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Association of body mass index with patients of chronic obstructive pulmonary disease

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Abstract
Background: Chronic obstructive pulmonary disease is an important health problem across the globe. A U-shaped relationship of body mass index (BMI) was reported with dyspnea in men and with symptomatic airway hyper-responsiveness.
Aim: The current study was planned to assess the association between body mass index and patients with chronic obstructive pulmonary disease.
Materials and methods: The study was conducted in the Department of Chest Medicine of medical institution. For the study population, we selected 60 patients reporting to outpatient department. Detailed history regarding age, sex, smoking status, duration of disease and severity of symptoms were obtained from each patient. A complete thorough examination of the respiratory system of all the patients was done. The comparison of mean BMI of patients in different staging was done and analyzed statistically.
Results: A total of 60 patients participated in the study. The mean age of the patients in the study population was 54.26±2.32 years ranging from 40-80 years. The maximum number of patients was seen in the age-group 50-59 years with frequency of 22 patients. The severity of disease increases with increasing age and these results are statistically significant. Also, as the severity of the disease increases, the BMI of the patients decreases.

Keywords: Body mass index, patients, chronic obstructive pulmonary disease

Introduction
Chronic obstructive pulmonary disease is an important health problem across the globe. The disease is characterized by persistent airflow obstruction which is progressive resulting from inflammation and remodeling of the airways and lungs stimulated by exposure to toxins mainly due to a history of cigarette smoking [1]. It has been recognized as the third leading cause of death and continues to be the major cause of mortality and morbidity worldwide [2] Common clinical systemic manifestations are changes in body composition, metabolism and immune status which often lead to weight loss, dyspnea, fatigue, reduced exercise tolerance, poorer prognosis, increased susceptibility to infections and impaired quality of life independent of pulmonary function [3]. A U-shaped relationship of body mass index (BMI) was reported with dyspnea in men and with symptomatic airway hyper-responsiveness, which are asthma-related symptoms that include wheezing and dyspnea in men [4, 5]. Other studies have not observed a significant relationship between BMI and airway hyper-responsiveness [6, 7]. Hence, the current study was planned to assess the association between body mass index and patients with chronic obstructive pulmonary disease.

Materials and methods
The study was conducted in the Department of Chest Medicine of medical institution. The ethical clearance for the study was obtained prior to commencing the study.
Selection criteria for the study were:

- Male patients
- History of cigarette smoking
- Age ≥40 years
- Present symptoms of COPD (dyspnea, chronic cough, $FEV_1/FVC < 0.7$)

Exclusion criteria were

- Positive acid fast bacilli smear
- Bronchiectesis
- Pneumonia
- FEV $_1$/FVC less than 0.7 and significant reversibility
- Lung cancer
- Occupational lung disease
- Myocardial infarction within 1 month

For the study population, we selected 60 patients reporting to outpatient department. Detailed history regarding age, sex, smoking status, duration of disease and severity of symptoms were obtained from each patient. A complete thorough examination of the respiratory system of all the patients was done. For the assessment of radiological changes in the patients, posteoanterior chest x-ray (CXR-PA) was done in all the patients. Measurement of Body Mass Index (BMI) was done in all the patients (weight in kg/ height in meter). For the assessment of airway, pre and post bronchodilator spirometry was done for all the patients. Forced expiratory volume in 1st second /forced vital capacity was calculated for each patient (FEV_1/FVC). Patients with FEV_1/FVC less than 0.7 and significant reversibility were excluded from the study. Only those patients were selected who were without significant reversibility. The subjects were classified based on the GOLD staging. Patients with $FEV_1 \geq 80\%$ were grouped as stage 1, $FEV_1 \geq 50\%$ and $\leq 80\%$ were grouped as stage 2, $FEV_1 \geq 30\%$ and $\leq 50\%$ were grouped in stage 3, and $FEV_1 < 30\%$ were grouped as stage 4. The comparison of mean BMI of patients in different staging was done and analyzed statistically.

The statistical analysis of the data was done using SPSS software (20.0) for windows. The Chi-square test and Student's t-test were used to check the significance of the data. A p-value ≤ 0.05 was predefined to be statistically significant.

Results

A total of 60 patients participated in the study. The mean age of the patients in the study population was 54.26±2.32 years ranging from 40-80 years. Table 1 shows the frequency of patients in different age-groups. The maximum number of patients was seen in the age-group 50-59 years with frequency of 22 patients [Fig 1]. All the patients that participated in the study were males. Table 2 shows the comparative analysis of mean BMI and mean age of patients with different stages of COPD. We observed that in stage 1 of COPD, mean age of patients was 48.21±5.02 years and mean BMI was 27.33±1.63 kg/m^2. In stage 2 of COPD, mean age of patients was 58.44±7.32 years and mean BMI was 21.82±2.32 kg/m^2. In stage 3 of COPD, mean age of patients was 60.24±6.43 years and mean BMI was 21.22±0.92 kg/m^2. In stage 4 of COPD, mean age of patients was 69.41±4.82 years and mean BMI was 16.32±1.21 kg/m^2. We observed that severity of disease increases with increasing age and these results are statistically significant (p=0.03). Also, as the severity of the disease increases, the BMI of the patients decreases. The results are statistically significant (*p*=0.001) [Fig 2]

Table 1: Frequncy of patients in different age-groups

Age-group (years)	No. of patients	p-value
40-49	9	0.01
50-59	22	
60-69	13	
70-79	16	
Total	60	

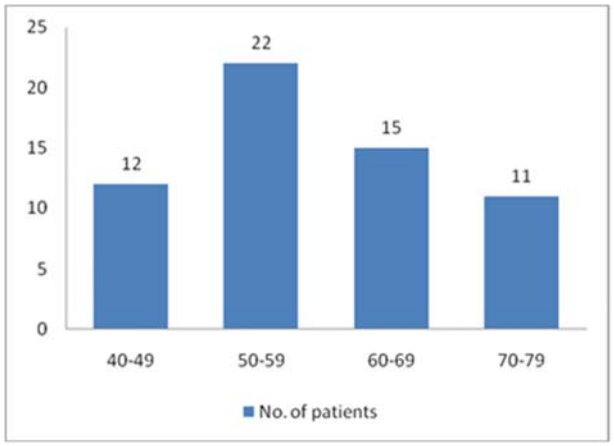

Fig 1: Showing Frequency of patients in different age-groups

Table 2: Mean age and mean BMI of patients in different stages of COPD

Stages of COPD	Mean age (years)	Mean BMI (kg/m^2)
1	48.21±5.02	27.33±1.63
2	58.44±7.32	21.82±2.32
3	60.24±6.43	21.22±0.92
4	69.41±4.82	16.32±1.21

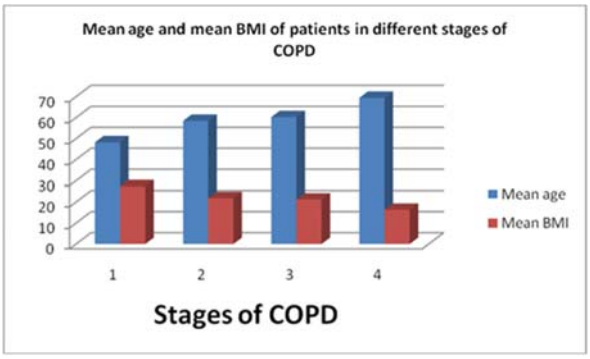

Fig 2: Showing mean age and mean BMI of patients in different stages of COPD

Discussion

Though COPD has been considered a respiratory condition mainly, it has important manifestations beyond the lungs, the so-called systemic effects. These include unintentional weight loss, skeletal muscle dysfunction, increased risk of cardiovascular disease, osteoporosis, gastroesophageal reflux disorder, and depression, among others. Nutritional depletion and weight loss are the features of COPD. The exact mechanisms are uncertain, but decreased food intake and increased energy expenditure in breathing are the most

important. Hypoxia has been shown to stimulate the production of inflammatory mediators and to contribute to the development of malnutrition in COPD patients. There are several studies which have documented the association between low body mass and poor prognosis and mortality in patients with established COPD [5, 6, 7].

The present study was conducted to assess the association between body mass index and patients with chronic obstructive pulmonary disease. A total of 60 patients participated in the study. All patients were males having habit of cigarette smoking. The age ranged from 40-80 years with mean age to be 54.26±2.32 years. On comparing the BMI with patients in different stages of COPD, we observed that as the severity of disease increases, the BMI of the patient decreases that are patients with stage 4 COPD were having lowest BMI. Also, it was observed that as the age increases, the severity of disease increases. These results are consistent with other studies. Montes de Oca M *et al* examined characteristics by BMI categories in the total and COPD populations in five Latin-American cities, and explored the factors influencing BMI in COPD. COPD was defined as a postbronchodilator forced expiratory volume in the first second/forced vital capacity (FEV_1/FVC) <0.70. BMI was categorized as underweight (< 20 kg/m^2), normal weight (20-24.9 kg/m^2), overweight (25.0-29.9 kg/m^2), and obese (> or = 30.0 kg/m^2). Interviews were completed in 5571 subjects from 6711 eligible individuals, and spirometry was performed in 5314 subjects. There were 759 subjects with COPD and 4555 without COPD. Compared with the non-COPD group, there was a higher proportion of COPD subjects in the underweight and normal weight categories, and a lower proportion in the obese category. Over one-half COPD subjects had BMI over 25 kg/m^2. No differences in BMI strata among countries were found in COPD subjects. Factors associated with lower BMI in males with COPD were aging, current smoking, and global initiative for chronic obstructive lung disease (GOLD) stages III-IV, whereas wheeze and residing in Santiago and Montevideo were associated with higher BMI. In females with COPD, current smoking, lower education, and GOLD stages II-IV were associated with lower BMI, while dyspnea and wheeze were associated with higher BMI. The authors concluded that BMI alterations are common in COPD with no significant differences among countries. Current smoking, age, GOLD stages, education level, residing in Santiago and Montevideo, dyspnea and wheeze were independently associated with BMI in COPD. Prescott E *et al* examined the prevalence and prognostic importance of weight change in unselected subjects with COPD. Subjects with COPD in the Copenhagen City Heart Study who attended two examinations 5 yrs apart, were followed for 14 yrs for COPD-related and all-cause mortality. The proportion of subjects who lost > 1 unit BMI (approximately 3.8 kg) between the two examinations was significantly associated with level of COPD, reaching approximately 30% in subjects with severe COPD. After adjusting for age, smoking habits, baseline BMI and lung function, weight loss was associated with higher mortality in both persons with and without COPD. Weight gain was associated with increased mortality, but not significantly so in subjects with COPD. Risk of COPD-related death increased with weight loss, but not with weight gain. In subjects without COPD or with mild-to-moderate COPD, the effect of weight change was the same irrespective of initial weight. In subjects with severe COPD, there was a significant risk ratio modification between effect of baseline BMI and weight change: in the normal-to-underweight (BMI < 25), best survival was seen in those who gained weight, whereas for the overweight and obese (BMI > or = 25), best survival was seen in stable weight. A high proportion of subjects with chronic obstructive pulmonary disease experienced a significant weight loss, which was associated with increased mortality. The results supported further intervention studies that aim at avoiding weight loss in normal-to-underweight chronic obstructive pulmonary disease patients [8, 9].

Vestbo J *et al* explored distribution of low fat-free mass index **(**FFMI) and its association with prognosis in a population-based cohort of patients with chronic obstructive pulmonary disease (COPD). They used data on 1,898 patients with COPD identified in a population-based epidemiologic study in Copenhagen. FFM was measured using bioelectrical impedance analysis. Patients were followed up for a mean of 7 yr and the association between body mass index (BMI) and FFMI and mortality was examined taking age, sex, smoking, and lung function into account. The mean FFMI was 16.0 kg/m(2) for women and 18.7 kg/m^2 for men. Among subjects with normal BMI, 26.1% had an FFMI lower than the lowest 10th percentile of the general population. BMI and FFMI were significant predictors of mortality, independent of relevant covariates. Being in the lowest 10th percentile of the general population for FFMI was associated with a hazard ratio of 1.5 for overall mortality and 2.4 for COPD-related mortality. FFMI was also a predictor of overall mortality when analyses were restricted to subjects with normal BMI. Meeuwsen S *et al* conducted a study aimed to establish the effects of age, gender and age-gender interactions on BMI-% fat relationships over a wide range of BMI and age. It also aimed to examine controversies regarding linear or curvilinear BMI-% fat relationships. Body composition was measured using validated bio-impedance equipment (Bodystat) in a large self-selected sample of 23,627 UK adults aged 18-99 (99% ≤70) years, of which 11,582 were males with a mean BMI of 26.3±4.7 (sd) kg/m^2, and 12,044 females, with a mean BMI of 25.7±5.1 kg/m^2. Multiple regression analysis was used. BMI progressively increased with age in women and plateaued between 40 and 70 years in men. At a fixed BMI, body fat mass increased with age (1.9 kg/decade), as did % fat (1.1-1.4% per decade). The relationship between BMI and % fat was found to be curvilinear (quadratic) rather than linear, with a weaker association at lower BMI. There was also a small but significant age-gender interaction. The authors concluded that the association between BMI and % body fat is not strong, particularly in the desirable BMI range, is curvilinear rather than linear, and is affected by age [10, 11].

Conclusion

From the results of above study, we conclude that COPD is a systemic disease**.** We observed significant association between BMI and severity of obstruction in COPD patients. With severity of the obstruction, BMI of the patient decreases and it was statistically significant.

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