Relationship between Bode Index and Quality Of Life in Copd Patients

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Abstract: Background and Aims: Malnutrition, weight loss, and peripheral muscle weakness are some of the systemic manifestations of COPD that seriously affect the health related quality of life and exercise capacity of patients [1]**.** The BODE index components are: body mass index (BMI), airway obstruction (O), dyspnea (D) and exercise capacity (E) [2]. The COPD Assessment Test (CAT) is a quick and easy test to be completed and provides a score that indicates the impact of the disease on the health status of the patients [3]. The aim of this study was the assessment of the quality of life in COPD patients using CAT and correlating with BODE index. **Materials and Methods:** COPD patients in this study were diagnosed and classified into four groups according to GOLD guidelines. BODE index score was calculated according to: BMI, FEV1%pred. post bronchodilator, mMRC and 6MWT (meters) by summing the points that were obtained. CAT questionnaire was used to assess the quality of life. Total CAT score and BODE index score were calculated and data analysed using various statistical tests. **Results:** In the current study, 60 COPD patients were investigated. Among these, the mean age of the patients were 63.383 ± 10.306 (40 - 87) and the sex ratio (M: F) was (58:2). The majority of the studied cases were Ex-smokers and only 3.33% were passive smokers. Mean BMI (kg/m^2) was 25.338 ± 4.810, mean FEV1% pred. post-bronchodilator was 40.433 ± 9.464, mean mMRC was 1.8 ± 0.9 and mean 6 MWT (m) 204.900 ± 83.926. In this study, mean BODE Index Score was 6.067 ± 1.745 and mean total CAT Score was 27.967 ± 7.746. BODE Index and CAT Score was found to be highly significantly related to the disease severity according to GOLD ($p < 0.001$). The BODE Index was positively correlated with CAT score ($r = 0.986$). This correlation was found to be statistically highly significant ($p < 0.001$). **Conclusion:** These results provide users of the CAT with a good sense of the health impact associated with the BODE index score**.** It highlights the importance of CAT as a complement to the BODE index in the evaluation of the true impact of COPD on patients' daily lives.

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1. Introduction

Chronic Obstructive Pulmonary Disease (COPD): is recently defined as 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 co morbidities contribute to the overall severity in individual patient [4].

Chronic obstructive pulmonary disease (COPD) has been a major public health problem during the 20th century, and will remain a challenge for the foreseeable future. Worldwide, COPD is in the spotlight, because its high prevalence, morbidity, and mortality create formidable challenges for healthcare systems [5].

In Egypt; prevalence, morbidity and mortality are still lacking and have to be estimated; however, COPD is arising significant health problem in Egypt [6].

The chronic, progressive clinical course of COPD is aggravated by exacerbations affecting quality of life and lung function. COPD patients have poor Health Related Quality of Life (HRQoL) due to their symptoms, diminished physical performance and the use of medications [7].

Health Related Quality of Life (HRQoL) is an important patient reported health outcome that is currently receiving increasing recognition [8]. The impairment in HRQoL in COPD is seen even at levels of relatively modest air flow limitation [9].

This weak association between HRQoL and the forced expiratory volume in one second (FEV1) has long been described and reflects the marked heterogeneity and complexity of this disease. The dissociation between FEV1 and patient centered outcomes such as HRQoL, and even survival has prompted an increasing interest in the multi-systemic evaluation of COPD [10].

The health status of patients with Chronic Obstructive Pulmonary Disease (COPD) [11] is currently being assessed using several different questionnaires. One of them is the COPD Assessment Test (CAT), which is a quick and easy test for patients to complete and provides a score that indicates the

impact of the disease on their health status. This is a multi-dimensional 10-point scale which integrates body mass index, degree of airflow obstruction (FEV1 - Forced Expiratory Volume in one second) and dyspnea by mMRC grading and exercise capacity measured in 6-min walk test [3].

The higher scores in BODE index indicate a higher risk of death. The BODE index was designed to show that it is important to consider a range of factors rather than just a single component in the course of comprehensive assessment of COPD patients [3 & 12].

In the light of these facts, the present study was planned to study the interrelationship between CAT score and BODE index in COPD patients**.**

2. Materials and Methods

This prospective cross-sectional study was carried out in Kafr El-Sheikh Chest Hospital. This study included all COPD patients either referred to outpatient chest clinics or admitted to the hospital. A total of 60 patients were enrolled in the present study over a period of six months beginning from March 2017 to August 2017.

Diagnosis of COPD was done according to ***Global Initiative for Chronic Obstructive Lung Disease guideline, 2016.***

Diagnostic Criteria for COPD

Diagnosis of COPD was previously established based on a combination of characteristic symptoms (chronic cough, expectoration and/or dyspnoea), suggestive findings on physical examination (hyperinflation, rhonchi) and documented airflow limitation on spirometry that was poorly reversible with bronchodilators in the presence of established risk factors (like tobacco smoking, domestic exposure to biomass fuel combustion or environmental tobacco smoke or occupational exposure to mineral dust).

Inclusion Criteria

1. COPD diagnosed as per Gold guidelines patients in stage I, II, III, IV.
2. Patients who have no COPD exacerbations over the preceding 6 weeks and willingness to undergo study-related testing that included spirometry and had documented airflow limitation on spirometry (as evidenced by a post-bronchodilator FEV1/FVC ratio less than 70%) at initial evaluation.
3. Patient should be in a stable state.
4. Patients should have no comorbidity.

Exclusion Criteria

1. Patient having drop in saturation to < 90% on 6-minute walk test.
2. Patient on long-term oxygen therapy.
3. Patient unable to perform 6 meter walk test (6-MWT) and Spirometry.

Each patient was subjected to the following:

1. Personal history.
2. History of comorbidities.
3. Body mass index (B):

Body mass index = Weight/ (Height) m^2 [13].

4. Airflow Obstruction (O):

Pre and post bronchodilator spirometric study was done according to ***Global Initiative for Chronic Obstructive Lung Disease guideline, 2015***. COPD staging was done according to GOLD 2016.

5. Dyspnea Severity (D):

The modified Medical Research Council (mMRC) scale was used for the evaluation of dyspnea [14].

6. Exercise Capacity (E):

It was assessed by 6-Minute walk Test (6MWT) whichwas simple test that requires a 30 meters hallway, but no exercise equipment or advanced training for technicians. This test measures the distance that a patient can walk on a flat, hard surface in a period of 6 minutes (6MWT) [15].

- **BODE index Score:** The overall index was calculated according to BMI, FEV1, mMRC, 6MWT by summing the points that were obtained as shown in Table 1. Further subgroupings like BODE 0, 1, 2, 3 were made, as defined in the formula [2].

It is classified into 4 stages according to scores:

Stage I (0-2), stage II (3-4), stage III (5-6), stage IV (7-10).

The higher the score, the more risk for hospitalization and death from COPD.

Table (1): Calculation of the BODE index. The total possible values range from 0 to 10:

Parameter	Points in BODE index			
	0	**1**	**2**	**3**
Body mass index (kg/m²)	> 21	≤ 21	-	-
FEV1 (% predicted)	≥ 65	50-64	36-49	**≤ 35**
MMRC dyspnea scale (score)	0-1	2	3	**4**
6 minute walking distance (m)	≥ 350	250-349	150-249	**≤ 149**

7. Quality of Life Questionnaire: The COPD Assessment Test was used to determine the quality of life and the results was correlated with the results of the components of BODE index [16].

Statistical analysis

Statistical presentation and analysis of the present study was conducted, using the mean, standard deviation, student t- test, Paired t-test, Chi-square, Linear Correlation Coefficient and Analysis of variance [ANOVA] tests by SPSS V17. In order to evaluate the correlation between parametric variables, the Pearson's correlation coefficient was utilised; p values < 0.05 were considered statistically significant.

3. Results

During the study period of six months a total of 60 patients, who fulfilled the inclusion criteria were enrolled for the study.

Table no. 2 shows The mean age was 63.383 ± 10.306, the sex ratio (M: F) was 58:2, smoking status indicated that the majority of studied cases were Ex-smokers and only 3.33% were passive smokers. BMI (kg/m^2), FEV1% predicted were 25.338±4.810, 40.433±9.464, and FEV1/FVC (base), mMRC, 6 MWT (m), BODE index and CAT Score were 53.867±7.545, 1.8±0.9, 204.900±83.926, 6.067±1.745, 27.967 ± 7.746 respectively.

Table 2: Showing Distribution of Demographic Data

Demographic Data	**N = 60**
Age (years)*	63.383 ± 10.306 (40 – 87)
Sex (M:F)	58:2 (96.67%: 3.33%)
Smoking Status:* **Current smoker** **Ex-smoker** **Smoking and Shisha** **Passive smoker**	 12 (20.00 %) 40 (66.67%) 6 (10.00%) 2 (3.33%)
WT (kg)	76.083±12.927 (49-106)
HT (cm)	173.583±7.742 (155-190)
BMI (kg/m^2)*	25.338±4.810 (15.6-37.3)
FEV1 (% pred.) post-bronchodilator	40.433±9.464 (24–64)
FEV1/FVC (base) post bronchodilator*	53.867±7.545 (38–68)
mMRC*	1.8±0.9 (2–4)
6Minutes Walk Test (meters)*	204.900±83.926 (45-400)
BODE Index*	6.067±1.745 (2-9)
CAT Score*	27.967±7.746 (9-40)

Values are presented as mean SD unless otherwise indicated.
Scores on the modified MRC dyspnea scale can range from 2 to 4, with a score of 4 indicating that the patient is too breathless to leave the house or becomes breathless when dressing or undressing.
*= value express as mean ± standard deviation (Min-Max), N (%), M = Male, F = Female, WT = Weight, HT = Height, cm = centimeter, kg/m^2 = kilogram per square meter, m = metre, BMI = Body Mass Index, FEV1 = Forced Expiratory Volume in the first second, FVC = Forced Vital Capacity, mMRC = Modified Medical Research Council Scale, 6MWT = 6-Minute Walk Test.

Table no. 3 shows COPD GOLD Stage of studied patients in 3 stages. In stage II (moderate) the mean BODE index was 3.727 ± 0.905 and CAT score was 17.818 ± 4.644. In Stage III (severe) the mean BODE index was 6.532 ± 1.412 and CAT score was 30.000 ± 6.318. Similarly, in Stage IV (very severe) the mean BODE index was 8.000 ± 1.414 and CAT score was 36.000 ± 5.657. On comparison of the patients among the three COPD GOLD stages, the p-value was highly significant in BODE index and CAT Score, (p < 0.001).

Table 3: Comparison of BODE Index and CAT Score with COPD GOLD Stage

COPD GOLD Stage								
	Moderate	**Severe**	**Very severe**	**ANOVA**		**TUKEY'S Test**		
	Mean± SD	**Mean± SD**	**Mean± SD**	**F**	**P-value**	**II & III**	**II & IV**	**III & IV**
BODE Score	3.727± 0.905	6.532± 1.412	8.000± 1.414	21.777	<0.001*	<0.001*	<0.001*	0.289
CAT Score	17.818± 4.644	30.000± 6.318	36.000± 5.657	19.919	<0.001*	<0.001*	0.001*	0.361

P < 0.001 = highly significant

Table no. 4 shows mMRC dyspnea scale of studied patients in 3 grades. In Grade II the mean BODE index was 4.458 ± 1.103 and CAT score was 20.500 ± 5.022. In Grade III the mean BODE index was 6.938 ± 1.076 and CAT score was 32.156 ± 4.190. Similarly, in grade IV the mean BODE index was 8.750 ± 0.500 and CAT score was 39.250 ± 1.500. On comparison of the patients among the three Dyspnea mMRC scale grades, the p-value was highly significant in BODE index and CAT Score, ($p < 0.001$).

Table 4: Comparison of BODE Index and CAT Score with mMRCDyspnea Scale

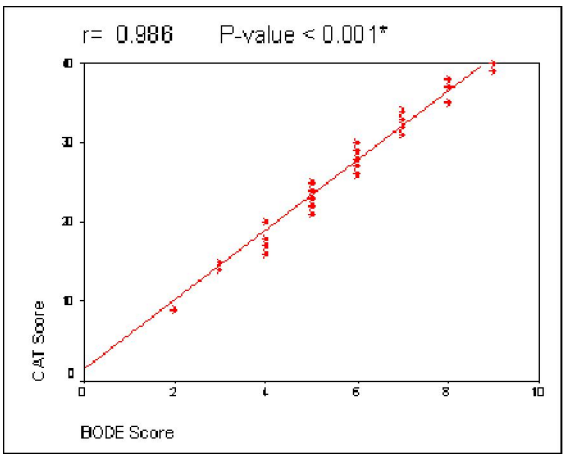
mMRC Dyspnea Scale								
	Grade II	Grade III	Grade IV	ANOVA		TUKEY'S Test		
	Mean± SD	Mean± SD	Mean± SD	F	P-value	II & III	II & IV	III & IV
BODE Score	4.458± 1.103	6.938± 1.076	8.750± 0.500	50.815	<0.001*	<0.001*	<0.001*	0.006*
CAT Score	20.500 ± 5.022	32.156± 4.190	39.250± 1.500	60.705	<0.001*	<0.001*	<0.001*	0.011*

Table no. 5 shows that on comparison of the patients, it was observed that while there was no significant difference in the Age, BMI and FEV1/FVC, The p-value was highly significant in FEV1%, 6MWT, BODE index and CAT Score, ($p < 0.001$).

Table 5: Comparison of BODE Index and CAT Score with Age, BMI, FEV1% Post Bronchodilator and 6MWT (m) Parameters

	BODE Score		CAT Score	
	r	P-value	r	P-value
CAT Score	0.986	<0.001*		
Age	0.341	0.008*	0.352	0.006*
BMI	-0.191	0.144	-0.137	0.295
FEV1 (%pred) post bronchodilator	-0.733	<0.001*	-0.708	<0.001*
6Minutes Walk Test (meters)	-0.732	<0.001*	-0.770	<0.001*

Correlation is significant at the 0.01 level (2-tailed). Correlation is significant at the 0.05 level (2-tailed), $p < 0.001$ = highly significant.



Line Graph showing Correlation between BODE Score and CAT Score

4. Discussion

COPD is a complex disease with multiple consequences including breathlessness, exercise limitation, muscle wasting, weight loss, increased hypercoagulability, depression, coronary artery disease and other systemic inflammatory effects [3].

Chronic obstructive pulmonary disease (COPD) has been a major public health problem during the 20th century, and will remain a challenge for the foreseeable future. Worldwide, COPD is in the spotlight, because its high prevalence, morbidity, and mortality create formidable challenges for healthcare systems [5].

COPD prevalence, morbidity and mortality in Egypt are still lacking and have to be estimated; however COPD is arising significant health problem in Egypt [6].

Recently, the BODE (body mass index, airflow obstruction, dyspnea, and exercise capacity) index, a Multidimensional grading system, was shown to be better than FEV1 alone in predicting the risk of death among patients with COPD. This multistage scoring system that incorporates an assessment of symptoms (dyspnea by MMRC), nutritional status (BMI), and exercise capacity (6MWT) together with the spirometric measure of airflow (FEV1) can provide useful prognostic information in patients with COPD [2].

This study was carried out to investigate the interrelationship between disease severity measured by

the BODE index and HRQoL measured by the CAT score in COPD patients in Kafr El-sheikh Chest Hospital during the period from March 2017 to August 2017 as regard demographic and clinical characteristic of the patients.

In the current study, among the 60 COPD patients, a highly significant correlation was found between BODE index and Disease Severity (COPD stages) according to GOLD**;** this was surely due to the impact of FEV1 in both GOLD staging and BODE index. Also, The BODE index was found highly significantly related to mMRC Dyspnea Scale and 6MWT (meters).

Weight loss is one of the common systemic effects of COPD. In a retrospective study of 400 patients, Schols AM et al reported increased mortality in severe COPD patients with chronic hypoxaemia and a BMI < 25 kg/m2 [17]. Another study showed a significant correlation between Fat Free Mass Index (FFMI) and MMRC, FEV1, FEV1/FVC. BMI and FFMI were found to be related to 6-MWT, but there was no correlation between BMI and disease severity. It was suggested that FFMI showed a better correlation with disease severity than BMI. 6-MWT utilisation has recently been increased in the evaluation of functional status and exercise performance of COPD patients. In the current study similar to Marin's findings [18]6-MWT was found correlated with mMRC, COPD stage according to GOLD and FEV1% post bronchodilator. There was also a highly significant relationship between 6-MWT and age.

In present study, the CAT score was found to be highly significantly and positively related to BODE index as r = 0.986 and p <0.001. Also, there was A highly significant correlation with each component of BODE index: BMI, FEV1% pred. post bronchodilator, MMRC Dyspnea Scale and 6MWT (meters) and Disease Severity (COPD stages) according to GOLD. **Ladeira I et al.** was reported positive correlation between CAT score and BODE index as R = 0.475, p < 0.001 [19]. Another study of **Gu et al.,** was found to be positive correlated as r = 0.888 and p < 0.001[3]. Further on comparison, the positive correlations found with BODE index reinforce the discriminative validity of CAT as a complement in the evaluation of what the true impact of COPD is on a patient's daily life. The CAT is relevant to the BODE index in evaluating incidence of exacerbation and mortality for patients with COPD and CAT is more easily to be applied.

The CAT with a good sense of the health impact associated with BODE index. More generally they provide a surprising insight into the severity of the effects of COPD, even in patients with apparently mild-moderate health status impact.

Conclusion

On the basis of observations made in the present study comparing the patients among the four COPD GOLD stages, it was observed that there was no significant association with age, BMI and 6MWT (meters). However, a highly significant association of different GOLD stages with BODE index and CAT score was observed (p < 0.001). It was observed that increase in mMRC grade and decrease in 6-MWT is associated with increased CAT score. FEV1 (%) predicted had a negative correlation (r = -0.708) with CAT score; the BODE index (r = 0.986) was positively correlated with CAT scores. This association was found to be statistically highly significant (p < 0.001). These results provide users of the CAT with a good sense of the health impact associated with the BODE index score. When the relation of these parameters with each other was investigated, a high degree of correlation was observed (Pearson correlation test). The correlation of CAT and BODE index was higher than others. It highlights the importance of CAT as a complement to the BODE index in the evaluation of the true impact of COPD on patients' daily lives.

Therefore, the BODE index is a clinical test which evaluates the pulmonary and extra-pulmonary effects of the disease all together. In this study, it was showed the feasibility of BODE and the efficacy of CAT. In the future, the BODE index could replace FEV1 and with CAT, they could become the standard for the classification and clinical evaluation of COPD, as measuring the real impact of COPD on the quality of life of patients using CAT ("COPD Assessment Test") can complement BODE index, an indicator of mortality.

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