A cross-sectional correlation study of BODE index and CAT score in male COPD patients

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Abstract: **Chronic Obstructive Pulmonary Disease (COPD) is a preventable and treatable disease with some significant extra pulmonary effects that may contribute is characterized by airflow limitation that is not fully reversible. The Global initiative for Chronic Obstructive Lung Disease (GOLD) staging has been used to stratify severity of COPD. The BODE index was proven superior to FEV_1 in predicting disease severity in patients with COPD. Dyspnea or breathlessness is the hallmark symptom of COPD. Modified Medical Research Council (MMRC) questionnaire is the simple way to quantify the impact of breathlessness on a patient's health status. The impact of COPD on an individual patient depends not just on the degree of airflow limitation, but also on the severity of symptoms. COPD Assessment test (CAT) scores were used to assess health related quality of life in COPD patients. The present study was aimed to evaluate the correlation of severity of disease (using BODE index) with disease specific quality of life (using CAT scores). Spearman's correlation coefficients were calculated and showed that both the scoring systems had more statistically significant (P<0.05) correlation when compared on the basis of MMRC dyspnea scale than the GOLD criteria for classification of severity.**

Keywords: **Chronic Obstructive Pulmonary Disease, BODE index, COPD assessment test (CAT), Dyspnea, Global initiative for Chronic Obstructive Lung Disease, Modified Medical Research Council (MMRC), forced expiratory volume in one second (FEV_1), forced vital capacity (FVC).**

I.   INTRODUCTION

Chronic Obstructive Pulmonary Disease (COPD) is a progressive and prevalent disease characterized by poorly reversible airflow limitation. Its pulmonary component is associated with an abnormal inflammatory response of the lung to noxious particles or gases [1]. Cigarette smoke is the most important environmental challenge that influences lung function decline and development of the disease. Smoking is more prevalent in men than women; therefore, there are more number of males affected by COPD as compared to their female counterparts [2]. The chronic airflow limitation characteristic of COPD is caused by a mixture of small airway disease and parenchymal destruction in the lungs. It is a condition associated with a high level of disability related to breathlessness. Dyspnea or breathlessness is an important symptom in COPD, where it is associated with limited physical activity and decreased health-related quality of life and reduced survival [3]. The pulmonary function test by the use of spirometry is the standard method recommended by the Global Initiative for Chronic Obstructive Lung Disease (GOLD) guidelines, for grading the COPD severity. A forced expiratory volume in the first second (FEV_1) and the ratio of FEV_1/ FVC (force vital capacity) less than 70% are used to determine COPD severity [4]. The impact of COPD on an individual depends on the severity of symptoms (breathlessness and decreased exercise capacity), any comorbidities and systemic effects in the patients. The systemic manifestations of disease are not fully reflected by FEV_1/FVC in the clinical practice. BODE index is a multidimensional parameter including the body mass index (BMI), the degree of airflow obstruction (O), dyspnea (D) and exercise capacity (E) [5]. BODE index was reported to be applicable in predicting an individual's survival with severe COPD and reflecting the disease modification [6]. BODE index is also helpful in measuring follow-up lung function changes in pulmonary rehabilitation [7]. Another parameter to measure the symptomatic impact of COPD is the CAT (COPD Assessment Test) score which is a unidimensional measure of health status impairment of COPD [8]. The CAT was developed as a short and simple questionnaire for qualifying the symptom burden of COPD in routine practice. little is known about the

correlation of CAT score and BODE index in terms of measurement of disease specific quality of life in the clinically stable COPD patients. This study aimed to elucidate this information by comparing the CAT score and BODE index on the basis of GOLD classification and MMRC dyspnea scale.

II.   MATERIALS AND METHODS

Subjects: Male patients with stable COPD recruited in the study were from the outpatient clinic department of Chest and Pulmonary Medicine, TB hospital, Patiala, Punjab. Each recruited COPD patient was diagnosed on the basis of medical history, chest radiographs, current symptoms and Pulmonary function test as per the GOLD criteria. This study was approved by institutional ethical committee and written consent was obtained from all participants. The inclusion criteria for study were: i) A known post-bronchodilator forced expiratory volume in one second/ forced vital capacity (FEV_1/FVC) ratio less than 70%. ii) No history suggestive of bronchial asthma. The exclusion criteria for the study were Pulmonary disorder other than COPD and serious, unstable cardiovascular or neurological disease.

Assessment of BODE index:

BODE index was calculated by evaluating its various components and each component was scored as described in the Table1 [9]. i) Body Mass Index (BMI): It was assessed as the ratio of body weight and height in meter square (kg/m^2). ii) Obstruction: The airflow obstruction was assessed by pulmonary function test using spirometry. The diagnostic classification was performed by pulmonary physicians. Post-bronchodilator FEV_1 was assessed at 20 min after the inhalation of bronchodilator using a metered dose inhaler. iii) Dyspnea: The level of dyspnea was evaluated by the MMRC (Modified Medical Research Council) dyspnea scale [10]. This dyspnea scale measures perceived respiratory disability (Table2). iv) Exercise performance: The 6-minute walking test (6MWT) was conducted to assess the exercise impairment in the patients [11]. Before and after test the patient's resting heart rate and arterial oxygen saturation level were monitored. For Body mass index, the point was either 0 or 1 ad for airflow obstruction, dyspnea and Exercise test, the patients received points ranging from 0 to 3. The points for each component were added, so that the BODE index ranged from 0 to 10 points for each patient. The BODE score was further categorized into quartiles as: quartile 1(score of 1 to 2 points), quartile 2(score of 3 to 4), quartile 3(score of 5 to 6 points) and quartile 4(score of 7 to 10 points).

Table 1: The BODE index scoring				
	0	**1**	**2**	**3**
FEV1%pred	≥65	50-64	36-49	≤35
6MWD (m)	≥350	250-349	150-249	≤149
MMRC	0-1	2	3	4
BMI (kg/m^2)	>21	≤21		

Table 2: Modified Medical Research Council Questionnaire for assessing the severity of Breathlessness	
0	Breathless only with strenuous exercise
1	Short of breath when hurrying on the level or walking up a slight hill
2	Slower than most people of the same age on the level because of breathlessness or have to stop for breath when walking at my own pace on the level
3	Stop for breath after walking about 100 meters or after a few minutes at my own pace on the level
4	Too breathless to leave the house or I am breathless when dressing

Table 3: COPD Assessment Test (CAT)							
I am very happy	0	✻	2	3	4	5	I am very sad
I never cough	0	1	2	3	4	5	I cough all the time
I have no phlegm (mucus) in my chest at all	0	1	2	3	4	5	My chest is completely full of Phlegm(mucus)
My chest does not feel tight at all	0	1	2	3	4	5	My chest feels very tight
When I walk up a hill or one flight of stairs I am not breathless	0	1	2	3	4	5	When I walk up a hill or one flight of stairs I am very breathless
I am not limited doing any activities at home	0	1	2	3	4	5	I am very limited doing activities at home
I am confident leaving my home despite my lung condition	0	1	2	3	4	5	I am not at all confident leaving my home because of my lung condition
I sleep soundly	0	1	2	3	4	5	I don't sleep soundly because of my lung condition
I have lots of energy	0	1	2	3	4	5	I have no energy at all

Assessment of CAT score:

The disease-specific quality of life was evaluated with the COPD Assessment Test (CAT) score [8]. It is comprised of eight items assessing cough, phlegm, chest tightness, breathlessness going up stairs, activity limitations at home, confidence leaving home, seep and energy. Each item was scored 0 to 5 points. The total score range from 0 to 40, corresponding to best to worst health status in the patients.

Statistical analysis:

Statistical analysis was performed using SPSS software, version 11.5(SPSS Inc. Chicago, IL, USA). The continuous variables as absolute number and percentage. Spearman's rank correlation test was performed to measure how closely the BODE index score agreed with CAT score and that by MMRC dyspnea scale and GOLD classification for disease severity.

III. RESULTS AND DISCUSSION

One hundred and forty clinically stable COPD patients (men) were included in the study. Their clinical and baseline characteristics used in this study are detailed in Table 4. Most of the subjects were elderly and had former or current smoking history with minimum disease history of three years. On the basis of post-bronchodilator spirometry, all patients were categorized into mild, moderate, severe and very severe COPD. Frequency distribution of patients on the basis of disease severity recommended by GOLD guidelines is shown in Table 5. Maximum number of patients had severe or stage III COPD in this study as shown in Table 5.

Table 4: Baseline and clinical characteristics of male patients with clinically stable COPD

Characteristics	Mean (±SD)
Age (years)	59.22(±9.8)
Smoking history (pack years)	58.2 (±21.3)
BMI (Body mass index)	25.4 (±4.6)
FEV_1/FVC	50.3 (17.3)
FEV_1 (% predicted)	38.6(±18.2)
MMRC dyspnea scale	2.5 (±1.2)
Exercise test (6MWT)	226.5(±70.51)
BODE index	5.97(±2.16)
CAT score	26.02 (±5.07)

Table 5: Frequency of COPD patients according to GOLD stages.

GOLD classification of airflow limitation severity of COPD	Number of patients (%)
Stage I (FEV_1/FVC <0.70, $FEV_1 \geq$80% predicted)	2 (1.4)
Stage II (FEV1/FVC <0.70, 50% ≤ FEV1 80% predicted)	30 (21.4)
Stage III (FEV1/FVC <0.70, 30% ≤ FEV1 < 50% predicted)	69 (49.2)
Stage IV (FEV1/FVC <0.70, FEV1 <30% predicted or FEV1 <50% predicted)	39 (27.8)

Table 6: Frequency of COPD patients classified according to BODE index.

BODE index	1	2	3	4	5	6	7	8	9	10
Number of patients n(%)	2(1.4)	9(6.4)	12(8.5)	16(11.2)	13(9.2)	20(14.3)	29(20.7)	28(20)	6(4.2)	5(3.5)

Table 7: frequency of patients according to BODE quartiles and their respective CAT scores

BODE quartiles	1	2	3	4
Number of patients n (%)	11 (7.8)	28(20)	33(23.5)	68(48.7)
CAT score (mean ±SD)	22.5 (±2.06)	22.03 (±4.59)	26.12 (±4.63)	27.95 (4.52)

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BODE index was calculated using the empirical model described by Celli et al. [9] and CAT score was calculated by using questionnaire described by Jones et al. [8]. The frequency distribution of patients according to BODE index and BODE quartiles with their respective CAT scores are shown in table 6 table 7, respectively. The maximum number of patients appeared with 7and 8 BODE index score and fall in quartile 4 in this study. The means and standard deviation of the total CAT scores and BODE index according to GOLD classification in assessment of severity of COPD and their spearman correlation coefficients (r_s) are detailed in Table 8. Similarly, the means and standard deviation of the total CAT score and BODE index stratified according to MMRC Dyspnea scale for breathlessness are shown in table 9. The mean CAT score and the mean BODE index in the study were 26.02 and 5.97 respectively. The mean CAT score corresponding to BODE quartiles were as: 22.51(quartile 1), 22.03(quartile 2), 26.12(quartile 3) and 27.95 (quartile 4). There is an increment in CAT score with increase in BODE index score. As shown in Table 8, the CAT score and BODE index correlated at GOLD stage III and IV of severity of COPD with statistically significant values (P<0.05). Whereas, the CAT score and BODE index score for stage I and stage II are correlated but non-significantly. On the other hand, it was observed that the CAT score and BODE index correlated with each other on 2, 3and 4 points of the MMRC dyspnea scale with statistically significant values as shown in Table 9. Both the scores were correlating to each other with increase of severity of the disease in COPD patient but more close correlation in two scoring systems was found among MMRC dyspnea scale as compared to GOLD classification criteria. The BODE index is the independent predictor of survival in COPD [12] and CAT score are used in the assessment of impact of COPD on health status of COPD patient during pulmonary rehabilitation [13]. Dyspnea is one of the main determinants of disease-specific health related quality of life in patients with COPD [14]. The CAT, novel COPD-specific measurement, was associated with dyspnea scale and BODE index and provide us the information about systemic manifestations of COPD.

Table 8: Spearman's correlation between CAT scores and the BODE index according to GOLD classification in the assessment of severity of COPD

GOLD classification	CAT scores (mean ±SD)	BODE index (Mean ±SD)	Correlation coefficient (r_s)	P value
Stage I (Mild)	16.5 (±1.5)	2 (±0.3)	0.674	0.141
Stage II (Moderate)	20.37 (±4.83)	3.1 (±1.16)	0.130	0.491
Stage III (Severe)	26.78 (±4.47)	6.31 (±1.59)	0.364	0.001*
Stage IV (very severe)	27.26 (±5.03)	7.76 (1.20)	0.403	0.011*

Table 9: Spearman's correlation between CAT scores and the BODE index according to MMRC dyspnea scale classification in the assessment of severity of COPD.

MMRC dyspnea scale classification	CAT scores (mean ±SD)	BODE index (Mean ±SD)	Correlation coefficient (r_s)	P value
0	-	-	-	-
1	2.7 (±0.90)	21.3 (± 3.23)	0.355	0.177
2	4.9(±1.56)	24.2 (±4.56)	0.301	0.049*
3	7.0 (±1.21)	27.3 (±4.48)	0.046	0.012*
4	9.5 (±0.70)	34.1 (±3.40)	0.082	0.022*

IV. CONCLUSION

In conclusion, the Correlation of BODE index with CAT score shows that it is directly related with self-perceived symptoms, difficulties with daily life activities and Physical mobility and the level of adaption to a Chronic disease. In our study, the CAT score were better correlated with BODE index on the basis of MMRC dyspnea scale as compared to GOLD classification for the severity of COPD. The BODE index and CAT score were significantly correlated to each other with advancement of disease severity.

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