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# Correlation of Body Mass Index with the Severity of Chronic Obstructive Pulmonary Disease as per GOLD Criteria

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**Abstract:** ***Introduction: Chronic obstructive pulmonary disease (COPD) is the fourth leading cause of death worldwide that causes more than 2.7 million deaths in 2000 and it will be the third leading cause of death worldwide by 2020.[1,2] The association between low body mass index (BMI) and poor prognosis of patients with COPD is a common clinical observation and it varies with different stages of COPD. Aim & Objectives: To study the Correlation of body mass index (BMI) with the severity of Chronic obstructive pulmonary disease (COPD). Material and Methods: All outdoor & indoor patients attending the department of Respiratory Medicine with clinical history consistent with COPD during January 2018 to June 2019 and diagnosed so as per GOLD guidelines (7), were enrolled. All enrolled patients were subjected to detailed clinical evaluation and investigations. Inclusion Criteria for the study included: a) Age 40 and above, b) Stable disease for at least 3 months and c) Willingness of the patient to participate in study. Exclusion Criteria included: a) Use of systemic steroids in the past 3 months, b) Presence of present or past history of wheeze, chest tightness, eye allergy, nasal allergy or skin allergy, suggesting bronchial asthma and/or c) Presence of other illnesses like active pulmonary tuberculosis, Malignancy, Renal or Hepatic disease. A written informed consent was taken from all the patients after explaining the study protocol. Results: Among 260 study population, 11 (4.23%) patients were in stage 1, 110 (42.30%) in stage 2, 111 (42.69%) in stage 3, and 28 (10.76%) in stage 4. we found that BMI of the patients were decreasing with severity of the disease (GOLD) and it was statistically significant (P < 0.05). The BMI was better in the study populations where post FEV1% predicted value was higher. Conclusion: In our study we found out that there was a positive correlation presents in between BMI and severity of obstruction in COPD patients.***

**Keywords:** BMI- Body Mass Index, COPD- Chronic Obstructive Lung Disease, FEV1- Forced Expiratory Volume in 1 Second, FVC- Forced Vital Capacity

## 1. Introduction

Chronic obstructive pulmonary disease (COPD) is the fourth leading cause of death worldwide that causes more than 2.7 million deaths in 2000 and it will be the third leading cause of death worldwide by 2020.[1,2] COPD is a systemic disease. Malnutrition in COPD is due to increased metabolic demands caused by basal oxygen consumption, release of cachexia producing cytokines like tumor necrosis factor α, interleukin-6, etc.[3,4] The association between low body mass index (BMI) and poor prognosis of patients with COPD is a common clinical observation and it varies with different stages of COPD. Nutritional depletion and weight loss are features of COPD. There are many studies documented the prognostic value of low body weight in patients with COPD.[5,6] Patients with low BMI are at increased risk for developing severity of COPD.[5] Low BMI is also an independent negative determinant of survival in patients with COPD.[6] To the best of our knowledge a limited studies have been conducted in India to show the correlation between BMI and Global Initiative for Chronic Obstructive Lung Disease (GOLD) staging in COPD patients. The specific objectives of our study were to classify the severity of obstruction in COPD patients according to GOLD staging through spirometry, to find out the BMI of patients and to find out any correlation between severities of obstruction in COPD patients (through spirometry) with their body mass indices.

## 2. Aim & Objectives

To study the Correlation of body mass index (BMI) with the severity of Chronic obstructive pulmonary disease (COPD)

## 3. Material and Methods

It was a cross sectional Study. Sample size was calculated using the formula, $n=4pq/e^2$ (Where, $n$ is the desired sample size, $p$ is prevalence, $q$ is quotient, and $e$ is margin for error). Total sample size found out to be 260. Approval of the Institutional Ethical Committee was obtained.

All outdoor & indoor patients attending the department of Respiratory Medicine with clinical history consistent with COPD during January 2018 to June 2019 and diagnosed so as per GOLD guidelines[(7)], were enrolled. All enrolled patients were subjected to detailed clinical evaluation and investigations as under: a) Complete blood counts b) Urine complete examination, c) Sputum smears for Acid fast bacilli and Grams stain, d) Random blood sugar & urea and serum creatinine.

Inclusion Criteria for the study included: a) Age 40 and above, b) Stable disease for at least 3 months and c) Willingness of the patient to participate in study. Exclusion Criteria included: a) Use of systemic steroids in the past 3 months, b) Presence of present or past history of wheeze, chest tightness, eye allergy, nasal allergy or skin allergy, suggesting bronchial asthma and/or c) Presence of other illnesses like active pulmonary tuberculosis, Malignancy, Renal or Hepatic disease.

All the study patients were subjected to pulmonary function test, using spirometer (RMS Helios), to assess forced expiratory volume in one second (FEV1), forced vital capacity (FVC) and ratio of FEV1/FVC (The best of three attempts was selected). FEV1/FVC ratio of <70% was considered as indicative of obstructive airway disease.

Reversibility was also assed in those with airway obstruction by 2 puffs of salbutamol inhaler and repeating spirometry after 15 minutes. Any increase in FEV1 by more than 12% and/or 200ml was considered reversible airway obstruction.[8] Such patients were excluded and only those with irreversible airway obstruction were finally included in the study. A written informed consent was taken from all the patients after explaining the study protocol.

Severity of the disease was assessed using post bronchodilator FEV1) as per GOLD criteria i.e. a) GOLD 1 (mild; $FEV_1 \geq 80\%$ predicted), b) GOLD 2 (moderate; $FEV_1$ <80% predicted but ≥50%), c) GOLD 3 (severe; $FEV_1$ <50% predicted but ≥30%) and d) GOLD 4 (Very severe; $FEV_1$ <30% predicted).[7]

BMI was used as the independent variable. According to the standard of the World Health Organization (WHO), all participants were classified into four subgroups, underweight (BMI <18.5 $Kg/m^2$), normal weight (18.5 $Kg/m^2 \leq$ BMI <25 $Kg/m^2$), overweight (25 $Kg/m^2 \leq$ BMI <30 $Kg/m^2$) and obesity (BMI ≥30 $Kg/m^2$).

## 4. Results

All the patients of the study population were in age range of 40-90 years. The mean age of all the patients was 62.38 ± 11.03 years. Commonest age group was 50-59 years (40%) [Figure 1]. No patients were less than 40 years, only 19 of the patients were ≥ 80 years. In our study, there were 160 (61.5%) males and 100 (38.5%) females.

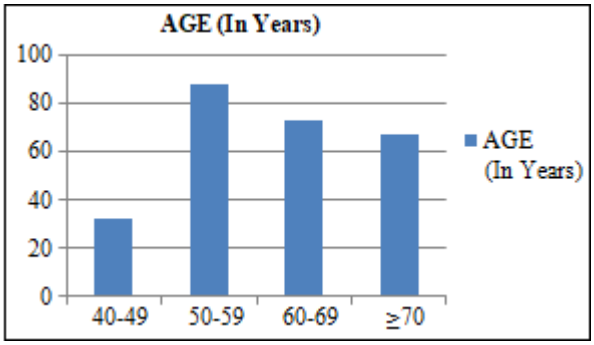


**Figure 1:** Distribution of subjects according to age

The COPD patients were classified by their post-bronchodilator FEV1% predicted in four stages according to GOLD. Among 260 study population, 11 (4.23%) patients were in stage 1, 110 (42.30%) in stage 2, 111 (42.69%) in stage 3, and 28 (10.76%) in stage 4.

**Table 1:** Correlation of BMI with Severity of the Disease

| Severity | Mild (n=11) | | Moderate (n=110) | | Severe (n=111) | | Very Severe (n=28) | |
|---|---|---|---|---|---|---|---|---|
| | No. | % | No. | % | No. | % | No. | % |
| Under weight | 00 | 00 | 34 | 30.90 | 57 | 51.35 | 25 | 89.28 |
| Normal | 11 | 100 | 75 | 68.18 | 54 | 48.64 | 03 | 10.71 |
| Over weight | 00 | 00 | 01 | 0.009 | 00 | 00 | 00 | 00 |

In Table 1 we also showed the mean BMI of the COPD patients in their different GOLD stages. Applying the Pearson correlation test we found that BMI and post FEV1%predicted were positively correlated ($P < 0.05$). Now by applying one-way ANOVA, we found that BMI of the patients were decreasing with severity of the disease (GOLD) and it was statistically significant ($P < 0.05$). The BMI was better in the study populations where post FEV1% predicted value was higher.

## 5. 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.[9-11] Nutritional depletion and weight loss are the features of COPD. The exact mechanisms are uncertain,[12] but decreased food intake and increased energy expenditure in breathing are the most important.[13] Hypoxia has been shown to stimulate the production of inflammatory mediators and to contribute to the development of malnutrition in COPD patients.[9] There are several studies[14-16] which have documented the association between low body mass and poor prognosis and mortality in patients with established COPD. In addressing the association between BMI and severity of obstruction of COPD (GOLD), Nemery *et al.*,[17] raised the possibility that subjects who are susceptible to COPD may be leaner than subjects who were not susceptible. Thus, it is not clear whether low body weight is a risk factor for COPD or merely a consequence of established lung disease. The mean age of study population was 62.38 ± 11.03 years and maximum number of the patients were more than 50 years of age, which was consistent with the previous literatures as the disease has highest prevalence in 5th and 6th decades of life.[18,19] As COPD is more common in male in our country, all the patients in our study were male.[20] In 2009, Kohansal *et al.*,[21] that severity of airflow obstruction increases more with age. The study was consistent to our study as we showed that with increase severity of GOLD staging average age of the patient was also increasing. In 2009, Qiu *et al.*,[22] demonstrated that there was a positive correlation present in between BMI and FEV1/FVC, FEV1% predicted. Sahebjami *et al.*,[23] also demonstrated a correlation between BMI and pulmonary function tests and they recommended BMI as a criterion to evaluate the nutritional status of COPD patients. Thus these above studies are consistent with our present study. In the Platino study,[24] a population-based epidemiologic study conducted in five Latin American cities (2008) showed that up to normal BMI (i.e., BMI up to 25.00 kg/m2) FEV1% predicted is positively and linearly correlated with BMI, that is, with increase in FEV1%predicted, BMI also increased and vice versa. But in cases of pre-obese or obese patients they are not linearly correlated. In our study the mean BMI of the population is 20.5 ± 2.39 kg/m2. And thus our study is consistent with the above study. A study conducted by Vestbo *et al.*, Findings from the Copenhagen City Heart Study[25] showed that there was no correlation between BMI and post-bronchodilator spirometry (post FEV1/FVC, post %predicted), that is, severity of obstruction. In the above study total number of population was 1,898 that was large scale study. But in our study total number of cases was 260. We need further studies involving larger sample size is required to confirm

the correlation between BMI and severity of obstruction (GOLD) in COPD patients. Another study published by Ischaki *et al*.,[26] also demonstrated that there was no correlation between BMI and severity of obstruction (determined by spirometry) in COPD patients. Moreover, our study was cross-sectional study and we believe longitudinal study is also required to find out the correlation between BMI and severity of obstruction (GOLD) in COPD patients.

## 6. Conclusion

COPD is a systemic disease. The association between BMI and poor prognosis of patients with COPD is a common clinical observation and it varies with different stages of COPD. In our study we found out that there was a positive correlation present in between BMI and severity of obstruction in COPD patients. With severity of the obstruction (GOLD staging) BMI of the patient decreases and it was statistically significant.

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