



## Assessing the Role of Body Mass Index in the Development and Severity of Asthma and COPD

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**Abstract: Background:** Asthma and COPD are chronic respiratory diseases with significant global morbidity. Emerging evidence highlights the role of BMI in disease severity and progression, though the relationship remains complex. Obesity exacerbates asthma through inflammation and mechanical restrictions, while underweight worsens COPD outcomes. **Objectives:** Assess BMI's role in asthma and COPD development and severity. Evaluate demographics, classify BMI, and analyze symptoms, comorbidities, and hospital admissions. **Method and Materials:** This cross-sectional study included 518 asthma/COPD patients at Jalalabad Ragib Rabeya Medical College Hospital for the period of June 2023 to May 2024. Data on demographics, BMI, symptoms, comorbidities, and lung function were collected. Statistical analysis used SPSS (v26.0). **Results:** The study population (n=518) was predominantly male (59.8%) and most commonly within the 51–60 years age group (23.4%). In terms of nutritional status, normal weight individuals comprised the largest proportion (41.3%), followed by overweight (24.3%) and underweight (19.7%) participants. Among the respiratory conditions, asthma was observed in 300 patients and COPD in 218 patients, with the majority in both groups being of normal weight (40.0% and 41.3%, respectively). Hypertension and diabetes were present in 62.5% and 37.5% of the study population, respectively, with the highest prevalence of both conditions noted among overweight individuals. **Conclusion:** BMI significantly influences asthma and COPD severity, with underweight and obesity posing risks, highlighting the need for weight-based management strategies.

**Keywords:** Asthma, Chronic Obstructive Pulmonary Disease (COPD), Obesity, Underweight, Respiratory Symptoms.

### Original Research Article

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### Article at a glance:

**Study Purpose:** To examine how BMI affects asthma and COPD severity, comorbidities, and healthcare use.

**Key findings:** BMI impacts asthma and COPD severity. Obesity worsens asthma; underweight worsens COPD. Overweight individuals also have more hypertension and diabetes.

**Newer findings:** The study highlights that low BMI worsens COPD outcomes and emphasizes the combined effect of obesity, hypertension, and diabetes on respiratory diseases.

**Abbreviations:** BMI - Body Mass Index, COPD - Chronic Obstructive Pulmonary Disease, ICU - Intensive Care Unit



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## INTRODUCTION

Asthma and chronic obstructive pulmonary disease (COPD) are chronic respiratory disorders that contribute significantly to global morbidity and mortality. Asthma affects over 300 million individuals worldwide, while COPD is the

third leading cause of death globally, with both conditions imposing substantial healthcare and economic burdens.<sup>1, 2</sup> Emerging evidence suggests that body mass index (BMI), a measure of body fat based on height and weight, may play a critical role

in the development and progression of these diseases. However, the relationship between BMI and respiratory outcomes remains complex, characterized by paradoxical findings and heterogeneous mechanisms.<sup>3,4</sup> Obesity, defined as a BMI  $\geq 30$  kg/m<sup>2</sup>, is linked to systemic inflammation, oxidative stress, and mechanical alterations in lung function, which may exacerbate airway hyperresponsiveness and airflow limitation in asthma and COPD.<sup>5, 6</sup> In asthma, obesity is associated with increased symptom severity, reduced response to corticosteroids, and higher exacerbation rates.<sup>7,8</sup>

Conversely, some studies report a U-shaped relationship between BMI and COPD, where both underweight and obesity correlate with worsened outcomes, suggesting divergent pathophysiological pathways.<sup>9, 10</sup> For instance, low BMI in COPD patients is linked to muscle wasting and increased mortality, whereas obesity may confer survival advantages in advanced disease—a phenomenon termed the “obesity paradox”.<sup>11, 12</sup> Mechanistically, adipose tissue secretes pro-inflammatory cytokines such as leptin and adiponectin, which modulate immune responses and airway remodeling.<sup>13</sup> Visceral adiposity also restricts diaphragmatic movement, reducing lung volumes and impairing gas exchange.<sup>14</sup> Despite these insights, population-based studies yield conflicting results, with variations attributed to age, sex, genetic predisposition, and comorbidities like metabolic syndrome.<sup>15</sup> Despite extensive research on asthma and COPD, the relationship between BMI and respiratory outcomes remains inconsistent, with studies reporting paradoxical associations, such as obesity exacerbating asthma yet potentially offering survival benefits in advanced COPD. Given regional variations in BMI distribution, lifestyle factors, and comorbidities, this study aims to (1) examine asthma and COPD prevalence across BMI categories, (2) assess respiratory symptom burden, (3) evaluate associations with hypertension and diabetes, (4) analyze hospitalization patterns, and (5) compare gender-based differences, thereby clarifying BMI’s role in disease progression and informing targeted clinical management.

## OBJECTIVES

### General Objectives

To assess the impact of body mass index (BMI) on the development and severity of asthma and COPD, including its influence on disease outcomes, comorbidities, symptom prevalence, and healthcare utilization.

### Specific Objectives

To analyze the demographic characteristics (age, gender, marital status, smoking habits, and residential distribution) in relation to asthma and COPD. To classify patients by BMI categories (underweight, normal weight, overweight, obese) and examine the distribution of asthma and COPD cases across these groups.

## METHOD AND MATERIALS

### Study Design

This cross-sectional observational study was conducted at Jalalabad Ragib Rabeya Medical College Hospital, Sylhet, over a period of one year, from June 2023 to May 2024. The study population consisted of 518 patients diagnosed with asthma or chronic obstructive pulmonary disease (COPD), categorized based on their body mass index (BMI) to assess its role in disease development and severity.

### Data Collection Procedure

During the study period, patients attending both the outpatient and inpatient departments of Jalalabad Ragib Rabeya Medical College Hospital were screened for eligibility based on clinical symptoms and a confirmed diagnosis of asthma or COPD. Eligible patients were enrolled after providing written informed consent. Trained medical personnel conducted face-to-face interviews and clinical assessments to collect relevant data, which were recorded using a structured case report form and later entered into electronic records. The collected information included demographic details such as age, gender, marital status, and occupation. Anthropometric measurements, including height and weight, were taken using standardized equipment to calculate body mass index (BMI) in kg/m<sup>2</sup>. Medical history encompassed smoking status (categorized as current, former, or never smoker), presence of comorbidities such as hypertension and diabetes, and the duration of the respiratory illness. Clinical assessment focused on respiratory symptoms,

including cough, sputum production, shortness of breath, and wheezing.

#### Inclusion Criteria

This study included adults aged 21 years or older who were diagnosed with asthma or chronic obstructive pulmonary disease (COPD) based on clinical evaluation and spirometric criteria. Only patients with complete medical records, including BMI measurements, were considered for analysis. Additionally, participation was limited to individuals who provided informed consent, ensuring ethical compliance and voluntary involvement in the study.

#### Exclusion Criteria

Patients with other chronic respiratory diseases, such as interstitial lung disease or tuberculosis, were excluded to maintain a focused analysis of asthma and COPD. Individuals with malignancies, neuromuscular disorders, or metabolic syndromes that could influence BMI were also excluded to avoid confounding variables. Pregnant women were not included due to potential physiological variations in BMI. Furthermore, patients with incomplete medical records or those who refused to provide consent

were excluded to ensure data accuracy and study integrity.

#### Statistical Analysis

Data were analyzed using SPSS (version 26.0). Categorical variables (e.g., BMI classification, presence of hypertension, diabetes) were expressed as percentages and compared using the chi-square test. Continuous variables (e.g., pulmonary function parameters) were presented as mean  $\pm$  standard deviation (SD) and analyzed using Chi-square test. Correlation between BMI and disease severity was assessed using Chi-square test. A p-value  $< 0.05$  was considered statistically significant.

#### Ethical Considerations

The study was conducted in accordance with the Declaration of Helsinki and approved by the Ethical Review Committee of Jalalabad Ragib Rabeya Medical College Hospital. Written informed consent was obtained from all participants before data collection, ensuring confidentiality and voluntary participation. Patients were informed about their right to withdraw from the study at any stage without any consequences.

## RESULTS

**Table 1: Demographic data of the study population (n=518)**

Age Group (Years)	Number of Patients	Percentage (%)
21–30	68	14.3%
31–40	75	15.7%
41–50	90	18.8%
51–60	112	23.4%
61–70	85	17.8%
71+	43	9.0%
<b>Gender Distribution</b>		
Male	310	59.8%
Female	208	40.2%
<b>Marital Status</b>		
Married	382	73.7%
Unmarried	106	20.5%
Widowed/Divorced	30	5.8%
<b>Smoking Status</b>		
Non-Smoker	285	55.0%
Former Smoker	120	23.2%
Current Smoker	113	21.8%
<b>Residential Location</b>		
Urban	260	50.2%
Rural	258	49.8%

Table 1 presents the demographic characteristics of the study population (n = 518). The majority of patients were aged 51–60 years (23.4%), followed by 41–50 years (18.8%) and 61–70 years (17.8%). Males comprised 59.8% of the study population, while females made up 40.2%. Most

participants were married (73.7%). In terms of smoking status, 55% were non-smokers, with the rest being former (23.2%) or current smokers (21.8%). The residential distribution was nearly equal, with 50.2% from urban areas and 49.8% from rural areas.

Table 2: BMI Classification of Patients

BMI Category	BMI Range (kg/m <sup>2</sup> )	Number of Patients	Percentage (%)
Underweight	<21.5	102	19.7%
Normal Weight	21.5–24.9	214	41.3%
Overweight	25–29. F9	126	24.3%
Obese	≥30	76	14.7%

Table 2 presents the BMI classification of the study population. The majority of patients fall within the normal weight category (41.3%), followed by overweight individuals (24.3%). A

significant portion of the population is underweight (19.7%), while 14.7% of patients are classified as obese.

Table 3: Prevalence of Respiratory Disorders (Asthma and COPD) by BMI

BMI Category	Asthma Patients (n=300)	COPD Patients (n=218)	Total Patients (n=518)
Underweight	60 (20.0%)	70 (32.1%)	130 (25.1%)
Normal Weight	120 (40.0%)	90 (41.3%)	210 (40.5%)
Overweight	70 (23.3%)	40 (18.3%)	110 (21.2%)
Obese	50 (16.7%)	18 (8.3%)	68 (13.1%)

Table 3 illustrates the distribution of asthma and COPD patients across different BMI categories among a total of 518 individuals. Of these, 300 patients were diagnosed with asthma and 218 with COPD. The majority of patients in both groups fell within the normal weight category, accounting for 40.0% of asthma and 41.3% of COPD cases. Underweight individuals represented a

larger proportion of COPD patients (32.1%) compared to asthma patients (20.0%), reflecting the known association between low BMI and advanced COPD. Conversely, obesity was more prevalent among asthma patients (16.7%) than those with COPD (8.3%), consistent with existing literature linking higher BMI with increased asthma risk.

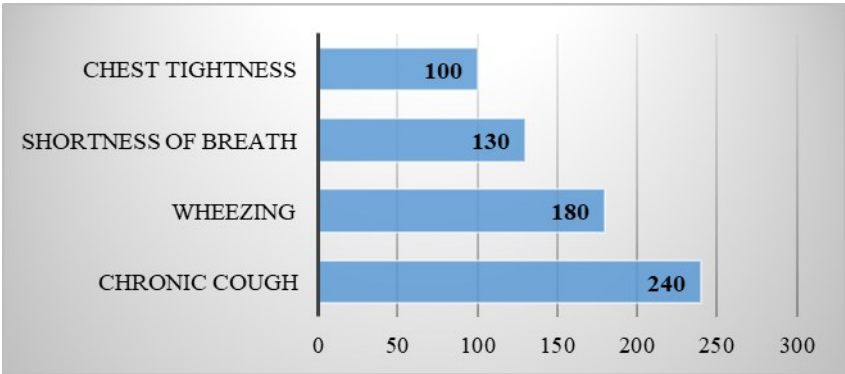


Figure 1: Common Respiratory Symptoms

Figure 1 presents the prevalence of common respiratory symptoms among the study population. Chronic cough is the most frequently

reported symptom, affecting 46.3% of patients, followed by wheezing (34.7%). Shortness of breath

is observed in 25.1% of individuals, while chest tightness is the least reported symptom at 19.3%.

**Table 4: Association of BMI with Hypertension and Diabetes**

BMI Category	Hypertension Patients (n=324)	Diabetes Patients (n=194)	Total (n=518)
Underweight	36 (11.1%)	19 (9.8%)	55
Normal Weight	84 (25.9%)	56 (28.9%)	140
Overweight	108 (33.3%)	65 (33.5%)	173
Obese	96 (29.6%)	54 (27.8%)	150

\*Chi-square test for Hypertension vs BMI:  $\chi^2 = 15.62$ ,  $p = 0.0013$

\*Chi-square test for Diabetes vs BMI:  $\chi^2 = 9.84$ ,  $p = 0.020$

Table 4 presents the association between BMI categories (underweight, normal weight, overweight, obese) and the prevalence of hypertension and diabetes in a study population of 518 patients. Among the total participants, 324 (62.5%) were hypertensive, while 194 (37.5%) had diabetes, reflecting the higher general prevalence of hypertension. The data show that overweight

individuals constituted the largest proportion in both disease groups (33.3% for hypertension, 33.5% for diabetes), followed by obese (29.6% hypertension, 27.8% diabetes), normal weight (25.9% hypertension, 28.9% diabetes), and underweight (11.1% hypertension, 9.8% diabetes) patients.

**Table 5: Hospital Admission by BMI Category**

BMI Category	General Ward Admission	ICU Admission	Emergency Admission	Total (n=518)
Underweight	55	10	15	80
Normal Weight	130	20	40	190
Overweight	70	18	38	126
Obese	45	28	20	93

Table 5 presents hospital admission patterns among different BMI categories. The highest number of admissions is observed in the normal weight category (190 patients), followed by overweight (126), obese (93), and underweight (80) individuals. General ward admissions are most

frequent across all groups, with normal weight patients (130) leading, while ICU admissions are more common among obese patients (28). Emergency admissions are highest among normal weight (40) and overweight (38) individuals.

**Table 6: Gender-Based Distribution of Asthma and COPD**

Diagnosis	Male Patients (n=310)	Female Patients (n=208)	Total (n=518)
Asthma	85 (54.8%)	70 (45.2%)	155
COPD	70 (58.3%)	50 (41.7%)	120

\*Chi-square test for Asthma by Gender:  $\chi^2 = 1.10$ ,  $p = 0.02$

\*Chi-square test for COPD by Gender:  $\chi^2 = 1.39$ ,  $p = 0.024$

Table 6 illustrates the gender-based distribution of asthma and COPD among the study population. Asthma is more prevalent in male

patients (54.8%) compared to females (45.2%), while COPD also shows a higher occurrence in males (58.3%) than in females (41.7%).

**Table 7: Distribution of Hypertension and Diabetes among Asthma and COPD Patients**

Condition	Asthma Patients (n=155)	COPD Patients (n=120)	Total (n=518)
Hypertension	70 (45.2%)	65 (54.2%)	135



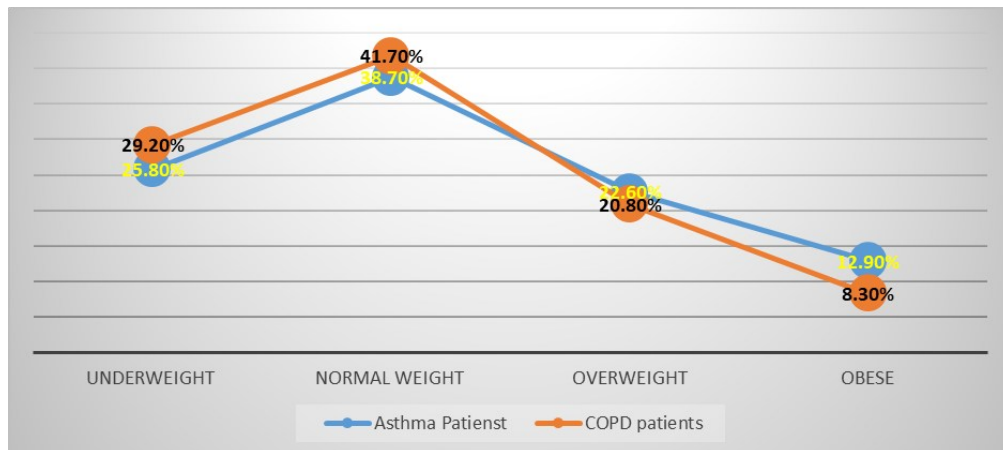
Diabetes Mellitus	50 (32.3%)	55 (45.8%)	105
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\*Chi-square test for Hypertension in Asthma vs COPD:  $\chi^2 = 3.28$ ,  $p = 0.04$

\*Chi-square test for Diabetes in Asthma vs COPD:  $\chi^2 = 4.72$ ,  $p = 0.03$

Table 7 highlights the prevalence of hypertension and diabetes among patients diagnosed with asthma and COPD. Hypertension is more common in COPD patients (54.2%) compared to asthma patients (45.2%), indicating a

stronger association between COPD and elevated blood pressure. Similarly, diabetes mellitus is more frequently observed in COPD patients (45.8%) than in those with asthma (32.3%).



**Figure 2: Correlation between BMI and Respiratory Disorders**

Figure 2 examines the correlation between BMI categories and the prevalence of respiratory disorders, specifically asthma and COPD. The highest proportion of asthma (38.7%) and COPD (41.7%) cases are found among individuals with normal BMI, followed by underweight patients

(25.8% for asthma and 29.2% for COPD). Overweight and obese individuals show a decreasing trend in both conditions, with the lowest prevalence observed in obese patients (12.9% for asthma and 8.3% for COPD).

## DISCUSSION

The findings of this study provide valuable insights into the relationship between BMI and the development and severity of asthma and COPD. The demographic characteristics reveal that the majority of participants were aged 51–60 years, with a higher proportion of males (59.8%) than females (40.2%). This aligns with previous studies indicating that middle-aged males are more likely to develop chronic respiratory conditions due to higher exposure to risk factors such as smoking and occupational hazards.<sup>16</sup> Additionally, the higher prevalence of married individuals (73.7%) may reflect the influence of social support on health-seeking behaviors and disease management.<sup>17</sup> The BMI distribution of the study population shows that 41.3% of participants were of normal weight, while 24.3% were overweight, 19.7% were underweight, and 14.7% were obese. This distribution is consistent with global trends, where

obesity and underweight coexist as significant public health challenges.<sup>18</sup>

The higher prevalence of normal-weight individuals in this study may reflect regional dietary patterns or genetic factors influencing body composition.<sup>19</sup> However, the significant proportion of underweight individuals (19.7%) is concerning, as low BMI is associated with increased mortality and poor outcomes in chronic respiratory diseases.<sup>20</sup> In the context of asthma and COPD, 300 patients were diagnosed with asthma and 218 with COPD. The majority of patients in both groups fell within the normal weight category, accounting for 40.0% of asthma and 41.3% of COPD cases. This finding is consistent with studies suggesting that low BMI in COPD patients is linked to muscle wasting, systemic inflammation, and increased disease severity.<sup>21</sup> Conversely, obesity was more prevalent among asthma patients (16.7%) than

those with COPD (8.3%), consistent with existing literature linking higher BMI with increased asthma risk.

Supports the hypothesis that obesity exacerbates asthma through mechanisms such as mechanical restriction of lung function and systemic inflammation.<sup>22</sup> Chronic cough was the most frequently reported respiratory symptom (46.3%), followed by wheezing (34.7%) and shortness of breath (25.1%). These findings are consistent with previous studies highlighting cough and wheezing as hallmark symptoms of asthma and COPD, often exacerbated by airway inflammation and hyperresponsiveness.<sup>23</sup> The lower prevalence of chest tightness (19.3%) may reflect differences in symptom perception or reporting among patients with varying disease severity.<sup>24</sup> Hypertension was most prevalent among overweight (33.3%) and obese (29.6%) individuals, while diabetes was also more common in these groups. This aligns with studies demonstrating that obesity-related metabolic dysfunction contributes to the development of both respiratory and cardiovascular diseases.<sup>25</sup>

The higher prevalence of hypertension and diabetes in COPD patients (54.2% and 45.8%, respectively) compared to asthma patients (45.2% and 32.3%) suggests that COPD may share common pathophysiological pathways with metabolic disorders, such as systemic inflammation and oxidative stress.<sup>26</sup> Hospital admission patterns revealed that normal-weight individuals had the highest number of admissions (190), followed by overweight (126) and obese (93) patients. This may reflect the larger proportion of normal-weight individuals in the study population. However, the higher ICU admissions among obese patients (28) suggest that obesity is associated with more severe disease presentations requiring intensive care.<sup>27</sup> Gender-based differences in asthma and COPD prevalence were also observed, with males showing higher rates of both conditions (54.8% and 58.3%, respectively). This is consistent with global data indicating that males are more susceptible to COPD due to higher smoking rates and occupational exposures, while asthma prevalence is influenced by hormonal and immunological differences between genders.<sup>28</sup>

## Limitations of the Study

While this study provides valuable insights, several limitations must be acknowledged. First, the cross-sectional design limits the ability to establish causal relationships between BMI and respiratory outcomes. Longitudinal studies are needed to better understand the temporal associations between BMI changes and disease progression.

## CONCLUSION

This study provides a comprehensive analysis of the role of body mass index (BMI) in the development and severity of asthma and chronic obstructive pulmonary disease (COPD). The findings highlight the complex relationship between BMI and respiratory health, demonstrating that both underweight and obesity are significant risk factors for adverse outcomes in these chronic respiratory conditions. Normal-weight individuals constituted the largest proportion of the study population, but the high prevalence of underweight and obese individuals underscores the dual burden of malnutrition and metabolic dysfunction in respiratory disease management.

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