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Original Article

Effects of Buteyko Breathing Technique Versus Diaphragmatic Breathing on Exercise Capacity and Quality of Life in Patients with Chronic Obstructive Pulmonary Disease

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ABSTRACT

Background: Chronic obstructive pulmonary disease (COPD) is a significant public health concern characterized by persistent respiratory symptoms and airflow limitation. Pulmonary rehabilitation has been shown to improve symptoms, quality of life, and physical function in patients with COPD. However, the impact of specific breathing techniques, particularly the Buteyko breathing technique and diaphragmatic breathing, on the functional capacity and respiratory performance of COPD patients remains underexplored.

Objective: This study aimed to evaluate the effects of the Buteyko breathing technique versus diaphragmatic breathing on exercise capacity and quality of life in patients with COPD.

Methods: A total of 48 patients with moderate to severe COPD were recruited from a pulmonary rehabilitation clinic and randomly assigned to either an intervention group (Buteyko breathing technique) or a control group (diaphragmatic breathing technique), with 24 participants in each group. The intervention group received Buteyko breathing training three times a week for eight weeks, in addition to standard care. The control group received diaphragmatic breathing training under the same conditions. The primary outcome was the distance walked in the six-minute walk test (6MWT). Secondary outcomes included the Timed Up and Go (TUG) test, Short Physical Performance Battery (SPPB) scores, Hospital Anxiety and Depression Scale (HADS) scores, Mini-Mental State Examination (MMSE) scores, and health-related quality of life assessed using the Patient Satisfaction Questionnaire (PSQ). Data were analyzed using SPSS version 25, with a significance level set at $p<0.05$. Ethical approval was obtained from the institutional review board, and all participants provided written informed consent.

Results: The intervention group showed a significant improvement in the 6MWT distance, with a mean increase of 45 meters ($p<0.01$), compared to the control group's mean increase of 10 meters. The TUG test time decreased significantly in the intervention group from 12.45 ± 1.23 seconds to 10.12 ± 1.10 seconds ($p=0.002$), while the control group improved from 12.78 ± 1.56 seconds to 11.34 ± 1.20 seconds. The SPPB score improved significantly in the intervention group from 8.34 ± 1.12 to 10.23 ± 1.30 ($p=0.046$), whereas the control group showed a modest improvement from 8.50 ± 1.10 to 9.56 ± 1.45. HADS-Anxiety scores decreased from 9.23 ± 2.45 to 7.12 ± 2.00 ($p=0.025$) in the intervention group, and HADS-Depression scores from 8.56 ± 2.34 to 6.34 ± 2.10 ($p=0.015$). MMSE scores increased in both groups but were not statistically significant. PSQ scores increased significantly in both groups post-intervention, with Group A improving from 70.45 ± 5.23 to 82.34 ± 4.78 ($p=0.012$) and Group B from 71.12 ± 5.10 to 78.89 ± 5.45.

Conclusion: Diaphragmatic breathing training significantly enhances functional exercise capacity, reduces dyspnea, and improves quality of life in patients with moderate to severe COPD. These findings support the incorporation of diaphragmatic breathing exercises into standard pulmonary rehabilitation programs for COPD patients.

Keywords: Chronic Obstructive Pulmonary Disease, Buteyko Breathing, Diaphragmatic Breathing, Pulmonary Rehabilitation, Exercise Capacity, Quality of Life, Six-Minute Walk Test, Timed Up And Go Test, Short Physical Performance

Journal of Health and Rehabilitation Research 2791-156X JHRR

INTRODUCTION

Chronic Obstructive Pulmonary Disease (COPD) is still a significant global health concern, characterized by persistent airflow limitation and progressive respiratory symptoms, primarily emphysema and chronic bronchitis (1-3). Emphysema involves the gradual destruction of alveoli, leading to reduced gas exchange and airflow obstruction, while chronic bronchitis is marked by inflammation and scarring of the bronchial tubes, resulting in excessive mucus production and chronic cough. Both conditions contribute to the characteristic symptoms of COPD, including dyspnea, chronic cough, and frequent respiratory infections, which collectively impair patients' quality of life and functional capacity (4-9). COPD's global impact is substantial, affecting millions worldwide, with a high burden of morbidity and mortality. It is projected that COPD will become the third leading cause of death by 2030 (2). The progression of COPD often leads to muscle dysfunction, notably respiratory muscle weakness, exacerbating symptoms and limiting physical activity (10-17). Consequently, interventions that can enhance respiratory muscle function and overall exercise capacity are critical for improving outcomes in COPD patients (18).

Pulmonary rehabilitation programs that incorporate various breathing exercises have been shown to alleviate symptoms, improve functional capacity, and enhance the quality of life in COPD patients (4). Among these, diaphragmatic breathing and the Buteyko breathing techniques are prominent. Diaphragmatic breathing focuses on strengthening the diaphragm and optimizing breathing patterns, which has been reported to reduce dyspnea and increase exercise tolerance (19). The Buteyko breathing technique, developed by Konstantin Buteyko, emphasizes slow, controlled breathing to normalize respiratory patterns, potentially offering benefits such as improved exercise tolerance, reduced medication dependence, and enhanced quality of life (6). Despite the documented benefits of these techniques, there is a need for comparative studies to determine their relative effectiveness in managing COPD symptoms and improving patients' overall health status (20-26).

This study aims to address this gap by comparing the effects of the Buteyko breathing technique versus diaphragmatic breathing on exercise capacity and quality of life in COPD patients. Employing a randomized controlled trial design, the study seeks to provide robust evidence on which technique offers superior benefits, thereby informing clinical practice and optimizing rehabilitation strategies for COPD management. The findings are expected to contribute to the growing body of literature on non-pharmacological interventions in COPD, offering insights into effective approaches for enhancing patient outcomes and quality of life (27-31). Such comparative analysis is essential for developing targeted and effective rehabilitation protocols that can be seamlessly integrated into existing pulmonary rehabilitation programs, ultimately aiming to improve the holistic management of COPD and reduce its global burden (32-39).

By providing detailed insights into the physiological and functional improvements associated with each breathing technique, this study not only enhances our understanding of COPD management but also underscores the importance of individualized patient care. The use of standardized and validated outcome measures, including the six-minute walk test (6MWT), the St. George's Respiratory Questionnaire (SGRQ), and other relevant assessments, ensures the reliability and applicability of the findings to clinical practice. In doing so, it aims to foster a more nuanced approach to COPD rehabilitation, where specific patient needs and conditions guide the choice of therapeutic interventions, thereby optimizing patient outcomes and quality of life.

MATERIAL AND METHODS

The study was designed as a randomized controlled trial to evaluate the effects of the Buteyko breathing technique versus diaphragmatic breathing on exercise capacity and quality of life in patients with Chronic Obstructive Pulmonary Disease (COPD). Ethical approval was obtained from the institutional ethics committee, adhering to the principles outlined in the Declaration of Helsinki. Participants were recruited from the outpatient pulmonary rehabilitation clinic of Jinnah Hospital, Lahore, and informed consent was obtained from all individuals prior to participation (40).

Patients aged 40-65 years with a clinical diagnosis of moderate to severe COPD, both male and female, in stable condition and on regular medications such as bronchodilators were included. Exclusion criteria comprised the presence of restrictive lung diseases, risk of pneumothorax, recent cardiovascular events (e.g., myocardial infarction or unstable angina within the last six months), intubation, resting oxygen saturation below 90% on room air, recent abdominal or thoracic surgery (within the last three months), recent exacerbations, active infections, orthopedic or urogenital conditions, neurological disorders affecting cognition and mobility, and red flag symptoms such as fever, night sweats, or malaise. A sample size of 60 patients was determined using G*Power Analysis Software, Version 3.1.9.2, ensuring a statistical power of 0.80, a type I error probability (α) of 0.05, and accounting for a 10% attrition

rate. Patients were randomized into two groups, Group A (Buteyko breathing technique) and Group B (diaphragmatic breathing technique), using simple random sampling and sealed opaque envelopes (5, 7-9).

Data collection involved a comprehensive baseline assessment, including demographic information, medical history, and clinical evaluations. The primary outcome measure was exercise capacity, assessed using the six-minute walk test (6MWT). Secondary outcomes included the Timed Up and Go (TUG) test, Short Physical Performance Battery (SPPB), Hospital Anxiety and Depression Scale (HADS), Mini-Mental State Examination (MMSE), and Patient Satisfaction Questionnaire (PSQ). The intervention group received Buteyko breathing technique training, while the control group received diaphragmatic breathing training. Both interventions were administered three times a week for eight weeks. Each session consisted of three sets of 10 repetitions. The Buteyko breathing technique involved a series of exercises focusing on controlled, shallow breathing, while the diaphragmatic breathing technique emphasized deep, diaphragmatic breaths.

Statistical analysis was performed using SPSS software, Version 25. Descriptive statistics were used to summarize the demographic and baseline characteristics of the participants. The normality of the data distribution was assessed using the Shapiro-Wilk test. Depending on the data distribution, parametric tests (e.g., paired sample t-tests for within-group comparisons and independent sample t-tests for between-group comparisons) or non-parametric tests (e.g., Wilcoxon rank test and Mann-Whitney U test) were employed to evaluate the differences in outcome measures. The significance level was set at $p<0.05$. Ethical considerations were strictly adhered to throughout the study, ensuring the confidentiality and anonymity of participants' data. The results were intended to provide evidence-based insights into the comparative effectiveness of Buteyko and diaphragmatic breathing techniques in improving exercise capacity and quality of life in COPD patients, contributing to the optimization of pulmonary rehabilitation programs.

RESULTS

A total of 48 participants were randomized into two groups: Group A (Buteyko breathing technique) and Group B (diaphragmatic breathing technique), with 24 participants in each group. The demographic and baseline characteristics of the participants are summarized in Table 1.

Table 1: Demographic and Baseline Characteristics

Characteristic	Group A (n=24)	Group B (n=24)	p-value
Age (years)	53.63 ± 6.73	55.21 ± 4.26	0.335
Height (meters)	1.67 ± 0.115	1.61 ± 0.15	0.121
Weight (kg)	53.63 ± 7.37	50.08 ± 7.08	0.096
Body Mass Index (BMI)	19.45 ± 3.25	20.89 ± 5.09	0.246
Gender (Male/Female)	21/3	21/3	1.000
Smoking History (Smokers)	24 (100%)	24 (100%)	N/A
Socioeconomic Status			
- Lower Class (%)	5 (20.8%)	8 (33.3%)	
- Middle Class (%)	14 (58.3%)	16 (66.7%)	
- Upper Class (%)	5 (20.8%)	0 (0%)	
History of Respiratory Illness	24 (100%)	16 (66.7%)	<0.001

The groups were well-matched in terms of age, height, weight, BMI, gender distribution, and smoking history. However, a significant difference was observed in the history of respiratory illness, with Group A having a higher prevalence ($p<0.001$).

Table 2: Timed Up and Go Test (TUG)

Variable	Group A (n=24)	Group B (n=24)	t-value	p-value
TUG at Baseline (seconds)	12.45 ± 1.23	12.78 ± 1.56	-0.835	0.409
TUG at post-intervention	10.12 ± 1.10	11.34 ± 1.20	-3.489	0.002

Group A showed a significant improvement in the Timed Up and Go Test (TUG), with a reduction in time from 12.45 ± 1.23 seconds to 10.12 ± 1.10 seconds ($p=0.002$). Group B also improved, though less markedly, from 12.78 ± 1.56 seconds to 11.34 ± 1.20 seconds. The difference between groups post-intervention was statistically significant ($p=0.002$).

Journal of Health and Rehabilitation Research JHRR 2791-156X

Table 3: Short Physical Performance Battery (SPPB)

Variable	Group A (n=24)	Group B (n=24)	t-value	p-value
SPPB at Baseline (score)	8.34 ± 1.12	8.50 ± 1.10	-0.491	0.626
SPPB at post-intervention	10.23 ± 1.30	9.56 ± 1.45	2.044	0.046

The Short Physical Performance Battery (SPPB) scores also improved significantly in Group A, from 8.34 ± 1.12 to 10.23 ± 1.30 (p=0.046), whereas Group B showed a modest improvement from 8.50 ± 1.10 to 9.56 ± 1.45. The difference between groups post-intervention was statistically significant (p=0.046).

Table 4: Hospital Anxiety and Depression Scale (HADS)

Variable	Group A (n=24)	Group B (n=24)	t-value	p-value
HADS-Anxiety at Baseline	9.23 ± 2.45	9.78 ± 2.10	-0.812	0.422
HADS-Anxiety at Post-Intervention	7.12 ± 2.00	8.45 ± 1.90	-2.318	0.025
HADS-Depression at Baseline	8.56 ± 2.34	8.89 ± 2.56	-0.500	0.620
HADS-Depression at Post-Intervention	6.34 ± 2.10	7.78 ± 2.30	-2.565	0.015

For the Hospital Anxiety and Depression Scale (HADS), Group A exhibited significant reductions in anxiety and depression scores post-intervention. HADS-Anxiety scores decreased from 9.23 ± 2.45 to 7.12 ± 2.00 (p=0.025), and HADS-Depression scores from 8.56 ± 2.34 to 6.34 ± 2.10 (p=0.015). Group B showed reductions in these scores, but they were less pronounced and not statistically significant for anxiety.

Table 5: Mini-Mental State Examination (MMSE)

Variable	Group A (n=24)	Group B (n=24)	t-value	p-value
MMSE at Baseline (score)	26.45 ± 2.34	26.89 ± 2.10	-0.635	0.530
MMSE at post-intervention	28.12 ± 1.89	27.56 ± 2.00	1.036	0.305

The Mini-Mental State Examination (MMSE) scores improved in both groups. Group A's scores increased from 26.45 ± 2.34 to 28.12 ± 1.89, and Group B's from 26.89 ± 2.10 to 27.56 ± 2.00. The difference between groups post-intervention was not statistically significant (p=0.305).

Table 6: Patient Satisfaction Questionnaire (PSQ)

Variable	Group A (n=24)	Group B (n=24)	t-value	p-value
PSQ at Baseline (score)	70.45 ± 5.23	71.12 ± 5.10	-0.459	0.649
PSQ at post-intervention	82.34 ± 4.78	78.89 ± 5.45	2.612	0.012

Patient satisfaction, measured by the Patient Satisfaction Questionnaire (PSQ), increased significantly in both groups post-intervention. Group A's score improved from 70.45 ± 5.23 to 82.34 ± 4.78 (p=0.012), while Group B's score improved from 71.12 ± 5.10 to 78.89 ± 5.45. The difference in satisfaction scores between the groups post-intervention was statistically significant (p=0.012).

DISCUSSION

The findings of this study indicated that both the Buteyko breathing technique and diaphragmatic breathing significantly improved the exercise capacity and quality of life in patients with Chronic Obstructive Pulmonary Disease (COPD). Participants in the Buteyko breathing technique group demonstrated greater improvements in several key outcome measures compared to those in the diaphragmatic breathing technique group. These results align with previous research suggesting that breathing retraining exercises can enhance respiratory function and overall well-being in COPD patients (11, 27).

The greater efficacy of the Buteyko breathing technique observed in this study can be attributed to its specific focus on reducing hyperventilation and promoting nasal breathing, which may improve arterial oxygenation and reduce breathlessness (3). This technique's ability to reduce respiratory rate and increase carbon dioxide levels might have contributed to the significant improvement in quality of life and symptom scores observed in the Buteyko group (4). In contrast, the diaphragmatic breathing

technique primarily aimed to strengthen the diaphragm and improve ventilation efficiency, which, while beneficial, may not address hyperventilation patterns as effectively as the Buteyko method (41-43).

The significant improvements in the Timed Up and Go Test (TUG) and Short Physical Performance Battery (SPPB) scores in the Buteyko group suggest enhanced functional mobility and lower extremity function, which are crucial for maintaining independence in daily activities. These findings are consistent with previous studies that reported similar benefits from structured breathing exercises in COPD patients (6). The reductions in Hospital Anxiety and Depression Scale (HADS) scores highlight the psychological benefits of breathing exercises, which have been shown to alleviate anxiety and depression in chronic disease populations (44).

However, the study had several limitations. The sample size was relatively small, which might limit the generalizability of the findings. Additionally, the study duration was short, and long-term adherence to and benefits of the breathing techniques were not assessed. The study also relied on self-reported measures for some outcomes, which could introduce bias (45). Future research should include larger sample sizes, longer follow-up periods, and objective measures of respiratory function to validate and extend these findings.

Strengths of this study include its randomized controlled design, which minimized selection bias and enhanced the validity of the results. Furthermore, the use of standardized assessment tools ensured consistency and reliability in data collection. The inclusion of two different breathing techniques allowed for a comparative analysis, providing insights into their relative efficacy (46).

CONCLUSION

In conclusion, this study proved that the Buteyko breathing technique was more effective than the diaphragmatic breathing technique in improving exercise ability and quality of life in COPD patients. These findings support the incorporation of the Buteyko breathing technique into pulmonary rehabilitation programs for COPD patients. Future studies should address the limitations noted and explore the long-term benefits and adherence to these breathing techniques in diverse COPD populations. The integration of such non-pharmacological interventions could significantly enhance the management of COPD, leading to better patient outcomes and reduced healthcare costs.

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Journal of Health and Rehabilitation Research 2791-156X JHRR

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