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Article

Effects of Teach Back Training Intervention on Pulmonary Functions in Chronic Obstructive Pulmonary Disease Patients

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ABSTRACT

Background: Chronic Obstructive Pulmonary Disease (COPD) is a leading cause of morbidity and mortality globally, characterized by progressive airflow limitation and dyspnea. Despite the proven benefits of physiotherapeutic breathing exercises, poor patient understanding often limits their effectiveness. Structured educational models like Teach Back Training (TBT) may bridge this gap by enhancing comprehension and adherence. **Objective:** This study aimed to evaluate the effectiveness of Teach Back Training intervention in improving pulmonary functions and reducing dyspnea in COPD patients, using spirometric parameters and the Borg Dyspnea Scale. **Methods:** A single-blind randomized controlled trial was conducted with n = 45 COPD patients recruited from pulmonary wards of tertiary care hospitals in Lahore. Participants aged 18–75 years with FEV1/FVC < 70% and no cognitive impairment were randomized into TBT (n = 20) and conventional training groups (n = 20). The TBT group received structured instruction on diaphragmatic, pursued-lip breathing, and effective coughing, while the control group received standard care. Outcomes were measured using digital spirometry and Borg Dyspnea Scale at baseline and after four weeks. The study was approved by the institutional ethical board and conducted in accordance with the Declaration of Helsinki. Statistical analysis was performed using SPSS v26, applying paired and independent t-tests. **Results:** Post-intervention spirometric values showed significant improvement in the TBT group versus controls: FEV1 (2.48 ± 1.33 vs. 1.99 ± 0.12 L, $p < 0.001$), FVC (2.83 ± 0.35 vs. 2.40 ± 0.44 L, $p = 0.002$), FEV1/FVC ratio (64.51 ± 6.46 vs. 59.51 ± 5.46%, $p = 0.012$), and Borg Dyspnea scores (3.35 ± 1.25 vs. 6.10 ± 1.65, $p < 0.001$). All improvements were both statistically and clinically significant. **Conclusion:** Teach Back Training significantly enhances pulmonary function and reduces dyspnea in COPD patients, offering a clinically valuable, low-cost adjunct to standard physiotherapy. Its implementation in rehabilitation programs may improve patient outcomes and reduce healthcare burden.

Keywords: Chronic Obstructive Pulmonary Disease, Teach-Back Communication, Pulmonary Function Tests, Patient Education, Dyspnea, Respiratory Therapy, Randomized Controlled Trial.

INTRODUCTION

Chronic Obstructive Pulmonary Disease (COPD) remains a critical public health concern, characterized by chronic inflammation of the airways and progressive airflow limitation resulting from exposure to harmful particles and gases. It compromises lung compliance due to the destruction of alveolar walls and elastic fibers, contributing to reduced gas exchange and respiratory efficiency (1). COPD is currently one of the most prevalent respiratory conditions globally and is projected by the World Health Organization to become the third leading cause of death by 2030 (4). Epidemiological studies suggest a global prevalence rate of approximately 29.6%, surpassing that of asthma, and indicate that while the disease affects both genders, men appear to be at higher risk (5, 6). Risk factors contributing to COPD include cigarette smoking, environmental pollutants, occupational exposures, and genetic predispositions such as alpha-1 antitrypsin deficiency (7, 8). This

chronic condition frequently leads to acute exacerbations triggered by infections or pollutants, significantly impacting patients' quality of life and imposing a substantial economic burden on healthcare systems (1, 9, 10).

The diagnosis of COPD relies on a comprehensive assessment that includes clinical history, physical examination, spirometric evaluation, and sometimes imaging studies. Symptoms such as chronic cough, sputum production, dyspnea, and exercise intolerance guide initial clinical suspicion, while objective confirmation is typically achieved through spirometry, with a post-bronchodilator FEV1/FVC ratio below 0.7 serving as the diagnostic criterion (12, 13). Imaging modalities like chest X-ray and CT scans further assist in evaluating emphysematous changes and bronchial wall thickening (14). Management of COPD involves a multidisciplinary approach, combining pharmacological therapy—including bronchodilators, corticosteroids, and phosphodiesterase inhibitors—with non-pharmacological strategies such as pulmonary rehabilitation (1, 7, 15). Pulmonary physiotherapy plays a pivotal role in enhancing respiratory mechanics, reducing symptoms, and improving functional outcomes through techniques such as diaphragmatic breathing, pursed-lip breathing, airway clearance, and ventilatory feedback exercises (17, 18).

Despite the proven efficacy of these physiotherapeutic interventions, a major barrier to optimal patient outcomes lies in patients' limited understanding and improper execution of breathing exercises, particularly in low-literacy populations. This gap underscores the need for structured educational interventions that can enhance patient engagement and self-management. Teach-Back Training (TBT) emerges as a promising solution by facilitating patient-centered learning wherein individuals are educated through repetition and demonstration to ensure accurate knowledge transfer and execution (19). TBT emphasizes patient recall and comprehension, encouraging active participation and personalized feedback, thereby aligning with self-management theories such as Dorothea Orem's nursing model (20, 21). Previous research on TBT in pulmonary rehabilitation contexts has shown promising results in improving outcomes such as dyspnea, pulmonary function, and quality of life in patients with asthma, COPD, and lung cancer (26, 27, 30). Moreover, studies integrating TBT with adjunctive tools like WeChat and combined interactive training approaches have reported superior outcomes in patient education, symptom control, and emotional well-being compared to standard education alone (21, 27).

However, existing literature often evaluates TBT in combination with other interventions or in populations outside of COPD, leaving a gap regarding its standalone effectiveness on lung function parameters. Furthermore, while numerous studies validate the benefits of diaphragmatic and pursed-lip breathing, few explore the added impact of delivering these exercises via a structured TBT model in COPD patients. This oversight limits the clinical adoption of TBT in respiratory care despite its potential to address both knowledge deficits and technique execution. Consequently, this study seeks to bridge this knowledge gap by investigating the effectiveness of a Teach-Back Training intervention—centered on diaphragmatic breathing, pursed-lip breathing, and effective coughing—on spirometric lung function outcomes and dyspnea levels in COPD patients. The primary objective is to determine whether TBT significantly enhances pulmonary parameters and perceived dyspnea compared to conventional physiotherapy protocols, thereby providing evidence for integrating structured educational methods in pulmonary rehabilitation. The research hypothesizes that TBT will yield statistically significant improvements in FEV1, FVC, FEV1/FVC, and Borg Dyspnea Scale scores relative to standard treatment modalities.

MATERIALS AND METHODS

This randomized controlled trial was conducted over a six-month period across pulmonary wards of three tertiary care hospitals in Lahore, including Jinnah Hospital, Services Hospital, and Fatima Memorial Hospital. The study enrolled 45 patients diagnosed with Chronic Obstructive Pulmonary Disease (COPD), selected through non-probability convenience sampling. Inclusion criteria were individuals aged 18 to 75 years with a confirmed diagnosis of COPD based on spirometry showing a post-bronchodilator FEV1/FVC ratio of less than 70%, absence of cognitive impairments, ability to attend training sessions, and a documented history of smoking. Patients were excluded if they had a history of malignancy, cardiovascular disease (e.g., myocardial infarction or angina), stroke, long-term bed rest, inability to perform the 6-minute walk test, or any immunocompromised condition. Informed consent was obtained from all participants prior to enrollment, and ethical approval was secured from the institutional review board of the host institution. All procedures were conducted in accordance with the ethical standards of the Declaration of Helsinki.

Participants were randomly assigned into two equal groups: Group A received Teach-Back Training (TBT) alongside conventional treatment, and Group B received only conventional treatment. The primary outcomes of interest were pulmonary function parameters including Forced Expiratory Volume in one second (FEV1), Forced Vital Capacity (FVC), the FEV1/FVC ratio, Vital Capacity (VC), Inspiratory Capacity (IC), and Peak Expiratory Flow Rate (PEFR), as measured by digital spirometry. Dyspnea was assessed using the Modified Borg Dyspnea Scale (BDS), a validated 10-point scale used to measure subjective breathlessness. Baseline and post-intervention measurements were recorded over a four-week intervention period. TBT was delivered in small group or individual sessions by trained physiotherapists and involved a five-step interactive approach including demonstration, patient rehearsal, therapist feedback, and clarification opportunities. The breathing techniques taught included diaphragmatic breathing in a supine position, pursed-lip breathing in a seated posture, and effective coughing to facilitate secretion clearance. All participants in Group A also received standard incentive spirometry training and were advised to adhere to prescribed bronchodilator and inhaler medication regimens. Group B followed the same conventional treatment protocol without TBT. Exercise sessions were conducted for 30–45 minutes, three times per week, across four weeks.

Data were analyzed using SPSS version 26. The Shapiro-Wilk test was performed to assess data normality, which confirmed a

normal distribution ($p > 0.05$ for all variables), allowing for the use of parametric tests. Descriptive statistics including mean and standard deviation were used to summarize demographic and clinical characteristics. Within-group differences between pre- and post-intervention outcomes were assessed using paired t-tests, while independent t-tests were used for between-group comparisons. A p-value less than 0.05 was considered statistically significant. All patient data were anonymized during analysis, and confidentiality was maintained throughout the study duration.

RESULTS

A total of 45 patients with Chronic Obstructive Pulmonary Disease (COPD) were enrolled and randomized into two intervention groups: Group A received Teach Back Training (TBT) in addition to conventional treatment, while Group B received only conventional treatment. Demographic analysis confirmed that participants in both groups were comparable in terms of age, body mass index (BMI), and gender distribution, ensuring that baseline characteristics were well balanced and unlikely to confound the treatment effects.

Table 1. Descriptive Summary of Participant Demographics (Mean ± SD)

Variable	Teach Back Training (mean ± SD)	Conventional Training (mean ± SD)
Age (years)	51.25 ± 12.93	49.70 ± 13.21
BMI (kg/m^2)	21.00 ± 3.87	20.30 ± 3.45

Table 1 presents the mean age and BMI across both groups. The average age in the TBT group was 51.25 ± 12.93 years, and in the conventional group, it was 49.70 ± 13.21 years. BMI was also comparable, with means of 21.00 ± 3.87 in the TBT group and 20.30 ± 3.45 in the conventional group. These similarities suggest randomization effectively minimized initial group differences. Table. 2 details the gender distribution across the study arms. The TBT group included 12 males (60%) and 8 females (40%), while the conventional group comprised 13 males (65%) and females (35%).

Table 2. Gender Distribution of Participants

Gender	Teach Back Training (n, %)	Conventional Training (n, %)
Male	12 (60%)	13 (65%)
Female	8 (40%)	7 (35%)

Table 3. Within-Group Comparisons Using Paired T-Test (Pre vs Post Intervention)

Outcome Measure	Group	Pre-Treatment (mean ± SD)	Post-Treatment (mean ± SD)	p-value
FEV1 (L)	Teach Back	1.587 ± 1.35	2.48 ± 1.33	<0.001
FVC (L)	Teach Back	2.10 ± 0.39	2.83 ± 0.35	<0.001
FEV1/FVC (%)	Teach Back	57.27 ± 6.42	64.51 ± 6.46	<0.001
PEF (L)	Teach Back	2.76 ± 0.20	3.49 ± 0.263	<0.001
VC (L)	Teach Back	2.74 ± 1.34	3.64 ± 1.33	<0.001
IC (L)	Teach Back	3.77 ± 0.22	4.55 ± 0.28	<0.001
BDS	Teach Back	7.30 ± 1.22	3.35 ± 1.25	<0.001

Table 4. Between-Group Comparisons Using Independent T-Test

Outcome Measure	Pre-Treatment (TBT vs CT)	Post-Treatment (TBT vs CT)	p-value
FEV1 (L)	1.587 ± 1.35 vs 1.59 ± 0.12	2.48 ± 1.33 vs 1.99 ± 0.12	<0.001
FVC (L)	2.10 ± 0.39 vs 2.08 ± 0.39	2.83 ± 0.35 vs 2.40 ± 0.44	0.002
FEV1/FVC (%)	57.27 ± 6.42 vs 56.53 ± 5.46	64.51 ± 6.46 vs 59.51 ± 5.46	0.012
PEF (L)	2.76 ± 0.20 vs 2.77 ± 0.20	3.49 ± 0.26 vs 3.16 ± 0.25	<0.001
VC (L)	2.74 ± 0.133 vs 2.75 ± 0.134	3.64 ± 0.134 vs 3.14 ± 0.125	<0.001
IC (L)	3.77 ± 0.22 vs 3.78 ± 0.19	4.55 ± 0.28 vs 4.16 ± 0.18	<0.001
BDS	7.30 ± 1.22 vs 7.15 ± 1.56	3.35 ± 1.25 vs 6.10 ± 1.65	<0.001

Both treatment groups exhibited statistically significant improvements in all spirometric and dyspnea measures from pre- to post-intervention ($p < 0.001$ for all outcomes). However, the magnitude of improvement was consistently higher in the TBT group. For instance, mean FEV1 improved from 1.587 ± 1.35 L to 2.48 ± 1.33 L in the TBT group, and from 1.59 ± 0.12 L to 1.99 ± 0.12 L in the conventional group. Similar trends were observed across FVC, FEV1/FVC ratio, PEFR, VC, IC, and Borg Dyspnea Scale scores, underscoring the superior within-group effects of TBT on pulmonary function. Independent t-tests confirmed no statistically significant differences in baseline values between the two groups ($p > 0.05$ for all variables), affirming comparability at study entry. However, post-intervention comparisons revealed that the TBT group achieved significantly greater improvements across all outcomes. Notably, post-treatment FEV1 was significantly higher in the TBT group (2.48 ± 1.33 L) compared to the CT group (1.99 ± 0.12 L; $p < 0.001$). Similarly, FVC, FEV1/FVC ratio, VC, IC, and PEFR all demonstrated significantly superior post-intervention values in the TBT group. The Borg Dyspnea Scale also showed a greater reduction in the TBT group

(3.35 ± 1.25) than in the CT group (6.10 ± 1.65; $p < 0.001$), indicating better control of dyspnea symptoms.

The statistically significant differences in post-treatment values, coupled with the large mean differences, suggest that Teach Back Training produces not only statistically significant but also clinically meaningful improvements in pulmonary function and dyspnea perception among COPD patients. These findings underscore the value of integrating structured educational methodologies like TBT into standard physiotherapeutic care. The greatest effect sizes were observed for FEV1 and BDS, indicating enhanced airway patency and symptom relief, potentially translating to improved quality of life and functional independence.

DISCUSSION

The present study evaluated the clinical effectiveness of a structured Teach Back Training (TBT) intervention in enhancing pulmonary function and alleviating dyspnea among patients with Chronic Obstructive Pulmonary Disease (COPD). Results demonstrated that participants receiving TBT alongside conventional therapy experienced significantly greater improvements in spirometric outcomes—namely FEV1, FVC, FEV1/FVC, VC, IC, and PEF—along with a more pronounced reduction in perceived dyspnea on the Borg Dyspnea Scale, compared to those who received only conventional care. These findings highlight the therapeutic advantage of patient-centered education in managing chronic pulmonary conditions and align with the growing evidence that structured instructional strategies can empower individuals with COPD to perform physiotherapeutic exercises more accurately and consistently, thereby optimizing clinical outcomes (25, 26).

The study's findings corroborate earlier work by Wang et al., who reported that TBT improved pulmonary parameters and reduced pain in lung cancer patients, suggesting the adaptability of this educational approach across respiratory pathologies (26). Similarly, Zhang et al. demonstrated that combining TBT with WeChat-based instruction significantly enhanced self-care behaviors and pulmonary function among COPD patients, although the present study focused solely on in-person education, thus emphasizing the inherent efficacy of the TBT approach itself (27). Furthermore, the current results are in agreement with Imanipour et al., who observed significant improvements in FEV1, FVC, and FEV1/FVC following TBT in asthma patients, reinforcing the cross-condition applicability of this intervention for obstructive lung diseases (30). These collective findings underscore the generalizability of TBT's impact on respiratory rehabilitation, irrespective of the specific underlying condition.

Mechanistically, the effectiveness of TBT likely stems from its iterative, feedback-based structure, which ensures patients not only receive but also correctly internalize and replicate complex breathing exercises. By facilitating active participation, clarification of misunderstandings, and reinforcement of correct performance patterns, TBT likely fosters enhanced neuromuscular coordination of respiratory musculature. This, in turn, contributes to improvements in lung volumes and airflow dynamics. The inclusion of diaphragmatic breathing, pursed-lip breathing, and effective coughing exercises—all validated interventions in COPD management—augments ventilatory efficiency, reduces dynamic hyperinflation, and promotes mucus clearance, thereby supporting improved spirometric outcomes and symptom control (18, 23, 24, 45).

Notably, the TBT group demonstrated a more substantial reduction in dyspnea severity as measured by the Borg Dyspnea Scale, a result consistent with previous reports that effective patient education contributes to reduced symptom burden and enhanced functional capacity (25, 32). The statistically and clinically significant improvements observed in PEFR and IC further support the notion that TBT may enhance inspiratory effort and expiratory flow, ultimately contributing to greater ease of breathing during exertion. These outcomes bear important implications for patient quality of life and daily activity tolerance, particularly given COPD's association with reduced physical performance and frequent hospitalizations (4, 5).

Despite these promising findings, the study is not without limitations. The modest sample size, although adequately powered, restricts the generalizability of results to broader COPD populations with varying disease severities, socioeconomic backgrounds, or comorbidities. Additionally, the study employed a single-center convenience sampling approach across select hospitals in Lahore, potentially introducing selection bias. The follow-up duration was limited to four weeks, precluding assessment of the long-term sustainability of the observed improvements. Moreover, while the spirometric data offer objective insights into pulmonary function, the study did not assess other potentially relevant outcomes such as quality of life scores, anxiety levels, or health-related costs, which could further elucidate the multifaceted impact of TBT in COPD care.

Nevertheless, a key strength of this study lies in its rigorous methodology, including randomized allocation, standardized intervention protocols, and the use of validated assessment tools. The integration of practical breathing techniques into a structured educational format reflects real-world rehabilitation practices, thereby enhancing the study's translational value. The comprehensive within- and between-group analyses provide robust statistical support for the efficacy of TBT as a supplement to conventional physiotherapy.

Future research should explore the durability of TBT-induced benefits over extended follow-up periods and across larger, more diverse populations. Additionally, comparative studies evaluating TBT against other educational frameworks, such as motivational interviewing or digital health modules, may yield insights into optimal instructional modalities for pulmonary rehabilitation. Incorporating quality of life indices, healthcare utilization rates, and caregiver burden assessments would also offer a more holistic appraisal of the intervention's broader impact.

In conclusion, this study provides compelling evidence that Teach Back Training significantly enhances pulmonary function and reduces dyspnea severity in COPD patients when integrated with conventional physiotherapy. These findings support the incorporation of structured, feedback-oriented educational strategies in respiratory rehabilitation programs and suggest

that enhancing patient understanding through TBT may be a critical, yet underutilized, component in optimizing long-term COPD management.

CONCLUSION

This randomized controlled trial demonstrated that the Teach Back Training intervention, when integrated with conventional physiotherapy, significantly improved pulmonary functions—including FEV1, FVC, FEV1/FVC, VC, IC, and PEF—and reduced dyspnea severity in patients with Chronic Obstructive Pulmonary Disease (COPD). These findings align with the study's objective and affirm the clinical value of structured, patient-centered education in enhancing respiratory outcomes. By enabling better comprehension and execution of breathing exercises, Teach Back Training offers a practical, non-pharmacological approach that can be seamlessly implemented in physiotherapy settings to optimize COPD management. The results support its broader application in clinical practice and highlight the need for further research into long-term effects, scalability, and integration with digital health tools for chronic respiratory care.

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