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Original Research Article

Comparison of the immediate effects of Buteyko breathing technique, stacked breathing technique and conventional therapy on the peak expiratory flow rate and dyspnea level in asthmatic patients

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ABSTRACT

Background: Asthma is a chronic inflammatory airway disease characterized by airflow limitation and recurrent symptoms that may persist despite standard medical treatment. Breathing retraining techniques have been increasingly used as adjunctive interventions to improve respiratory function. This study compared the immediate effects of the Buteyko breathing technique (BBT), stacked breathing technique (SBT), and conventional therapy on peak expiratory flow rate (PEFR) and dyspnea in individuals with bronchial asthma.
Methods: A quasi-experimental study was conducted among 63 clinically stable adults with bronchial asthma (20–50 years). Participants were allocated into three groups (n=21 each): BBT with conventional therapy, SBT with conventional therapy, or conventional therapy alone. Each participant received a single 30–45-minute intervention. PEFR and dyspnea were assessed before and immediately after treatment using a peak flow meter and the modified Borg dyspnea scale. Data were analyzed using appropriate parametric and non-parametric statistical tests, with significance set at $p<0.05$.
Results: All groups demonstrated significant post-intervention improvements in PEFR and dyspnea. The BBT group showed the greatest increase in PEFR (mean difference: 30.0 l/min) and the largest reduction in dyspnea (mean difference: 1.42), followed by the SBT and conventional therapy groups. Between-group comparisons confirmed significantly better outcomes with BBT.
Conclusions: BBT, when combined with conventional therapy, produced greater immediate improvements in expiratory flow and dyspnea than SBT or conventional therapy alone, supporting its use as an adjunct in bronchial asthma rehabilitation.

Keywords: Bronchial asthma, Breathing exercises, Buteyko breathing technique, Peak expiratory flow rate, Dyspnea, Pulmonary rehabilitation

INTRODUCTION

Bronchial asthma is a chronic inflammatory disorder of the airways characterized by variable airflow limitation, airway hyper-responsiveness, and recurrent respiratory symptoms such as wheezing, cough, and dyspnea. The disease affects individuals across all age groups and presents with a wide spectrum of clinical severity, influenced by genetic predisposition and environmental exposures.[1,2] Despite advances in diagnostic methods and therapeutic strategies, achieving optimal asthma control remains a challenge for a substantial proportion of patients.

Pharmacological management, including inhaled bronchodilators and corticosteroids, continues to be the cornerstone of asthma treatment. However, long-term medication use may be associated with adverse effects, financial burden, and issues related to adherence, particularly in chronic disease management.[2,3] As a result, non-pharmacological interventions have gained attention as adjunctive approaches aimed at improving symptom control, reducing medication dependency, and enhancing quality of life. Pulmonary rehabilitation programs increasingly incorporate breathing retraining techniques to address dysfunctional breathing patterns commonly observed in individuals with asthma.[4-6]

The Buteyko breathing technique (BBT) is a structured breathing retraining method that emphasizes nasal breathing, reduced tidal volume, breath control, and relaxation. The technique is based on the hypothesis that chronic hyperventilation and resultant hypocapnia may contribute to airway instability and symptom perception in asthma. By reducing minute ventilation and improving tolerance to carbon dioxide, BBT aims to normalize ventilatory control and reduce bronchial smooth muscle constriction.[5,7,8] Previous clinical trials and systematic reviews have reported improvements in peak expiratory flow rate, asthma symptoms, and quality of life following Buteyko breathing interventions.[9-13]

The stacked breathing technique (SBT) involves the gradual accumulation of inspiratory volumes through successive breath holds followed by controlled expiration. This technique is commonly used to enhance lung expansion, improve inspiratory capacity, and optimize ventilation–perfusion matching. Evidence from postoperative and cardiothoracic populations suggests that stacked breathing improves pulmonary mechanics and expiratory flow by increasing lung volumes and respiratory muscle recruitment.[14-17] However, limited research has explored its immediate effects on airway function and dyspnea in patients with bronchial asthma.

Objective monitoring of airway function is essential for assessing disease severity and treatment response in asthma. Peak expiratory flow rate (PEFR) measurement using a peak flow meter provides a simple, portable, and reliable assessment of expiratory airflow limitation and is recommended in clinical practice and asthma self-management plans.[18-21] In addition to objective measures, dyspnea is a key symptom influencing patient comfort and functional capacity. The modified Borg dyspnea scale offers a rapid and validated method for quantifying perceived breathlessness, particularly in acute and clinical settings.[22,23]

While several studies have independently evaluated the effects of Buteyko breathing and stacked breathing techniques, direct comparisons of these interventions—particularly focusing on their immediate effects when combined with conventional therapy—remain limited.[24] Therefore, the present study aims to compare the immediate effects of BBT, SBT, and conventional therapy on PEFR and dyspnea levels in patients with bronchial asthma, with the objective of identifying the most effective adjunctive intervention for rapid symptomatic improvement.

METHODS

Study design and setting

This quasi-experimental pre-post intervention study was conducted over 10 months (August 2024–June 2025) at the Departments of Respiratory Medicine and Pulmonology, PSG Hospitals, Coimbatore, India.

Study participants

This study included 63 clinically stable patients aged 20-50 years with physician-diagnosed bronchial asthma, allocated into three groups (n=21 each) using convenience sampling. Inclusion criteria were mild-to-moderate airway obstruction (PEFR 100-300 l/min), modified Borg scale (MBS) score 0.5-3, regular inhaler/medication use, and willingness to participate; both sexes were eligible. Exclusion criteria comprised epilepsy, mental retardation, recent abdominal/thoracic surgery, cardiac/neurological disorders, active pulmonary infections (e.g., tuberculosis), lung carcinoma, childhood-onset asthma, or restrictive lung diseases.

Study procedure

Participants fulfilling inclusion criteria provided written informed consent and were allocated to three parallel groups (n=21 each): group A received BBT plus conventional therapy; group B received SBT plus conventional therapy; and group C received conventional therapy alone (single 30-minute session each). PEFR was measured using a peak expiratory flow meter, and dyspnea was assessed via the MBS before intervention and 6 minutes post-intervention.

Ethical consideration

This study was approved by the Institutional Human Ethics Committee at PSG Institute of Medical Sciences and Research (PSG IMSR), Coimbatore (Approval No. PSG/IHEC/2024/Appr/Exp/272). Written informed consent was obtained from all participants prior to enrollment.

Statistical analysis

Data analysis was performed using IBM statistical package for the social sciences (SPSS) statistics version 31.0. Normality was assessed via the Kolmogorov-Smirnov test. Within-group pre-post comparisons used paired t-tests for normally distributed data and Wilcoxon signed-rank tests otherwise. Between-group comparisons employed one-way ANOVA for normal data and Kruskal-Wallis tests for non-normal data, with post-hoc Tukey's HSD or Mann-Whitney U tests as appropriate. Statistical significance was set at $p<0.05$.

RESULTS

A total of 63 participants of both genders completed the study, with 21 participants allocated to each group. Group A received BBT along with conventional therapy, group B received the SBT with conventional therapy, and group C received conventional therapy alone. Baseline demographic characteristics and outcome measures were comparable across the three groups, with no statistically significant differences observed at baseline (Table 1).

Peak expiratory flow rate

Within-group analysis demonstrated a statistically significant improvement in PEFR in all three groups following the intervention ($p<0.05$) (Table 2). In group A, the mean PEFR increased from 215.71±32.9 l/min pre-intervention to 245.71±35.8 l/min post-intervention, with a mean difference of 30.0 l/min. Group B showed an increase in mean PEFR from 205.71±25.6 l/min to 218.57±26.6 l/min, with a mean difference of 12.8 l/min. In group C, the mean PEFR improved marginally from 195.71±28.3 l/min to 200.0±30.0 l/min, with a mean difference of 4.2 l/min. Between-group comparison revealed a statistically significant difference in post-intervention PEFR among the three groups ($p<0.05$) (Table 3). Pairwise comparison further demonstrated statistically significant differences between group A and group B, group A and group C, and group B and group C ($p<0.05$) (Table 4), indicating that the greatest improvement in PEFR was observed in group A, followed by group B and group C.

Modified Borg dyspnea scale

Within-group comparison of dyspnea scores showed a statistically significant reduction in all three groups following the intervention ($p<0.05$) (Table 2). Group A demonstrated the greatest reduction in dyspnea scores, with a mean difference of 1.42 and a Z value of 3.95. Group B showed a mean difference of 0.61 with a Z value of 3.34, while group C showed a mean difference of 0.23 with a Z value of 2.23. Effect size analysis revealed a large effect in group A ($d=0.86$), a moderate effect in group B ($d=0.73$), and a small-to-moderate effect in group C ($d=0.49$) (Table 2).

Between-group comparison demonstrated a statistically significant difference in mean rank values for dyspnea among the three groups ($p<0.05$), with the highest mean rank observed in group A (47.21), followed by group B (29.76) and group C (19.02) (Table 3). Pairwise comparison revealed statistically significant differences in modified Borg dyspnea scale scores between group A and group B, group A and group C, and group B and group C ($p<0.05$) (Table 4). The lowest U value (37.0) and highest Z value (4.7) were observed between group A and group C, indicating the strongest difference between these groups.

Table 1: Demographic and anthropometric characteristics of study participants.

Variables	Group A (n=21), mean±SD	Group B (n=21), mean±SD	Group C (n=21), mean±SD
Age (years)	35.14±8.78	38.24±9.26	39.43±9.51
Males/females	4/17	3/18	8/13
Height (cm)	162.14±8.24	157.76±5.99	162.10±9.12
Weight (kg)	69.43±8.05	66.81±8.53	68.81±10.96
BMI (kgs/m^2)	26.47±2.58	26.9±3.09	26.02±1.88
Hip circumference (cm)	97.90±6.48	98.67±6.30	97.48±4.57
Waist circumference (cm)	87.52±6.29	87.43±7.05	88.67±4.83
W: H	0.89±0.038	0.88±0.033	0.91±0.033
Neck circumference (cm)	36.62±2.33	35.71±2.55	36.38±3.27

Values are presented as mean±SD unless otherwise stated. Table shows baseline demographic and anthropometric characteristics of the study participants

Table 2: Within group comparison of peak expiratory flow rate and modified Borg dyspnea scale.

Outcomes	Group	Pre-intervention	Post-intervention	Test statistic	Effect size	P value
Peak expiratory flow rate	Group A	215.71±32.9	245.71±35.8	t=13.1	d=2.86	<0.05
	Group B	205.71±25.6	218.57±26.6	t=8.21	d=1.79	<0.05
	Group C	195.71±28.3	200±30	t=3.28	d=0.71	<0.05
Modified Borg dyspnea scale	Group A	-	-	Z=−3.95	r=0.86	<0.05
	Group B	-	-	Z=−3.34	r=0.73	<0.05
	Group C	-	-	Z=−2.23	r=0.49	<0.05

Values for PEFR are presented as mean±SD and analyzed using paired t-test. MBS were analyzed using Wilcoxon signed-rank test; Z and effect size (r) are reported. *Statistically significant at $p<0.05$

Table 3: Between-group comparison of post-intervention outcomes of peak expiratory flow rate and modified Borg dyspnea scale.

Outcomes	Statistical test	Test statistic (df)	Effect size	P value
PEFR	One-way ANOVA	F=54.78 (2,60)	0.646	<0.05
MBS	Kruskal-Wallis test	H=27.129 (df=2)	-	<0.05

F=ANOVA F statistic; H=Kruskal–Wallis statistic; df=degrees of freedom. *Statistically significant p<0.05

Table 4: Post hoc pairwise comparison of peak expiratory flow rate and modified Borg dyspnea scale.

Outcomes	Group	Test statistic	Mean difference	P value	Significance
Peak expiratory flow rate	Group A versus group B	-	17.14	<0.05	Significant
	Group A versus group C	-	25.71	<0.05	Significant
	Group B versus group C	-	8.57	<0.05	Significant
Modified Borg dyspnea scale	Group A versus group B	U=84.5, Z=3.5	-	<0.05	Significant
	Group A versus group C	U=37.0, Z=4.7	-	<0.05	Significant
	Group B versus group C	U=131.5, Z=2.4	-	<0.05	Significant

Post hoc analysis for peak expiratory flow rate was performed using Tukey HSD test following one-way ANOVA. Post hoc analysis for modified Borg dyspnea scale was performed using Mann–Whitney U test following Kruskal–Wallis test. *Statistically significant at p<0.05

DISCUSSION

The present study investigated the immediate effects of BBT, SBT, and conventional therapy on PEFR and dyspnea in individuals with bronchial asthma. Although all three interventions produced statistically significant short-term improvements, the magnitude of change differed notably between groups. Participants who received BBT in addition to conventional therapy demonstrated the greatest enhancement in expiratory airflow and the most pronounced reduction in perceived breathlessness, indicating a superior immediate response compared to the other interventions.

The improvement in PEFR observed in the Buteyko group suggests that breathing pattern modification may exert rapid physiological effects on airway function. The larger mean difference and effect size in this group, relative to stacked breathing and conventional therapy alone, indicate a clinically meaningful benefit even after a single intervention session. Similar improvements in expiratory flow following Buteyko-based interventions have been reported in earlier clinical trials and systematic reviews.[6-11] Although most previous studies primarily examined longer-term outcomes rather than immediate effects.

Stacked breathing also resulted in a statistically significant increase in peak expiratory flow rate; however, the extent of improvement was comparatively smaller. This finding may be explained by the underlying mechanism of stacked breathing, which primarily enhances lung volume recruitment and inspiratory capacity rather than directly influencing ventilatory control. Previous studies in postoperative and cardiothoracic populations have demonstrated that stacked breathing improves pulmonary mechanics and expiratory flow through lung expansion and respiratory muscle recruitment.[14-17] The comparatively modest immediate response observed in the present study suggests that repeated or prolonged application of this technique may be necessary to achieve greater benefits in asthmatic patients.

A reduction in dyspnea was observed across all groups following intervention, reflecting the contribution of both breathing techniques and conventional therapy to symptom relief. The Buteyko group exhibited the largest decrease in MBS scores, accompanied by a large effect size, indicating a clinically meaningful improvement in perceived breathlessness. Previous research has shown that Buteyko breathing can reduce subjective dyspnea by improving regulation of respiratory drive and decreasing hyperventilation-related respiratory effort.[9,10-13,25] In contrast, the smaller reductions observed in the stacked breathing and conventional therapy groups suggest a less pronounced immediate effect on symptom perception.

The parallel improvement in PEFR and dyspnea observed in this study highlights the relationship between objective airway function and subjective symptom perception in asthma. Participants demonstrating greater gains in expiratory airflow also reported larger reductions in breathlessness, supporting the clinical relevance of peak expiratory flow rate as a rapid and practical outcome measure reflecting short-term functional changes.[18,20,21] The use of the MBS further enabled efficient assessment of symptom severity in a clinical setting where rapid evaluation is required.[22,23]

The differential outcomes observed between the breathing techniques may be attributed to their distinct physiological mechanisms. BBT emphasizes reduced breathing frequency, controlled ventilation, and decreased tidal volume, which may help limit chronic hyperventilation and improve carbon dioxide tolerance.[5,7,8] These physiological adjustments may reduce airway smooth muscle constriction and respiratory effort, leading to immediate improvements in airflow and symptom perception. In contrast, stacked breathing primarily produces mechanical benefits through lung expansion and improved ventilation distribution, which may not directly address altered ventilatory control mechanisms commonly associated with asthma.[14-17]

Overall, the findings of this study support existing evidence that breathing retraining techniques can provide meaningful short-term benefits when used alongside conventional therapy in bronchial asthma, with BBT demonstrating the most pronounced immediate effects.[24,26,27] Incorporating structured breathing interventions into routine physiotherapy and pulmonary rehabilitation programs may enhance early symptom relief and functional outcomes. Future studies using randomized designs, extended follow-up periods, and comprehensive spirometric assessments are recommended to evaluate the sustainability of these effects and further clarify the role of breathing-based interventions in asthma management.

Limitations

This study has certain limitations that should be acknowledged. Dyspnea was assessed using the Modified Borg Scale, which is a subjective measure and may be influenced by individual perception and response variability. In addition, lung function assessment was limited to peak expiratory flow rate, and spirometric parameters such as forced expiratory volume in one second (FEV_1) and forced vital capacity (FVC) were not included. The inclusion of comprehensive spirometric measures could have provided a more detailed evaluation of airway function and strengthened the interpretation of physiological outcomes.

CONCLUSION

The findings of this study indicate that BBT produces superior immediate improvements in PEFR and reduction in dyspnea in patients with bronchial asthma when compared to SBT and conventional therapy alone. While stacked breathing demonstrated moderate benefits, conventional therapy showed only minimal improvement. The observed association between improved airflow and reduced breathlessness highlights the clinical relevance of combining objective and patient-reported outcomes. These results support the inclusion of structured breathing retraining, particularly Buteyko breathing, as a cost-effective adjunct to routine physiotherapy-based asthma management.

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