A STUDY OF CORRELATION OF BODY MASS INDEX AND PEAK EXPIRATORY FLOW RATE WITH FEV_1 IN PATIENTS OF COPD

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ABSTRACT

BACKGROUND
COPD is an important public health challenge characterized by obstruction to airflow that is not reversible. Low BMI is also considered as an independent negative determinant of survival in patients with COPD. There are few studies comparing association between peak expiratory flow rate (PEFR) and forced expiratory volume in 1st second (FEV1) for severity classification of COPD. The role of PEFR as a substitute of FEV1 in situations and resource limited areas has not been extensively studied.

METHODS
This was a cross sectional, observational study. The study was conducted in the Respiratory Medicine Department at SRM Medical College Hospital and Research Center, Chennai, Tamilnadu. The study population was selected from among 117 consecutive patients of COPD. BMI was measured in each patient. Both FEV1 and PEFR were obtained at a single visit using spirometer and FEV1, post-bronchodilator FVC, and ratio of FEV1/FVC (FEV1%) were measured and statistically analysed. Data was coded and entered in MS Excel and analysed using the statistical package SPSS version 18. Pearson Correlation test was done for linear relations between quantitative variables.

RESULTS
Among the 117 study participants, on applying the Pearson correlation test, we found that PEFR (L/min) and post FEV1% predicted were strongly correlated (positive correlation) ($r= 0.725$, $p< 0.001$) but same test applied for BMI and post FEV1% predicted were weakly (Positive correlation) correlated ($r= 0.283$, $p= 0.002$).

CONCLUSIONS
Both BMI and PEFR had positive correlation with post FEV1% predicted. BMI showed weak correlation but PEFR showed strong correlation with FEV1%, hence we can use PEFR as a surrogate marker for daily monitoring in patients with COPD.

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BACKGROUND

Chronic Obstructive Pulmonary Disease (COPD) is currently the fourth leading cause of death in the world but is anticipated to be the 3rd leading cause of death by 2020.[1] More than three million people died of COPD in 2012 reported for 6% of all deaths worldwide.[2] The primary reason of COPD is exposure to tobacco smoke (Either active smoking or second hand smoke).

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Additional risk factors comprise contact to indoor and outdoor air pollution and occupational dust and fumes. Contact to indoor air pollution can disturb the unborn child and characterize a risk factor for emerging COPD late in their life. COPD is possible to upsurge in impending years due to greater smoking prevalence and aging populations in numerous nations. Many cases of COPD are preventable by early termination of smoking. COPD is not curable, but management can relieve the symptoms, improve the quality of life and decrease the risk of death.

Weight loss and nutritional depletion are common features of COPD. Patients with low BMI are at high risk for developing severe COPD and found to be an important predictor of morbidity and mortality.[3] The relationship between low body mass index and bad prognosis of COPD patients is a routine clinical observation and it varies with different stages of COPD.[4]

Definition and the assessment of severity of COPD are currently founded on post-bronchodilator % predicted FEV1, forced vital capacity and FEV1/FVC estimations. These estimations are normally taken by spirometry are favoured as it is significantly more reproducible.[5] But, spirometry isn't generally accessible in our nation because of the specialized challenges of performing spirometry much of as far as possible use, particularly at primary care level. A few reports propose that peak flow estimations might be a modest method for screening and initial identification of extreme cases of COPD for subsequent confirmatory spirometry.[6] Thus, Using PEFR estimation is increasingly prudent and considerably more generally accessible, along these lines it is proposed as an option in contrast to spirometry.

The objectives of our study were to find out the correlation between severities of obstruction in COPD patients with their body mass indices. Another objective is to find out the utility of PEFR or BMI as an alternative tool for assessing the severity of COPD.

METHODS

This was a cross sectional, observational study. The study was conducted in the Respiratory Medicine department at SRM medical hospital and Research center, Potheri, Chennai, Tamil Nadu. The study was carried out from June 2017 to September 2018 after obtaining the appropriate clearance from the scientific and ethical committee of the institute. Sample size was calculated based on the study population was selected using universal sampling method that means during the study period all the eligible patients were enrolled in our study. 117 patients of COPD, who attended our Respiratory Medicine Department during the study period was the sample size. The subjects who were more than 40 years of age, confirmed cases of COPD defined by GOLD guidelines and determined by post bronchodilator spirometry detected were included in the study after obtaining the appropriate informed consent. Any contraindication for Spirometry (As given by GOLD criteria), pregnant women and patients who do not give informed consent were excluded from our study. All patients were subjected to history taking and clinical examination. BMI (Weight in kg/height in m^2) was measured in each patient. Both FEV1 and PEFR were acquired from similar patients at a single visit utilizing spirometer. All subjects were estimated for post-bronchodilator FVC, FEV1, and ratio of FEV1/FVC (FEV1%). Every patient performed the PEFR in a standing position, Patients were told to take a deep breath then exhale by forceful expiration quickly while keeping an air tight seal between lip and mouth piece of the device with standard procedures established by the American Thoracic Society.

Statistical Analysis

The data were entered and coded in MS Excel and analysed using the SPSS version 18. The qualitative data were summarized by percentage and quantitative data by mean and standard deviation. Statistical differences between two groups were tested using ANOVA (Analysis of variance) with post Hoc test (Tukey test) for quantitative variables. Pearson Correlation test were done for association between two quantitative variables. P-value less than or equal to 0.05 were considered statistically significant.

Gold	Age (Mean ± SD)	BMI (Mean ± SD)	FEV1% (Mean ± SD)	PEFR (L/min) (Mean ± SD)
Stage 1	58.50 (8.54)	27.1 (2.94)	85.00 (5.77)	396.10 (16.05)
Stage 2	56.68 (11.57)	26.11 (6.92)	61.50 (7.75)	212.22 (67.38)
Stage 3	57.86 (10.53)	23.09 (5.43)	40.79 (5.28)	140.97 (47.08)
Stage 4	62.50 (8.01)	21.23 (2.90)	24.00 (4.05)	130.80 (45.33)
p Value	0.282	0.008	<0.001	< 0.001

Table 1. Age, BMI, FEV1% Predicted, PEFR (L/min) of The COPD Patients in Their Different GOLD Stages

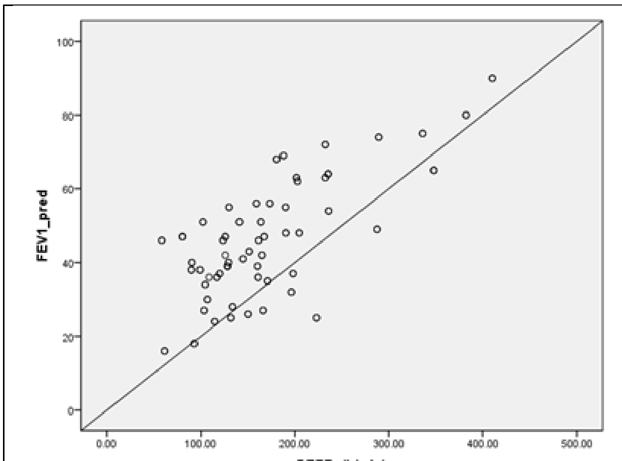

Figure 1. Scatter Diagram Display the Correlation Between PEFR and Post Force Expiratory Volume in 1st Second % Predicted in COPD Patients

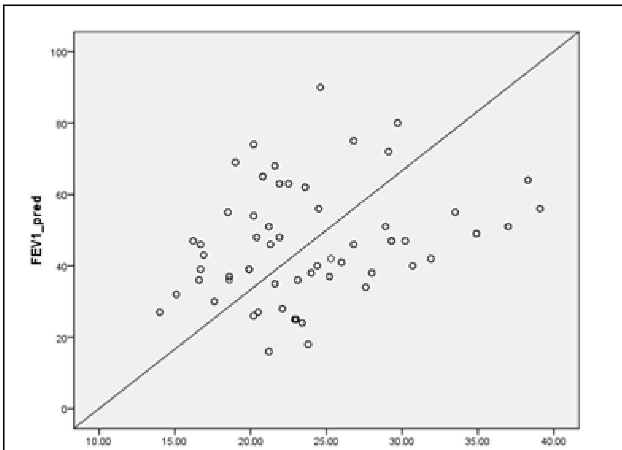

Figure 2. Scatter Diagram Display the Correlation Between Body Mass Index and Post Force Expiratory Volume in 1st Second % Predicted in COPD Patients

RESULTS

In our study among the 117 study participants, mean age was 58.21 (SD=10.54), minimum and maximum age is 40 & 80 respectively. Males were 64.1% (n= 72). Among the males 96% (n=72) had smoking history and 61.3 % had a history of alcoholic intake. Out of all study participants 55.6% (n=65) had Diabetes mellitus and 49.6% (n=58) had systemic hypertension. According to GOLD, COPD patients were classified in four stages by their predicted post bronchodilator FEV1%.

Amongst 117 study subjects, in stage I there were 4 (3.4%) patients, in stage II - 38 (32.5%), in stage III - 57 (48.7%), and in stage IV - 18 (15.4%) patients respectively. The mean ages of the patients in four stages of COPD were shown in Table 1. From the above table and by using one-way ANOVA, it was established that low body mass index was associated with increased severity of obstruction which was statistically significant (F=4.129, p=0.008). The post hoc Tukey test also indicated that there were significant differences present in GOLD stages 2 and 4 of COPD in respect to BMI (p value = 0.016). But age of the patients was not statistically significant (F=1.289, p=0.282).

From the above table and by applying one-way ANOVA, it was found that FEV1% and PEFR (L/min) was statistically significant (F=39.94, p= <0.001). The post hoc Tukey test also indicated that there were significant mean differences present in GOLD stages 1 and 2 between FEV1% and PEFR (L/min). (p value < 0.001). Using the Pearson correlation test we establish that PEFR (L/min) and predicted post FEV1% were strongly correlated (Positive correlation) (r = 0.725, p<0.001) but same test applying for body mass index and predicted post FEV1% were weakly (Positive correlation) correlated (r = 0.283, p = 0.002).

DISCUSSION

The mean (SD) age of study population was 58.21 years (± 10.54) and maximum number of the patients were more than 50 years of age, which was consistent with the previous literature.[7] In our study, we found that BMI was positively correlated with the post bronchodilator FEV1% predicted. But the degree of correlation was very weak (r= 0.283) in this study, it may be due to the fact that almost all the study subjects in this study had normal BMI. Thus, low BMI was found to be associated with increased severity of obstruction (i.e. decreased FEV1) which was statistically significant (F=4.129, p=0.008). The post hoc Tukey test also indicated that there were significant differences present in GOLD stages 2 and 4 of COPD in respect to BMI. In the Platino study,[8] a population-based study conducted in 5 Latin American cities (2008) showed that (GOLD) stages 3 and 4 was associated with lower BMI in 397 male patients.[8]

Relation of COPD and Body Mass Index

COPD is conceptualized as a 'syndrome' that affects almost all body systems. Nutritional status disturbances and skeletal muscle weakness are among the most common extrathoracic manifestations of the disease. Low Body mass index causes disturbances in breathing physiology, decrease in diffusion and increased air-trapping as a consequence of breathlessness and vice versa. In a study that was comparing the nutritional status in chronic obstructive pulmonary disease and asthma it was concluded that "COPD produces malnutrition with regards to both fat and fat free components whereas asthma does not produce any malnutrition. In this study the severity of COPD did not demonstrate any intergroup differences it may be concluded that it is the disease process, independent of the stage of the disease that is responsible for the malnutrition. It is recommended on the basis of this study that COPD patients be treated accordingly, with individualized overall dietary additions along with pharmacotherapy, whereas the same does not apply to asthmatics. It is suggested for further study to look for any reversal of nutritional disturbances in patients with COPD through a pulmonary rehabilitation program".[9] Hypoxia has been revealed to stimulate the production of inflammatory mediators and to add to the development of malnutrition in COPD patients.[10]

There are several studies[11–13] which have documented the association between low body mass and poor prognosis and mortality in patients with COPD. Gray Donald et al in his study on the nutritional status and mortality in COPD observed that "In the total cohort, low body mass index (BMI) and use of domiciliary oxygen were independently associated with decreased survival. In hospitalized patients, predictors of respiratory mortality were high $PaCO_2$ and decreased BMI and diffusing capacity. PaO2, FEV1, PEmax, age, smoking behaviour and gender were not associated with survival. They concluded that low body mass index, a potentially modifiable factor, was associated with respiratory mortality, but whether it has a casual effect or is a marker of declining health can only be resolved through an intervention trial".[13]

Further in our study we found that PEFR was positively correlated with post FEV1% predicted. It shows very strong correlation with r value 0.0725. A study done in Thailand shows the similar results of correlation among the predicted FEV1% and PEFR were strongly significant (r=0.76)(14). In our study it was found that the correlation of FEV1% and PEFR (L/min) was statistically significant (F=39.94, p= <0.001) and also indicated that there were significant mean differences present in GOLD stages 1 and 2 between FEV1% and PEFR (L/min) (p value < 0.001).

In COPD patients, after the early rapid increase in expiratory flow, there is raised intra thoracic pressure. This causes segmental and other large airways to collapse and obstruct the passage of air through those airways. It effects in rapid decrease in flow after a comparatively normal peak has been achieved, which leads to significantly lower values for FEV1 compared to PEFR. These problems could bring about a significant discordance if predicted FEV1% is exchanged by % predicted PEFR for the purpose of severity classification.[14]

A study by Jithoo et al compared the case finding strategies for COPD using data from the Burden of Obstructive Lung Disease study and their results supported the use of PEFR as a simple, cost-effective initial screening tool for conducting COPD case-finding in adults aged ≥40 yrs.[15]

PEFR may not be able to precisely identify GOLD stage, but earlier studies showed some efficacy of peak flow rate measurements for daily monitoring in patients with COPD, COPD screening and initial identification of severe cases of COPD and then subsequently confirmed by spirometry.[15,16] It was also observed that PEFR has a good predictive value for determining the death risk in COPD patients requiring hospitalization for acute exacerbation. Another study from People's Republic of China revealed that a lower peak expiratory flow rate was associated with increased mortality from respiratory causes like bronchogenic carcinoma and also in cardiovascular diseases.

CONCLUSIONS
Both Body Mass Index and Peak Expiratory Flow Rate correlated positively with FEV1% predicted. BMI shows weak correlation but PEFR shows strong correlation with FEV1%. Hence, PEFR can be used as a surrogate marker for daily monitoring in patients with COPD. Peak expiratory flow rate (PEFR) is good at assessing the severity of patients with chronic obstructive pulmonary disease in resource limited settings; however, it needs further confirmation by spirometry.

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