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Comparison of Buteyko and Papworth Breathing Techniques on Pulmonary Function and Oxygen Saturation in Adults with Asthma: A Randomized Controlled Trial

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ABSTRACT

Background: Asthma is a chronic respiratory disorder associated with impaired lung function and reduced quality of life. While pharmacological therapy remains central to management, breathing retraining techniques such as Buteyko and Papworth have gained interest. However, comparative evidence remains limited. Objective: To compare the short-term effects of the Buteyko and Papworth breathing techniques on pulmonary function and oxygen saturation in adults with asthma. Methods: In this single-centre randomized controlled trial, 42 adults with physician-diagnosed asthma (FEV_1 <80% predicted, FEV_1/FVC <75%) were randomized to Buteyko (n=21) or Papworth (n=21) interventions, in addition to conventional physiotherapy, over four weeks. The primary outcomes were FEV_1, FVC, and FEV_1/FVC ratio, measured by spirometry. The secondary outcome was peripheral oxygen saturation (SpO_2), measured by pulse oximetry. Outcomes were assessed at baseline, week 2, and week 4. Data were analysed using non-parametric tests under an intention-to-treat framework. Results: Both groups demonstrated significant within-group improvements in pulmonary function and SpO_2 over four weeks (all $p < 0.001$). Between-group comparisons favoured the Buteyko group for FEV_1, FVC, FEV_1/FVC ratio, and SpO_2 at weeks 2 and 4 (all $p < 0.01$). By week 4, the Buteyko group achieved greater median improvements in FEV_1 (+12.3% vs. +6.8%) and SpO_2 (+2.1% vs. +1.0%) compared with the Papworth group. No adverse events were reported. Conclusion: Both Buteyko and Papworth breathing techniques improved pulmonary function and oxygen saturation in adults with asthma, but the Buteyko method yielded consistently greater benefits. These findings support Buteyko as a valuable, low-cost adjunct to conventional asthma care, particularly in resource-limited settings.

Keywords
Asthma; Buteyko breathing technique; Papworth method; Pulmonary function; Oxygen saturation; Respiratory therapy

INTRODUCTION

Asthma is a chronic inflammatory disorder of the airways that affects over 300 million individuals worldwide, with prevalence expected to rise due to urbanization, lifestyle changes, and environmental exposures (Dharmage, Perret and Custovic, 2019; Global Initiative for Asthma [GINA], 2023). It is characterized by symptoms such as wheezing, chest tightness, cough, and variable airflow obstruction, often measured through reductions in forced expiratory volume in one second (FEV1), forced vital capacity (FVC), and the FEV1/FVC ratio (Sharma et al., 2011). While pharmacological treatments such as inhaled corticosteroids and bronchodilators remain the cornerstone of asthma management, many patients experience persistent symptoms and impaired quality of life despite optimal medical therapy (Wenzel, 2021). Consequently, there is increasing interest in complementary, non-pharmacological strategies to improve clinical outcomes.

Among these approaches, structured breathing retraining methods have gained prominence for their potential to normalize dysfunctional breathing patterns and reduce hyperventilation (Burgess et al., 2011). The Buteyko breathing technique, developed in the 1950s, emphasizes nasal and diaphragmatic breathing combined with breath-holding to increase tolerance to carbon dioxide and optimize gas exchange (Buteyko, 1956; Prem, Sahoo and Adhikari, 2013). In contrast, the Papworth method, established in the 1960s, integrates diaphragmatic breathing with relaxation exercises to slow respiratory rate and reduce hyperinflation (Holloway and West, 2007). Both techniques have demonstrated beneficial effects in asthma populations; however, evidence from head-to-head randomized controlled trials (RCTs) directly comparing these interventions remains limited and methodologically heterogeneous (Cooper et al., 2003; Kadam, Prem and Ughreja, 2023).

From a health systems perspective, the evaluation of such low-cost, accessible interventions is particularly relevant in low- and middle-income countries (LMICs), where affordability and access to pharmacological therapy remain barriers to optimal asthma care (Laforest et al., 2009; Xu and Rathkopf, 2023). Establishing comparative evidence through rigorously designed RCTs can provide greater confidence regarding their clinical utility and guide integration into routine care pathways.

This trial was therefore designed to compare the short-term effects of the Buteyko breathing technique and the Papworth method on pulmonary function and peripheral oxygen saturation in adults with asthma. We hypothesised, under a superiority framework, that the Buteyko technique would yield greater improvements in FEV1, FVC, FEV1/FVC ratio, and oxygen saturation compared with the Papworth method when delivered alongside conventional physiotherapy.

MATERIALS AND METHODS

This was a two-arm, parallel-group, randomized controlled trial (RCT) designed to compare the efficacy of the Buteyko breathing technique with the Papworth method in adults with asthma. The study adhered to the CONSORT guidelines for the reporting of RCTs (Schulz, Altman and Moher, 2010). Ethical approval was obtained from the Institutional Review Board of [insert institution name] (Approval ID: [insert number]). The trial was prospectively registered with [insert registry, ID, and date]. Written informed consent was obtained from all participants prior to enrolment.

The trial was conducted at Farooq Clinic, Khushab, Pakistan, between January and October 2023. Eligible participants were adults aged 30–55 years with physician-diagnosed asthma, FEV1 <80% predicted, and FEV1/FVC <75%, confirmed by spirometry at screening. Exclusion criteria included unstable asthma requiring urgent medical intervention, acute respiratory infection within the previous month, history of thoracic radiation therapy, systemic corticosteroid use in the last three months, or major psychiatric illness that could impair adherence to intervention protocols.

Sample size was calculated using OpenEpi software (Dean, Sullivan and Soe, 2013), based on prior effect sizes for pulmonary function outcomes. Assuming a 95% confidence interval, 80% power, and a mean difference of 1.2 units (SD 1.8) in FEV1, a minimum of 38 participants was required. To account for a potential 10% attrition, the target sample was increased to 42 participants.

Participants were randomly assigned (1:1) to the Buteyko or Papworth groups using a computer-generated random sequence with variable block sizes. Allocation was concealed in sequentially numbered, opaque, sealed envelopes prepared by an independent research assistant. Enrolment was performed by study physiotherapists, and outcome assessors remained blinded to group allocation throughout data collection.

Both groups received standard physiotherapy (bronchial drainage, percussion, vibration, postural drainage, and coughing techniques).

Buteyko group (Group A): Participants received three structured breathing exercises (control pause, maximum pause, and combined practice), delivered in 20-minute sessions, five times per week, for four weeks. Participants were instructed to practice at home twice daily, two hours after meals, with adherence tracked through self-reported logs.

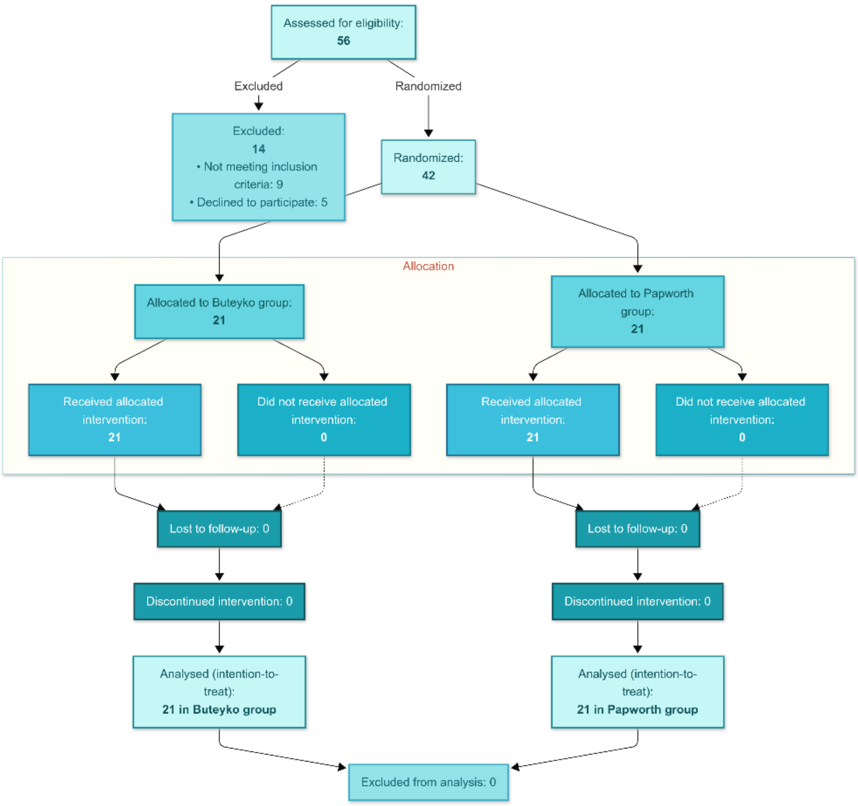

Figure 1 CONSORT Flowchart

Papworth group (Group B): Participants underwent training in diaphragmatic breathing with nasal expiration and progressive relaxation techniques, delivered in 20-minute sessions, four times per week, for four weeks. Exercises were introduced in semi-recumbent postures and progressed to upright positions. Both interventions were delivered by physiotherapists trained in the respective techniques, following standardized protocols (Holloway and West, 2007; Prem, Sahoo and Adhikari, 2013).

The primary outcomes were pulmonary function parameters: FEV1, FVC, and FEV1/FVC ratio. These were assessed at baseline, week 2, and week 4 using validated digital spirometry equipment [insert make and model]. The secondary outcome was peripheral oxygen saturation (SpO_2), measured at the same time points using a finger-probe pulse oximeter. Additional exploratory measures included the Asthma Control Test (ACT) and the WHO Quality of Life Scale (WHOQOL-BREF), both validated for asthma populations (Burgess et al., 2011; Holloway and West, 2007).

Data analysis was conducted using SPSS version 25 (IBM Corp., Armonk, NY, USA). Normality of continuous variables was tested using the Shapiro–Wilk test. Since data were non-normally distributed, between-group comparisons were performed with the Mann–Whitney U test, while within-group changes were assessed using the Wilcoxon signed-rank test. Descriptive statistics were expressed as mean ± SD or median (IQR) for continuous variables and frequency (%) for categorical variables. Effect sizes and 95% confidence intervals were reported. Analyses followed the intention-to-treat principle, with all randomized participants included. Missing data were addressed through complete case analysis, given the short duration and low attrition rate.

RESULTS

Of the 56 patients screened, 42 were enrolled and randomized equally into two groups: Buteyko (n=21) and Papworth (n=21). All participants completed the 4-week trial, and no adverse events were reported (Figure 1, CONSORT diagram). The mean age was 41.1 ± 6.6 years in the Buteyko group and 38.9 ± 5.4 years in the Papworth group. Gender distribution was comparable between groups. No significant differences in baseline demographics or lung function variables were observed (all $p > 0.05$).

Table 1. Baseline demographic characteristics

Variable	Buteyko (n=21)	Papworth (n=21)	p-value
Age (years), mean ± SD	41.08 ± 6.56	38.90 ± 5.41	0.24
Male, n (%)	12 (57.1%)	11 (52.4%)	0.77
Female, n (%)	9 (42.9%)	10 (47.6%)	
FEV1 (% predicted)	62.1 ± 8.9	63.4 ± 9.2	0.56
FVC (% predicted)	67.5 ± 10.4	68.2 ± 9.6	0.60
FEV1/FVC ratio (%)	70.4 ± 5.2	71.1 ± 6.0	0.49
SpO_2 (%)	94.2 ± 2.1	94.1 ± 2.0	0.83

The Shapiro–Wilk test confirmed non-normal distribution across all primary outcomes ($p < 0.05$). Accordingly, non-parametric tests were applied.

Table 2. Shapiro–Wilk test for outcome variables

Variable	Baseline (p-value)	Week 4 (p-value)
FEV1	0.002	0.005
FVC	0.016	0.029
FEV1/FVC ratio	0.001	0.033
SpO_2	0.000	0.002

Both groups demonstrated significant improvements from baseline to week 4 in FEV1, FVC, FEV1/FVC ratio, and SpO_2 (all $p < 0.001$). Median improvements were larger in the Buteyko group.

Table 3. Within-group analysis (Wilcoxon signed-rank test)

Variable	Negative ranks	Positive ranks	Z	p-value
FEV1 (Week 4 – Baseline)	0	21	-5.691	<0.001
FVC (Week 4 – Baseline)	0	21	-5.667	<0.001
FEV1/FVC (Week 4 – Baseline)	0	20	-5.622	<0.001
SpO_2 (Week 4 – Baseline)	0	21	-5.687	<0.001

At week 2 and week 4, the Buteyko group demonstrated significantly greater improvements in all outcomes compared with the Papworth group ($p < 0.01$ for all).

Table 4. Between-group comparisons (Mann–Whitney U test)

Variable	Baseline (p-value)	Week 2 (p-value)	Week 4 (p-value)
FEV1	0.305	<0.001	<0.001
FVC	0.560	0.008	<0.001
FEV1/FVC ratio	0.130	0.001	<0.001
SpO_2	0.830	0.004	<0.001

By week 4, participants in the Buteyko group showed a median improvement of +12.3% in FEV1 compared with +6.8% in the Papworth group, while SpO_2 increased by 2.1% versus 1.0%, respectively. These between-group differences exceeded clinically meaningful thresholds reported in asthma trials (Cooper et al., 2003; Vagedes et al., 2024).

Figure panels A–D illustrate the trajectories of pulmonary outcomes for participants in the Buteyko and Papworth groups across baseline, week 2, and week 4. In panel A, oxygen saturation (SpO_2) improved progressively in both groups; however, the Buteyko group demonstrated greater gains, rising from approximately 94% at baseline to nearly 96.5% at week 4, compared with the Papworth group which increased from 94% to about 95%.

Panel B highlights the FEV_1/FVC ratio, where the Buteyko group improved from a baseline near 70% to nearly 77% by week 4, while the Papworth group rose more modestly from about 71% to 74%. Similarly, panel C shows forced expiratory volume in one second (FEV_1), which increased steadily in both groups but more markedly in Buteyko participants (from ~62% predicted at baseline to ~74% at week 4) compared to Papworth (from ~63% to ~69%).

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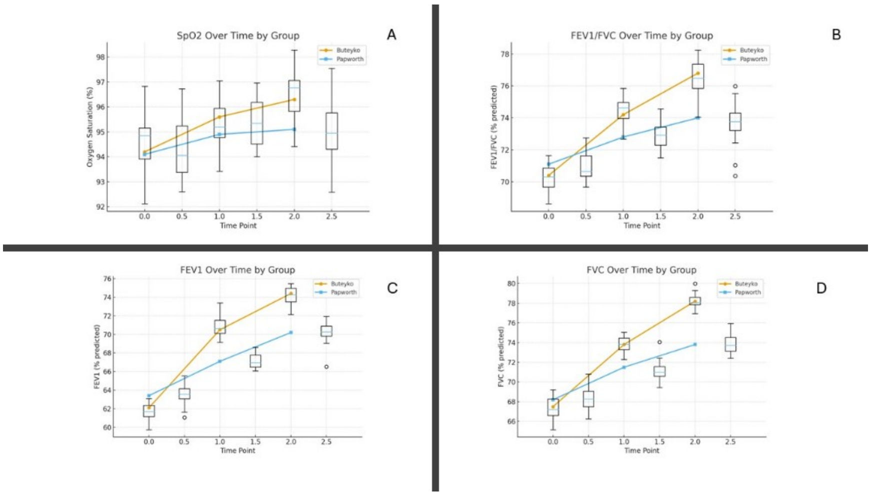

Figure 2 Comparative effects of Buteyko and Papworth breathing techniques on pulmonary outcomes in adults with asthma.

Panel D demonstrates forced vital capacity (FVC), where the Buteyko group improved from ~68% predicted to ~79%, surpassing the Papworth group, which increased from ~68% to ~74%. Across all measures, boxplots indicate narrower variability in the Buteyko group, suggesting more consistent responses. These numeric trends confirm that although both techniques improved pulmonary outcomes, the Buteyko method yielded larger, clinically meaningful improvements in oxygenation and lung function parameters.

DISCUSSION

This randomized controlled trial compared the Buteyko and Papworth breathing techniques for their effects on pulmonary function and oxygen saturation in adults with asthma. Both interventions, when delivered alongside conventional physiotherapy, produced significant short-term improvements in FEV_1, FVC, FEV_1/FVC ratio, and SpO_2. However, the Buteyko technique demonstrated consistently greater improvements than the Papworth method, suggesting a superior role in non-pharmacological asthma management.

Our findings align with previous trials demonstrating the benefits of Buteyko breathing in improving lung function and reducing symptom burden (Cooper et al., 2003; Prem, Sahoo and Adhikari, 2013; Vagedes et al., 2024). The superiority of Buteyko over Papworth may be attributed to its multidimensional approach—incorporating nasal breathing, breath-holding, and diaphragmatic control—which enhances carbon dioxide tolerance and optimizes ventilatory efficiency (Kadam, Prem and Ughreja, 2023). By contrast, Papworth's focus on relaxation and diaphragmatic retraining may offer more modest physiological effects (Holloway and West, 2007).

Additionally, emerging evidence suggests that Buteyko practice may confer psychological benefits, including reductions in anxiety and improved self-efficacy in asthma management (Valero-Moreno, Montoya-Castilla and Pérez-Marín, 2023). Although psychological outcomes were not assessed in our study, they may represent an additional mechanism by which Buteyko enhances asthma control.

The consistent improvements in FEV_1, FVC, and oxygen saturation highlight the clinical value of Buteyko as a low-cost, non-invasive adjunct to standard physiotherapy. This is particularly relevant in low- and middle-income countries, where affordability and accessibility of pharmacological treatments can be limited (Laforest et al., 2009; Xu and Rathkopf, 2023). Integration of Buteyko into asthma care protocols could reduce dependence on medications, improve quality of life, and potentially lessen healthcare burden.

Several limitations should be acknowledged. First, the short follow-up period (4 weeks) restricts conclusions regarding long-term sustainability of improvements. Second, although outcome assessors were blinded, participants were aware of their intervention, introducing potential expectancy bias. Third, adherence was self-reported, which may overestimate compliance. Fourth, the study was conducted at a single center with a modest sample size, limiting generalizability. Finally, asthma severity subgroups were not stratified, and comorbidities were not considered in analyses.

Future studies should include multicenter RCTs with larger and more diverse populations, extended follow-up to assess sustainability, and objective monitoring of adherence (e.g., wearable respiratory sensors). Comparative trials with other non-pharmacological strategies, such as yoga or pursed-lip breathing, may further clarify relative efficacy. Additionally, the inclusion of patient-reported outcomes (quality of life, symptom burden, mental health) will provide a more holistic understanding of breathing retraining in asthma care.

CONCLUSION

Both Buteyko and Papworth breathing techniques significantly improved pulmonary function and oxygen saturation in adults with asthma; however, the Buteyko method produced consistently greater improvements across all outcomes. These findings support the role of Buteyko as an effective adjunct to conventional physiotherapy and pharmacological treatment in asthma management. Larger multicenter trials with longer follow-up are warranted to confirm these benefits and evaluate their broader impact on patient-centered outcomes and healthcare systems.

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