

Article

Combined Effects of Inspiratory Muscle Training with Pilates on Dyspnea, Cardiorespiratory Fitness, and Quality of Life in Asthma Patients

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ABSTRACT

Background: Asthma is a chronic respiratory disorder that compromises cardiorespiratory fitness and quality of life due to persistent dyspnea and airway inflammation. While Inspiratory Muscle Training (IMT) has shown benefits in strengthening respiratory muscles, its limited scope fails to address postural and musculoskeletal deficits. There is a research gap regarding the combined effects of IMT and Pilates on multidimensional asthma outcomes. **Objective:** To evaluate the combined effects of Inspiratory Muscle Training and Pilates exercises on dyspnea, cardiorespiratory fitness, and quality of life in patients with asthma, compared to IMT alone. **Methods:** This randomized controlled trial included 52 clinically stable asthma patients (n = 52) recruited from Gulab Devi Chest Hospital, Lahore, using simple random sampling. Participants were allocated into Group A (IMT + Pilates) and Group B (IMT only), receiving three weekly sessions for six weeks. Primary outcomes included dyspnea (Modified Borg Scale), cardiorespiratory fitness (Six-Minute Walk Test), and quality of life (Asthma Quality of Life Questionnaire). Ethical compliance followed the Declaration of Helsinki, with written informed consent obtained. Data were analyzed using SPSS v25, applying t-tests, ANOVA, and non-parametric equivalents based on data distribution. **Results:** Group A showed significantly greater improvements in 6MWT distance (401.9 ± 30.9 vs. 336.1 ± 41.5 ; $p < 0.05$), post-intervention symptom scores (69.56 ± 10.92 vs. 79.14 ± 13.16 ; $p = 0.009$), and quality of life metrics compared to Group B. **Conclusion:** The integration of Pilates with Inspiratory Muscle Training offers superior clinical outcomes in asthma management by enhancing respiratory function, functional capacity, and overall quality of life, suggesting a viable, non-pharmacological adjunct for pulmonary rehabilitation.

Keywords: Asthma, Inspiratory Muscle Training, Pilates, Dyspnea, Cardiorespiratory Fitness, Quality of Life, Six-Minute Walk Test

INTRODUCTION

Asthma is a chronic respiratory condition characterized by airway inflammation, bronchial hyper-responsiveness, and variable airflow obstruction, resulting in symptoms such as wheezing, chest tightness, coughing, and dyspnea (1,2). These symptoms can severely limit physical activity and impair quality of life in affected individuals. While pharmacological treatments such as bronchodilators and corticosteroids remain central to asthma management, non-pharmacological interventions have gained increasing attention due to their potential to enhance respiratory mechanics, physical endurance, and psychosocial well-being (3). Inspiratory Muscle Training (IMT), a respiratory therapy focusing on strengthening the diaphragm and accessory muscles of respiration, has shown promise in alleviating dyspnea and improving inspiratory muscle strength in asthma patients (8).

However, IMT primarily targets respiratory function and does not comprehensively address other physiological or psychological dimensions affected by asthma.

On the other hand, Pilates training—a mind-body exercise method emphasizing diaphragmatic breathing, core stability, postural alignment, and flexibility—has demonstrated positive effects on pulmonary function and overall functional capacity, especially in populations with chronic respiratory conditions (14,15). Several studies suggest that Pilates may reduce breathlessness, enhance respiratory efficiency, and improve emotional well-being through controlled movements and rhythmic breathing patterns (16,17). Combining IMT with Pilates may offer a synergistic approach by addressing not only the respiratory limitations but also the broader

musculoskeletal and psychological challenges associated with asthma (13). For example, while IMT strengthens inspiratory muscles and improves lung capacity, Pilates could further optimize ventilation mechanics through better posture and controlled breathing, thus reducing the perceived effort of breathing during physical exertion.

Despite the individual benefits of IMT and Pilates, there remains limited evidence examining the combined effects of these interventions on asthma outcomes. Most existing studies focus on each modality in isolation, creating a knowledge gap regarding the additive or synergistic potential of their integration. Moreover, comprehensive outcome measures such as cardiorespiratory fitness, dyspnea intensity, and disease-specific quality of life have rarely been evaluated in a unified framework. Understanding how these two interventions complement each other could lead to the development of a more holistic and multidimensional therapeutic strategy for asthma management. Given this background, the current study aims to evaluate the combined effects of Inspiratory Muscle Training and Pilates exercises on dyspnea, cardiorespiratory fitness, and quality of life in patients with asthma. It is hypothesized that the combined intervention will yield superior outcomes in comparison to IMT alone, by targeting a broader spectrum of physiological and psychosocial mechanisms critical to the daily functioning and well-being of asthma patients.

MATERIAL AND METHODS

This study was a randomized controlled trial conducted to evaluate the combined effects of Inspiratory Muscle Training (IMT) and Pilates exercises on dyspnea, cardiorespiratory fitness, and quality of life in individuals diagnosed with asthma. Participants were recruited from Gulab Devi Chest Hospital, Lahore, using a simple random sampling method through sealed opaque envelope allocation. The inclusion criteria comprised individuals with a clinical diagnosis of asthma and a history of respiratory illness, aged between 40 and 60 years, who were medically stable and capable of performing physical exercise. Participants with musculoskeletal limitations, cardiovascular instability, or any contraindications to exercise were excluded. All participants provided written informed consent prior to enrollment, and the study adhered to the ethical principles outlined in the Declaration of Helsinki. Confidentiality was maintained by anonymizing data and securely storing participant records.

A total of 56 participants were randomly allocated into two equal groups: Group A received combined Inspiratory Muscle Training and Pilates exercises, while Group B received only Inspiratory Muscle Training. The intervention lasted for six weeks, with sessions conducted three times per week, each lasting 40 minutes. The IMT protocol was delivered using an incentive spirometer. Participants were instructed to inhale deeply, hold the breath for 2–3 seconds, and exhale slowly. This cycle was repeated 10 times per session with 30-second rest intervals between repetitions, summing to 10–15 minutes per session. Pilates exercises administered to Group A included five movements: The Hundred, Single Leg Stretch, Side Kick, Toe Taps, and Leg Pull Front, all performed with structured breathing patterns to emphasize respiratory control and core stabilization. Both groups

also received baseline diaphragmatic breathing exercises as part of their training regimen.

Outcome measures were assessed at baseline and after the six-week intervention period. Primary outcomes included dyspnea and cardiorespiratory fitness, while quality of life was assessed as a secondary outcome. Dyspnea was evaluated using the Modified Borg Scale. Cardiorespiratory fitness was measured via the Six-Minute Walk Test (6MWT), a validated submaximal exercise test that records the distance walked in meters to assess aerobic capacity and endurance. Quality of life was assessed using the Asthma Quality of Life Questionnaire (AQLQ-J) developed by Juniper et al., consisting of 32 items across four domains: symptoms, activity limitation, emotional function, and environmental exposure, scored on a 7-point Likert scale.

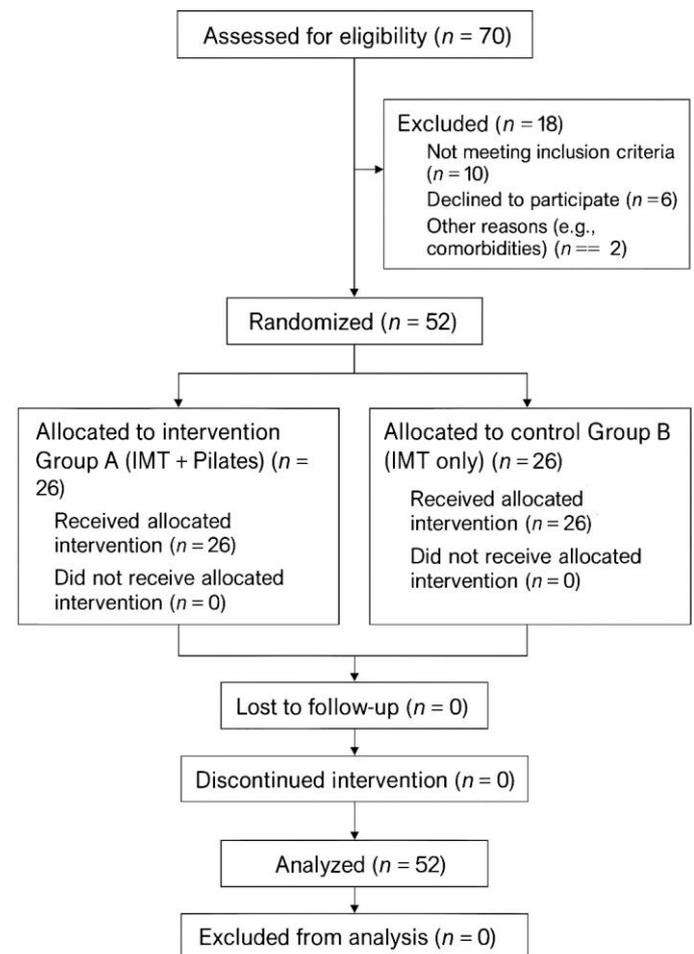


Figure 1 CONSORT Flowchart

Statistical analysis was performed using SPSS version 25. Normality of data was assessed using the Shapiro-Wilk test. For normally distributed data, parametric tests such as the independent samples t-test and repeated measures ANOVA were applied. Non-normally distributed variables were analyzed using non-parametric tests including the Wilcoxon signed-rank test for within-group comparisons and the Mann-Whitney U test for between-group comparisons. A p-value of less than 0.05 was considered statistically significant. Missing data was not imputed as all participants completed the study, and no dropouts were reported.

RESULTS

A total of 52 participants (42 males, 10 females) were enrolled in this randomized controlled trial and completed the intervention. Group A received combined Inspiratory Muscle Training (IMT) with Pilates exercises, while Group B received IMT alone. Baseline demographic and clinical characteristics were comparable

between groups. Both groups had identical gender distributions (87.5% male, 12.5% female), and all participants reported a smoking history. Notably, a higher proportion of participants in Group A reported a history of respiratory illness (100%) compared to Group B (66.7%). Additionally, more participants in Group B belonged to the lower socioeconomic class, whereas Group A had a greater representation from the upper class.

Table 1. Demographic and Clinical Characteristics of Participants

Variable	Group A (IMT + Pilates)	Group B (IMT Only)
Gender - Male (%)	21 (87.5%)	21 (87.5%)
Gender - Female (%)	3 (12.5%)	3 (12.5%)
Smoking History - Smokers (%)	24 (100%)	24 (100%)
Socioeconomic Status - Lower Class (%)	5 (20.8%)	8 (33.3%)
Socioeconomic Status - Middle Class (%)	14 (58.3%)	16 (66.7%)
Socioeconomic Status - Upper Class (%)	5 (20.8%)	N/A
History of Respiratory Illness - Yes (%)	24 (100%)	16 (66.7%)
History of Respiratory Illness - No (%)	N/A	8 (33.3%)

At baseline, no statistically significant differences were found in participant age, height, or weight. Although Group A had slightly

higher body weight, the difference approached but did not reach significance ($p = 0.096$).

Table 2. Baseline Characteristics – Mean Comparison Between Groups

Variable	Group A Mean \pm SD	Group B Mean \pm SD	t-value	Mean Difference	p-value
Participant Age (years)	53.63 \pm 6.73	55.21 \pm 4.26	-0.974	-1.583	0.335
Height (m)	1.67 \pm 0.115	1.61 \pm 0.15	1.579	0.061	0.121
Weight (kg)	53.63 \pm 7.37	50.08 \pm 7.08	1.698	3.542	0.096

Post-intervention results revealed significant improvements in cardiorespiratory fitness and dyspnea levels in both groups, with more pronounced effects in Group A. The Six-Minute Walk Test (6MWT) showed a substantial increase in distance walked in Group

A compared to Group B. Symptom scores at baseline were comparable between groups, but post-intervention scores revealed significantly better outcomes in Group A ($p = 0.009$).

Table 3. Functional and Clinical Outcomes Post-Intervention

Variable	Group A Mean \pm SD	Group B Mean \pm SD	t-value	Mean Difference	p-value
6MWT Distance (Post, meters)	401.9 \pm 30.9	336.1 \pm 41.5	–	–	<0.05
Symptom Score (Baseline)	80.47 \pm 5.93	81.91 \pm 12.88	-0.495	-1.432	0.623
Symptom Score (Post-Intervention)	69.56 \pm 10.92	79.14 \pm 13.16	-2.744	-9.581	0.009

Table 4. Mann-Whitney U Test Results: Post-Intervention Activity and 6MWT

Variable	Group A Mean Rank	Group B Mean Rank	U Value	Z Score	p-value
Activity Score (Baseline)	24.13	24.88	279	-0.18	0.853
Activity Score (Post)	18.23	30.77	137.5	-3.1	0.002
6MWT Distance (Baseline)	26.63	22.38	237	-1.06	0.285
6MWT Distance (Post)	34.77	14.23	41.5	-5.25	<0.001

Overall, both interventions yielded statistically and clinically significant improvements in the assessed outcomes, with Group A demonstrating superior gains across nearly all parameters. The combined IMT and Pilates protocol enhanced exercise tolerance, reduced dyspnea severity, and improved quality of life more effectively than IMT alone. These findings support the integration of multidimensional exercise interventions in pulmonary rehabilitation programs for asthma patients.

DISCUSSION

The present study demonstrated that combining Inspiratory Muscle Training (IMT) with Pilates exercises led to significantly greater improvements in dyspnea, cardiorespiratory fitness, and quality of life among asthma patients compared to IMT alone. These findings provide empirical support for an integrative rehabilitation approach that targets both respiratory and musculoskeletal systems and contribute to the growing body of literature advocating non-pharmacological adjuncts in asthma management. While both groups showed improvements, the

superior outcomes in the combined group underscore the synergistic potential of interventions that simultaneously enhance inspiration and postural mechanics.

These results are consistent with prior investigations that have reported the efficacy of IMT in improving respiratory muscle function and exercise tolerance in asthmatic populations. Guedes et al. observed significant improvements in inspiratory muscle strength and decreased breathlessness following eight weeks of IMT in asthma patients (36). Similarly, Silva et al. found that IMT alone led to reduced dyspnea and increased exercise capacity (37). However, these studies did not account for broader functional domains such as posture, core stability, or psychological well-being—factors that are addressed more holistically by Pilates-based interventions. The addition of Pilates in our study appears to have contributed to improved ventilation efficiency, postural control, and neuromuscular coordination, as evidenced by greater enhancements in Six-Minute Walk Test (6MWT) performance and symptom reduction.

Pilates training has previously been associated with favorable outcomes in chronic respiratory disorders. Mehri et al. demonstrated that Pilates exercises enhanced pulmonary function and reduced ventilatory burden by optimizing diaphragmatic breathing and spinal alignment in asthma patients (14). These mechanisms are likely mediated through improved thoracoabdominal coordination, core strength, and flexibility—all of which reduce the work of breathing and minimize mechanical inefficiencies. Additionally, the structured breathing patterns inherent to Pilates may contribute to autonomic regulation and psychological relaxation, further mitigating the perception of breathlessness. The integration of IMT and Pilates, therefore, aligns with the biopsychosocial model of chronic disease management by targeting physiological, functional, and emotional domains. Clinically, the results suggest that a multimodal intervention may offer a more comprehensive and sustainable improvement in asthma-related outcomes than isolated respiratory training. This is especially relevant given that pharmacological management often does not fully address the functional limitations and psychosocial burdens experienced by asthma patients. The enhanced 6MWT performance observed in the combined group reflects not only improved respiratory capacity but also increased functional endurance and confidence during physical exertion—key factors for long-term disease self-management.

Despite these strengths, several limitations should be acknowledged. The sample size was modest, which may limit the statistical power and generalizability of findings. The study was also conducted at a single center with a predominantly male participant pool, further restricting extrapolation to broader populations. Additionally, the use of self-reported outcome measures introduces the potential for subjective bias, although validated instruments were used. The intervention duration was relatively short (six weeks), and long-term adherence and effects were not evaluated. Future studies should explore the sustainability of benefits over extended periods and investigate the effects of varying frequencies and intensities of Pilates training.

Further research with larger, more diverse cohorts is warranted to confirm these findings and to examine the role of psychosocial mediators, such as anxiety and self-efficacy, in modulating treatment response. Comparative studies involving other forms of exercise (e.g., yoga, tai chi, aerobic training) could also clarify the relative efficacy of different mind-body interventions when integrated with respiratory therapies. Moreover, mechanistic studies using objective physiological markers such as spirometry, heart rate variability, or imaging of respiratory musculature could offer deeper insights into the pathways through which these interventions exert their effects. The current study highlights the added value of incorporating Pilates exercises alongside IMT in the management of asthma. This integrative approach not only enhances clinical parameters such as dyspnea and functional capacity but also addresses underlying biomechanical and psychological contributors to respiratory dysfunction. Such evidence-based, non-pharmacological strategies can enrich asthma care protocols and promote holistic patient well-being.

CONCLUSION

This study concludes that the combined intervention of Inspiratory Muscle Training (IMT) and Pilates training significantly improves dyspnea, cardiorespiratory fitness, and quality of life in asthma patients compared to IMT alone. These findings support a multidimensional rehabilitation approach targeting both respiratory and musculoskeletal systems, offering a more effective management strategy for individuals with asthma. Clinically, the integration of Pilates with IMT can enhance functional capacity and reduce the burden of breathlessness, promoting better disease control and patient well-being. From a research perspective, the study underscores the need for further exploration into holistic exercise-based interventions and their long-term effects on asthma-related outcomes in diverse populations.

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