Original article

Can Body Mass Index correlate with severity of Chronic Obstructive Pulmonary Disease? A cross sectional study done in rural population of Jaipur

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Abstract:

Background: Association between BMI and poor prognosis of patients with COPD is a common clinical observation and it varies with different stages of COPD. Despite its importance, little information is available regarding BMI alteration in COPD from a population-based study. Aim: To study the correlation between examine BMI and severity categories in COPD and explore the factors influencing BMI in COPD.

Material and Methods: Patients with clinical history consistent with COPD were subjected to spirometry to stratify them according to severity. 20 healthy relatives of these patients or other visitors of the hospital served as controls for the study.

Results: 80 stable COPD patients were studied and analysed on the basis of the clinical history, mMRC grade, GOLD & ABCD classification, to assess their functional status. . The distribution of the patients in various risk categories was fair as there were 13, 21, 21 and 25 patients in category A, B, C and D respectively. In this study mean BMI of the patients was 21.20±3.37. It was lower in category D i.e. 18.86±2.43 Kg/M^2as compared to the rest of the patients, the differences being statistically significant (P=0.000).

Conclusion: This study was conducted in rural population of Jaipur district. We found that as the severity of COPD increased the BMI decreased and vice versa. Hence, we conclude that the association of BMI with COPD is of inverse correlation and a strongly significant one.

Keywords: BMI,COPD

Introduction

Chronic Obstructive Pulmonary Disease (COPD) is a common preventable and treatable disease, characterized by persistent airflow limitation that is usually progressive and associated with an enhanced chronic inflammatory response in the airways and the lung, to noxious particles or gases. Exacerbations and comorbidities contribute to the overall severity in individual patients.[1]

Mitra et al[2] stated that association between BMI and poor prognosis of patients with COPD is a common clinical observation and it varies with different stages of COPD. With severity of the obstruction (GOLD staging) BMI of the patient decreases and it was statistically significant. Hence, BMI is an important parameter to assess the functional status, and prescribing correct medical therapy and pulmonary rehabilitation programs in COPD patients. Despite its importance, little information is available regarding BMI alteration in COPD from a population-based study. We examined characteristics by BMI stratification in severity categories in COPD and explored the factors influencing BMI in COPD.

World Health Organization (WHO) stratification of BMI shown in Table 1[3]:-

Category	BMI range – kg/m^2	BMI Prime
Very severely underweight	less than 15	less than 0.60
Severely underweight	from 15.0 to 16.0	from 0.60 to 0.64
Underweight	from 16.0 to 18.5	from 0.64 to 0.74
Normal (healthy weight)	from 18.5 to 25	from 0.74 to 1.0
Overweight	from 25 to 30	from 1.0 to 1.2
Obese Class I (Moderately obese)	from 30 to 35	from 1.2 to 1.4
Obese Class II (Severely obese)	from 35 to 40	from 1.4 to 1.6
Obese Class III (Very severely obese)	over 40	over 1.6

Methodology:

The present study was conducted on all patients attending the out-patient of the Department of Respiratory Medicine, NIMS Hospital, Shobha Nagar, Jaipur, with clinical history consistent with COPD during the period July 2014 to July 2015. 20 healthy relatives of these patients or other visitors of the hospital served as controls for the study. Approval of the Institutional Ethical Committee was obtained for the study. A written informed consent was also undertaken from all the patients and controls after duly explaining the study protocol before enrolling them for the study.

All the study patients were evaluated by taking a detailed present & past clinical history and physical examination including height & weight measurement to calculate the BMI [BMI= Weight in Kg/(Height in metres)^2]. Blood tests for total /differential blood counts, ESR, TEC, Hb%, RBS, Urea, Creatinine and SGOT/PT, Sputum smears for AFB by ZN staining method- 2 samples,Urine routine examination, X-ray chest PA view and any other view as indicated in individual patient, Electrocardiography were done.

Patients showing obvious pulmonary or other system abnormalities like active pulmonary tuberculosis, Malignancy, Diabetes mellitus, Coronary artery disease, Stroke, Renal or Hepatic disease were excluded at this stage itself. The remaining patients were subjected to spirometry including the reversibility test as per ATS guidelines

Pulmonary Function Tests

Standardized pulmonary function tests were performed using a RMS HELIOS spirometer device. Each subject underwent a forced spirometry to obtain the following parameters: FVC, $FEV_1$and FEV_1/FVC ratio. Three such attempts were made and the best was selected and recorded. A repeat spirometry was obtained after inhaling 200 microgram of salbutamol to know the reversibility of airways. Post-bronchodilator FVC, FEV_1 and FEV_1/FVC ratio were recorded.

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All the patients who showed fixed airway obstruction (post bronchodilator FEV_1/FVC ratio less than 70% with less than 12% reversibility of FEV_1), were finally recruited in this study. Those patients with history of wheeze, chest tightness, eye allergy, nasal allergy or skin allergy, suggesting bronchial asthma were excluded.

Based on post bronchodilator FEV_1, these patients were classed as per Global Initiative for Obstructive Lung Diseases (GOLD) criteria as mild, moderate or severe.[1]

Classification of Severity of Airflow Limitation in COPD (Based on Post-Bronchodilator FEV_1)
GOLD 1: Mild: $FEV_1 \geq 80\%$ predicted
GOLD 2: Moderate: $50\% \leq FEV_1 < 80\%$ predicted
GOLD 3: Severe: $30\% \leq FEV_1 < 50\%$ predicted
GOLD 4: Very Severe: $FEV_1 < 30\%$ predicted

All the study patients were further evaluated as under:-

Combined risk assessment:-

1. Each patient was subjected to & classified as per mMRC questionnaire [4,5]
2. Each individual patient's history of exacerbations, whether needing hospitalization or not, in the past 2 years was assessed and the average risk per year was recorded.

Combined risk assessment of individual patient was done using GOLD class, risk of exacerbation per year, number of hospitalization for exacerbation per year and/or mMRC grade of symptoms and the study patients were categorized as category A, B, C and D as follows:-:

Patient Group A – Low Risk, Less Symptoms Typically GOLD 1 or GOLD 2 (Mild or Moderate airflow limitation); and/or 0-1 exacerbations per year and no hospitalization for exacerbation; and or mMRC grade 0-1

Patient Group B – Low Risk, More Symptoms Typically GOLD 1 or GOLD 2 (Mild or Moderate airflow limitation); and/or 0-1 exacerbations per year and no hospitalization for exacerbation; and or mMRC grade ≥ 2

Patient Group C – High Risk, Less Symptoms Typically GOLD 3 or GOLD 4 (Severe or Very Severe airflow limitation); and/or ≥ 2 exacerbations per year or ≥ 1 with hospitalization for exacerbation; and or mMRC grade 0-1

Patient Group D – High Risk, More Symptoms Typically GOLD 3 or GOLD 4 (Severe or Very Severe airflow limitation); and/or ≥ 2 exacerbations per year or ≥ 1 with hospitalization for exacerbation; and or mMRC grade ≥ 2.

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<table>
<tr><th colspan="5">Assessment Using Symptoms, Breathlessness, Spirometric Classification and Risk of Exacerbations</th></tr>
<tr><td rowspan="4">RISK (Gold classification of airflow limitation)</td><td>4</td><td>(C)</td><td>(D)</td><td rowspan="4">≥2or ≥1 leading to hospital admission

1 (not leading to hospital admission)</td><td rowspan="4">RISK (Exacerbation history)</td></tr>
<tr><td>3</td><td>(A)</td><td>(B)</td></tr>
<tr><td>2</td><td colspan="2">Symptoms
mMRC 0 -1 mMRC ≥ 2
Breathlessness</td></tr>
<tr><td>1</td><td colspan="2"></td></tr>
</table>

The data so obtained were tabulated and assessed for statistical significance using Anova test, X^2 test and Fisher Exact test, as and when applicable. Parameters showing p<0.001 will be subjected to multivariate analysis also.

The Pearson correlation test was used to verify the relationship between numerical variables with normal distributions. Values of $p < 0.05$ were considered to be significant.

Observations & results

Table-1

Distribution of patients according to Gold Class

FEV_1%	Gold class	**A**	**B**	**C**	**D**	**Total no. of patients**
≥ 50	2	13	21	00	00	34
≥ 30 - <50	3	00	00	15	20	35
<30	4	00	00	06	05	11
Total	-	13	21	21	25	80
Mean FEV1 %	-	57.84±5.80	56.76±4.91	36.47±10.65	39.12±9.90	46.1±12.75

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Table 1 shows the distribution of the patients according to post bronchodilator FEV_1% (GOLD class). Mean Post Bronchodilator FEV_1% of all the patients was 46.1%±12.75.None of the patients had post bronchodilator FEV_1% value of >80%. Mean Post Bronchodilator FEV_1% values were significantly higher in category A and B patients i.e.57.84±5.80and 56.76±4.91as compared to category C and D patients i.e.36.47±10.65 and 39.12±9.90(F=33.76, P=<0.000).

TABLE 2

Distribution of patients according to Smoking Status

Smoking Status	A	B	C	D	Total
Current	10	15	16	18	59
Reformed/ Ex-smoker	03	06	05	07	21
Total	13	21	21	25	80

Table 2 shows the distribution of patients according to smoking status. Non-smokers did not fulfil the inclusion criteria of the study. All the patients in the study were bidi smokers. 59 patients were current smokers and the rest 21 were reformed or ex-smokers. There were no differences in the COPD categories with regard to the smoking status (x^2=0.23, P=0.972)

TABLE 3

Distribution of patients according to BMI in (in Kg/M^2)

	A	B	C	D	Total
<18.5	01	01	07	15	24
≥18.5 -≤25	08	14	14	10	46
>25	04	06	00	00	10
Total	13	21	21	25	80
Mean BMI	23.67±3.17	23.38±2.22	20.28±3.19	18.86.±2.43	21.20±3.37

Table 3 shows the distribution of patients according to BMI. Mean BMI were significantly lower in category D i.e.18.86.±2.43 Kg/M^2 as compared to the rest. (F=14.95, P=0.000)

Discussion

In our study 80 stable COPD patients were studied and analysed on the basis of the clinical history, mMRC grade, GOLD & ABCD classification, to assess their functional status. The distribution of the patients in various risk categories was fair as there were 13, 21, 21 and 25 patients in category A, B, C and D respectively.

In this study mean BMI of the patients was 21.20±3.37. It was lower in category D i.e.

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18.86±2.43 Kg/M^{2}as compared to the rest of the patients, the differences being statistically significant (P=0.000). Ran et al[6] compared COPD patients with non-COPD subjects. BMI was significantly lower in COPD patients as compared to the non COPD patients [(22.7+/-3.5) vs. (24.1+/-3.4) kg/m^2(P<0.01] and in smokers than in non-smokers [(23.6+/-3.4) vs. (24.2+/-3.5) kg/m^2(P<0.01]. An addictive interaction to BMI between COPD and smoking was also observed (P<0.05). BMI decreased with the increase of the stage of COPD (F=45.6, P<0.01), with a negative relationship (P<0.01). Lower BMI was significantly associated with increased risk of COPD (P<0.01). Compared to subjects with normal BMI (BMI=24.0-27.9 kg/m^2), those with lower BMI (BMI<18.5 kg/m^2) were more likely to have COPD [adjusted OR=2.12 (95% CI 1.73-2.59)], while those with higher BMI (BMI=24.0-27.9 kg/m^2) and obesity (BMI>or=28.0 kg/m^2) were less likely to have COPD [adjusted OR=0.67 and 0.60, respectively]. Our Findings were similar to, Montes de etal[7] who studied subjects with COPD and without COPD, amongst 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. Zhou Yet al[8] study showed that compared to subjects with normal BMI (18.5 to 23.9 kg/m^2), those with low BMI (<18.5 kg/m^2) had a higher prevalence of COPD (21.1% vs. 7.5%), with an adjusted OR of 2.75 [95% confidence intervals (CI): 1.69 to 4.47].

Agarwal et al[9]stated that COPD produces malnutrition with regards to both fat and fat free components irrespective of the severity of COPD. It is recommended on the basis of this study that COPD patients be treated accordingly, with individualized overall dietary additions along with pharmacotherapy. Gupta et al[10] stated in his study that 66.3% of patients with severe and very severe COPD (stage III and IV) are undernourished. Yang et al[11] too supported similar findings and also found that low BMI was predicted as an indicator of mortality amongst the COPD patients, thus inferring that low BMI is an indicator of advanced stage of COPD. Harik-Khan et al[12] reasoned that the possible explanation of nutritional abnormality and weight loss is due to decreased caloric intake and increased basal metabolic rate.[13-16] Loss of muscle mass is main cause of weight loss in COPD patients, where loss of fat free mass contributes to lesser extent.[13]It has been seen that at a microscopic level, muscle fiber atrophy and alteration of fiber type can occur.[17] Plasma levels of certain pro-inflammatory cytokines like TNF-α are increased in COPD that can provoke muscle cell apoptosis and protein degradation via the ubiquitin/proteasome system leading to loss of muscle mass.[17,18]In most patients with COPD there is an imbalance between metabolic requirement and calorie intake leading to weight loss.[19]

Conclusion

With reference to the available scientific studies we found the association of BMI with pathogenesis of COPD and its severity to be controversial. So, we conducted this study in rural population of Jaipur. We found that as the severity of COPD increased the BMI decreased and vice versa. Hence, we conclude that the association of BMI with COPD is of inverse correlation and a strongly significant one.

We also recommend further studies should be conducted in this regard and if possible the impact of nutritional supplementation, pulmonary rehabilitation and pharmacological interventions in COPD patients must be assessed.

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