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Effect of Breathing Exercises with Aerosol Therapy Through Telerehabilitation Approaches on Lung Function, Health Awareness, Self Management, Quality of Life in Moderate Asthma Individuals

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ABSTRACT

Background: Asthma is a chronic inflammatory airway disease characterised by variable airflow limitation, airway hyperresponsiveness and recurrent respiratory symptoms that can impair lung function, daily activities and quality of life. This study evaluated changes in lung function, health awareness, self-management and quality of life after physician-prescribed aerosol therapy combined with pursed-lip breathing delivered through telerehabilitation in individuals with moderate asthma.

Methodology: A single-group pre-test/post-test quasi-experimental study included 30 individuals with moderate asthma aged 40–60 years. Participants completed a 12-week programme of physician-prescribed aerosol therapy followed by pursed-lip breathing exercises delivered through structured telerehabilitation. Outcomes were forced expiratory volume in one second (FEV_1 % predicted), peak expiratory flow rate (PEFR), Asthma Awareness Scale (AAS), Asthma Self-Management Knowledge Questionnaire (ASMKQ) and Asthma Quality of Life Questionnaire (AQLQ). Normality was assessed using the Shapiro–Wilk test and pre/post comparisons using Wilcoxon signed-rank tests.

Results: Mean FEV_1 increased from 69.30 (SD 4.43) to 82.03 (SD 4.54) % predicted and mean PEFR from 275.07 (SD 14.83) to 335.23 (SD 14.68) L/min. Mean AAS increased from 9.00 (SD 1.44) to 13.53 (SD 1.01), ASMKQ from 19.63 (SD 1.85) to 26.93 (SD 1.08), and AQLQ from 44.30 (SD 3.16) to 63.83 (SD 3.88). All pre/post comparisons were statistically significant ($p<0.001$).

Conclusion: The 12-week combined programme was associated with significant within-group improvements in pulmonary function, asthma awareness, self-management knowledge and quality of life. Because there was no control group, the findings do not establish that the programme caused these improvements.

Keywords: Forced Expiratory Volume in One Second (FEV_1); Peak Expiratory Flow Rate (PEFR); Asthma Awareness Scale (AAS); Asthma Self-Management Knowledge Questionnaire (ASMKQ); Asthma Quality of Life Questionnaire (AQLQ).

INTRODUCTION

Asthma is a chronic inflammatory airway disease characterised by airway inflammation, bronchial hyperresponsiveness and variable expiratory airflow limitation, leading to recurrent wheezing, breathlessness, chest tightness and cough [1,3,4,5]. Asthma continues to impose a substantial health burden worldwide [2,6].

Management of asthma includes pharmacological treatment together with patient education, self-management and regular follow-up [1]. Appropriate inhaler-device selection and correct inhaler technique are important components of aerosol therapy [51,52,53,55].

Breathing exercises are used as non-pharmacological adjuncts in respiratory rehabilitation. Previous literature describes breathing retraining as a strategy intended to improve breathing efficiency, respiratory control and symptom management [44,45,48,49]. Controlled expiration has also been discussed in relation to dyspnoea, hyperinflation and airflow limitation [46,47].

Telerehabilitation provides a means of delivering supervision, education, monitoring and feedback remotely. Telemedicine and emerging technologies can support healthcare delivery in allergy and immunology, including asthma-related care [38].

Objective assessment of pulmonary function is important in asthma. Spirometry should be performed according to standardised technical recommendations [56]. In addition to pulmonary function, asthma knowledge, self-management and quality of life are relevant patient-centred outcomes [57,58,59,62].

The present study therefore evaluated changes in lung function, asthma awareness, self-management knowledge and quality of life following a 12-week programme of physician-prescribed aerosol therapy and pursed-lip breathing delivered through telerehabilitation in individuals with moderate asthma.

MATERIALS

1. Digital Spirometer for measuring FEV1 and PEFR
2. Metered dose inhaler
3. Smart phone\ computer
4. Asthma Awareness Scale, Asthma Self Management Questionnaire, Asthma Quality Of Life Questionnaire
5. Patient consent and data recording sheets.

METHODOLOGY

Study setting: Sri Venkateswara Institute Of Medical Sciences,SVIMS Hospital,Tiruapti.
Study Design: Pre and post test – Quasi Experimental Designs
Sampling Technique: Purposive sampling technique
Sample size: 30
Treatment Duration: 12 weeks

INCLUSION CRITERIA

- Individuals diagnosed with moderate bronchial asthma (GINA Guidelines 2025).

- Age group: 40–60 years.
- Pre bronchodilator FEV1 60–79% predicted.
- Reliable access to a stable internet connection and a smartphone, or computer capable of supporting video conferencing for telerehabilitation sessions.
- Willing to participate in remote training and follow-ups over the study period.

EXCLUSION CRITERIA

- Have severe or uncontrolled asthma requiring frequent hospitalization.
- Severe asthma (FEV1 < 60% predicted).
- Asthma exacerbation requiring systemic corticosteroids or hospitalization within the last 4 weeks.
- Suffer from other significant respiratory conditions (e.g., COPD, bronchiectasis, pulmonary fibrosis).
- Have cognitive, visual, or physical impairments that prevent them from following breathing instructions or using tele rehab tools.
- Individuals currently enrolled in another pulmonary rehabilitation program.
- Have a history of cardiovascular disease that limits physical activity.
- Pregnant or lactating mothers.
- Presence of any musculoskeletal or neurological condition that physically prevents the proper execution of breathing exercises (e.g., severe spinal deformity, paralyzing conditions).
- Current smokers or individuals with a significant smoking history.

OUTCOME MEASURES

Baseline demographic information included age, sex, height, weight and body mass index. Pulmonary function was assessed using a digital spirometer. Three acceptable manoeuvres were performed and the best value was used for analysis.

1. **FEV_1:** Forced expiratory volume in one second was recorded as percentage predicted.
2. **PEFR:** Peak expiratory flow rate was recorded in litres per minute.
3. **Asthma Awareness Scale (AAS):** The 15-item scale was scored 1 for a correct response and 0 for an incorrect or 'don't know' response, giving a total score of 0–15; higher scores represented greater awareness.
4. **Asthma Self-Management Knowledge Questionnaire (ASMKQ):** The 28-item questionnaire was scored 1 for a correct response and 0 for an incorrect response, giving a total score of 0–28; higher scores represented greater self-management knowledge.
5. **Asthma Quality of Life Questionnaire (AQLQ):** The 16-item, 5-point questionnaire used in the dissertation covered symptoms/health, emotional function, environmental exposure and activity limitation. Total scores ranged from 16 to 80, with higher scores representing better quality of life.

INTERVENTION

The intervention group received physician-prescribed aerosol therapy followed by pursed-lip breathing exercises delivered through a telerehabilitation approach for a period of 12 weeks. Participants were instructed to use their prescribed aerosol medication before each exercise session. A waiting period of approximately 5–15 minutes was maintained after aerosol therapy to allow adequate bronchodilator action before performing the breathing exercises. Pursed-lip breathing exercises were demonstrated during the

initial virtual session, and participants were trained to perform the technique correctly by inhaling slowly through the nose and exhaling gently through partially closed lips, maintaining an expiratory phase longer than the inspiratory phase. The breathing exercises were performed according to the prescribed protocol and progressed based on individual tolerance.

Health education regarding asthma, inhaler technique, trigger avoidance, medication adherence, and self-management strategies was provided during the intervention period. Participants were encouraged to practice prescribed breathing exercises regularly at home. Participants recruited on the same day attended scheduled virtual sessions together whenever feasible, while those recruited on different dates followed individual intervention schedules. Regular telerehabilitation follow-up sessions were conducted to supervise exercise performance, reinforce proper breathing technique, monitor adherence, address participants' concerns, and provide continuous motivation throughout the intervention period. Reassessment was carried out after completion of the 12-week intervention using the same outcome measures, including Forced Expiratory Volume in one second (FEV_1), Peak Expiratory Flow Rate (PEFR), Asthma Awareness Scale (AAS), Asthma Self-Management Knowledge Questionnaire (ASMKQ), and Asthma Quality of Life Questionnaire (AQLQ).

STATISTIC ANALYSIS

Data were analysed using IBM SPSS Statistics Version 20. Descriptive statistics were calculated for demographic and outcome variables. Normality was assessed using the Shapiro–Wilk test. The dissertation used Wilcoxon signed-rank tests to compare pre- and post-intervention outcomes. Statistical significance was set at $p<0.05$. SPSS outputs reported as $p=0.000$ are presented as $p<0.001$.

RESULTS

Thirty participants completed the 12-week intervention and were included in the analysis. The outcome measures were assessed before and after the intervention. Normality was examined using the Shapiro-Wilk test, followed by Wilcoxon signed-rank testing for pre-post comparisons, as specified in the thesis.

Table 1 - Tests of normality: Shapiro-Wilk test

Outcome measure	W	p value	Distribution
FEV_1	0.947	0.143	Normal
PEFR	0.959	0.284	Normal
Asthma Awareness Scale (AAS)	0.925	0.036	Not normal
Asthma Self-Management Knowledge Questionnaire (ASMKQ)	0.924	0.035	Not normal
Asthma Quality of Life Questionnaire (AQLQ)	0.958	0.273	Normal

Interpretation: The Shapiro-Wilk test showed that FEV_1, PEFR and AQLQ were normally distributed ($p > 0.05$), whereas AAS and ASMKQ were not normally distributed ($p < 0.05$). The Wilcoxon signed-rank test was used for the pre-post comparisons reported in the thesis.

Table 2 - Comparison of pre and post values of FEV_1 (% predicted)

Time	N	Mean	SD	Min	Max	Median	Z	p value
Pre	30	69.30	4.43	63	78	68.50	−5.04	<0.001
Post	30	82.03	4.54	75	91	81.50		

Interpretation: The Wilcoxon Signed-Ranks Test demonstrated a statistically significant improvement in FEV_1 percentage following the intervention ($Z = -5.04$, $p < 0.001$). The median FEV_1 increased from 68.50% before the intervention to 81.50% after the intervention, indicating a significant improvement in pulmonary function.

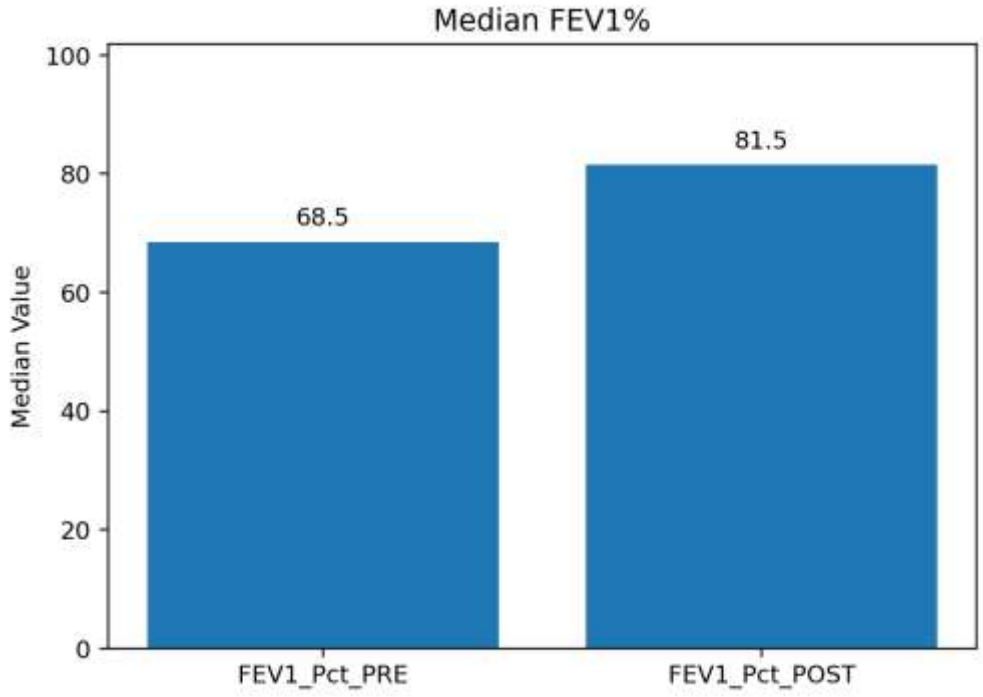


Figure 1 - Graphical representation of median pre and post values of FEV_1

Table 3 - Comparison of pre and post values of PEFR (L/min)

Time	N	Mean	SD	Min	Max	Median	Z	p value
Pre	30	275.07	14.83	250	300	275.50	−5.20	<0.001
Post	30	335.23	14.68	310	360	335.50		

Interpretation: The Wilcoxon Signed-Ranks Test demonstrated a statistically significant improvement in PEFR following the intervention ($Z = -5.20$, $p < 0.001$). The median PEFR increased from 275.50 L/min before the intervention to 335.50 L/min after the intervention, indicating improved expiratory airflow.

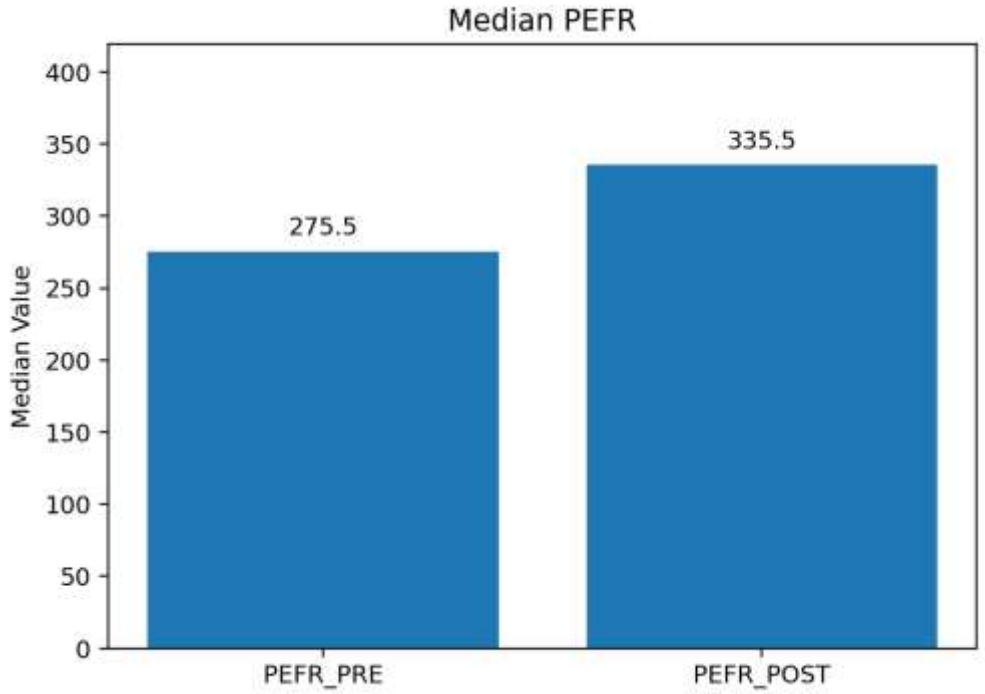


Figure 2 - Graphical representation of median pre and post values of PEFR

Table 4 - Comparison of pre and post values of Asthma Awareness Scale (AAS)

Time	N	Mean	SD	Min	Max	Median	Z	p value
Pre	30	9.00	1.44	5	11	9.00	−4.93	<0.001
Post	30	13.53	1.01	12	15	13.00		

Interpretation: The Wilcoxon Signed-Ranks Test demonstrated a statistically significant improvement in Asthma Awareness Scale scores following the intervention ($Z = -4.93$, $p < 0.001$). The median AAS increased from 9.00 before the intervention to 13.00 after the intervention, indicating enhanced asthma awareness.

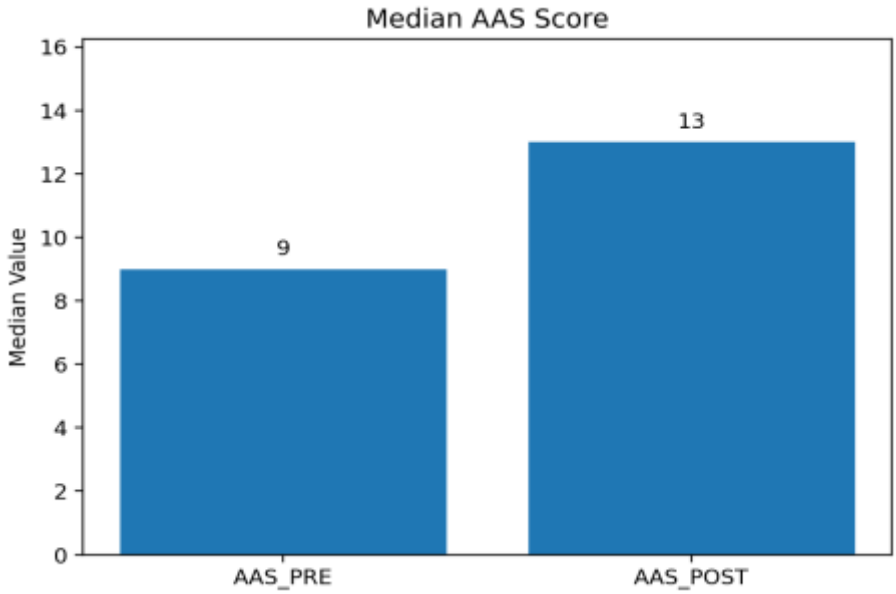


Figure 3 - Graphical representation of median pre and post values of AAS

Table 5 - Comparison of pre and post values of Asthma Self-Management Knowledge Questionnaire (ASMKQ)

Time	N	Mean	SD	Min	Max	Median	Z	p value
Pre	30	19.63	1.85	15	22	20.00	−4.86	<0.001
Post	30	26.93	1.08	25	28	27.00		

Interpretation: The Wilcoxon Signed-Ranks Test demonstrated a statistically significant improvement in Asthma Self-Management Knowledge Questionnaire scores following the intervention ($Z = -4.86$, $p < 0.001$). The median ASMKQ score increased from 20.00 before the intervention to 27.00 after the intervention, indicating improved asthma self-management knowledge.

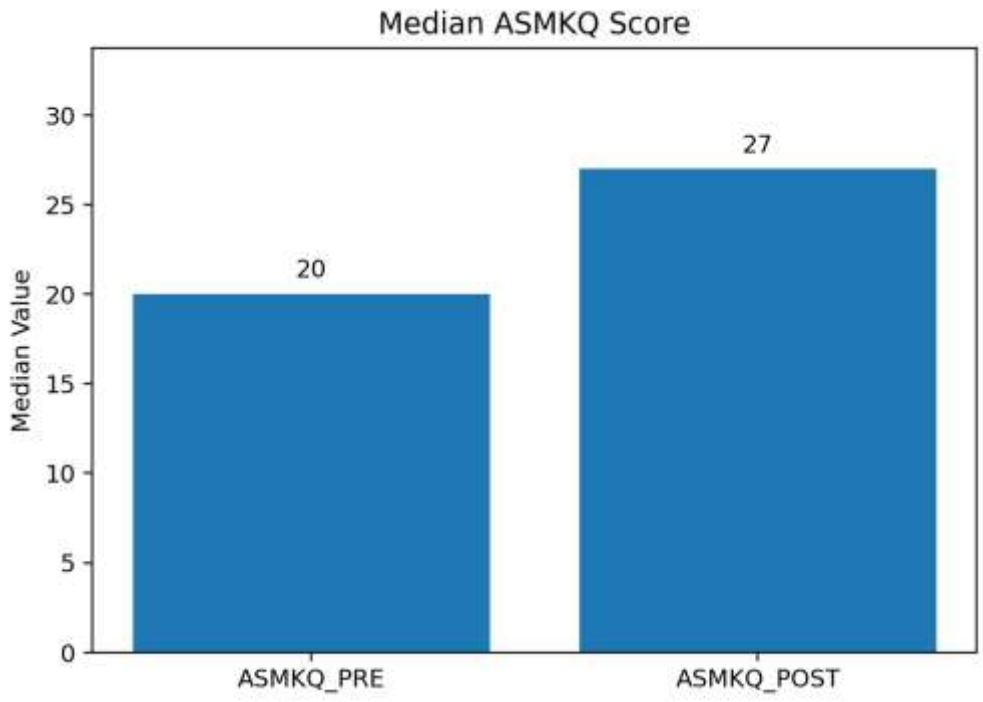


Figure 4 - Graphical representation of median pre and post values of ASMKQ

Table 6 - Comparison of pre and post values of Asthma Quality of Life Questionnaire (AQLQ)

Time	N	Mean	SD	Min	Max	Median	Z	p value
Pre	30	44.30	3.16	39	50	44.00	−4.79	<0.001
Post	30	63.83	3.88	48	71	64.00		

Interpretation: The Wilcoxon Signed-Ranks Test demonstrated a statistically significant improvement in Asthma Quality of Life Questionnaire scores following the intervention ($Z = -4.79$, $p < 0.001$). The median AQLQ score increased from 44.00 before the intervention to 64.00 after the intervention, indicating improved asthma-related quality of life.

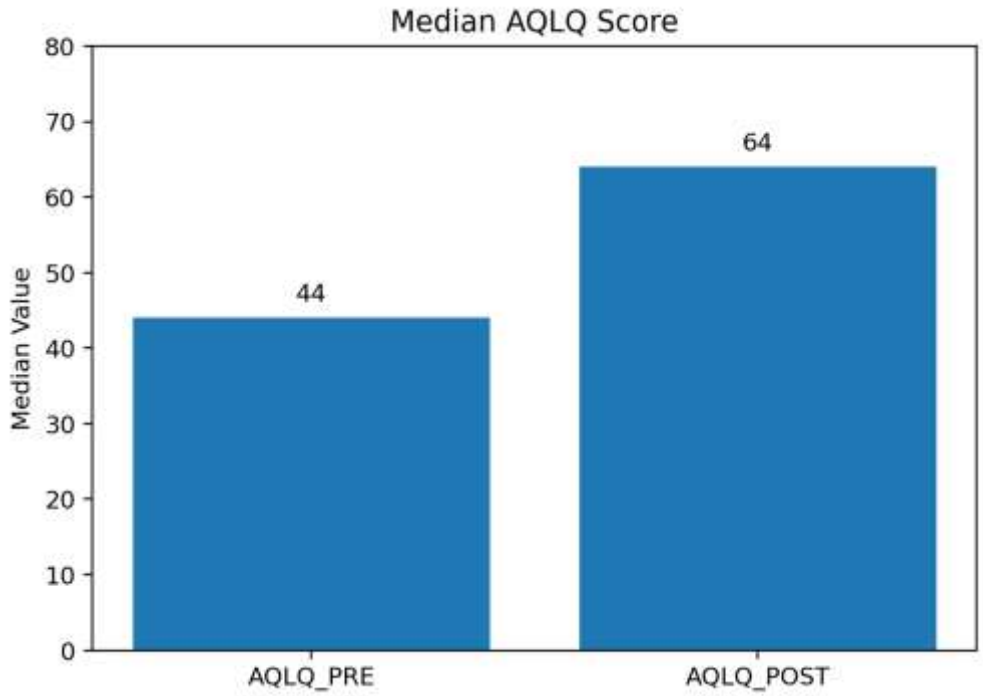


Figure 5 - Graphical representation of median pre and post values of AQLQ

DISCUSSION

This single-group quasi-experimental study identified significant within-group improvements in pulmonary function, asthma awareness, self-management knowledge and quality of life after 12 weeks of physician-prescribed aerosol therapy combined with pursed-lip breathing delivered through telerehabilitation. FEV_1 increased by 12.73 percentage points on average and PEFR by 60.16 L/min.

The pulmonary-function findings are consistent with the rationale presented in previous literature for combining prescribed inhaled therapy with breathing retraining. Aerosol therapy is influenced by inhaler selection, delivery and technique [51,52,53,55], while breathing retraining has been discussed in relation to respiratory control, dyspnoea, hyperinflation and ventilatory efficiency [46,47,48,49]. However, the present design cannot determine how much of the observed change was attributable to medication, breathing exercise, education, repeated professional contact, natural variation in asthma or other factors.

Asthma awareness increased from a mean of 9.00 to 13.53 and self-management knowledge from 19.63 to 26.93. The programme incorporated repeated education on asthma, inhaler technique, medication adherence, trigger avoidance and self-management. Regular virtual follow-up provided opportunities to reinforce information and correct technique. Previous literature identifies asthma knowledge, self-management education and regular review as important components of asthma care [57,58,59,1].

Quality-of-life scores increased from 44.30 to 63.83. Improved symptom management, greater confidence with self-management and ongoing professional contact may have supported daily activity and emotional well-being. Previous breathing-exercise literature also reports improvements in respiratory symptoms and quality-of-life-related outcomes [44,45,48,49]. Because the study used a pre/post design without a comparator, this result should be interpreted as a within-group change rather than proof of a treatment effect.

A practical feature of the programme was the use of telerehabilitation to provide demonstration, supervision and follow-up in participants' homes. Telemedicine and emerging technologies can support

remote healthcare delivery [38]. In the present study, participants followed their own 12-week schedule from baseline, while small-group virtual sessions could be used when participants were recruited together. Further controlled studies should quantify adherence, document medication regimens in greater detail, include longer follow-up and evaluate whether improvements are sustained.

STRENGTHS

1. The study used both objective pulmonary function tests and validated outcome questionnaires to comprehensively assess the effectiveness of the intervention.
2. A structured 12-week telerehabilitation programme ensured regular supervision, participant adherence, and continuity of care.
3. The intervention combined physician-prescribed aerosol therapy with breathing exercises, addressing both physiological and self-management aspects of moderate asthma.

LIMITATIONS

1. The study included a relatively small sample size of 30 participants, which may limit the generalizability of the findings.
2. The study followed a quasi-experimental design without a control group, limiting direct comparison of the intervention effects.
3. The intervention duration was limited to 12 weeks; therefore, the long-term effectiveness of the intervention could not be assessed.
4. The study included only individuals with moderate asthma, limiting the applicability of the findings to other asthma severity levels.

FUTURE RECOMMENDATIONS

1. Future studies can include a larger sample size to improve the generalizability of the findings.
2. Randomized controlled trials with appropriate control groups are recommended to strengthen the evidence for the effectiveness of the intervention.
3. Studies with longer follow-up periods are recommended to evaluate the long-term sustainability of the intervention.
4. Future research may investigate the effectiveness of similar telerehabilitation programmes in individuals with different asthma severity levels and age groups.

CLINICAL IMPLICATIONS

1. Pursed-lip breathing can be incorporated as an adjunct to physician-prescribed aerosol therapy in pulmonary rehabilitation programmes.
2. Telerehabilitation provides an accessible and feasible platform for delivering breathing exercise programmes. 3. Structured patient education improves asthma awareness and self-management.
3. Regular virtual follow-up may improve treatment adherence and exercise compliance.
4. The combined intervention may enhance pulmonary function and quality of life in individuals with moderate asthma.

CONCLUSION

In this group of 30 individuals with moderate asthma, a 12-week programme combining physician-prescri-

bed aerosol therapy, pursed-lip breathing, patient education and telerehabilitation was associated with statistically significant improvements in FEV_1, PEFR, asthma awareness, self-management knowledge and asthma-related quality of life. The absence of a control group prevents attribution of the observed changes to the intervention. Larger controlled studies with longer follow-up are warranted.

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