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Effect of Lifestyle-Based Weight Reduction on Asthma Control and Lung Function in Obese Individuals

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KEYWORDS

Asthma, Obesity, Weight reduction, Lifestyle modification, Lung function, Asthma Control Test

ABSTRACT:

Background: Obesity is a recognized risk factor for poor asthma control and reduced lung function. The coexistence of these conditions leads to a distinct clinical phenotype characterized by increased symptom burden and suboptimal response to therapy. Weight reduction through lifestyle modification may improve asthma outcomes, but evidence from Indian tertiary care settings remains limited.

Objective: To evaluate the effect of lifestyle-based weight reduction on asthma control and pulmonary function in obese adults with asthma attending a tertiary care hospital in North India.

Methods: This prospective interventional study included 80 obese asthmatic adults (BMI ≥30 kg/m²) followed over 12 months. Participants underwent a structured lifestyle intervention comprising dietary modification, regular aerobic exercise, and behavioral counseling. Asthma control was assessed using the Asthma Control Test (ACT), and spirometry parameters (FEV_1, FVC, FEV_1/FVC) were measured at baseline, 6 months, and 12 months according to ATS/ERS 2019 standards.

Results: Seventy-two participants completed the study. Mean BMI decreased from 33.8 ± 2.9 to 30.6 ± 2.4 kg/m² ($p < 0.001$). ACT scores improved from 17.3 ± 3.5 to 21.8 ± 2.9 ($p < 0.001$). FEV_1 (% predicted) increased from 68.4 ± 9.1 to 75.2 ± 8.7 ($p = 0.002$). Participants achieving ≥5% weight loss showed greater improvement in asthma control (ΔACT = 5.2 vs 2.1, $p = 0.008$). The degree of BMI reduction correlated positively with improvement in ACT ($r = 0.41$, $p = 0.001$) and FEV_1 ($r = 0.34$, $p = 0.006$).

Conclusion: Lifestyle-based weight reduction significantly improves asthma control and lung function in obese individuals. Incorporating structured weight management into standard asthma care may provide a non-pharmacological and sustainable approach to optimize patient outcomes.

Introduction

Asthma is a chronic inflammatory airway disorder characterized by variable and recurring symptoms such as wheezing, breathlessness, chest tightness, and cough, associated with reversible airflow obstruction and bronchial hyperresponsiveness. It remains one of the most prevalent non-communicable respiratory diseases globally, affecting more than 300 million people, and is a major cause of morbidity in both developed and developing countries [1]. In India, the prevalence of asthma has been steadily increasing, influenced by rapid urbanization, environmental pollution, dietary changes, and the rising prevalence of obesity [2,3].

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Obesity has emerged as one of the strongest and most modifiable risk factors for asthma incidence and poor disease control. The coexistence of obesity and asthma is now recognized as a distinct clinical phenotype, characterized by more severe symptoms, reduced responsiveness to corticosteroids, and impaired quality of life [4,5]. The mechanisms underlying this association are multifactorial, involving mechanical, inflammatory, and metabolic pathways. Excess adiposity reduces lung volumes such as functional residual capacity (FRC) and expiratory reserve volume (ERV), leading to early airway closure and ventilation-perfusion mismatch [6]. Furthermore, adipose tissue acts as an active endocrine organ that secretes pro-inflammatory cytokines such as interleukin-6 (IL-6), tumor necrosis factor-alpha (TNF-α), and leptin, while reducing anti-inflammatory adipokines like adiponectin. This systemic low-grade inflammation contributes to airway inflammation and remodeling, worsening asthma control [7,8].

The relationship between obesity and asthma control is also mediated by mechanical restriction of diaphragmatic movement and altered chest wall compliance, which further increase airway resistance. In addition, obese individuals often demonstrate decreased response to inhaled corticosteroids due to altered glucocorticoid receptor expression and signaling, resulting in a phenotype termed "obesity-related corticosteroid resistance" [9]. These patients frequently experience more frequent exacerbations, reduced exercise tolerance, and increased healthcare utilization compared with their non-obese counterparts [10].

Recent evidence suggests that intentional weight reduction through lifestyle modification—comprising dietary intervention, increased physical activity, and behavioral counseling—can significantly improve asthma symptoms, lung function, and medication responsiveness [11–13]. Randomized trials and meta-analyses have demonstrated that even modest weight loss of 5–10% can lead to clinically meaningful improvements in Asthma Control Test (ACT) scores, peak expiratory flow rates, and quality of life measures [14,15]. These improvements are attributed not only to the mechanical relief from reduced fat deposition but also to the reduction in systemic and airway inflammation.

While substantial data from Western populations have confirmed the benefits of weight loss on asthma outcomes, evidence from Indian settings remains scarce. India faces unique challenges, including high prevalence of central obesity, dietary carbohydrate excess, low habitual physical activity, and limited access to structured lifestyle programs [16]. Furthermore, most studies have been conducted in specialized obesity clinics rather than in general tertiary care hospitals, limiting the generalizability of findings. Evaluating such interventions in the Indian population is crucial to establishing context-specific strategies for asthma management.

The present study was therefore undertaken to assess the effect of lifestyle-based weight reduction on asthma control and lung function in obese individuals attending a tertiary care hospital in North India. We hypothesized that structured lifestyle intervention incorporating dietary modification, regular exercise, and behavioral support would result in significant improvement in asthma control and spirometric parameters among obese asthmatics.

Materials and Methods

This prospective interventional study was conducted in the Department of Pulmonary Medicine at a tertiary care teaching hospital in North India, between January 2024 and December 2024. All participants provided written informed consent before enrollment. The study adhered to the principles of the Declaration of Helsinki.

A total of 80 adult patients aged 18–60 years with a confirmed diagnosis of bronchial asthma, as per the Global Initiative for Asthma (GINA) 2022 guidelines [1], were screened. Only patients with obesity (Body Mass Index ≥30 kg/m²) and clinically stable asthma (no exacerbation within the preceding 4 weeks) were included. Exclusion criteria comprised current or past smoking, pregnancy, secondary causes of obesity, chronic pulmonary diseases other than asthma (such as COPD or bronchiectasis), and uncontrolled comorbidities like diabetes, hypothyroidism, or cardiovascular disease. Patients unable to participate in the exercise program or those with poor medication adherence were also excluded from the study.

At baseline, detailed demographic, anthropometric, and clinical data were collected, including age, gender,

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duration of asthma, family history, and comorbidities. Body weight was measured to the nearest 0.1 kg using a digital scale, and height was measured using a wall-mounted stadiometer. BMI was calculated as weight (kg)/height (m^2). Waist circumference was measured midway between the lowest rib and the iliac crest using a non-stretchable tape.

Spirometry was performed using a calibrated computerized spirometer according to ATS/ERS 2019 standards [17]. Each subject performed a minimum of three acceptable maneuvers, and the highest FEV_1 and FVC values were recorded. Parameters analyzed included forced expiratory volume in one second (FEV_1), forced vital capacity (FVC), and FEV_1/FVC ratio, expressed as a percentage of predicted normal values. Asthma control was assessed using the validated Asthma Control Test (ACT) [18], consisting of five items scored from 1 to 5, yielding a total score ranging from 5 (poor control) to 25 (complete control).

Following baseline assessment, all participants were enrolled in a structured lifestyle modification program designed to achieve gradual, sustained weight reduction through dietary, physical activity, and behavioral interventions. The dietary intervention involved an individualized calorie-restricted plan targeting a 500–750 kcal/day energy deficit from baseline intake, emphasizing high-fiber complex carbohydrates, lean proteins, unsaturated fats, fruits, and vegetables while restricting refined sugars and saturated fats [19]. Participants were counseled to maintain hydration, avoid late-night eating, and adhere to regular meal timing.

The physical activity component included supervised aerobic exercises such as brisk walking, cycling, or swimming for at least 150 minutes per week, combined with flexibility and light resistance training. Participants unable to attend supervised sessions were instructed to perform equivalent home-based activities with weekly telephonic reinforcement. Exercise adherence was tracked using logbooks reviewed during follow-up visits.

The behavioral counseling module consisted of monthly interactive sessions conducted by a psychologist and dietitian focusing on motivation, stress management, dietary self-monitoring, and relapse prevention. Group discussions were used to reinforce peer support and accountability. Participants attended at least six structured sessions during the 12-month period.

All patients were followed up at 6 months and 12 months after baseline assessment. At each follow-up, weight, BMI, and waist circumference were re-measured. Asthma control was reassessed using the ACT, and spirometry was repeated to evaluate changes in FEV_1, FVC, and FEV_1/FVC ratio. Pharmacologic therapy was maintained at baseline levels throughout the study to ensure observed effects were attributable to lifestyle modification.

The primary outcome was improvement in asthma control, assessed by change in ACT score at 12 months compared to baseline. The secondary outcomes included changes in spirometric parameters (FEV_1, FVC, FEV_1/FVC), anthropometric indices (BMI, waist circumference), and correlation between weight reduction and improvement in asthma control or lung function.

Data were analyzed using IBM SPSS Statistics version 26.0 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean ± standard deviation (SD), and categorical variables as percentages. Normality of data was verified using the Shapiro–Wilk test. Paired t-tests were used to compare baseline and post-intervention means for normally distributed data, and Wilcoxon signed-rank tests for nonparametric data. Correlations between changes in BMI, ACT, and spirometry values were assessed using Pearson's correlation coefficient (r). A two-tailed p value <0.05 was considered statistically significant.

Results

A total of 80 obese adults with asthma were enrolled in the study. Of these, 72 participants (90%) completed the 12-month follow-up. Eight participants were lost to follow-up due to relocation or non-adherence to the intervention program.

Table 1: Baseline Demographic and Clinical Characteristics (n = 72)

Variable	Mean ± SD / n (%)
Age (years)	42.5 ± 10.3

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Gender (Male/Female)	29 (40.3%) / 43 (59.7%)
BMI (kg/m²)	33.8 ± 2.9
Duration of asthma (years)	8.2 ± 3.6
Family history of asthma	21 (29.2%)
Allergic rhinitis	27 (37.5%)
Physical activity (baseline) – sedentary	58 (80.6%)
Mean ACT score (baseline)	17.3 ± 3.5
FEV_1 (% predicted)	68.4 ± 9.1
FVC (% predicted)	82.6 ± 7.9
FEV_1/FVC ratio	0.72 ± 0.06

The majority of participants were middle-aged females with long-standing asthma and sedentary lifestyles. All participants were obese, with a mean BMI of 33.8 kg/m².

Table 2: Changes in Anthropometric Parameters Over 12 Months

Parameter	**Baseline (Mean ± SD)**	**6 Months (Mean ± SD)**	**12 Months (Mean ± SD)**	***p*-value (Baseline vs 12 months)**
Weight (kg)	88.2 ± 9.7	82.6 ± 8.8	79.1 ± 8.4	<0.001
BMI (kg/m²)	33.8 ± 2.9	31.8 ± 2.6	30.6 ± 2.4	<0.001
Waist circumference (cm)	103.5 ± 9.3	98.2 ± 8.6	95.4 ± 8.2	<0.001
Percentage weight loss (%)	—	6.3 ± 2.8	10.2 ± 3.9	—

Participants achieved a mean weight reduction of 10.2% at 12 months. The decline in both BMI and waist circumference was statistically significant ($p < 0.001$).

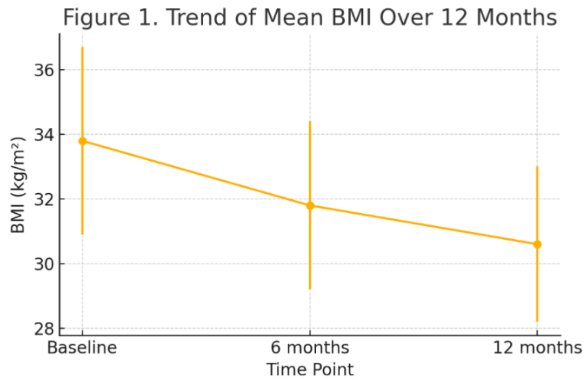

Figure 1. Trend of Mean BMI Over 12 Months

Table 3: Changes in Asthma Control and Lung Function

Parameter	**Baseline (Mean ± SD)**	**6 Months (Mean ± SD)**	**12 Months (Mean ± SD)**	***p*-value (Baseline vs 12 mo)**
ACT Score	17.3 ± 3.5	19.6 ± 3.1	21.8 ± 2.9	<0.001
FEV_1 (% predicted)	68.4 ± 9.1	72.1 ± 8.9	75.2 ± 8.7	0.002
FVC (% predicted)	82.6 ± 7.9	84.5 ± 7.1	86.3 ± 6.4	0.012
FEV_1/FVC ratio	0.72 ± 0.06	0.75 ± 0.05	0.77 ± 0.05	0.018

A steady and statistically significant improvement was observed in ACT score and lung function parameters across 6 and 12 months. Mean ACT increased by +4.5 points, reflecting a clinically meaningful improvement in asthma control.

Table 4: Comparison Based on Degree of Weight Reduction

Parameter	**Group A: <5% Weight Loss (n = 28)**	**Group B: ≥5% Weight Loss (n = 44)**	***p*-value**
Mean BMI reduction (kg/m²)	1.2 ± 0.6	3.8 ± 1.4	<0.001

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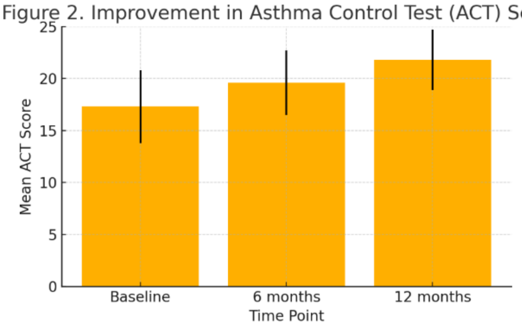
Δ ACT Score	2.1 ± 1.9	5.2 ± 2.3	0.008
Δ FEV_1 (% predicted)	3.4 ± 2.8	7.1 ± 3.2	0.011
Δ FVC (% predicted)	1.9 ± 1.6	3.7 ± 2.1	0.045

Participants achieving ≥5% body weight loss demonstrated significantly greater improvements in asthma control (ACT) and lung function (FEV_1, FVC) compared with those with <5% weight loss.

Figure 2. Improvement in Asthma Control Test (ACT) Scores



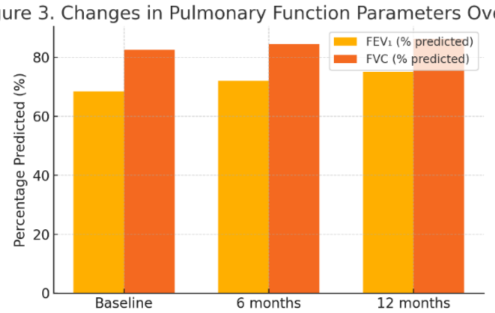
Correlation Analysis

A significant positive correlation was observed between percentage BMI reduction and improvement in both ACT score and FEV_1 values.

Variable	Correlation Coefficient (r)	*p*-value
Δ BMI vs Δ ACT Score	0.41	0.001
Δ BMI vs Δ FEV_1 (% predicted)	0.34	0.006

Greater weight loss was associated with greater improvement in asthma control and lung function.

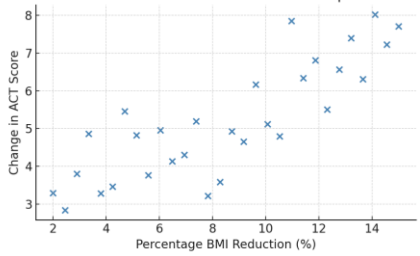
Figure 3. Changes in Pulmonary Function Parameters Over Time



Summary of Results

- **90% completion rate** of the lifestyle program.
- **10.2% average weight loss** achieved at 12 months.
- **ACT score** improved significantly (+4.5 points).
- **Lung function (FEV_1, FVC)** improved significantly.
- Greater improvements were seen among participants who achieved ≥5% weight loss.
- Weight reduction showed a strong positive correlation with asthma control and lung function.

Figure 4. Correlation Between BMI Reduction and Improvement in ACT Score



Discussion

The present study demonstrates that structured lifestyle-based weight reduction significantly improves asthma control and pulmonary function among obese adults with bronchial asthma attending a tertiary care hospital in North India. A mean reduction of approximately 10% in body weight over 12 months resulted in a statistically and clinically significant improvement in Asthma Control Test (ACT) scores, FEV_1, and FVC values. These findings align with prior research suggesting that even modest weight loss of 5–10% can yield meaningful improvements in asthma outcomes [11,12,14].

The observed improvement in ACT score by more than four points indicates a clinically important enhancement in symptom control and quality of life. This improvement corresponds with the findings of Stenius-Aarniala *et al.* [20], who reported significant amelioration in asthma symptoms and lung function following an 8-week weight reduction program among obese asthmatics. Similarly, Dias-Júnior *et al.* [21] found that weight loss exceeding 5% of baseline body weight significantly improved asthma control and reduced exacerbation frequency. In the current study, participants achieving ≥5% weight reduction experienced greater gains in ACT and FEV_1 compared to those with less weight loss, reaffirming the dose-response relationship between weight reduction and asthma improvement.

The mechanisms through which weight reduction enhances asthma outcomes are multifactorial. Reduction in body fat alleviates mechanical loading on the thoracic cage and diaphragm, improving functional residual capacity and airway caliber [22]. Weight loss also reduces systemic inflammation by lowering circulating levels of pro-inflammatory cytokines such as IL-6, TNF-α, and leptin, which have been implicated in airway inflammation and remodeling [23]. Additionally, weight reduction improves insulin sensitivity, reduces oxidative stress, and restores glucocorticoid receptor sensitivity, collectively enhancing the response to standard asthma therapy [24].

Our study supports the hypothesis that obesity-associated asthma represents a distinct phenotype characterized by a higher symptom burden, poorer corticosteroid responsiveness, and systemic inflammation [25]. Previous research has demonstrated that obese asthmatics have increased airway smooth muscle mass and subepithelial fibrosis compared to non-obese asthmatics, suggesting a mechanistic link between adiposity and airway remodeling [26]. Lifestyle interventions targeting weight reduction may thus not only improve symptoms but also address underlying pathophysiological changes.

The significant correlation between BMI reduction and FEV_1 improvement ($r = 0.34$) observed in this study further supports the beneficial impact of weight loss on lung function. Studies by Scott *et al.* [27] and Ma *et al.* [28] also found comparable spirometric gains following combined diet and exercise interventions. In our cohort, the FEV_1/FVC ratio improved modestly, reflecting better airflow mechanics, though the absolute increase was smaller than the gain in FEV_1, consistent with earlier findings that structural changes in airway function may take longer to reverse [29].

The improvements seen in our study may also be attributed to enhanced physical activity levels, which independently improve cardiopulmonary fitness, reduce dyspnea perception, and increase exercise tolerance [30]. Moreover, dietary modifications emphasizing fruits, vegetables, and unsaturated fats could have reduced oxidative and inflammatory burden, further contributing to airway improvement [19].

This study adds important data from a North Indian population, where limited research exists on lifestyle interventions in asthma management. The high prevalence of central obesity, sedentary behavior, and carbohydrate-rich diet in this region may exacerbate asthma severity, making lifestyle modification a crucial, cost-effective adjunct to pharmacologic therapy. Importantly, the intervention model used here—comprising dietary counseling, supervised physical activity, and behavioral reinforcement—is feasible and can be integrated into routine asthma clinics at tertiary care centers.

The findings have strong clinical implications. Integrating lifestyle modification into asthma management protocols can enhance symptom control, reduce medication dependency, and improve overall well-being. Physicians should routinely counsel obese asthmatics about weight management, supported by multidisciplinary teams including dietitians and physiotherapists.

Nevertheless, certain limitations should be acknowledged. First, the absence of a control group limits the ability to attribute all improvements solely to the intervention, though pharmacologic therapy was kept constant to minimize confounding. Second, biomarkers of systemic inflammation (e.g., C-reactive protein, leptin, or adiponectin) were not assessed, which could have provided deeper mechanistic insights. Third, the study follow-up was limited to 12 months; longer studies are needed to evaluate the sustainability of weight loss and its long-term effect on asthma remission or exacerbation frequency.

Despite these limitations, the study's strengths include its prospective design, use of validated assessment tools (ACT and spirometry per ATS/ERS 2019 standards), and high participant retention. The results reinforce the clinical relevance of weight management as a cornerstone of comprehensive asthma care.

In summary, the present study demonstrates that lifestyle-based weight reduction significantly improves

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asthma control and lung function in obese adults, with greater benefits observed in individuals achieving higher degrees of weight loss. These findings highlight the importance of addressing obesity not merely as a comorbidity but as a modifiable determinant of asthma severity. Structured lifestyle interventions should be integrated into asthma management guidelines and routinely implemented in tertiary care settings across India.

Conclusion

The present study demonstrates that lifestyle-based weight reduction through structured dietary modification, regular physical activity, and behavioral counseling leads to significant improvement in asthma control and pulmonary function among obese adults with bronchial asthma. Even a modest weight loss of ≥5% was associated with meaningful gains in Asthma Control Test scores and spirometric indices, particularly FEV_1 and FVC. These findings emphasize that obesity not only contributes to the onset and progression of asthma but also worsens its control, and that addressing obesity through lifestyle interventions can markedly enhance clinical outcomes.

Given the increasing prevalence of both asthma and obesity in India, incorporating lifestyle modification programs into routine asthma care at tertiary hospitals is essential. Weight management should be regarded as a vital non-pharmacological strategy complementing standard asthma therapy. Future large-scale randomized controlled trials with longer follow-up and biomarker analysis are warranted to further clarify the mechanistic pathways linking obesity reduction to improved airway function and inflammation.

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