Volume 3, Issue 5, 2025

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

EFFECTIVENESS OF PERIPHERAL MUSCLES STRENGTH TRAINING OF LOWER LIMBS ON ASTHMATIC SYMPTOMS IN ADULTS WITH MODERATE PERSISTENT ASTHMA

Dr Azka Mustafa[1], Dr Aamna Masood[2], Dr Rubina Zulfqar*[3], Shahzadi Zulfiqar[4], Dr Sundas Farooq[5], Dr Nisar Fatima[6]

[1,2]Physical Therapist, Department of Rehabilitation Sciences, The University of Faisalabad, Faisalabad, Pakistan
*[*3,5]Assistant Professor, Department of Rehabilitation Sciences, The University of Faisalabad, Faisalabad, Pakistan*
[4]Clinical Psychologist, Department of psychology, Riphah International University, Faisalabad Pakistan
[6]Assistant Professor, Department of Rehabilitation Sciences, The University of Faisalabad, Faisalabad, Pakistan

[1]dr.azkamustafa@gmail.com, [2]Aamnashojat@hotmail.com, *[3]drrubinazulfqar355@gmail.com[4], [4]mehrozulfiqar26@gmail.com, [5]sundasfrq@gmail.com, [6]fatimaakeel0427@gmail.com

DOI: https://doi.org/10.5281/zenodo.16728848

Keywords
calf muscle, strength training, moderate persistent asthma

Article History
Received: 08 April, 2025
Accepted: 25 June, 2025
Published: 17 July, 2025

Corresponding Author: *
Dr Rubina Zulfqar

Abstract

Limited information is present describing effects of calf muscle strengthening in alleviating asthma symptoms. Different studies used to strengthen of both upper and lower limb muscles.

Objectives: *To assess how strength training of peripheral muscles (calf) of lower limbs alleviate asthma symptoms and improve FEV1/FVC.*

Methodology: *34 adults, both male and female (mean age ±8.578 years), allergic patients with moderate persistent asthma and FEV1/FVC value 60-80%, were randomized into control and treatment group. Vital signs (pulse rate, respiratory rate), SGRQ, BRPE was assessed and 6MWT was performed. Control group performed 20 minutes of stationary cycle, treatment group performed strength training of calf using free weights (4 sets and 6-8 repetitions). Independent t-test and paired t-test were applied. Standardized ST George's Respiratory Questionare, BRPE, spirometer test were used as outcome measures*

Results: *Comparing the value of FEV1/FVC of the treatment and control group, the results obtained were significant ($p \leq 0.05$, $p=0.001$). There is a significant effect of peripheral muscle strength training of lower limbs on asthmatic symptoms in adults with moderate persistent asthma. While comparing the value of SGRQ between the treatment and control group the results obtained were significant ($p=0.025$).* ***Conclusion:*** *The FEV1/FVC value was improved as a result of combined strength and endurance training. Load carrying capacity was increased and nocturnal symptoms were reduced as a result of progressive free weight strength training.*

INTRODUCTION

Asthma is a chronic inflammatory disorder of the airways that affects approximately 334 million individuals worldwide, posing a significant burden on public health systems and negatively impacting patients' quality of life and functional abilities (To et al., 2012). Characterized by variable airflow obstruction, airway hyper responsiveness, and respiratory symptoms such as wheezing, dyspnea,

Frontier in Medical & Health Research
ISSN: (e) 3007-1607 (p) 3007-1593

chest tightness, and nocturnal coughing, asthma remains a leading cause of work absenteeism and hospitalization across various age groups (Kim & Mazza, 2011). In developing countries such as Pakistan, the situation is compounded by limited access to healthcare, environmental pollution, poor public awareness, and high rates of consanguinity, which increases genetic predisposition to atopic and allergic conditions (Sabar et al., 2018). Environmental factors such as tobacco smoke, viral respiratory infections, exposure to allergens, and poor indoor air quality further exacerbate the condition (McCracken et al., 2017). Although asthma primarily affects the lungs, systemic manifestations, including muscle weakness and deconditioning, are often overlooked.

Evidence suggests that peripheral and respiratory muscle strength is significantly reduced in patients with asthma, especially those undergoing long-term corticosteroid therapy, which can lead to steroid-induced myopathy (Ramos et al., 2015b). Additionally, asthmatic individuals tend to avoid physical activity due to fear of symptom exacerbation, contributing to a sedentary lifestyle, reduced cardiorespiratory fitness, and increased obesity — all of which are known risk factors for worsening asthma control (Turner et al., 2011; Ramos et al., 2015a). A growing body of research supports the use of exercise training as a complementary therapeutic approach to improve pulmonary function, exercise capacity, and health-related quality of life in asthma patients (Andrade et al., 2014; Refaat & Gawish, 2015). For instance, Refaat and Gawish (2015) demonstrated that structured physical training significantly enhanced lung function and reduced symptom severity in moderate to severe asthmatics. Similarly, Ortega et al. (2002a) found that combined strength and endurance training yielded greater physiological benefits in patients with chronic obstructive pulmonary disease (COPD) than strength or endurance training alone. However, existing studies have predominantly emphasized large muscle groups in both upper and lower limbs, often overlooking the role of specific muscle regions such as the calf muscles (gastrocnemius and soleus), which play a vital role in ambulatory function and venous return. These muscles may be particularly significant in improving functional capacity and symptom relief through enhanced oxygen utilization and improved exercise tolerance, even in individuals with compromised pulmonary function.

Despite their potential, there is limited empirical evidence investigating whether isolated peripheral muscle strength training, specifically targeting the calf muscles, can yield measurable improvements in spirometric outcomes (FEV_1/FVC) and asthmatic symptom burden. Addressing this knowledge gap is essential, especially for developing accessible, low-cost rehabilitation protocols for asthma management in resource-limited settings. Therefore, the present study aims to evaluate the effectiveness of progressive strength training of the calf muscles, in conjunction with endurance exercise, on lung function, symptom severity, and quality of life in adults with moderate persistent asthma. The results may offer a novel, targeted approach to pulmonary rehabilitation that extends beyond traditional aerobic-focused interventions.

METHODOLOGY

A single-blinded randomized controlled trial was conducted over four months at the Chest Outpatient Department of Allied Hospital, Faisalabad. Thirty-four adult participants (aged 30–55 years) with diagnosed moderate persistent asthma were recruited and randomly assigned into two equal groups: treatment (n = 17) and control (n = 17). Participants included both males and females with an FEV_1/FVC ratio between 60–80% and a history of allergic asthma. Exclusion criteria included chronic cardiorespiratory conditions, cognitive or mental instability, persistent antibiotic use unrelated to asthma, COPD-asthma overlap, pregnancy, and exercise-induced asthma.

Participants were selected through convenience sampling, and randomization was performed using the lottery method following informed consent. All participants received baseline treatment comprising a 10-minute warm-up through slow walking, 20 minutes of stationary cycling, and a 5–10 minute cool-down period. For the control group, endurance training was administered using a stationary cycle. Each session included two 10-minute cycling periods with a 5-minute rest in between. Pre- and post-session measurements included pulse rate, respiratory rate,

Frontier in Medical & Health Research
ISSN: (e) 3007-1607 (p) 3007-1593

dyspnea rating using the Borg RPE scale, and spirometry readings (FEV_1/FVC). This regimen was maintained consistently across four weeks.

The treatment group received the same endurance training as the control group, along with additional strength training targeting the calf muscles. Strengthening was implemented through seated and standing calf raises using free weights. The seated calf raise was performed while sitting with hips and knees at 90 degrees, holding weights in both hands, lowering the heels fully, then lifting them by pressing into the balls of the feet. The standing calf raise was done near a wall for balance, with feet hip-width apart and weights in both hands. Participants pressed through the balls of their feet to raise the heels while maintaining abdominal stability. Weight progression was individualized and monitored weekly, beginning with 2 kg dumbbells in week one, increasing to 3 kg in week two, 4 kg in week three, and 5 kg in week four. Four sets of 6–8 repetitions were completed per session, and one-repetition maximum (1RM) was used to reassess lifting capacity before weekly load increases. The Borg RPE scale was applied at 5-minute intervals to monitor perceived exertion during exercises.

Outcome measures included lung function via spirometry (FEV_1, FVC, and FEV_1/FVC), quality of life using the St. George's Respiratory Questionnaire (SGRQ), perceived exertion using the Borg RPE scale, and functional capacity through the 6-Minute Walk Test (6MWT). Baseline and post-intervention assessments were conducted under standardized conditions. All instructions were provided in Urdu or Punjabi as needed to ensure participant understanding. Ethical approval was obtained from the Department of Physical Therapy and the OPD head at Allied Hospital Faisalabad, and all participants signed informed consent forms. Data were analyzed using SPSS version 23, employing appropriate descriptive and inferential statistical tests to interpret group differences, with results presented in tables and figures.

RESULTS

A total of 34 participants were enrolled in the study, with a mean age of 40.44 ± 8.58 years. Among the participants, 56% were female and 44% were male. Each group—treatment and control—comprised 17 participants. No adverse events or severe asthma exacerbations occurred during or after the intervention.

At baseline, the mean spirometric measure (FEV_1/FVC) was 71.78 ± 5.63 in the treatment group and 68.54 ± 5.03 in the control group. After four weeks of intervention, the treatment group demonstrated a significant improvement with a mean of 76.75 ± 4.88, compared to 70.52 ± 4.79 in the control group. The between-group difference at third follow-up was statistically significant ($p = 0.001$). Within-group analysis showed a significant improvement in spirometric values across all participants from baseline to follow-up (mean difference = 3.48 ± 2.26, $p = 0.000$). The treatment group showed a notable improvement in spirometric measures ($FEV_1/FVC\%$) and a greater reduction in SGRQ scores, indicating improved lung function and respiratory quality of life. The control group demonstrated only modest changes across both parameters. **Figure 1**

In terms of quality of life, measured using the St. George's Respiratory Questionnaire (SGRQ), the treatment group showed a greater reduction in symptom scores compared to the control group. At baseline, the SGRQ scores were 63.94 ± 17.91 in the treatment group and 57.08 ± 17.65 in the control group. Post-intervention, scores declined to 38.07 ± 19.77 in the treatment group and 49.97 ± 16.56 in the control group. The difference in post-treatment SGRQ scores between the two groups was statistically significant ($p = 0.025$). Paired analysis also showed a significant within-group improvement in SGRQ scores (mean difference = 16.57 ± 12.38, $p = 0.000$).

Frontier in Medical & Health Research
ISSN: (e) 3007-1607 (p) 3007-1593

Table 1

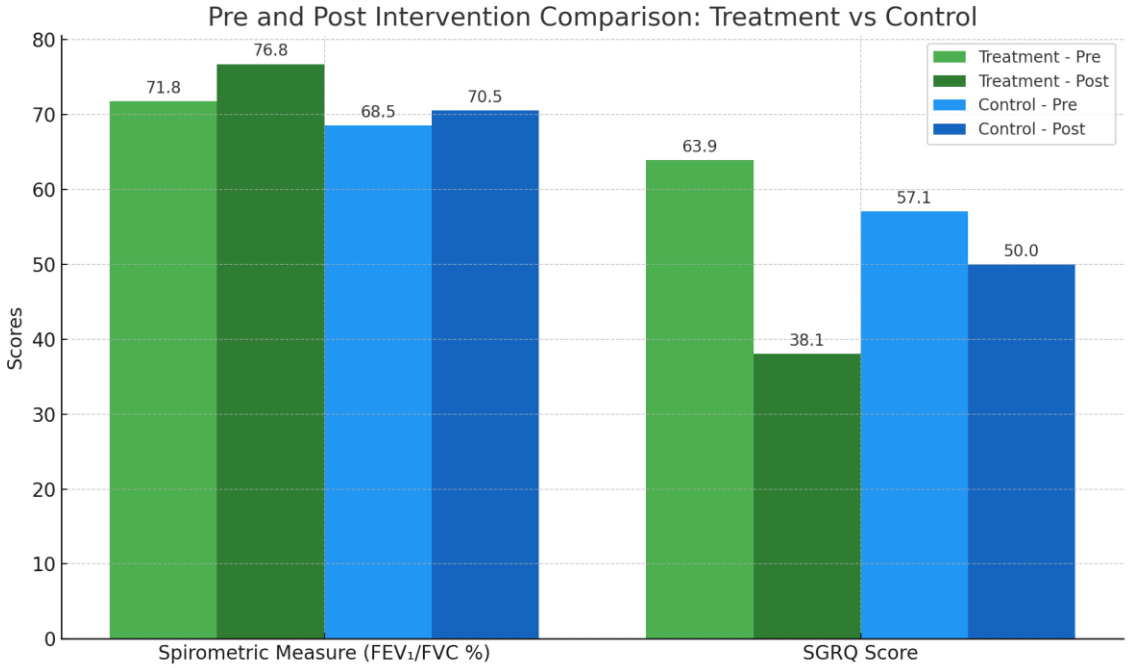

Figure 1. Comparison of pre- and post-intervention outcomes for treatment and control groups.

Table 1. Comparison of Outcomes between Treatment and Control Groups (n = 34)

Outcome Measure	Time Point	Treatment Group (Mean ± SD)	Control Group (Mean ± SD)	p-value
Spirometric Measure (FEV_1/FVC %)	Baseline	71.78 ± 5.63	68.54 ± 5.03	0.086
	Post-intervention	76.75 ± 4.88	70.52 ± 4.79	**0.001**
SGRQ Score	Baseline	63.94 ± 17.91	57.08 ± 17.65	0.502
	Post-intervention	38.07 ± 19.77	49.97 ± 16.56	**0.025**

Statistical significance at $p \leq 0.05$. Independent samples t-test used for between- group comparisons

DISCUSSION

The findings of this randomized controlled trial suggest that progressive strength training of the calf muscles, when combined with endurance exercise, significantly improves pulmonary function (as measured by FEV_1/FVC) and quality of life in adults with moderate persistent asthma. Notably, the treatment group demonstrated statistically significant improvements in FEV_1/FVC ratios and SGRQ scores compared to the control group, indicating better lung mechanics and reduced symptom severity.

In current study's focus on isolated peripheral muscle training—specifically the calf muscles—adds to a growing body of literature exploring non-pharmacologic strategies for asthma management. This work supports the hypothesis that muscle-specific training enhances ventilatory efficiency, oxygen utilization, and overall functional capacity in individuals with chronic respiratory disease. Previous studies have shown that patients with asthma often suffer from muscle deconditioning, especially due to corticosteroid use, physical inactivity, and systemic inflammation. For example, Ramos et al. (2015) reported that muscle endurance, rather than absolute strength, was significantly compromised in individuals with moderate to severe asthma, leading to reduced exercise tolerance and quality of life. These study findings align with this by demonstrating that even modest improvements in

Frontier in Medical & Health Research
ISSN: (e) 3007-1607 (p) 3007-1593

peripheral strength can yield clinically meaningful respiratory outcomes. The results were statistically significant and lungs function was improved by just focusing on calf muscles. In contrast, according to Refaat and Gawish (2015) physical training improve HRQOL and lung function in patients with moderate and severe asthma. The study included 68 patients (physical training group n=38, control group n=30), one group received physical training on major muscles of lower limbs including wall squats, step ups, cycle ergometer and upper limb endurance training while other group receive only medical treatment. Ortega et al., (2002) stated that combined strength and endurance training of patients with COPD is more beneficial and physiologically complete rather than specific training program alone.

The benefit of combining aerobic and resistance training is also well-supported in chronic lung conditions. Ortega et al. (2002) found that COPD patients who underwent both strength and endurance training had better outcomes than those in single-mode training protocols. Likewise, Nyberg et al. (2016) emphasized the importance of limb muscle endurance as a predictor of functional performance in pulmonary patients, underscoring the need for targeted lower-limb training programs.

While most asthma-related rehabilitation studies focus on upper limb or whole-body training, limited evidence exists on the impact of training specific muscle groups such as the calves. The gastrocnemius and soleus muscles are central to daily ambulation and are metabolically active, thus making them a logical target for improving exercise tolerance and reducing fatigue.

Andrade et al. (2014) demonstrated that aerobic training not only improves lung function in asthmatic children but also reduces systemic inflammation. This reinforces the idea that peripheral muscle conditioning has downstream benefits on respiratory efficiency, possibly by optimizing oxygen extraction and reducing ventilatory load during exertion.

Additionally, Turner et al. (2011) highlighted the psychological barriers to exercise in asthma patients, noting that structured and supervised training protocols could help mitigate exercise-induced anxiety and avoidance behavior. Our study, through supervised progressive loading, likely addressed these issues and contributed to the observed improvements in activity level and symptom control. Recent evidence underscores the role of peripheral muscle dysfunction in limiting exercise capacity among asthma patients. In a 2025 case-control study, Kaya et al. found that children with asthma showed significantly reduced lower limb muscle strength and endurance, which was correlated with reduced exercise capacity and poorer pulmonary performance—even in cases with normal pulmonary function test (PFT) readings (Kaya et al.).

Current study findings also align with Özdemir et al. (2024), who reported that adult patients with stable asthma displayed significantly lower VO_2peak, reduced peripheral muscle strength, and impaired sleep quality compared to healthy controls. The authors concluded that peripheral deconditioning was a major factor limiting respiratory efficiency and quality of life, supporting the rationale behind our targeted strength training protocol (Özdemir et al., 2025).

Furthermore, studies such as Boşnak Güçlü et al. (2024) emphasize the utility of peripheral muscle training even in populations recovering from respiratory conditions like COVID-19, where expiratory and peripheral muscle weakness compromise rehabilitation outcomes. The transferability of these strategies to asthma care opens new possibilities for symptom alleviation through muscle-specific interventions.(Bejta and Boşnak Güçlü). Unlike traditional rehabilitation that emphasizes whole-body endurance training, our study is novel in isolating the calf musculature—the gastrocnemius and soleus—which are metabolically active and play a central role in walking and venous return. Our approach not only produced statistically significant changes in FEV_1/FVC values, but also improved patients' functional mobility, nocturnal symptom burden, and perceived exertion (as per Borg RPE scores).

Recent pulmonary rehabilitation research also suggests that neuromuscular adaptations, such as increased muscle oxidative capacity and mitochondrial efficiency, contribute significantly to enhanced respiratory outcomes—often independent of central cardiopulmonary gains (Kaya et al., 2025; Özdemir et al., 2024). Additionally, our findings

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

echo those of Kulli et al. (2023), who demonstrated that strengthening of knee extensors and lower limb musculature significantly improved 6-minute walk distance and dyspnea scores in asthmatic adolescents, highlighting the relevance of limb-focused exercise interventions in pulmonary disease management

In contrast to outdated paradigms that discourage exercise among asthmatic individuals, recent guidelines now advocate for supervised, structured physical activity as an essential component of care. The reduction in nocturnal symptoms and inhaler use observed in our study aligns with these modern rehabilitation philosophies.

CONCLUSIONS:

The conclusion of our study was that lungs function FEV1/FVC was improved as a result of combined strength (calf muscles) and endurance training. Load carrying capacity was increased and nocturnal symptoms of moderate persistent asthmatic patients were reduced as a result of progressive free weight strength training.

Recommendations:

It is recommended to increase the time duration of the treatment procedure I.e. more than 4 weeks, guide a home plan exercise to prevent detraining effects. Further studies should be done on strength training of calf muscles (gastrocnemius and soleus) by using free weights and progressive increase in loading.

References

ALIVERTI, A. 2016. The respiratory muscles during exercise. Breathe (Sheff), 12, 165-8.

ANDRADE, L. B., BRITTO, M. C., LUCENA-SILVA, N., GOMES, R. G. & FIGUEROA, J. N. 2014. The efficacy of aerobic training in improving the inflammatory component of asthmatic children. Randomized trial. Respir Med, 108, 1438-45.

KIM, H. & MAZZA, J. 2011. Asthma. Allergy Asthma Clin Immunol, 7 Suppl 1, S2. KOULOURIS, N. & DIMITROULIS, I. 2001. Structure and function of the respiratory muscles. Pneumon, 14, 91-108.

MCCRACKEN, J. L., VEERANKI, S. P., AMEREDES, B. T. & CALHOUN, W. J. 2017. Diagnosis and management of asthma in adults: a review. Jama, 318, 279-290.

NYBERG, A., TÖRNBERG, A. & WADELL, K. 2016. Correlation between limb muscle endurance, strength, and functional capacity in people with chronic obstructive pulmonary disease. Physiotherapy Canada, 68, 46-53.

ORTEGA, F., TORAL, J., CEJUDO, P., VILLAGOMEZ, R., SANCHEZ, H., CASTILLO, J. & MONTEMAYOR, T. 2002a. Comparison of effects of strength and endurance training in patients with chronic obstructive pulmonary disease. Am J Respir Crit Care Med, 166, 669-74.

ORTEGA, F., TORAL, J., CEJUDO, P., VILLAGOMEZ, R., SÁNCHEZ, H., CASTILLO, J. & MONTEMAYOR, T. 2002b. Comparison of effects of strength and endurance training in patients with chronic obstructive pulmonary disease. American journal of respiratory and critical care medicine, 166, 669-674.

RAMOS, E., DE OLIVEIRA, L. V., SILVA, A. B., COSTA, I. P., CORREA, J. C., COSTA, D., ALVES, V. L., DONNER, C. F., STIRBULOV, R., ARENA, R. & SAMPAIO, L. M. 2015a. Peripheral muscle strength and functional capacity in patients with moderate to severe asthma. Multidiscip Respir Med, 10, 3.

RAMOS, E., DE OLIVEIRA, L. V. F., SILVA, A. B., COSTA, I. P., CORRÊA, J. C. F., COSTA, D., ALVES, V.L., DONNER, C. F., STIRBULOV, R. & ARENA, R. 2015b. Peripheral muscle strength and functional capacity in patients with moderate to severe asthma. Multidisciplinary respiratory medicine, 10, 3.

REFAAT, A. & GAWISH, M. 2015. Effect of physical training on health-related quality of life in patients with moderate and severe asthma. Egyptian Journal of Chest Diseases and Tuberculosis, 64, 761-766.

SABAR, M. F., AKRAM, M., AWAN, F. I., GHANI, M. U., SHAHID, M., IQBAL, Z., KOUSAR, S. & IDREES, M. 2018. Awareness of Asthma Genetics in Pakistan: A Review with Some

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

Recommendations. Advancements in Life Sciences, 6, 1-10.

TO, T., STANOJEVIC, S., MOORES, G., GERSHON, A. S., BATEMAN, E. D., CRUZ, A. A. & BOULET, L.- P. 2012. Global asthma prevalence in adults: findings from the cross-sectional world health survey. BMC public health, 12, 204.

TURNER, S., EASTWOOD, P., COOK, A. & JENKINS, S. 2011. Improvements in symptoms and quality of life following exercise training in older adults with moderate/severe persistent asthma. Respiration, 81, 302-310

BEJTA, R. & BOŞNAK GÜÇLÜ, M. Cardiopulmonary rehabilitation in Covid-19: A case report.

KAYA, M., UCGUN, H., GEMICI KARAASLAN, B., KIYKIM, A. & DENIZOGLU KULLI, H. Do pulmonary and extrapulmonary characteristics differ between asthmatic and healthy children? European Respiratory Journal, 64, PA3204.

ÖZDEMIR, F., MERAL, B. G., EDA, G. H. & AND OĞUZÜLGEN, İ. K. 2025. Maximal exercise capacity, peripheral muscle strength, sleep quality, and quality of life in adult patients with stable asthma. Journal of Asthma, 62, 608-620.