean FEV_1 value was 56.63±20.39 after exercises (p=0.410). The FVC value increased to 87.6±23.2, but this increase was not statistically significant (p=0.270). In addition, no significant difference was found in FEV_1/FVC value (p=0.840), PEF value (p=0.270), MBS values (p=0.700), blood oxygen saturation value (p=0.810), and heart rate values (p=0.750) (Table 1).

In the participants in the asthma group, the difference in the FEV_1/FVC ratio was found to be significant after exercise (p=0.027). However, the change in PEF value (p=0.390), FEV_1 value (p=0.100), MBS values (p=0.490), blood oxygen saturation value (p=0.720), and heart rate values (p=0.390) were not statistically significant (Table 1).

Table 1. Evaluation of participants before and after breathing exercise

Asthma (n=30)	Before exercise Mean±SD	After exercise Mean±SD	p
FEV_1	70.6±14.8	76.5±14.5	0.100
FVC	96.9±18.7	101±18.9	0.300
FEV_1/FVC	76.1±5.9	79.3±5.9	0.027
PEF	67.7±14.7	70.2±13.9	0.390
MBS	2.9±2.4	2.3±1.9	0.490
Saturation	98.1±1.4	98.3±1	0.720
Heart rate	80.6±3.3	81.2±3.2	0.390
COPD (n=30)			
FEV_1	53.7±18.7	56.6±20.4	0.410
FVC	82.1±21.8	87.6±23.2	0.270
FEV_1/FVC	66.7±12.8	67.2±13.8	0.840
PEF	49.6±17.3	52.7±15.9	0.270
MBS	4±2.6	3.7±2.4	0.700
Saturation	91±3.1	91.3±3.2	0.810
Heart rate	81.4±5.7	81.4±3.8	0.750

SD: Standard deviation, FEV_1: Forced expiratory volume 1, FVC: Forced vital capacity, PEF: Peak expiratory volume, MBS: Modified borg scale, COPD: Chronic obstructive pulmonary disease.

Discussion

In this retrospective study, BE were performed 4 times a week for 4 weeks in patients with COPD and asthma, and PFT parameters, dyspnea severity, heart rate, and blood oxygen saturation were evaluated. After the BE, a significant increase in FEV_1/FVC value was found only in the asthma group, while no significant change was found in the other values in both groups.

There are studies in the literature reporting strengthening in respiratory muscles after BE is applied in patients with COPD.[12,13] In this study, there was no worsening in PFTs and dyspnea severity as a result of BE in patients with COPD. Stable conditions in patients with COPD within 1 month may be related to the strengthening of respiratory muscles.

There are also studies indicating that BE applied to patients with COPD resulted in an increase in aerobic capacity assessed by the 6 m walk test in this patient group.[14] Factors such as decreased airway resistance, strengthening of respiratory muscles, and increased thoracic mobility play a role in the increase in aerobic capacity of patients.

Like the results of this study, in a meta-analysis examining the effects of BE applied to patients with COPD, it was found that there was no significant change in PFT parameters and dyspnea severity. It is thought that there is no significant change due to irreversible lung parenchymal and airway changes that occur in COPD disease.[3]

It has been reported that at least a 4-week exercise program should be implemented in patients with COPD for BE to lead to a statistically significant improvement in functional and clinical parameters.[15] In this study, a 4-week exercise program was applied, and if a longer program had been applied, significant differences could have been found in the clinical and functional parameters of the patients.

Respiratory muscles, such as other skeletal muscles, respond to muscle training and exercise according to certain principles. To obtain a response to inspiratory muscle training, the duration of inspiratory muscle training in most studies reported in respiratory patients is 8–12 weeks. However, structural changes in the inspiratory muscles are seen as early as 6 weeks. Inspiratory muscle training has a specific functional improvement in the inspiratory muscles and has been shown to produce adaptive positive changes in the structure of the intercostal muscles.[16] The lack of significant changes after BE in this study may be related to the short duration of the exercise program; therefore, it is recommended that longer exercise interventions should be performed in future studies. In addition, it is also important to evaluate the long-term effects of BE applied to individuals with chronic lung disease. Therefore, it is recommended to evaluate the long-term effects of BE in future studies.

There are studies showing a reduction in dyspnea severity, as measured by the MBS, as a result of BE in people with COPD.[17] In this study, although not statistically significant, there was a reduction in dyspnea severity as measured by the MBS. It is also thought that this may be related to the outbreak of COVID-19 during the period of data collection in the study. Factors such as a sedentary lifestyle and mask use may have had a negative impact on dyspnea.

BE is widely used in the treatment of asthma as an adjunct to pharmacologic therapy to reduce the symptoms of the disease. In addition to improving long-term respiratory function in asthma, BE can also produce positive improvements during attacks.[5] Therefore, BE has an important place for asthma patients. There are also studies that report an improvement in quality of life and a decrease in the frequency of medication use with the use of BE in patients with asthma.[18] Therefore, it is recommended that patients with asthma practice these exercises regularly.

In addition, there are publications showing a decrease in the frequency of acute exacerbations in asthma patients with a BE program of at least 8 weeks.[19] Based on this information, it is possible to say that BE is an effective and safe therapy modality in asthma.

Positive changes in asthma have been observed not only in the clinical setting but also in the home environment.

Therefore, after teaching BE to patients in the clinical setting under the supervision of a specialist or physiotherapist, it is recommended to apply it in the home environment as well.[20] In this study, patients were taught supervised BE in the clinical setting and then recommended to continue the program at home. Patients' adherence to the exercise program was monitored through weekly telephone interviews.

This study has some limitations. These limitations include the BE program being 4 weeks, not including long-term follow-up parameters, and not measuring quality of life. There is a need for future studies in which a longer BE intervention is performed, and the long-term effectiveness of BE is evaluated. However, the heterogeneity between both groups and the lack of baseline assessment are important limitations that prevent the generalization of the results. In future studies, it is recommended to be more careful in group selection and to give importance to homogeneity. In addition, due to the COVID-19 pandemic during the period of the study, factors such as mask use and sedentary lifestyle of the participants were not included in the study, which created uncertainty in the interpretation of the results.

Conclusion

In this study, no significant change was observed in FVC, FEV_1, PEF, MBS, SpO_2, and negative binomial (NB) results in asthma patients after BE, while a significant increase was found in FEV_1/FVC value. In COPD patients, data changes in FVC, FEV_1, FEV_1/FVC, PEF, MBS, SpO_2, and NB results were found to be insignificant. BE stabilized the respiratory functions and the dyspnea severity of the patients.

Disclosures

Ethics Committee Approval: The study was approved by the Bahçeşehir University Clinical Research Ethics Committee (no: 2021-07/05, date: 07/04/2021).

Informed Consent: Informed consent was obtained from all participants.

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