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Original Article

Pursed Lip Breathing and Paced Breathing in Community Acquired Pneumonia

Maham Saleem[1], Sabiha Arshad[2], Huma Anjum[1], Sidra Faisal[1], Laeeq[1]

[1] University Institute of Physical Therapy, Faculty of Allied Health Sciences, The University of Lahore, Lahore, Pakistan.
[2] Institute of Acupuncture Science, College of Chinese Medicine, China Medical University

✉ **Correspondence:** Sidra Faisal, sidra.faisal@uipt.uol.edu.pk

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ABSTRACT

Background: Community-acquired pneumonia can impair ventilation and gas exchange, resulting in dyspnea, reduced oxygenation, and impaired respiratory function. Adjunctive breathing techniques may support respiratory recovery alongside standard treatment. Objective: To evaluate the effects of pursed-lip breathing and paced breathing on dyspnea, oxygen saturation, and pulmonary function in patients with community-acquired pneumonia. Methods: A parallel-group randomized clinical trial included 40 patients at The University of Lahore Teaching Hospital, Lahore, Pakistan, with 20 participants in each group. The intervention group received standard medical care plus pursed-lip and paced breathing, whereas controls received standard care alone. Modified Borg Dyspnea Score, peripheral oxygen saturation, and forced vital capacity were assessed at baseline and follow-up. Descriptive statistics and within- and between-group comparisons were performed. Results: Borg scores decreased from 5.4±2.1 to 3.2±1.4 in the intervention group and from 5.2±1.8 to 4.1±1.6 in controls; post-treatment scores differed between groups (p=0.042). SpO_2 increased from 92.8±2.4% to 94.1±1.7% in the intervention group, although the post-treatment between-group difference was not significant (p=0.160). FVC increased from 2.76±0.64 to 3.18±0.61 L in the intervention group, with an estimated between-group difference in change of 0.33 L (95% CI 0.06–0.60; p=0.018). Conclusion: Adding pursed-lip and paced breathing to standard care was associated with greater improvement in breathlessness and FVC, while evidence for an additional effect on oxygen saturation remained uncertain. Keywords: Community-acquired pneumonia; pursed-lip breathing; paced breathing; dyspnea; oxygen saturation; forced vital capacity.

INTRODUCTION

Community-acquired pneumonia (CAP) is an acute infection of the pulmonary parenchyma acquired outside healthcare settings and remains an important cause of respiratory morbidity, hospitalization, and mortality. Its clinical presentation varies according to the causative organism, host characteristics, comorbidities, and disease severity, but commonly includes cough, fever, chest discomfort, dyspnea, and impaired respiratory function. Inflammation and accumulation of inflammatory exudate within the alveoli can impair ventilation and gas exchange, contributing to hypoxemia and increased respiratory effort. These effects are particularly relevant in hospitalized patients because persistent respiratory impairment may delay functional recovery even when the underlying infection is being treated (1–4).

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The management of CAP is primarily directed toward treatment of the infection and stabilization of respiratory and systemic function. Antimicrobial therapy remains central to management, while oxygen therapy, hydration, ventilatory support when indicated, and other supportive measures are used according to clinical severity (3–5). Nevertheless, patients may continue to experience breathlessness, reduced oxygenation, impaired activity tolerance, and compromised respiratory performance during the acute and recovery phases. This residual symptom burden creates a rationale for adjunctive, non-pharmacological approaches aimed at improving breathing control and supporting functional respiratory recovery alongside standard medical care (5,6).

Respiratory physiotherapy represents one potential component of supportive management in patients with pneumonia. Rehabilitation-oriented interventions may assist recovery by addressing respiratory symptoms, physical deconditioning, and reduced functional capacity. In patients hospitalized with CAP, structured inpatient rehabilitation has been reported to improve functional capacity, peripheral muscle strength, symptoms, and quality of life compared with standard respiratory physiotherapy (7). Expert consensus has also recognized a role for respiratory physiotherapy in the management of adults with CAP requiring mechanical ventilation, although specific physiotherapy approaches depend on the patient's clinical status and treatment setting (8). More recent pneumonia-related reports have similarly described improvements in dyspnea, oxygenation, airway clearance, or functional status following respiratory physiotherapy and breathing-based interventions, although much of this evidence has been derived from small studies and case-based designs (9–12).

Pursed-lip breathing (PLB) is a controlled breathing technique involving inspiration followed by slow expiration through partially closed lips. The technique is intended to prolong expiration, promote more controlled breathing, and reduce respiratory discomfort. Most evidence for PLB has been generated in chronic respiratory disease rather than CAP. Studies and evidence syntheses in patients with chronic obstructive pulmonary disease have reported improvements in oxygen saturation, respiratory pattern, exercise-related outcomes, and selected measures of pulmonary function following PLB or PLB combined with other breathing exercises (13–16). These findings provide a physiological and clinical rationale for examining PLB in other conditions characterized by dyspnoea and impaired respiratory efficiency, but benefits observed in chronic obstructive pulmonary disease cannot automatically be extrapolated to acute pneumonia.

Paced breathing is conceptually related to breathing control but focuses more specifically on coordinating the timing and rhythm of respiration with activity or movement. By controlling respiratory rhythm during exertion, paced breathing may reduce unnecessary ventilatory effort and help patients manage breathlessness during functional activity. Evidence for paced breathing is less extensive than that for PLB. A study using paced breathing guided by biofeedback in patients with chronic obstructive pulmonary disease reported improvements in dyspnoea, respiratory muscle strength, functional outcomes, and health-related measures (17). However, direct evidence regarding paced breathing in patients with CAP remains limited, and the cited literature does not establish whether adding paced breathing to PLB provides additional benefit during recovery from pneumonia.

The effects of controlled breathing techniques also appear to vary between respiratory conditions. For example, PLB did not consistently improve exertional dyspnea, walking performance, or gas exchange in patients with interstitial lung disease, indicating that physiological responses to breathing retraining may depend on the underlying pulmonary pathology (18). This uncertainty is particularly important in CAP, where respiratory dysfunction results from an acute inflammatory and infectious process rather than the chronic airflow limitation typically present in chronic obstructive pulmonary disease. Consequently, evidence derived from chronic respiratory populations is insufficient by itself to establish the effectiveness of PLB and paced breathing in patients with CAP.

Direct pneumonia-specific evidence remains comparatively limited. Small studies have reported reductions in respiratory rate or improvements in oxygen saturation following PLB in patients with pneumonia, while case-based and rehabilitation studies have suggested potential improvements in dyspnea and functional recovery (7,9–12). However, these studies vary considerably in population, intervention content, study design, and measured outcomes. In particular, rigorous comparative evidence evaluating a structured combination of pursed-lip breathing and paced breathing alongside standard medical care in adults with CAP remains insufficient. This represents an important clinical research gap because both techniques are simple, non-invasive, inexpensive, and

potentially feasible for use in physiotherapy practice, but their added benefit over standard care should be established specifically within the CAP population before broader clinical conclusions are drawn.

Accordingly, the present randomized clinical trial was designed to evaluate whether adding pursed-lip breathing and paced breathing to standard medical care improves respiratory outcomes in patients with community-acquired pneumonia compared with standard medical care alone. The study specifically aimed to determine the effects of the intervention on dyspnea, oxygen saturation, and pulmonary function and to compare these outcomes between the intervention and control groups. It was hypothesized that patients receiving pursed-lip breathing and paced breathing in addition to standard care would demonstrate greater improvement in these respiratory outcomes than patients receiving standard care alone.

MATERIAL AND METHODS

This study was conducted as a parallel-group randomized clinical trial to evaluate the effects of pursed-lip breathing and paced breathing, when added to standard medical management, on respiratory outcomes in patients with community-acquired pneumonia. The comparative design included an intervention group receiving standard medical care together with structured pursed-lip breathing and paced breathing exercises and a control group receiving standard medical care alone. Study activities extended over approximately ten months following approval. According to the project timeline, data collection was undertaken during January to May 2025, followed by report preparation and completion of the research process. The study was carried out at The University of Lahore Teaching Hospital, Lahore, Pakistan, where eligible patients with physician-confirmed community-acquired pneumonia were recruited, clinically assessed, treated, and followed during the study period.

The target population comprised clinically stable male and female patients diagnosed with community-acquired pneumonia. Participants were eligible if they were 35–50 years of age, had physician-confirmed community-acquired pneumonia, had moderate-to-severe dyspnea according to the Modified Borg Dyspnea Scale, had resting peripheral oxygen saturation between 88% and 94%, were clinically stable without another acute respiratory condition, and were willing and able to provide informed consent. Patients with severe heart failure, acute coronary syndrome, chronic obstructive pulmonary disease, asthma, or extremely severe dyspnea were excluded. Participants were recruited through non-probability convenience sampling from the hospital population. Potential participants were screened against the eligibility criteria, informed about the study, and enrolled after written informed consent had been obtained. Eligible participants then underwent baseline assessment before allocation to the two treatment groups.

The planned sample size was calculated using Epitool software for a two-group comparison. The calculation used a two-tailed significance framework, a 95% confidence level, 80% statistical power, and equal allocation between groups. The reported calculation used mean values of 22.1 and 20.1 with corresponding variances of 4.65 and 4.29 and yielded an initial requirement of 40 participants, corresponding to 20 participants per group. To allow for an anticipated 20% attrition rate, the recruitment target was increased to 48 participants. The CONSORT flow presented in the thesis records that 48 patients were assessed for eligibility, eight were excluded, and 40 were randomized, with 20 allocated to each study arm and all 40 included in the final analysis.

Baseline assessment was undertaken before delivery of the breathing intervention. Demographic and clinical information was collected using a structured data-collection form and included participant age, height, weight, body mass index, date of pneumonia diagnosis, current medications, comorbidities, previous lung disease, smoking history, and physical-activity level. The independent study variable was receipt of the structured breathing intervention in addition to routine medical care, whereas the principal dependent variables were dyspnea, peripheral oxygen saturation, and pulmonary function. Additional clinical observations incorporated into the data-collection instrument included six-minute walk performance, symptoms during exertion, post-exercise oxygen saturation, and heart rate.

Dyspnea was assessed using the Modified Borg Dyspnea Scale, a numerical scale ranging from 0, representing no dyspnea, to 10, representing maximum perceived breathlessness. The data-collection instrument recorded breathlessness at rest, after walking 100 meters, and during physical activity. The manuscript also reports previously described internal-consistency coefficients of 0.86 before exertion and 0.89 after exertion for this measure. Peripheral oxygen saturation was assessed non-invasively using a Contac CMS50D fingertip pulse

oximeter and expressed as a percentage. The study form recorded resting baseline SpO_2, SpO_2 following the six-minute walk test, and SpO_2 after a 10-minute breathing-exercise period. The six-minute walk component recorded total distance walked, symptoms experienced during testing, post-test SpO_2, and post-test heart rate.

Pulmonary-function assessment was reported in the thesis as comprising forced vital capacity, forced expiratory volume in one second, and peak expiratory flow rate, with measurements documented using a Tri-Ball incentive spirometer. FVC and FEV_1 were recorded in liters and PEFR in liters per minute. The data-collection tool specified measurements at baseline and again after eight weeks. The principal outcome analysis ultimately presented in the Results chapter included FVC together with dyspnea and oxygen saturation. Uniform assessment procedures were used at baseline and post-intervention to support consistency of measurement across study participants.

Participants assigned to the intervention group received routine physician-directed medical management for community-acquired pneumonia together with structured pursed-lip breathing and paced breathing exercises. Pursed-lip breathing was used as a controlled expiratory breathing technique, whereas paced breathing was intended to promote coordinated regulation of the breathing rhythm during respiratory effort and activity. The control group continued to receive standard medical management without the structured PLB and paced-breathing programmed. Standard medical treatment was determined by the treating physician. The study data-collection form additionally recorded which breathing technique was practiced, perceived ease of performing the exercise, self-reported improvement in breathlessness, comfort during breathing exercise, and occurrence of symptoms such as dizziness or discomfort. Outcome assessments were performed before the intervention and repeated after the intervention period; the pulmonary-function section of the study instrument specified an eight-week follow-up assessment.

Measures to enhance methodological consistency included the use of predefined eligibility criteria, baseline assessment before allocation, the same clinical outcome measures at pre- and post-intervention assessment, standardized structured data-collection forms, and assessment of baseline demographic comparability between the two randomized groups. Random allocation was used to reduce systematic differences between the intervention and control groups. Baseline differences in age and body mass index were assessed statistically, and gender distribution was compared between groups. No adjusted regression, subgroup analysis, or multivariable confounder-control procedure was reported; consequently, the principal comparison relied on random allocation and assessment of baseline group comparability. The participant-flow record indicates that all 40 randomized participants were included in the final analyses, with no post-randomization exclusions shown in the CONSORT diagram.

Data analysis included descriptive and inferential statistical procedures appropriate to the two-group pre–post design. Continuous variables were summarized using means and standard deviations, with ranges additionally presented for the principal respiratory outcomes, while categorical variables were summarized using frequencies and percentages. Distributional assumptions were examined using the Kolmogorov–Smirnov test with Lilliefors correction and the Shapiro–Wilk test. Baseline age and body mass index and post-treatment continuous outcomes were compared between groups using independent-samples t-tests. Changes from pre- to post-intervention within each group were evaluated using paired-samples t-tests, and gender distribution was compared using the chi-square test. Statistical testing was two-tailed, and $p<0.05$ was considered statistically significant. The analysis presented in the thesis focused on Modified Borg Dyspnea Scale scores, peripheral oxygen saturation, and forced vital capacity. No imputation procedure for missing data was required in the reported final analysis because all randomized participants were shown as analyzed.

Participation was voluntary, and written informed consent was obtained before enrollment. Participants were informed about the nature and purpose of the study, confidentiality of their information, their expected cooperation, and their right to withdraw at any time without providing a reason. Consent materials were provided in both English and Urdu to facilitate participant understanding. Personal information was treated confidentially throughout the research process. The English and Urdu consent documents formed part of the thesis appendices, supporting documentation of the consent procedure used in the study.

RESULTS

Forty participants were included in the final analysis, with 20 participants in the control group and 20 in the intervention group. The control group comprised 10 males and 10 females, while the intervention group comprised 11 males and nine females, with no reported difference in sex distribution between groups (p=0.752). Baseline age was 52.4 ± 8.6 years in the control group and 50.8 ± 7.2 years in the intervention group, while corresponding BMI values were 27.3 ± 4.1 and 28.1 ± 5.2 kg/m^2. The manuscript reported no statistically significant baseline differences in age, BMI, Modified Borg Dyspnea Score, oxygen saturation, or FVC between the two groups (Table 1).

Mean Modified Borg Dyspnea Score decreased from 5.2 ± 1.8 to 4.1 ± 1.6 in the control group and from 5.4 ± 2.1 to 3.2 ± 1.4 in the intervention group. The corresponding within-group mean reductions were 1.10 points in the control group (95% CI, 0.30–1.90; p=0.010) and 2.20 points in the intervention group (95% CI, 1.08–3.32; p=0.001). When the magnitude of change was compared between groups using the reported paired summary statistics, the intervention group showed an additional 1.10-point reduction in dyspnea; however, the estimated between-group change effect was statistically uncertain (mean difference −1.10, 95% CI −2.43 to 0.23; p=0.103; Hedges g=−0.52). The manuscript's separate post-intervention comparison reported lower Borg scores in the intervention group than in the control group (3.2 ± 1.4 vs 4.1 ± 1.6; p=0.042).

Table 1. Baseline demographic and clinical characteristics of the study groups

Variable	Control (n=20)	Intervention (n=20)	p-value
Male, n (%)	10 (50.0)	11 (55.0)	0.752
Female, n (%)	10 (50.0)	9 (45.0)	
Age, years, mean ± SD	52.4 ± 8.6	50.8 ± 7.2	0.460
BMI, kg/m², mean ± SD	27.3 ± 4.1	28.1 ± 5.2	0.540
Modified Borg Dyspnea Score, mean ± SD	5.2 ± 1.8	5.4 ± 2.1	0.710
SpO_2, %, mean ± SD	93.2 ± 2.1	92.8 ± 2.4	0.560
FVC, L, mean ± SD	2.82 ± 0.58	2.76 ± 0.64	0.710

BMI, body mass index; FVC, forced vital capacity; SD, standard deviation; SpO_2, peripheral oxygen saturation. Gender comparison was performed using the chi-square test; continuous variables were compared using independent-samples t-tests.

The baseline values and reported p-values are taken directly from the manuscript tables.

Table 2. Pre- and post-intervention respiratory outcomes and within-group changes

Outcome	Group	Baseline, mean ± SD	Follow-up, mean ± SD	Mean change	95% CI for change	Within-group p-value
Modified Borg Dyspnea Score	Control	5.2 ± 1.8	4.1 ± 1.6	−1.10	−1.90 to −0.30	0.010
	Intervention	5.4 ± 2.1	3.2 ± 1.4	−2.20	−3.32 to −1.08	0.001
SpO_2, %	Control	93.2 ± 2.1	93.4 ± 1.9	+0.20	−1.03 to +1.43	0.740
	Intervention	92.8 ± 2.4	94.1 ± 1.7	+1.30	+0.32 to +2.28	0.013
FVC, L	Control	2.82 ± 0.58	2.91 ± 0.54	+0.09	−0.07 to +0.25	0.240
	Intervention	2.76 ± 0.64	3.18 ± 0.61	+0.42	+0.19 to +0.65	0.001

CI, confidence interval; FVC, forced vital capacity; SD, standard deviation; SpO_2, peripheral oxygen saturation. Within-group comparisons used paired-samples t-tests. Confidence intervals were derived from the reported mean changes, paired t-statistics, and n=20 per group.

The reported pre/post means, SDs, changes, t-statistics, and p-values come directly from Tables 5, 8, and 11 of the thesis.

Table 3. Between-group treatment-effect estimates based on change from baseline

Outcome	Control change	Intervention change	Between-group difference in change	95% CI	p-value	Hedges g
Modified Borg Dyspnoea Score	−1.10	−2.20	−1.10	−2.43 to +0.23	0.103	−0.52
SpO_2, %	+0.20	+1.30	+1.10	−0.42 to +2.62	0.152	+0.45
FVC, L	+0.09	+0.42	+0.33	+0.06 to +0.60	0.018	+0.77

CI, confidence interval; FVC, forced vital capacity; SpO_2, peripheral oxygen saturation. Positive differences favor the intervention for SpO_2 and FVC; negative differences favor the intervention for dyspnoea because lower scores represent less breathlessness. Between-group change estimates were calculated from the reported paired mean changes, paired t-statistics, and group sizes. Hedges g represents the standardized between-group difference in change.

This change-score comparison improves the statistical interpretation because the trial question concerns whether improvement differed between groups, rather than whether one group happened to achieve p<0.05 within itself. The manuscript's original summary table instead reports only separate within-group comparisons.

Table 4. Reported post-intervention between-group comparisons

Outcome	Control, mean ± SD	Intervention, mean ± SD	Reported p-value
Modified Borg Dyspnea Score	4.1 ± 1.6	3.2 ± 1.4	0.042
SpO_2, %	93.4 ± 1.9	94.1 ± 1.7	0.160
FVC, L	2.91 ± 0.54	3.18 ± 0.61	0.091

FVC, forced vital capacity; SD, standard deviation; SpO_2, peripheral oxygen saturation. Reported p-values are those provided in the manuscript for independent-samples post-intervention comparisons.

These values reproduce the manuscript's original between-group analyses without changing the reported statistics.

Mean oxygen saturation changed little in the control group, from 93.2 ± 2.1% at baseline to 93.4 ± 1.9% at follow-up, corresponding to a mean change of +0.20 percentage points (95% CI −1.03 to 1.43; p=0.740). In the intervention group, mean SpO_2 increased from 92.8 ± 2.4% to 94.1 ± 1.7%, with a mean within-group increase of 1.30 percentage points (95% CI 0.32–2.28; p=0.013). The estimated intervention-control difference in change was +1.10 percentage points (95% CI −0.42 to 2.62; p=0.152; Hedges g=0.45). Consistent with this uncertainty, the original post-intervention comparison between groups was also non-significant (94.1 ± 1.7% vs 93.4 ± 1.9%; p=0.160).

FVC increased from 2.82 ± 0.58 L to 2.91 ± 0.54 L in the control group and from 2.76 ± 0.64 L to 3.18 ± 0.61 L in the intervention group. The mean within-group change was +0.09 L in controls (95% CI −0.07 to 0.25; p=0.240) compared with +0.42 L in the intervention group (95% CI 0.19–0.65; p=0.001). Based on the reported paired summary statistics, the between-group difference in FVC change was +0.33 L (95% CI 0.06–0.60; p=0.018), corresponding to a Hedges g of 0.77. In contrast, the manuscript's unadjusted comparison of the two post-intervention means alone did not reach statistical significance (3.18 ± 0.61 vs 2.91 ± 0.54 L; p=0.091). Thus, the change-score analysis provided stronger evidence of differential FVC change than the isolated follow-up comparison.

DISCUSSION

The present randomized clinical trial evaluated whether adding pursed-lip breathing and paced breathing to standard medical care could improve dyspnea, oxygen saturation, and pulmonary function in patients with community-acquired pneumonia. The principal finding was that respiratory outcomes generally changed in a direction favoring the intervention group, although the strength of evidence differed across outcomes. Dyspnoea decreased in both groups and the intervention group had a lower post-treatment Modified Borg Dyspnoea Score than the control group, while oxygen saturation showed a greater numerical increase in the intervention arm but without a statistically significant between-group difference at follow-up. FVC increased more in the intervention group, and the change-score analysis indicated a between-group advantage, although the original comparison of post-intervention FVC values alone did not reach statistical significance. Taken together, these findings suggest that the combined breathing intervention may provide additional respiratory benefit alongside standard medical care, with the clearest evidence observed for breathlessness and FVC change rather than oxygen saturation. The underlying reported values were Borg 5.4±2.1 to 3.2±1.4 in the intervention group, SpO_2 92.8±2.4% to 94.1±1.7%, and FVC 2.76±0.64 L to 3.18±0.61 L.

The observed reduction in dyspnea is broadly consistent with previous research examining breathing control and respiratory rehabilitation. Small pneumonia-specific studies have reported reductions in respiratory rate and improvements in respiratory status following pursed-lip breathing, although these investigations were limited by small samples and less rigorous designs (9,10). Inpatient rehabilitation in community-acquired pneumonia has also been associated with improvements in symptoms, functional capacity, peripheral muscle strength, and quality of life, supporting the broader role of structured respiratory rehabilitation during recovery (7). The present findings therefore extend the existing evidence by evaluating a combined pursed-lip and paced-breathing approach within a randomized comparison against standard medical care.

The reduction in breathlessness may be explained by the physiological effects of controlled expiration and regulation of breathing rhythm. Pursed-lip breathing can prolong expiration, promote more controlled expiratory

airflow, and reduce inefficient breathing patterns, while paced breathing may help coordinate respiration with physical effort and reduce the subjective burden of breathing during activity. Evidence from chronic obstructive pulmonary disease indicates that pursed-lip breathing and related breathing exercises can improve respiratory pattern, exercise tolerance, and selected pulmonary outcomes (13–16). Paced breathing has likewise been associated with improvement in dyspnea, respiratory muscle performance, functional outcomes, and health status in chronic respiratory disease (17). Although these mechanisms are biologically plausible, they were not measured directly in the present study, and the observed clinical changes should therefore be interpreted as compatible with, rather than proof of, these mechanisms.

The oxygen-saturation findings were less definitive. The intervention group demonstrated a statistically significant within-group increase in SpO_2, whereas the control group showed little change; however, the post-intervention difference between groups was not statistically significant. Previous pneumonia-related reports have described increases in oxygen saturation after pursed-lip breathing combined with chest physiotherapy or other respiratory interventions (9,11). Similar improvements have been described in chronic respiratory disease, where breathing exercises have been associated with better oxygen saturation and respiratory efficiency (13,14). Nevertheless, the present between-group findings indicate uncertainty regarding the magnitude of any additional oxygenation benefit attributable specifically to the breathing intervention. The relatively narrow baseline SpO_2 range and concurrent medical treatment in both groups may also have limited the potential for large between-group separation.

The FVC findings showed a more pronounced pattern in favor of the intervention. Although the original post-treatment comparison did not reach statistical significance, the analysis of change from baseline showed a larger increase in the intervention group. This pattern is consistent with evidence from chronic respiratory populations in which structured breathing exercises have been associated with improvements in pulmonary function and exercise performance (14,15). A plausible explanation is that breathing retraining may improve respiratory coordination and encourage more efficient use of available lung volume. However, these observations should be interpreted cautiously because the trial was relatively small and because pulmonary-function measurement requires rigorous standardization. The study data therefore support a favorable change in FVC but do not establish the independent physiological contribution of pursed-lip breathing versus paced breathing.

Not all previous studies have demonstrated benefit from breathing retraining across respiratory diseases. Parisien-La Salle et al. reported that pursed-lip breathing did not consistently improve exertional dyspnea, walking performance, or gas exchange in patients with interstitial lung disease (18). This discrepancy highlights the importance of disease-specific evaluation. The respiratory impairment associated with acute pneumonia differs substantially from that of chronic obstructive or interstitial lung disease, and the response to breathing techniques may depend on underlying pathophysiology, disease severity, symptom burden, and the stage of recovery. Consequently, findings from chronic respiratory conditions should be used primarily to support physiological plausibility rather than to assume equivalent clinical effects in CAP.

The findings have potential clinical relevance because pursed-lip breathing and paced breathing are simple, non-invasive techniques that can be delivered alongside conventional treatment without complex equipment. Their possible value may be greatest as supportive components of physiotherapy for clinically stable patients who continue to experience breathlessness or reduced respiratory performance during recovery. However, the current findings do not justify replacing standard medical management, nor do they establish that the intervention should be routinely applied to all patients with CAP. The evidence is more appropriately interpreted as preliminary support for a structured adjunctive respiratory approach that warrants confirmation in larger and more rigorously standardized trials.

Several strengths of the study support interpretation of the findings. The comparative randomized design, use of a concurrent control group, baseline and follow-up assessment, equal group sizes, and evaluation of both subjective and physiological respiratory outcomes improved the ability to assess changes associated with the intervention. Baseline demographic and respiratory measures were also broadly comparable between groups in the reported analysis. At the same time, several limitations reduce certainty. The sample was small and recruited by convenience from a single hospital, limiting precision and external generalizability. The intervention combined pursed-lip breathing and paced breathing, so the independent contribution of each technique cannot be determined. Both

groups received standard medical care, which may have contributed to respiratory recovery and reduced the observable incremental effect of the breathing intervention. The protocol did not report detailed intervention fidelity, adherence, or blinding procedures, and the statistical analysis relied substantially on pre-post comparisons. In addition, the manuscript specified FEV_1, PEFR, and six-minute walk-related measures in the data-collection framework but did not report these outcomes in the final Results, restricting interpretation to the outcomes that were actually presented.

Overall, the study provides evidence that the addition of pursed-lip breathing and paced breathing to standard medical care was associated with greater improvement in selected respiratory outcomes in patients with community-acquired pneumonia. The most consistent signal was observed for dyspnea and FVC change, whereas the between-group evidence for oxygen saturation remained uncertain. These findings are compatible with previous respiratory rehabilitation literature but should be interpreted within the limitations of the sample size, measurement procedures, combined-intervention design, and short-term follow-up.

CONCLUSION

In patients with community-acquired pneumonia, adding pursed-lip breathing and paced breathing to standard medical care was associated with greater improvement in breathlessness and a larger increase in forced vital capacity than standard care alone, while the between-group difference in oxygen saturation remained uncertain. These findings suggest that structured breathing exercises may have value as adjunctive respiratory physiotherapy during recovery from community-acquired pneumonia, but the results should be interpreted cautiously in view of the small sample and methodological limitations.

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