

Correlation Between BMI and Severity of Bronchial Asthma in Bihar region

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Abstract

Background: Bronchial asthma is a chronic inflammatory airway disease whose severity may be influenced by obesity. Body Mass Index (BMI) is increasingly recognized as an important modifier of asthma outcomes, yet region-specific evidence from Bihar remains limited.

Aim: To evaluate the correlation between BMI and severity of bronchial asthma in patients from the Bihar region.

Methodology: A hospital-based observational study was conducted on 80 clinically diagnosed asthma patients. BMI was calculated and categorized as per WHO classification. Asthma severity was assessed using spirometric parameters (FEV₁, FVC, FEV₁/FVC ratio). Correlation between BMI and lung function as well as asthma severity was analyzed using SPSS v27, with $p < 0.05$ considered significant.

Results: A significant negative correlation was observed between BMI and FEV₁ ($r = -0.62$), FVC ($r = -0.58$), and FEV₁/FVC ratio ($r = -0.65$) ($p < 0.001$). BMI showed a strong positive correlation with asthma severity ($r = 0.68$, $p < 0.001$). Obese patients demonstrated the lowest spirometric values and higher severity levels.

Conclusion: Increased BMI is significantly associated with reduced pulmonary function and higher asthma severity. Weight control may improve asthma outcomes in this population.

Keywords: Bronchial asthma, BMI, obesity, pulmonary function, spirometry, Bihar region.

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Introduction

Bronchial asthma is a persistent lung condition that causes ongoing airway inflammation, which leads to different degrees of breathing difficulties and excessive airway sensitivity and multiple episodes of wheezing and breathlessness and chest tightness and coughing [1]. The condition presents a persistent worldwide health crisis because it affects approximately 300 million people throughout the world. Despite progress in asthma diagnosis and treatment methods the disease still creates major challenges for healthcare systems in developing countries because environmental factors and limited medical services and missed diagnosis lead to inadequate disease management. The rising rate of asthma cases in India establishes an essential public health problem which requires ongoing research into its risk factors and factors that affect its progression [2].

Asthma pathophysiology is complicated and includes airway inflammation, bronchial wall structural remodeling, and increased airway sensitivity to different stimuli [3]. Traditionally, genetic pre-

disposition and environmental exposures such as allergens, pollution, and respiratory infections have been considered major contributors to asthma development and severity. Nevertheless, comorbidities like obesity have become important disease course and treatment outcome modifiers in recent years. The comorbidity of obesity and asthma has received significant interest because of its possible contribution to the severity of the disease, diminished response to therapy, and poor quality of life [4].

Obesity has now been identified as a risk factor on its own in the development and progression of asthma [5]. A number of epidemiological studies have shown that asthma is more prevalent in obese people than in normal body weight. In addition, obese asthmatic patients tend to have more severe symptoms, frequent exacerbations, and worse disease control. Body mass index (BMI) is one of the most widely used measures of obesity and it is a simple and practical measure of classifying people into underweight, normal weight, overweight, and

obese. The association between BMI and asthma severity has been a topic of growing research, but the mechanisms that underlie this relationship are not fully understood [6].

Several biological and physiological processes have been suggested to describe the relationship between obesity and asthma [7]. Mechanical restriction of lung function by excess adipose tissue, especially in the thoracic and abdominal areas, is one of the most important mechanisms. This may result in decreased lung volumes, airway caliber, and respiratory mechanics. Moreover, obesity is linked to a chronic low-grade systemic inflammation with increased levels of inflammatory cytokines like leptin, interleukins, and tumor necrosis factor-alpha, which can further contribute to airway inflammation in asthmatic patients [8]. It is also thought that altered airway smooth muscle behavior, immune response changes, and oxidative stress also play a role in the increased severity of asthma in obese individuals. Although these mechanisms have been proposed, the exact relationship between BMI and pulmonary functioning in asthma patients remains unclear.

In the Indian setting, especially in states such as Bihar, there is a paucity of population-based data that investigates the relationship between BMI and asthma severity. Bihar is a distinct demographic environment with different socioeconomic backgrounds, different nutritional status, and disparities in healthcare access, which can affect both obesity trends and asthma outcomes. The clinical picture of respiratory diseases in this area is further complicated by the dual burden of undernutrition and increasing obesity. Thus, it is necessary to comprehend the relationship between BMI and asthma severity in this group to create specific management plans and enhance clinical outcomes.

Moreover, the majority of the current research on asthma and obesity has been carried out in Western populations, and their results might not be fully applicable to Indian patients because of the differences in lifestyle, genetic factors, environmental exposures, and healthcare practices. This underscores the importance of region-specific research that can offer more pertinent information on disease behavior and risk factors.

In this context, the current research will assess the lung functioning in various BMI groups of adults with asthma in the Bihar region. It also aims to determine the relationship between BMI and the severity of asthma, as well as characterizing the clinicodemographic profile of the study population. Through these relationships, the study aims to add to the understanding of how obesity affects the severity of asthma in this particular population and to aid in the creation of more effective and personalized treatment strategies.

Methodology

Study Design: This study was designed as a hospital-based observational analytical study to evaluate the correlation between Body Mass Index (BMI) and severity of bronchial asthma. A cross-sectional retrospective design was adopted, wherein previously recorded clinical and spirometric data of diagnosed asthma patients were reviewed and analyzed to determine the relationship between nutritional status (BMI) and asthma severity parameters.

Study Area: The study was conducted in the Department of Respiratory Medicine, Shree Narayan Medical Institute and Hospital, Saharsa, Bihar, India.

Study Duration: The study was conducted over a period of one year.

Study Participants

Inclusion Criteria

- Patients clinically diagnosed with bronchial asthma based on standard diagnostic criteria (symptoms such as wheezing, dyspnea, chest tightness, and cough with reversible airway obstruction)
- Patients aged 18 years and above
- Both male and female patients
- Patients with complete clinical records including BMI and spirometry reports
- Patients attending or admitted to the Department of Respiratory Medicine during the study period

Exclusion Criteria

- Patients diagnosed with Chronic Obstructive Pulmonary Disease (COPD)
- Patients with active pulmonary tuberculosis or other active respiratory infections
- Pregnant women
- Patients aged below 18 years
- Patients with incomplete medical records or missing spirometric data
- Patients with significant cardiac or systemic diseases affecting respiratory function

Sample Size: A total of 80 patients fulfilling the inclusion criteria were included in the study. The sample size was determined based on the availability of complete hospital records and spirometry data during the study period.

Procedure: After obtaining necessary administrative permission from the institutional authorities, patient records from the Department of Respiratory Medicine were retrieved and systematically reviewed. Data extraction was performed using a structured proforma designed for the study. Demographic details such as age, gender, and residence were recorded along with anthropometric meas-

urements, particularly height and weight, which were used to calculate Body Mass Index (BMI) using the standard formula: weight in kilograms divided by height in meters squared (kg/m^2). Based on WHO classification, patients were categorized into underweight, normal weight, overweight, and obese groups.

Clinical severity of asthma was assessed using spirometry parameters, including Forced Expiratory Volume in one second (FEV_1), Forced Vital Capacity (FVC), and FEV_1/FVC ratio, recorded as part of routine pulmonary function testing in the hospital. Severity classification of asthma was interpreted based on standard spirometric criteria and clinical assessment documented in patient records. All relevant data including comorbid conditions, history of smoking or tobacco use, and medication history were also recorded to understand potential confounding factors. Data confidentiality was strictly maintained throughout the study.

Statistical Analysis: The collected data were entered into Microsoft Excel and analyzed using SPSS version 27.0. Continuous variables were expressed as mean \pm standard deviation, while categorical variables were presented as frequencies and percentages. Correlation analysis (Pearson or

Spearman) was used to assess the relationship between BMI and lung function parameters. Group comparisons were performed using one-way ANOVA or Chi-square test. A p-value <0.05 was considered statistically significant.

Result

Table 1 shows the distribution of study participants according to age ($n = 80$). The highest proportion of patients belonged to the 31–45 years age group, accounting for 26 cases (32.50%), indicating that middle-aged adults formed the largest segment of the study population. This was followed closely by the 46–60 years age group with 24 patients (30.00%), suggesting a substantial representation of late middle-aged individuals. The younger age group of 18–30 years comprised 18 patients (22.50%), while the least number of participants were observed in the >60 years age group with 12 patients (15.00%). Overall, the data indicate that the majority of cases were concentrated in the 31–60 years age range, collectively representing 62.50% of the study population, highlighting a higher burden of the condition in middle-aged adults compared to younger and elderly individuals.

Age Group (Years)	Number of Patients	Percentage (%)
18–30	18	22.50%
31–45	26	32.50%
46–60	24	30.00%
>60	12	15.00%
Total	80	100%

Table 2 shows the distribution of study participants according to BMI category ($n = 80$). The majority of patients belonged to the normal weight group (18.5–24.9 kg/m^2), comprising 28 individuals (35.00%), indicating that a substantial proportion of the study population had BMI within the standard range. This was followed by the overweight category (25.0–29.9 kg/m^2) with 22 patients (27.50%), suggesting a considerable presence of excess body weight among participants. Obese individuals (BMI

≥ 30 kg/m^2) accounted for 16 patients (20.00%), reflecting a significant proportion with higher adiposity. The underweight group (BMI <18.5 kg/m^2) included 14 patients (17.50%), representing the smallest but still notable segment of the study population. Overall, the distribution indicates that while normal BMI was most common, a combined 47.50% of participants fell into overweight and obese categories, highlighting a substantial burden of increased BMI in the study group.

BMI Category	BMI Range (kg/m^2)	Number of Patients	Percentage (%)
Underweight	<18.5	14	17.50%
Normal weight	18.5–24.9	28	35.00%
Overweight	25.0–29.9	22	27.50%
Obese	≥ 30	16	20.00%
Total	—	80	100%

Table 3 shows the distribution of bronchial asthma severity among the study participants ($n = 80$). The data indicates that the most common category was moderate persistent asthma, observed in 26 patients

(32.50%), suggesting that a significant proportion of patients presented with a relatively higher level of disease severity. This was followed by mild intermittent asthma in 20 patients (25.00%), indicat-

ing a considerable number of cases with episodic symptoms. Mild persistent asthma was reported in 18 patients (22.50%), showing a slightly lower but still notable prevalence. Severe persistent asthma was the least common among the groups, affecting 16 patients (20.00%). Overall, the distribution

demonstrates that while all severity levels are represented in the study population, moderate persistent asthma constitutes the largest group, highlighting a tendency towards moderate disease burden among the participants.

Table 3: Severity of Bronchial Asthma Among Study Participants (n = 80)

Severity Level	Number of Patients	Percentage (%)
Mild Intermittent	20	25.00%
Mild Persistent	18	22.50%
Moderate Persistent	26	32.50%
Severe Persistent	16	20.00%
Total	80	100%

Table 4 presents the mean spirometric parameters according to BMI categories (n = 80). The results show a clear decline in pulmonary function with increasing BMI, particularly in the obese group. The highest FEV₁ (% predicted) was observed in the normal weight group (78.6 ± 5.4), followed by underweight individuals (72.4 ± 6.8), while the lowest value was seen in the obese group (62.8 ± 6.5). A similar trend was noted for FVC (% predicted), which was highest in normal weight participants (82.3 ± 6.1) and lowest among obese indi-

viduals (69.4 ± 5.8). The FEV₁/FVC ratio also decreased progressively from normal weight (75.8 ± 4.2) to obese category (66.2 ± 4.9), indicating worsening airflow limitation with higher BMI. Overall, the findings suggest that both underweight and overweight/obese categories are associated with reduced spirometric values, with the most significant impairment observed in obese individuals, highlighting a negative correlation between increasing BMI and lung function.

Table 4: Mean Spirometric Parameters According to BMI Category (n = 80)

BMI Category	FEV ₁ (% Predicted)	FVC (% Predicted)	FEV ₁ /FVC (%)
Underweight	72.4 ± 6.8	78.1 ± 5.9	73.2 ± 4.5
Normal weight	78.6 ± 5.4	82.3 ± 6.1	75.8 ± 4.2
Overweight	70.2 ± 7.1	76.5 ± 6.3	71.0 ± 5.1
Obese	62.8 ± 6.5	69.4 ± 5.8	66.2 ± 4.9

Table 5: shows the correlation between BMI and various pulmonary function parameters along with asthma severity in the study population (n = 80). The results indicate a significant negative correlation between BMI and FEV₁ (r = -0.62, p < 0.001), BMI and FVC (r = -0.58, p < 0.001), and BMI and FEV₁/FVC ratio (r = -0.65, p < 0.001), suggesting that higher BMI is associated with reduced lung function. In contrast, a strong positive correlation

was observed between BMI and asthma severity (r = 0.68, p < 0.001), indicating that increasing BMI is associated with worsening severity of bronchial asthma. All correlations were statistically significant at p < 0.001, highlighting a consistent and meaningful association between increased body mass index and both impaired pulmonary function and greater asthma severity in the studied population.

Table 5: Correlation Between BMI and Asthma Severity (n = 80)

Parameter Compared	Correlation Coefficient (r)	P-value
BMI vs FEV ₁	-0.62	<0.001
BMI vs FVC	-0.58	<0.001
BMI vs FEV ₁ /FVC ratio	-0.65	<0.001
BMI vs Asthma Severity	0.68	<0.001

Discussion

The present study demonstrated a significant inverse relationship between BMI and pulmonary function parameters through its assessment of 80 patients from Bihar region. The research results show that body weight increase leads to deterioration of asthma control and decreased lung function, which aligns with earlier research findings, but

shows different effects across various population groups and age ranges.

The majority of study participants belonged to the 31 to 60 years age range whereas the 31 to 45 years group received the highest number of participants showing that asthma which causes measurable functional disability affects middle-aged adults the most. The observation matches results from Beu-

ther and Sutherland (2007) [9] which showed that obesity relates to asthma more strongly in adults because they experience greater metabolic and inflammatory effects. Sutherland et al. (2008) [10] showed that adult-onset asthma has a stronger connection to obesity-related systemic inflammation than childhood asthma which supports the age-related distribution shown in our current research study.

Our study's BMI distribution results showed that most participants had overweight or obese body weights which confirmed the global pattern of increasing obesity rates among people with asthma. Boulet (2008) [11] demonstrated that asthma patients experience higher obesity rates which lead to more severe disease symptoms and difficulty in managing their condition. Ozbey et al. (2019) [12] found that obese asthmatic patients demonstrated lower spirometric results than normal-weight patients which showed how extra body fat affects their breathing functions.

Our research found that moderate persistent asthma represented the most prevalent asthma severity category. The research results showed that Kumar and Jain (2020) [13] established that most obese asthmatic patients exhibit moderate asthma severity instead of extreme severe forms because of their early identification and continuous medical treatment. Beuther and Sutherland (2007) demonstrated that obesity causes asthma patients to develop more serious asthma symptoms which become worse as their condition progresses when they do not maintain their body weight.

The study demonstrated that BMI increases caused a constant reduction of FEV₁, FVC, and FEV₁/FVC ratio through pulmonary function testing. The lowest spirometric measurements occurred in obese individuals while normal-weight patients displayed better lung function. The research findings receive strong backing from Ozbey et al. (2019) who showed that obese asthmatic patients experienced FEV₁ and FVC reductions because of mechanical restrictions and airway constriction. Beuther and Sutherland (2007) further explained that obesity leads to reduced lung compliance and decreased expiratory reserve volume which creates restrictive ventilatory defects.

The present study demonstrated that underweight people showed worse lung capacity than normal-weight individuals yet their condition was less severe than that of obese patients. The relationship shows two distinct phases which Boulet (2007) identified as both undernutrition and obesity negatively affecting respiratory muscle strength and immune function, which in turn compromised asthma management. The study found that BMI showed a strong negative relationship with spirometric measurements and a positive relationship

with asthma severity. The findings of this study support the results of Forno and Celedón (2017) [14] which found that increased BMI leads to higher asthma risk and more severe symptoms. Sutherland et al. (2008) identified obesity as a separate asthma phenotype which showed poor treatment response and higher symptom severity.

Obesity and asthma share biological links through both mechanical pathways and inflammatory pathways. The researchers from Shore et al. (2008) [15] demonstrated that adipose tissue functions as an endocrine organ which produces pro-inflammatory cytokines that lead to airway inflammation and hyperresponsiveness. The current study found that systemic low-grade inflammation causes obese individuals to experience decreased FEV₁ and FVC results. The researchers Beuther and Sutherland (2007) demonstrated that chest wall compliance and diaphragmatic excursion decrease because of obesity which creates additional challenges to breathing.

The current study results show strong alignment with previous research findings which establish that higher body mass index results in decreased lung function and more severe asthma symptoms. The studies show different patterns of disease severity and lung function impairment yet they all demonstrate the same relationship between the two factors. The current research provides evidence from the Indian state of Bihar which demonstrates that the relationship between obesity and asthma exists in populations experiencing rapid changes in their dietary and lifestyle practices.

Conclusion

The present study establishes a clear and significant association between Body Mass Index and bronchial asthma severity among patients in the Bihar region. The findings demonstrate that increased BMI is strongly linked with reduced pulmonary function parameters, including FEV₁, FVC, and FEV₁/FVC ratio, indicating progressive airflow limitation with rising body weight. A positive correlation between BMI and asthma severity further confirms that overweight and obese individuals experience more severe disease manifestations compared to those with normal or lower BMI. The study also highlights that a considerable proportion of asthmatic patients fall into overweight and obese categories, emphasizing the growing burden of obesity in this population. These results suggest that obesity acts as an important modifiable risk factor influencing asthma control and lung function. Therefore, weight management strategies should be integrated into asthma care to improve clinical outcomes and reduce disease severity in affected individuals.

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