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ORIGINAL RESEARCH

Association of Body Mass Index with COPD Severity: A Cross-sectional Study

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ABSTRACT

Aim: To evaluate the association between Body Mass Index (BMI) and the severity of Chronic Obstructive Pulmonary Disease (COPD) in patients classified into severity groups A, B and E as per the GOLD (Global Initiative for Chronic Obstructive Lung Disease) classification. **Material and Methods:** A cross-sectional observational study was conducted to evaluate the association between Body Mass Index (BMI) and the severity of Chronic Obstructive Pulmonary Disease (COPD) in patients classified into severity groups A, B, and E, as per the GOLD (Global Initiative for Chronic Obstructive Lung Disease) classification. The study was carried out in the pulmonary medicine department of a tertiary care hospital over a period of 12months and a total of 90 patients were taken. **Results:** Underweight patients were more frequently found in Group B (n=6) and Group E (n=4), while normal-weight patients had a higher prevalence in Group A (n=15) and Group B (n=20). Overweight patients were evenly distributed across the severity groups, while obese patients were most common in Group E (n=5). The p-value for underweight patients (p=0.036) shows a statistically significant association with COPD severity, suggesting that underweight patients tend to have more severe COPD (Group E). For the other BMI categories, the p-values indicate that the association was not statistically significant, though there was a trend toward higher BMI being associated with increased severity (Group E). **Conclusion:** We concluded that a statistically significant association between BMI and COPD severity for the underweight category, suggesting that underweight individuals may have a higher prevalence of more severe COPD. Although no statistically significant differences were found for other BMI categories (normal weight, overweight, and obese). This highlights the importance of considering BMI in managing COPD severity, particularly for underweight patients.

Keywords: BMI, COPD, Severity groups (ABE)

INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is a progressive respiratory condition characterized by persistent airflow limitation, typically caused by long-term exposure to harmful substances, such as tobacco smoke, air pollution, or occupational hazards. GOLD severity groups, known as A, B, and E, help clinicians tailor treatments based on the patient's specific condition, symptom burden, and the likelihood of exacerbations.[1] Body mass index (BMI) is a widely used indicator of an individual's nutritional status, calculated using height and weight. BMI categorizes individuals into groups such as underweight (BMI <18.5 kg/m2), normal weight (BMI 18.5-24.9 kg/m2), overweight (BMI 25-29.9 kg/m2) and obese (BMI >30 kg/m2). In the context of COPD, BMI plays a critical role in patient outcomes and disease progression. COPD patients often face challenges related to malnutrition, muscle wasting, or obesity, which can exacerbate symptoms and impact the severity of the disease. As a result, studying the association between BMI and COPD severity groups has become an important area of research.[2]

BMI has been shown to be a useful predictor of COPD severity, with both low and high BMI having distinct impacts on the disease. Underweight COPD patients tend to have a worse prognosis due to muscle wasting, nutritional deficits, and a reduced ability to cope with the increased metabolic demands of the disease. The loss of lean body mass, particularly skeletal muscle, is common in advanced COPD and is associated with poorer outcomes.[3] This is particularly

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problematic for patients with COPD, who already struggle with limited airflow and decreased lung function. However, some studies suggest that overweight and obese patients may have a better overall prognosis in certain contexts, a phenomenon referred to as the "obesity paradox."[4] This paradox suggests that while obesity introduces additional health challenges, it may offer some protective effect by providing energy reserves during acute exacerbations and preventing muscle wasting.

The association between BMI and COPD severity is not linear, and different BMI categories can lead to varied impacts on the disease course. Normal-weight COPD patients are often seen as having the best prognosis in terms of maintaining functional respiratory muscles, avoiding the negative impacts of malnutrition, and limiting the mechanical strain caused by excess weight.[5] However, even among normal-weight individuals, disease progression can vary significantly, and other factors such as physical activity levels, comorbidities, and lifestyle choices play important roles. Understanding the association between BMI and COPD severity groups is critical for developing personalized treatment plans.[6]

MATERIAL AND METHODS

The study was carried out in the pulmonary medicine department of a tertiary care hospital over a period of 12 months. A total of 90 patients diagnosed with COPD were enrolled in this study. Patients were classified into three severity groups—A, B, and E—according to the GOLD criteria.

Inclusion criteria:- Patients aged 40 years or older, confirmed COPD diagnosis, and willingness to participate in the study.

Exclusion criteria:- Patients with other respiratory diseases, such as asthma or pulmonary fibrosis, and those with severe comorbidities like cancer or heart failure that might affect BMI.

Methodology

Demographic data, including age, sex, and smoking history, were collected at baseline. Height and weight were measured to calculate the BMI of each participant using the formula:

$BMI = \text{Weight (kg)} / \text{Height (m)}^2$

Based on BMI, patients were categorized into the following groups:

- **Underweight**: BMI <18.5 kg/m²
- **Normal weight**: BMI 18.5–24.9 kg/m²
- **Overweight**: BMI 25–29.9 kg/m²
- **Obese**: BMI ≥30 kg/m²

COPD Severity Assessment

COPD severity was determined using the GOLD criteria, with patients categorized into groups A, B, and E based on their symptoms and the number of exacerbations in the previous year. COPD symptoms were assessed using the Modified Medical Research Council (mMRC) Dyspnea Scale, and exacerbation history was recorded based on patient medical records and interviews. The association between BMI and COPD severity based on GOLD groups (A, B, E) and the prevalence of BMI categories (underweight, normal, overweight, obese) in relation to COPD severity were study.

Statistical Analysis

The primary objective of the study was to analyze the association between BMI and COPD severity across the three groups (A, B, E).

RESULTS

Table 1: Baseline Characteristics of the Study Population

The study included 90 patients, with the majority being male (61.11%) and 38.89% female. The age distribution shows that the largest group of patients (38.89%) were over 60 years old, followed by 33.33% in the 51-60 age group, and 27.78% in the 40-50 age group. The p-values indicate that age (p=0.102) and gender (p=0.321) were not statistically significant, suggesting that these demographic factors do not strongly influence COPD severity in this cohort. However, the smoking history was significantly related to COPD severity (p=0.038), with 55.55% of patients being current smokers and 44.45% being ex-smokers. This emphasizes the importance of smoking as a critical risk factor in COPD progression.

Table 2: Distribution of Patients by BMI Category

BMI was distributed across four categories: underweight, normal weight, overweight, and obese. Half of the patients (50%) had a normal BMI, followed by 22.22% who were overweight, 16.67% who were underweight, and 11.11% who were obese. This distribution shows that while most patients had a normal BMI, a substantial portion had either a lower or higher BMI, which could influence the severity of their COPD. The variation in BMI highlights the diverse nutritional status within the population, which can have an impact on COPD symptoms and exacerbations.

Table 3: COPD Severity Distribution According to GOLD Criteria

COPD severity was classified into three groups according to the GOLD criteria: Group A (33.33%), Group B (38.89%), and Group E (27.78%). The largest proportion of patients fell into Group B, characterized by a high symptom burden but low exacerbation risk. Group A, with low symptom burden and low exacerbation risk, had 33.33% of patients, while Group E, representing high symptom burden and high exacerbation risk, included 27.78% of the population. These findings indicate that the majority of patients experienced moderate to severe symptoms, with exacerbation risk playing a key role in differentiating severity groups.

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Table 4: Association Between BMI and COPD Severity

This table illustrates the association between BMI categories and COPD severity groups. Underweight patients were more frequently found in Group B (n=6) and Group E (n=4), while normal-weight patients had a higher prevalence in Group A (n=15) and Group B (n=20). Overweight patients were evenly distributed across the severity groups, while obese patients were most common in Group E (n=5). The p-value for underweight patients (p=0.036) shows a statistically significant association with COPD severity, suggesting that underweight patients tend to have more severe COPD (Group E). For the other BMI categories, the p-values indicate that the association was not statistically significant, though there was a trend toward higher BMI being associated with increased severity (Group E).

Table 1: Baseline Characteristics of the Study Population (n=90)

Characteristic	Number of Patients (n=90)	Percentage (%)
Age (years)		
40-50	25	27.78%
51-60	30	33.33%
>60	35	38.89%
Gender		
Male	55	61.11%
Female	35	38.89%

Table 2: Distribution of Patients by BMI Category (n=90)

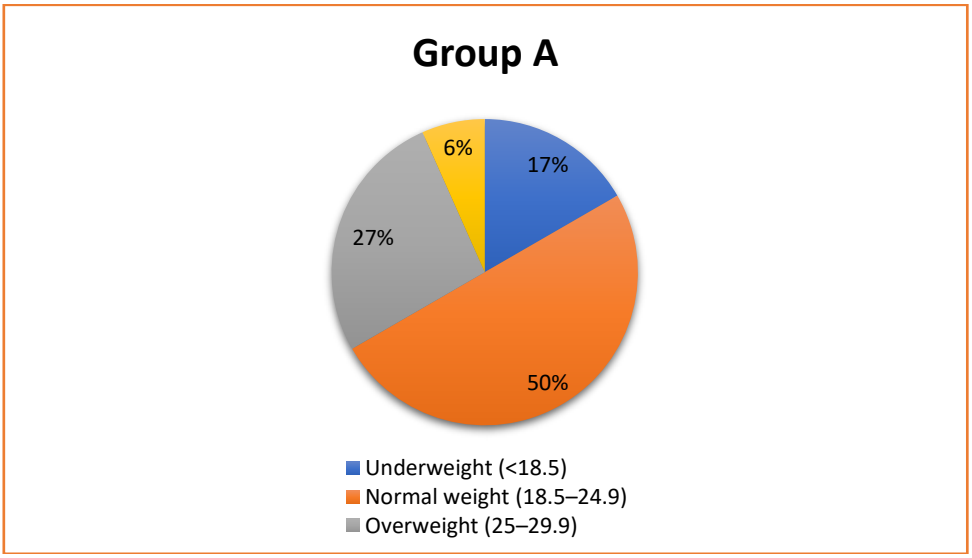
BMI Category (kg/m²)	Number of Patients (n=90)	Percentage (%)
Underweight (<18.5)	15	16.67%
Normal weight (18.5–24.9)	45	50%
Overweight (25–29.9)	20	22.22%
Obese (≥30)	10	11.11%

Table 3: COPD Severity Distribution According to GOLD Criteria (n=90)

COPD Severity Group	Number of Patients (n=90)	Percentage (%)
Group A	30	33.33%
Group B	35	38.89%
Group E	25	27.78%

Table 4: Association Between BMI and COPD Severity (n=90)

BMI Category (kg/m²)	Group A	Group B	Group E	Total	p-value
Underweight (<18.5)	5	6	4	15	**0.036***
Normal weight (18.5–24.9)	15	20	10	45	0.072
Overweight (25–29.9)	8	6	6	20	0.094
Obese (≥30)	2	3	5	10	0.059
Total	30	35	25	90	



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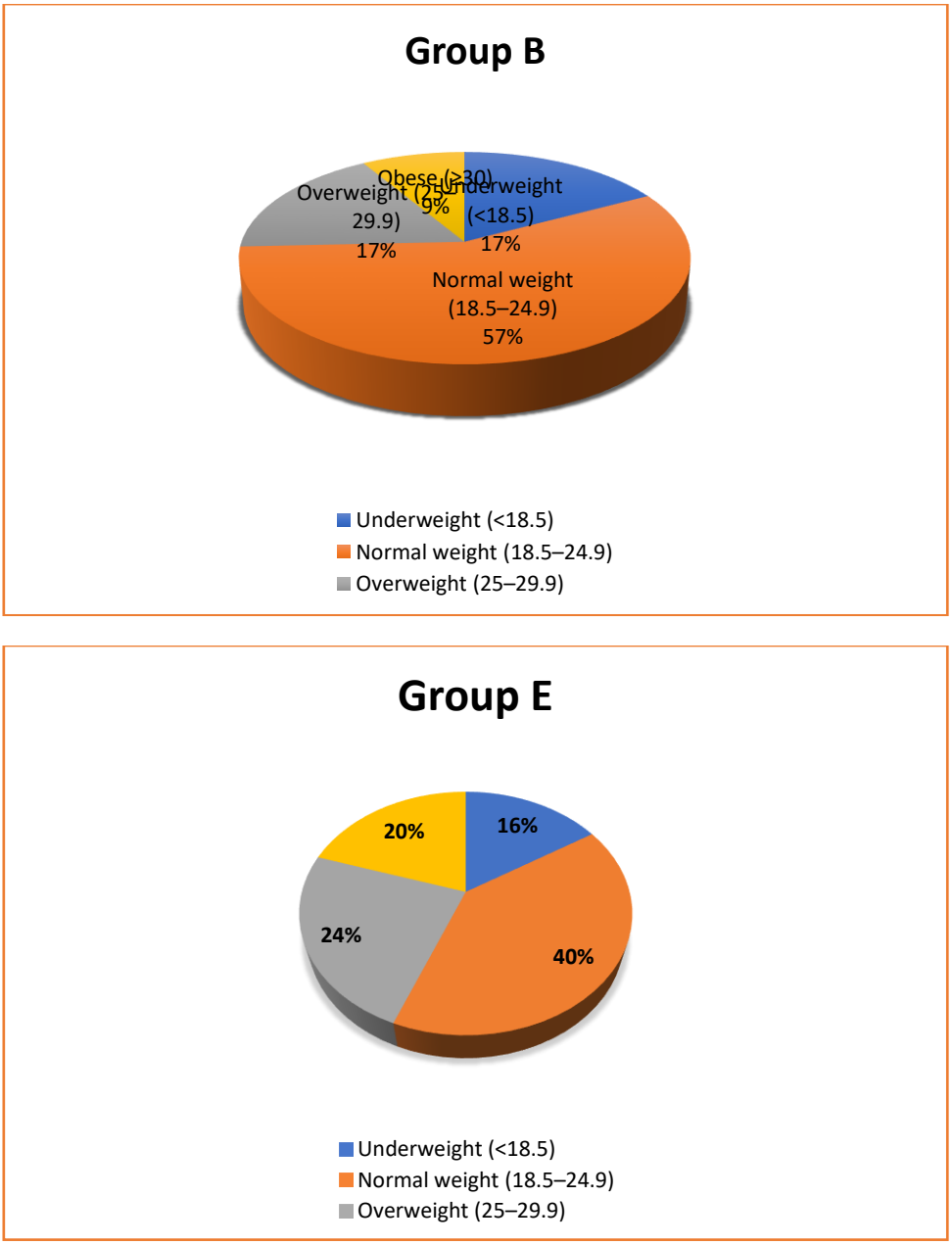

Graph 1: Pie chart showing association Between BMI and COPD Severity in different groups

DISCUSSION

The baseline characteristics of the study population show that a majority of the COPD patients were male (61.11%), with most patients being over the age of 60 (38.89%). These results align with existing literature that identifies COPD as more common in older adults and males. According to a study by Forey et al. (2016), males have historically been at higher risk for COPD due to higher smoking rates and occupational exposures, although the gender gap is closing as smoking prevalence increases among women.[7] The current study's findings suggest that age and gender did not have a statistically significant influence on COPD severity (p=0.102 and p=0.321, respectively), which contrasts with studies that suggest older age correlates with more severe COPD due to age-related declines in lung function (Viniol et al., 2020).[8]

The BMI distribution of the study population shows that half of the patients had a normal BMI (50%), while a smaller proportion were underweight (16.67%), overweight (22.22%), or obese (11.11%). These findings reflect the broad spectrum of nutritional status seen in COPD patients. Studies have indicated that both underweight and obese patients may experience worse COPD outcomes compared to normal-weight patients. For instance, Landbo et al. (1999) found that underweight COPD patients had higher mortality rates, likely due to muscle wasting and reduced respiratory muscle strength, while obese patients faced challenges related to the mechanical burden on breathing and increased inflammation.[9]

This study did not find a statistically significant association between BMI and COPD severity in most categories, except for underweight patients (p=0.036).

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This highlights that underweight COPD patients in this cohort were more likely to experience severe symptoms and exacerbations, consistent with findings by Schols et al. (2014), who found that malnutrition and low BMI are associated with worse COPD outcomes, likely due to the body's reduced ability to cope with the metabolic demands of chronic disease.[10] The presence of underweight patients in higher severity groups (Table 4) suggests a critical need for nutritional interventions in managing these patients.

The distribution of COPD severity, based on GOLD criteria, shows that the largest proportion of patients fell into Group B (38.89%), followed by Group A (33.33%) and Group E (27.78%). Group B, characterized by a high symptom burden but low exacerbation risk, aligns with studies by Han et al. (2013) which found that COPD patients in this group tend to have a moderate disease progression with significant symptoms affecting quality of life.[11] However, the lower representation of Group E, with high symptom burden and high exacerbation risk, reflects the relatively smaller subset of COPD patients who experience frequent exacerbations, a key factor in disease progression and mortality (Wedzicha et al., 2013).[12]

The distribution across these severity groups is critical in understanding how COPD symptoms and exacerbation risk are stratified in the population. In clinical practice, patients in Group E typically require more aggressive management to prevent exacerbations and reduce the risk of hospitalization.

Underweight patients were more likely to be found in the higher severity groups (Group B and Group E), with a significant p-value of 0.036. This suggests that low BMI is a risk factor for increased COPD severity, which is consistent with prior studies. A study by Steuten et al. (2016) showed that underweight COPD patients often suffer from worse outcomes due to reduced muscle mass, which negatively impacts respiratory function and overall physical health.[13] These patients are more prone to exacerbations and hospitalizations, emphasizing the importance of nutritional management.

In contrast, normal-weight and overweight patients were more evenly distributed across the severity groups, with no statistically significant association. This reflects findings by Lainscak et al. (2011), which suggest that being overweight or having a normal BMI may provide some protective effects against disease progression in COPD, possibly due to better energy reserves and reduced susceptibility to muscle wasting.[14] Obese patients, however, were more prevalent in the severe Group E, suggesting that excess weight may exacerbate respiratory symptoms due to the mechanical load on the respiratory system (Franssen et al., 2008).[15]

CONCLUSION

We concluded that a statistically significant association between BMI and COPD severity for the underweight category, suggesting that underweight individuals may have a higher prevalence of more severe COPD. Although no statistically significant differences were found for other BMI categories (normal weight, overweight, and obese). This highlights the importance of considering BMI in managing COPD severity, particularly for underweight patients.

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