



Effect of Weight Reduction on Asthma Control and Lung Function in Obese Adults: A Prospective Study

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KEYWORDS

Obesity, Asthma, Weight Reduction, Asthma Control Test, Lung Function, Spirometry, FEV₁.

ABSTRACT:

Background: Obesity has emerged as a significant comorbidity in asthma, associated with increased disease severity, poor symptom control, and diminished therapeutic response. Weight reduction is hypothesized to improve asthma outcomes by reducing systemic inflammation and enhancing pulmonary mechanics, yet evidence from prospective studies in adult populations remains limited.

Objective: To evaluate the effect of structured weight reduction on asthma control and lung function in obese adult asthmatics over a six-month period.

Methods: This prospective interventional study included 100 obese adults (BMI ≥ 30 kg/m²) with physician-diagnosed asthma as per GINA 2024 criteria. Participants underwent a structured six-month weight reduction program incorporating dietary modification, physical activity, and behavioral counseling. Asthma control was assessed using the Asthma Control Test (ACT), and pulmonary function was evaluated through spirometry measuring FEV₁, FVC, and FEV₁/FVC ratio at baseline and post-intervention. Data were analyzed using paired t-tests and Pearson's correlation coefficient.

Results: The mean BMI significantly decreased from 33.5 ± 2.8 kg/m² to 29.6 ± 2.4 kg/m² ($p < 0.001$). Mean ACT score improved from 16.4 ± 3.2 to 21.8 ± 2.6 ($p < 0.001$), and the proportion of well-controlled asthma increased from 12% to 64%. Significant improvements were observed in spirometric parameters: FEV₁ increased from 1.89 ± 0.51 L to 2.23 ± 0.48 L ($p < 0.001$), FVC from 2.56 ± 0.63 L to 2.94 ± 0.61 L ($p < 0.001$), and FEV₁/FVC ratio from $74.1 \pm 7.2\%$ to $76.7 \pm 6.5\%$ ($p = 0.032$). Percentage weight reduction correlated positively with improvement in ACT scores ($r = 0.52$, $p < 0.01$) and FEV₁ values ($r = 0.47$, $p < 0.01$).

Conclusion: Weight reduction significantly improves asthma control and lung function in obese adults. Incorporating structured lifestyle interventions focused on weight management into standard asthma care may enhance treatment efficacy and patient quality of life.

Introduction

Asthma is a chronic inflammatory disease of the airways characterized by variable respiratory symptoms such as wheezing, coughing, breathlessness, and chest tightness, together with reversible airflow limitation. It represents

a major global health problem, affecting more than 300 million individuals worldwide, with an increasing prevalence, particularly in urbanized and developing regions [1]. The disease not only imposes a significant health burden but also impacts quality of life and



productivity due to recurrent exacerbations, hospital visits, and long-term medication use [2].

In recent years, obesity has emerged as one of the most common and clinically significant comorbid conditions in asthma. The coexistence of obesity and asthma—often termed “obese asthma phenotype”—has been associated with increased disease severity, poor symptom control, frequent exacerbations, and reduced responsiveness to standard pharmacotherapy such as inhaled corticosteroids [3,4]. The prevalence of obesity has nearly tripled globally over the last four decades, and it is estimated that up to 40% of adults with asthma are overweight or obese [5]. This intersection between two major chronic health issues underscores the need to explore their pathophysiological relationship and therapeutic implications.

The mechanisms underlying the adverse impact of obesity on asthma are multifactorial and complex. Mechanical factors such as reduced chest wall compliance, decreased lung volumes, and increased airway resistance contribute to airflow limitation and dyspnea [6]. Additionally, obesity induces a state of chronic low-grade systemic inflammation mediated by adipose tissue-derived cytokines and adipokines such as leptin, resistin, and adiponectin, which alter airway inflammation and immune responses [7,8]. These inflammatory changes may result in a distinct asthma phenotype characterized by non-eosinophilic inflammation and corticosteroid resistance [9]. Moreover, metabolic dysregulation, oxidative stress, and gastroesophageal reflux commonly observed in obese individuals further aggravate airway dysfunction [10,11].

Weight reduction has been hypothesized to improve asthma outcomes through multiple pathways, including decreased systemic inflammation, improved lung mechanics, and enhanced medication responsiveness [12]. Clinical and interventional studies from various populations have shown that intentional weight loss—achieved through dietary modification, exercise, behavioral therapy, or bariatric surgery—can lead to significant improvement in asthma symptoms, control scores, and pulmonary function tests [13-15]. Even modest weight loss of 5-10% of baseline body weight has been linked to clinically meaningful improvements in Asthma Control Test (ACT) scores and spirometric

indices such as forced expiratory volume in one second (FEV₁) and forced vital capacity (FVC) [16,17].

Despite growing international evidence, data from Indian and other low- and middle-income settings remain limited. In these populations, unique dietary habits, environmental exposures, and varying asthma management practices may influence the relationship between obesity, weight reduction, and asthma outcomes [18]. Moreover, most existing studies are cross-sectional or retrospective, with few prospective interventions assessing the direct impact of lifestyle-based weight reduction on asthma control and lung function in adults.

Given this background, the present study was designed as a prospective investigation to evaluate the effect of structured weight reduction on asthma control and lung function among obese adult asthmatics. The study aimed to quantify changes in ACT scores and spirometric parameters (FEV₁, FVC, and FEV₁/FVC ratio) following a six-month weight reduction program, and to determine the correlation between the magnitude of weight loss and improvement in asthma outcomes. The findings of this study are expected to contribute to the growing body of evidence emphasizing the role of weight management as an integral component of asthma care.

Materials and Methods

This prospective interventional study was conducted over a period of twelve months from January to December 2024 at a tertiary care teaching hospital in Central India. All participants provided written informed consent prior to inclusion in the study. The study population consisted of adult patients aged between 18 and 55 years who were clinically diagnosed with bronchial asthma according to the Global Initiative for Asthma (GINA) guidelines [19]. The diagnosis was based on typical clinical features, variability in symptoms, and spirometric evidence of reversible airflow limitation. Only patients with a body mass index (BMI) of ≥ 30 kg/m² were included, classifying them as obese according to World Health Organization (WHO) criteria [20].

Participants were recruited from the outpatient department of Respiratory Medicine. The exclusion criteria were strictly applied to minimize confounding factors. Patients were excluded if they had any acute exacerbation of asthma in the preceding four weeks, a



history of smoking, coexisting chronic obstructive pulmonary disease (COPD), restrictive lung disease, cardiovascular disease, uncontrolled diabetes, thyroid dysfunction, pregnancy, lactation, or any other chronic illness that could influence weight or lung function. Individuals with previous bariatric surgery or those currently on weight-loss medications were also excluded [21].

At baseline, all participants underwent detailed clinical evaluation including medical history, anthropometric measurements, and spirometric assessment. Height and weight were measured using standardized equipment, and BMI was calculated as weight in kilograms divided by height in meters squared. Asthma control was assessed using the Asthma Control Test (ACT), a validated five-item questionnaire that evaluates symptom frequency, activity limitation, and rescue medication use during the previous four weeks [22]. Scores range from 5 to 25, with higher scores indicating better control - <20 denoting uncontrolled asthma, 20-24 partially controlled, and ≥ 25 well controlled [23].

Spirometry was performed using a calibrated spirometer (as per ATS/ERS standards) in the sitting position under the supervision of a trained technician [24]. The parameters recorded included forced expiratory volume in one second (FEV₁), forced vital capacity (FVC), and the FEV₁/FVC ratio, both in absolute values and as a percentage of predicted values based on age, gender, and height [25]. Each participant performed a minimum of three acceptable maneuvers, and the best value was considered for analysis. Measurements were taken at baseline and repeated at six months after the intervention.

The weight reduction program consisted of a structured six-month lifestyle modification plan supervised by a multidisciplinary team including a physician, dietitian, and physiotherapist. The program incorporated three major components: dietary modification, physical activity, and behavioral counseling. Dietary intervention included individualized calorie-restricted meal plans based on a 500-700 kcal/day deficit from the participant's estimated energy requirement, emphasizing a balanced intake of fruits, vegetables, whole grains, lean proteins, and reduced saturated fats [26]. Physical activity was prescribed as moderate-intensity aerobic exercise, such as brisk walking or cycling, for at least 150

minutes per week, in accordance with the American College of Sports Medicine (ACSM) recommendations [27]. Behavioral modification sessions were conducted monthly to improve motivation, adherence, and long-term sustainability of weight loss through cognitive reinforcement strategies [28].

Follow-up visits were scheduled every four weeks for clinical review, reinforcement of lifestyle advice, and monitoring of adherence. Any asthma exacerbations or medication adjustments were documented. Participants continued their regular inhaled corticosteroids and bronchodilators as prescribed, but no additional pharmacological interventions for weight loss were allowed. Compliance with the program was assessed through self-reported adherence logs and dietary recall records.

At the end of six months, all baseline measurements - weight, BMI, ACT score, and spirometric parameters - were reassessed. The primary outcome measures were change in ACT score and improvement in lung function (FEV₁, FVC, FEV₁/FVC ratio). The secondary outcome was correlation between the percentage of weight reduction and improvement in asthma control and spirometric indices.

All data were compiled and statistically analyzed using Statistical Package for the Social Sciences (SPSS) version 25.0 (IBM Corp., Armonk, NY, USA). Quantitative variables were expressed as mean \pm standard deviation (SD), while categorical variables were presented as frequencies and percentages. The normality of continuous variables was tested using the Shapiro-Wilk test. Comparisons between pre- and post-intervention values were performed using the paired t-test for normally distributed data and the Wilcoxon signed-rank test for non-parametric data. Pearson's correlation coefficient (r) was calculated to assess the relationship between percentage weight reduction and changes in ACT score or spirometric parameters. A p-value of <0.05 was considered statistically significant [29].

Results

Baseline Characteristics

A total of 100 obese adult asthmatic patients were included in the study, with a mean age of 38.2 ± 9.4 years. Of these, 62 were females (62%) and 38 were males



(38%). The mean baseline BMI was 33.5 ± 2.8 kg/m². Most participants (68%) had uncontrolled asthma at baseline.

Table 1. Baseline Demographic and Clinical Characteristics (n = 100)

Parameter	Mean \pm SD / n (%)
Age (years)	38.2 \pm 9.4
Gender (Male/Female)	38 (38%) / 62 (62%)
Duration of Asthma (years)	7.6 \pm 4.1
Baseline BMI (kg/m ²)	33.5 \pm 2.8
Baseline ACT Score	16.4 \pm 3.2
FEV ₁ (L)	1.89 \pm 0.51
FVC (L)	2.56 \pm 0.63
FEV ₁ /FVC (%)	74.1 \pm 7.2
Uncontrolled Asthma (ACT < 20)	68 (68%)
Partially Controlled (ACT 20-24)	20 (20%)
Well Controlled (ACT \geq 25)	12 (12%)

Weight Reduction and BMI Changes

After 6 months of the structured weight reduction program, participants achieved a significant reduction in body weight and BMI ($p < 0.001$).

Table 2. Changes in Body Weight and BMI Pre- and Post-Intervention

Parameter	Baseline (Mean \pm SD)	Post 6 Months (Mean \pm SD)	Mean Change	p-value
Weight (kg)	87.6 \pm 9.8	78.6 \pm 8.5	-9.0 \pm 2.6	<0.001
BMI (kg/m ²)	33.5 \pm 2.8	29.6 \pm 2.4	-3.9 \pm 1.1	<0.001

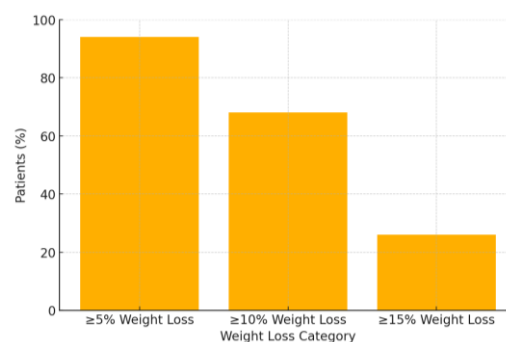


Figure 1 showing the percentage of patients achieving $\geq 5\%$, $\geq 10\%$, and $\geq 15\%$ weight loss- illustrating that most participants attained clinically meaningful reductions, with 94% achieving at least 5% loss, 68% achieving $\geq 10\%$, and 26% achieving $\geq 15\%$.

% Weight Loss Category	n (%) of Participants
$\geq 5\%$ loss	94 (94%)
$\geq 10\%$ loss	68 (68%)
$\geq 15\%$ loss	26 (26%)

Asthma Control (ACT Scores)

Significant improvement in asthma control was noted after weight reduction. The mean ACT score improved by 5.4 points ($p < 0.001$). The proportion of patients with *well-controlled asthma* increased from 12% to 64%.

Table 3. Asthma Control Test (ACT) Scores Before and After Weight Reduction

ACT Category	Baseline (n, %)	Post 6 Months (n, %)
Uncontrolled (ACT < 20)	68 (68%)	12 (12%)
Partially Controlled (ACT 20-24)	20 (20%)	24 (24%)
Well Controlled (ACT \geq 25)	12 (12%)	64 (64%)



Mean ACT Score (Mean ± SD)	16.4 ± 3.2	21.8 ± 2.6
p-value	-	<0.001

Lung Function Parameters

Lung function improved significantly across all spirometric indices after weight reduction.

Table 4. Spirometry Parameters Pre- and Post-Intervention

Parameter	Baseline (Mean ± SD)	Post 6 Months (Mean ± SD)	Mean Change	p-value
FEV ₁ (L)	1.89 ± 0.51	2.23 ± 0.48	+0.34 ± 0.14	<0.001
FVC (L)	2.56 ± 0.63	2.94 ± 0.61	+0.38 ± 0.17	<0.001
FEV ₁ /FVC (%)	74.1 ± 7.2	76.7 ± 6.5	+2.6 ± 1.8	0.032

Table 5. Lung Function Improvement According to Degree of Weight Loss

Weight Loss (%)	Mean FEV ₁ Change (L)	Mean FVC Change (L)	ACT Score Change	p-value (trend)
<5%	+0.12 ± 0.08	+0.15 ± 0.09	+2.1 ± 1.6	-
5-10%	+0.28 ± 0.12	+0.33 ± 0.14	+4.3 ± 1.9	-
>10%	+0.46 ± 0.18	+0.52 ± 0.21	+6.2 ± 2.3	<0.01

Correlation Analysis

Weight reduction showed a strong positive correlation with both asthma control and lung function improvement.

Table 6. Correlation between Weight Reduction and Asthma/Lung Function Outcomes

Variables Correlated	Correlation Coefficient (r)	p-value	Interpretation
Weight loss (%) vs. ACT score improvement	0.52	<0.01	Moderate positive correlation
Weight loss (%) vs. FEV ₁ improvement (L)	0.47	<0.01	Moderate positive correlation
Weight loss (%) vs. FVC improvement (L)	0.41	<0.05	Weak to moderate positive correlation
BMI reduction vs. ACT score improvement	0.50	<0.01	Moderate positive correlation

Summary of Key Findings

Parameter	Baseline	Post-Intervention	% Change / Outcome
Mean BMI	33.5	29.6	↓ 11.6%
Mean ACT Score	16.4	21.8	↑ 33%
FEV ₁	1.89	2.23	↑ 18%
FVC	2.56	2.94	↑ 15%
Well-Controlled Asthma	12%	64%	↑ 52%



Mean Weight Reduction	-	-	10.2% ± 3.6%
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Statistical Summary: Weight reduction $\geq 10\%$ was associated with the greatest improvement in asthma control and lung function ($p < 0.01$). Correlation analysis confirmed that as BMI decreased, ACT scores and spirometric values increased significantly.

Discussion

The present prospective study demonstrated that intentional weight reduction in obese adults with asthma significantly improved both asthma control and lung function over a six-month period. Participants who achieved greater reductions in body weight and BMI showed more pronounced improvement in Asthma Control Test (ACT) scores and spirometric indices, particularly FEV₁ and FVC. These findings support the hypothesis that obesity contributes to asthma severity and poor symptom control, and that weight loss can reverse some of these adverse effects [3,12,15].

The relationship between obesity and asthma has been well established in epidemiological studies, which consistently show that obese individuals have a higher risk of developing asthma, experience greater symptom burden, and demonstrate reduced response to standard pharmacological therapy [4,6,8]. Our study aligns with this evidence by showing that obese asthmatic patients had relatively low baseline ACT scores and spirometric values, indicative of poor control and impaired ventilatory mechanics. Following structured weight reduction, mean ACT scores improved by more than five points, which is clinically significant, and the proportion of well-controlled asthmatics increased from 12% to 64%. This level of improvement parallels observations from similar interventional trials by Aaron et al. [13] and Dias-Júnior et al. [14], both of which reported substantial gains in symptom control following 5-10% weight loss.

Improvement in lung function parameters observed in this study further substantiates the beneficial effect of weight reduction on airway physiology. Post-intervention spirometry revealed a statistically significant increase in FEV₁ and FVC, and a modest but meaningful rise in FEV₁/FVC ratio. These improvements

can be attributed to several physiological mechanisms. Obesity reduces functional residual capacity (FRC) and expiratory reserve volume (ERV), leading to premature airway closure and ventilation-perfusion mismatch [7,10]. Weight loss reduces mechanical loading on the chest wall and diaphragm, enhances lung compliance, and improves respiratory muscle efficiency [11,27]. Consequently, airway patency and elastic recoil are restored, resulting in better airflow and higher spirometric values.

The positive correlation between percentage weight reduction and both ACT score and FEV₁ improvement ($r=0.52$ and $r=0.47$, respectively) reinforces a dose-response relationship between the magnitude of weight loss and asthma outcomes. This observation is in line with previous studies indicating that even moderate reductions in body weight can translate into measurable clinical benefits [16,17]. A systematic review by Scott et al. [15] also concluded that weight loss through lifestyle modification or bariatric surgery consistently improves asthma control, lung function, and quality of life. The degree of improvement observed in our cohort suggests that structured, non-surgical interventions can achieve comparable benefits in resource-limited settings.

The potential biological mechanisms linking weight loss to asthma improvement extend beyond mechanical factors. Adipose tissue functions as an active endocrine organ that secretes numerous cytokines and adipokines, including leptin, interleukin-6 (IL-6), and tumor necrosis factor-alpha (TNF- α), all of which promote systemic inflammation and may exacerbate airway hyperresponsiveness [8,9]. Weight reduction has been shown to decrease circulating levels of these pro-inflammatory mediators and enhance anti-inflammatory adipokines such as adiponectin [28]. This modulation of systemic inflammation may explain the observed improvement in corticosteroid responsiveness and reduction in symptom burden after weight loss [12,29].

In addition to physiological and biochemical benefits, weight loss also enhances patients' self-efficacy and physical activity levels, which may indirectly contribute to better asthma control. Improved exercise tolerance and reduced dyspnea perception following weight loss can lead to a virtuous cycle of enhanced physical conditioning and psychological well-being [26]. Behavioral reinforcement and counseling, incorporated



into our intervention, likely played a role in sustaining adherence and promoting long-term lifestyle modification - a factor often underemphasized in previous trials.

Despite the encouraging results, certain limitations of the present study must be acknowledged. First, the sample size was modest and drawn from a single tertiary-care center, which may limit generalizability. Second, the study duration was six months, which is sufficient to observe short-term physiological improvements but not long-term weight maintenance or relapse rates. Third, dietary intake and physical activity adherence were self-reported, introducing possible recall bias. Furthermore, inflammatory biomarkers such as leptin, IL-6, or C-reactive protein (CRP) were not measured, which could have provided mechanistic insight into the anti-inflammatory effects of weight loss.

Nevertheless, the strengths of this study include its prospective design, objective spirometric assessment, and structured multidisciplinary intervention model that reflects real-world feasibility. The results demonstrate that non-pharmacological interventions can substantially enhance asthma control in obese individuals, complementing pharmacotherapy. These findings are particularly relevant in developing countries, where obesity rates are rising and access to advanced weight management therapies remains limited [18,19].

In light of these findings, integrating weight management counseling into asthma care should be emphasized as a routine clinical practice. Physicians managing obese asthmatic patients should consider structured lifestyle modification as an adjunct to pharmacologic treatment. Further multicentric studies with longer follow-up and inclusion of inflammatory biomarkers are warranted to establish causal mechanisms and to evaluate the durability of asthma improvement following weight reduction.

Conclusion

The present prospective study demonstrates that structured weight reduction in obese adults with asthma leads to significant improvement in both asthma control and lung function. Participants who achieved greater reductions in body weight and body mass index showed higher gains in Asthma Control Test (ACT) scores and spirometric parameters (FEV₁, FVC, and FEV₁/FVC

ratio). These findings suggest that weight loss not only reduces the mechanical burden on the respiratory system but may also attenuate systemic inflammation and improve corticosteroid responsiveness.

The results reinforce that weight management should be considered an integral component of asthma treatment, particularly in obese patients where traditional pharmacotherapy alone may be less effective. Implementing multidisciplinary, lifestyle-based interventions-comprising dietary modification, physical activity, and behavioral counseling-can achieve meaningful clinical outcomes even in resource-limited settings.

Further long-term, multicentric studies incorporating metabolic and inflammatory biomarkers are warranted to better elucidate the underlying mechanisms and to determine the sustainability of these improvements. Nonetheless, the current evidence strongly supports the integration of structured weight management programs into standard asthma care protocols to enhance overall patient health, symptom control, and quality of life.

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