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CORRELATION STUDY OF BODY MASS INDEX AND SEVERITY OF COPD

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ABSTRACT
The body mass index (BMI) is a prognostic factor for chronic obstructive pulmonary disease (COPD). Chronic obstructive pulmonary disease (COPD) has been redefined to indicate that, apart from the deleterious effects on the lungs, the disease is associated with clinically relevant extrapulmonary manifestations. Among the most extensively studied systemic features is unexplained weight loss, alterations in the body mass index (BMI) and in body composition. BMI has also been identified as an independent prognostic factor for COPD, with a clear association between decreased BMI and increased mortality, both in clinical patient series and in subjects from a population sample. Spirometry measurements can be used to define COPD, specifically the forced expiratory volume in the first second (FEV1), and the FEV1 to forced vital capacity (FVC) ratio. Hence a prospective and randomised study was conducted measuring B.M.I and FEV1 values from COPD patients. 94 patients were accessed for their BMI measurement. Among 94 patients 42 were found undernourished (44.68%) and 8 male and 1 female was found obese. The assessment of COPD based on FEV1 was done using a spirometer and following data were obtained. A total of 41.17% patients were found as mild, 30.88% of patients as moderate and 27.94% as severe. A correlation study was done on both FEV1 and B.M.I among the patients and an association was found i.e. with the decrease in the B.M.I there was an increase in severity of COPD condition.

KEYWORDS: COPD, BMI, $FEV_{1.}$

INTRODUCTION
The BMI is a prognostic factor for COPD. COPD has been redefined to indicate that, apart from the deleterious effects on the lungs, the disease is associated with clinically relevant extrapulmonary manifestations. Systemic consequences now recognized as important features of the disease contribute to exercise intolerance, decreased health status, and increased mortality. Among the most extensively studied systemic features is unexplained weight loss, alterations in the BMI and in body composition. Data from epidemiologic studies have shown that the prevalence of COPD is higher in those patients with lower BMI. In addition results from longitudinal studies have shown that low BMI is an important risk factor for subsequent development of COPD in men, for increased FEV_1 decline in the same gender and for having a new exacerbation in patients hospitalized for severe exacerbation. BMI has also been identified as an independent prognostic factor for COPD, with a clear association between decreased BMI and increased mortality, both in clinical patient series and in subjects from a population sample.[1]

Nutritional depletion and weight loss are features of COPD. Using the criteria of weight 90% of ideal body weight or weight loss of 5 to 10% of initial body weight, the incidence of malnutrition is 24 to 35% in patients with moderate-to-severe COPD. The relationship between body mass and pulmonary function is complex and is influenced by several factors that include age, gender, and smoking status, among others.[2]

The BMI or Quetelet index, is a statistical measure of the weight of a person scaled according to height. It was invented between 1830 and 1850 by the Belgian polymath Adolphe Quetelet during the course of developing "social physics". BMI is defined as the individual's body weight divided by the Square of their height. The mechanisms underlying weight loss and muscle wasting are incompletely understood but likely involve an imbalance in ongoing processes of protein degradation and replacement.[3] Anorexia, inflammation, infection and pharmacological therapy are contributing factors in COPD weight loss, Cytokines-mediated cachexia similar to other end-organ failure syndromes is a possible mechanism in COPD patients.[4]

Body mass index (BMI) of the patients can be calculated by measuring the weight in kgs divided by height (in meter) ^{2}. Based on their BMI, the patients were assigned to the following four groups (As per new classification for Asian Indians).
Undernourished: <18.0 kg/m^2
Normal weight: 18-22.9 kg/m^2
Overweight: 23-24.9 kg/m^2
Obese: >25 kg/m^2[5]

METHODOLOGY

A protocol of the study, which includes the objectives, methodology etc. was submitted to the Institutional ethics committee for approval. After getting the ethical clearance the researcher permitted to collect the detail from the patients. A total 155 patients were included in this present study. The purpose of this particular study has been explained to the study participants. After getting their inform consent form or oral approval from the participant we have collected the details of the study participants.

Study design: Randomized and Prospective Study.

Inclusion Criteria

The patients included in the study were men and women (both smokers and non-smokers) aged 30 years or above with history suggestive of COPD (cough with sputum production in chronic bronchitis and breathlessness in emphysema).

Exclusion Criteria

- Patients with current chest pain or pain with forceful expiration, had recent surgery of the eye, chest or the abdomen;
- had a recent heart attack, stroke, tuberculosis exposure, hemoptysis, a history of detached retina or pneumothorax, cardiovascular disease (uncontrolled blood pressure, irregular pulse on examination, taking medication for major arrhythmia, having an implanted defibrillator, or history of congenital heart disease) or taking certain prescription medications (a monoamine oxidase inhibitor, an anticonvulsant, a tricyclic antidepressant plus current treatment for cardiac disease, or potassium lowering drugs).
- Also, women who were pregnant or breastfeeding were excluded.

This study has been conducted on male and female patients who were satisfying the inclusion criteria. A suitably designed data collection form was prepared and used to record all the necessary data including patient demographic details, patient medication history, any allergic reaction, medication used and lab investigations.
This study requires utilization of spirometer (Contec sp10 Digital Spirometer) to measure the FEV_1 value. BMI measurements of the patients were done using digital weighing machine.

Measurement of FEV_1 by using spirometer

The patients were informed to breathe in fully and seal the lips around the mouthpiece and blast all air out as forcefully as possible. The exhalant gas transforms to rotary airflow by turbine, and then makes the blade rotate. At last, various parameter to be measured from the information which were processed by the microprocessor and displayed from the screen. The display screen was directly showed the forced vital capacity (FVC), forced expired volume in one second (FEV1), Peak expiratory flow (PEF) with the veracity and repetition. All the patients' data were stored for further study.

Measurement of BMI

Anthropometric measurements were obtained from patients using a stadiometer for measuring height and a pre-callibrated weighing machine for measuring weight. The BMI was calculated later for individual patients using standard equation for BMI. The researcher applied different methodology to fulfill the planned objective.

RESULTS

A total of 155 patients were included in our study. Out of that 124 were males and 31 were females (Fig.1). The patients were categorized according to their age and sex. The age group being kept at interval of 10 years. The maximum numbers of male patients are found in range of 60-69 years and minimum numbers of patients are found in 30-39 year age group. Whereas for female maximum number of patients are in 70-79 years age group and minimum in 30-39 year and 80 -90 age group(Table.2 and fig.2). Out of 155 patients some patients are not able to perform spirometer test. Only 94 patients were included for BMI and FEV1 correlation study.

Table 1: Mean age of patients.

Age	Male	Female.
Mean age	65.47	60.31
S.D	± 10.66	± 13.86

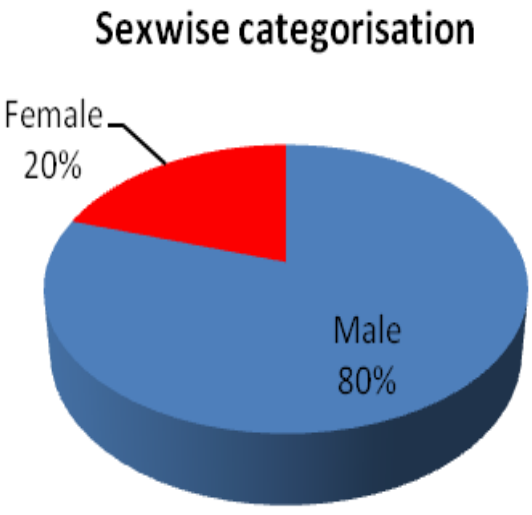

Fig.1: Sexwise categorisation of patients.

Table 2: Age wise categorization of patients.

Age group(year)	Male	Female	Percentage (%)
30-39	2	2	2.58
40-49	9	6	9.67
50-59	19	7	16.77
60-69	46	6	33.54
70-79	41	8	31.61
80-90	7	2	5.8
TOTAL	124	31	100

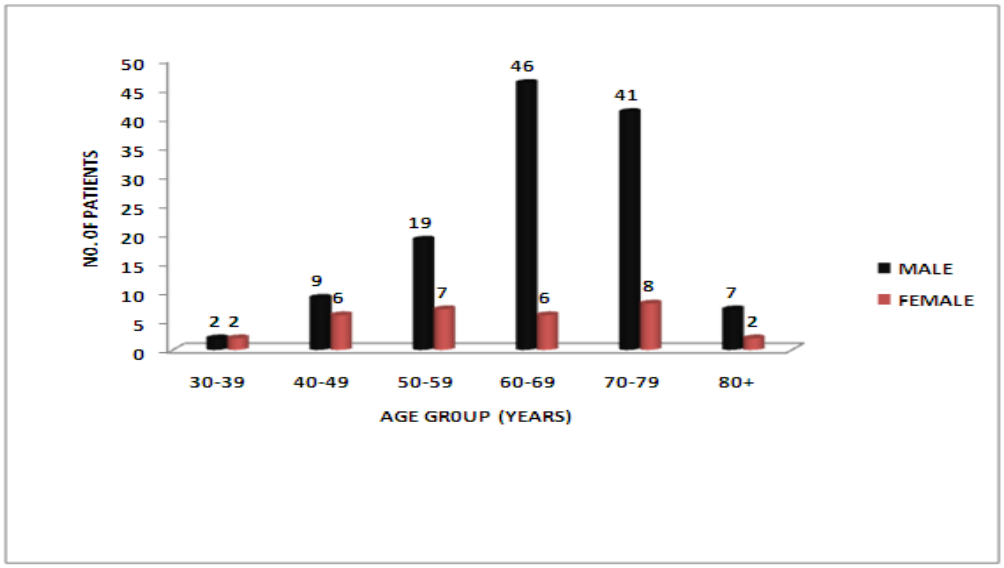

Fig 2: Age wise categorization of patients.

Categorization of patients according to their BMI

Out of 155 patients 94 patients were accessed for their BMI measurement. The patients were categorized as undernourished (<18), normal (18-22.9), overweight (23-24.9) and obese (>25). Among 94 patients 31 male and 11 female were found undernourished and 8 male and 1 female was found obese. There was a statistically significant BMI association between male and female patients. (Table.3)

Table 3: Categorization of patients according to BMI.

BMI	Male	Female	Total	Percentage
<18	31	11	42	44.68%
18-22.9	25	6	31	32.97%
23-44.9	8	4	12	12.76%
>25	8	1	9	13.23%
Total	72	22	94	100%

Kruskal-Wallis test = 6.686, P < 0.05

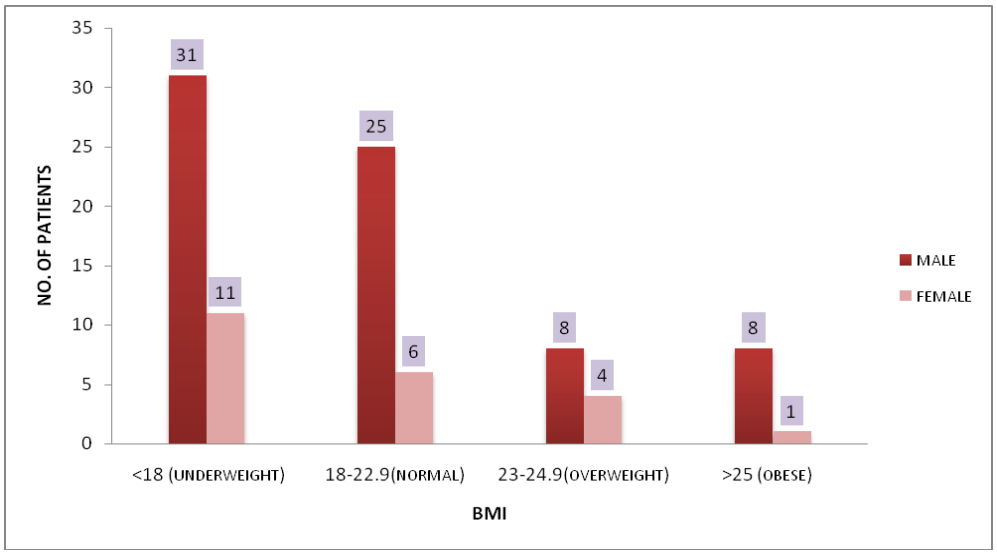

Fig. 3: Categorization of patients according to their BMI.

Severity Assessment of COPD

The assessment of COPD based on FEV1 recorded from the patients was analyzed. Out of 94 patients data only 68 patients were performed pre and post bronchodilator test. A total of 41.17% patients were found as mild, 30.88% of patients as moderate and 27.94% as severe. The male and female patients having significant association for their severity of COPD condition (Table.4 and fig.4).

Table 4: Severity of COPD based on FEV1.

Grade	Male	Female	Total	Percentage
Mild (>70)	21	7	28	41.17%
Moderate (50-69)	13	8	21	30.88%
Severe(< 50)	15	4	19	27.94%

F= 21.46, d.f = 2, 6, p = 0.001

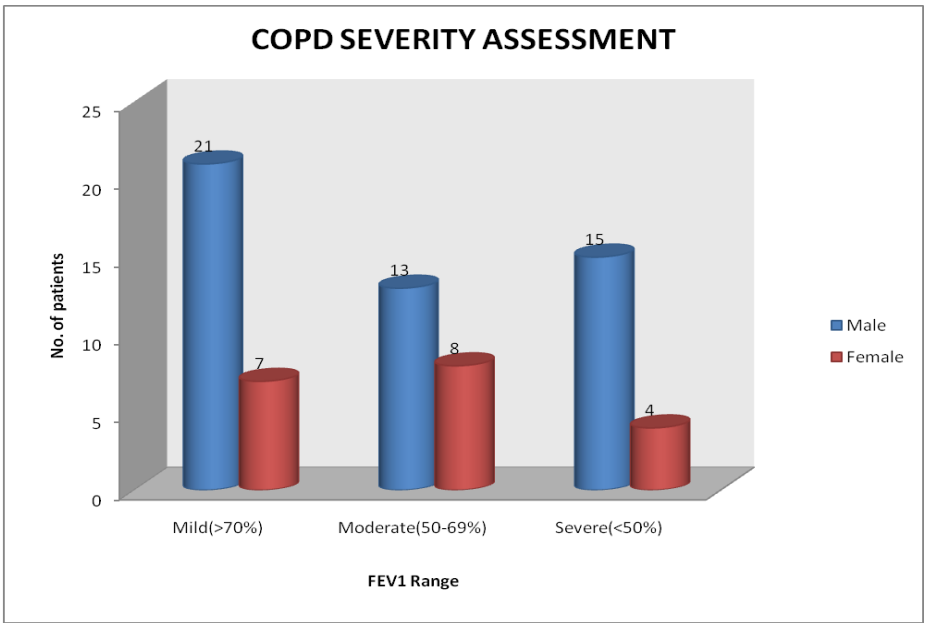

Fig. 4: Severity assessment of COPD patient.

CORRELATION BETWEEN BMI AND FEV_1 VALUES

The association between forced expiratory volumes in one second (FEV1) based disease severity and BMI measurements of the same patients were evaluated. There was a significant association between FEV1 based severity and BMI values. The BMI values decrease with increase in severity of disease (Table.5).

Table.5: Correlation between BMI and FEVI values.

FEV1	NO OF CASES	BMI MEAN	±SD
Mild	28	19.51	+3.08
Moderate	21	19.20	+3.496
Severe	19	18.21	+1.966
TOTAL	68	18.97	

F= 45.95, d.f = 2, 6, p = 0.0002

DISCUSSION

Respiratory disease is a common problem encountered in routine medical practice. COPD commonly occurs due to smoking and environmental pollution. Chronic respiratory disease is one of the most common causes of disease burden, both globally and in India.[5] Several studies have documented the association between nutritional depletion and weight loss in patients with established COPD, concomitantly there is a lack of prospective and retrospective studies in this subject in our country. In our study the statistical analysis had been shown that the underweight was more common among COPD group, also there was a significant relationship between the underweight group and low BMI and with the increase in COPD severity. The correlation relationship was also significant in which the underweight group is associated with decrease in FEV1 and increase in age.

Previous study suggested that the underweight more common in COPD group than that found in control group, and associated with more severe stages of COPD and in current smoker than in Ex-smoker and with increase in age ,but there is no significant difference between gender and nutritional status . Weight loss is a prevalent condition in patients with COPD and BMI can be used to assess this relationship there was an interaction between smoking habits and BMI in COPD patients. BMI correlates well with FEV1 and COPD severity and can be used by every clinician because it is a simple, inexpensive, readily available tool.[6] Another study reported that there was a significant relationship between low BMI and COPD and the correlation regression was also statistically significant in which low BMI is associated with more severe COPD[7].Wang et al conclusion similar to our study he found that BMI was significantly lower in COPD patients; BMI was also significantly lower in smokers than in non-smokers and

BMI decreased with the increase of the stages of COPD. He concluded that the lower BMI was strongly associated with COPD, possibly as a risk factor for COPD independent of smoking, and a potential predictor for COPD severity.[7, 8, 9, 10, 11]

With regard to the association between COPD and low BMI, researchers have previously suggested that low BMI was secondary to COPD and could be attributed to the systemic inflammation, imbalance of oxidative status and tissue hypoxia present in COPD patients.[12-14] In contrast to this hypothesis, they have observed that subjects with low BMI were at a substantially elevated risk of COPD even after adjusting for other potential risk factors. Our results were consistent with the reports of Harik-Khan and Higgins. Harik-Khan[15] has indicated that men with a low BMI are at increased risk of developing COPD, and Higgins[16] has demonstrated that the incidence of obstructive airway disease, defined as a predicted FEV1 < 65%, is highest in lean men and lowest in overweight men. The association between low BMI and an excessive incidence of COPD may be explained by several factors. First, poor nutritional status at birth or during early infancy is associated with impaired lung function or the development of COPD in adulthood. Although we assessed low adulthood BMI rather than low birth weight, both of these observations suggest that malnutrition reduces respiratory muscle and is likely to increase the likelihood of chronic lung infections. Second, increases in BMI over time provoked greater decreases in FVC than in FEV1; therefore, the ratios of FEV1/FVC increased as BMI increased because both FVC and FEV1 decreased. Third, the lower caloric intake by cigarette smokers may contribute to the finding that low BMI subjects were more susceptible to COPD. However, smoking-induced low caloric intake cannot completely account for low BMI because the association of leanness with a higher risk of respiratory mortality was also observed in nonsmokers (never smokers). Hence, weight loss in COPD is unlikely to be due to simple malnutrition.[17]

The association between COPD stage and BMI category revealed that with increasing COPD stage the proportion of subjects with undernourished BMI status increased significantly. The overall prevalence of 155 patients 94 patients were accessed for their BMI measurement. The patients were categorized as undernourished (<18), normal (18-22.9), overweight (23-24.9) and obese (>25). Among 94 patients 31 male and 11 female were found undernourished and 8 male and 1 female was found obese. Thus from our study 44.68% of patients were found undernourished and there is a correlation between nutritional status of patients and COPD condition. Thus nutritional supplements can be provided to the patients during their therapy, which would further be analyzed for any improvement in condition of the patient.

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