

Original article:

A cross sectional study assessing severity and systemic involvement in chronic obstructive pulmonary disease by bode index and gold classification

¹Dr. Pramod Thakral , ²Dr. Sivaranjani R , ³Dr. Manak Gujrani , ⁴Dr Abhishek Kawatra

¹Junior specialist, Department of Respiratory Medicine & Tuberculosis, S.P.Medical College, Bikaner, Rajasthan

²Asst. Professor, Department of Respiratory Medicine & Tuberculosis, Mahatma Gandhi Medical College, Pondicherry

³Head & Professor, Department of Respiratory Medicine & Tuberculosis , S.P.Medical College, Bikaner, Rajasthan

⁴Assistant Professor, Department of community Medicine, S.P.Medical College, Bikaner, Rajasthan

Corresponding author: Dr. Sivaranjani R

Abstract:

Chronic obstructive pulmonary disease (COPD) is a lung disease characterized by chronic obstruction of lung airflow that interferes with normal breathing and is not fully reversible. Global burden of COPD is increasing with increase in mortality, morbidity and prevalence of disease. The use of the BODE index to determine the risk of hospitalizations due to exacerbations and as well as its use to predict response to pulmonary rehabilitation programs. This study emphasizes on the fact that BODE index can be used as a valuable predictor of hospitalization and severity of systemic involvement in patients with COPD and The aim of this study is to compare BODE index and GOLD classification in prediction severity and systemic involvement in chronic obstructive pulmonary disease.

Key words: COPD, BODE Index, GOLD Classification, FEV₁

Introduction:

Chronic obstructive pulmonary disease (COPD) is a major cause of morbidity and mortality throughout the world. The morbidity and economic costs associated with COPD are very high, generally unrecognised and more than twice that associated with asthma.

The prevalence and burden of COPD are projected to increase in the coming decades due to continued exposure to COPD risk factors and the changing age structure of the world's population. It is projected to rank fifth in 2020 in burden of disease caused worldwide, according to a study published by the World Bank/World Health Organization.¹

Chronic obstructive pulmonary disease (COPD) is defined as a preventable and treatable disease with some significant extrapulmonary effects that may

contribute to the severity in individual patients. Its pulmonary component is characterized by airflow limitation that is not fully reversible. The airflow limitation is usually progressive and associated with an abnormal inflammatory response of the lung to noxious particles or gases.²

The pathogenesis and clinical manifestations of COPD are not restricted to pulmonary inflammation and structural remodeling³. Rather, this disorder is associated with clinically significant systemic alterations in biochemistry and organ function. As in other chronic inflammatory conditions, weight loss, muscle wasting, hypo proteinemia and tissue depletion are commonly seen in COPD patients⁴. Selective wasting of fat-free mass coupled with impaired respiratory and

peripheral muscle function and a reduced capacity for exercise occur in COPD patients^{2,5}.

These changes can overlap the pathologic findings present in other diseases associated with airflow obstruction, or other diseases that are manifested in the lung occur in COPD patients. Indeed, weight loss may directly impact poor prognosis in COPD patients. The systemic aspects of COPD include oxidative stress and altered circulating levels of inflammatory mediators and acute-phase proteins. The four factors that predicted the severity most were the body mass index (B), The degree of airflow obstruction (O), dyspnea (D) and exercise capacity (E) as measured by the six minute walk test. These variables were used to construct the BODE index, a multidimensional 10 point scale in which higher scores indicate a higher risk of death. The BODE index is a multidimensional grading system primarily used as a predictor of mortality risk in patients with COPD. However, this index has been widely used by the scientific community to classify the severity of COPD⁶⁻⁸. The use of the BODE index to determine the risk of hospitalizations due to exacerbations⁹ and as well as its use to predict response to pulmonary rehabilitation programs¹⁰ are examples of the use of this index outside the context of predicting mortality. Advances in understanding the systemic nature of COPD have given rise to the development of a combined index of multiple mortality predictors for this disease known as the “BODE index”. The BODE index includes both symptoms and physiological measurements and it has been reported as a better mortality predictor than forced expiratory volume in 1 second (FEV1)¹¹. It predicts mortality from any cause as well as respiratory causes and gives more comprehensive information than the FEV1-based staging system described in the Global

Initiative for Chronic Obstructive Lung Disease (GOLD)¹¹⁻¹³.

BODE index is being used as it is a better predictor of the risk of death from any cause and respiratory cause than GOLD alone¹¹. Also due to larger inter individual variability FEV₁ does not seem to be adequate as a basis for individual management plan in rehabilitation¹⁴. Studies has shown that GOLD classification is unidimensional but BODE index is multidimensional¹⁵. This study emphasizes on the fact that BODE index can be used as a valuable predictor of hospitalization and severity of systemic involvement in patients with COPD and This study is to compare BODE index and GOLD classification in prediction severity and systemic involvement in chronic obstructive pulmonary disease.

Material & Methods:

The cross sectional study was conducted in the Department of Respiratory Medicine, SP Medical College Bikaner. Total of 100 patients diagnosed to have Chronic Obstructive Pulmonary Disease (COPD) were included. The diagnosis of COPD was based on clinical criteria suggested by GOLD guidelines.

Key indicators for considering diagnosis of COPD

Consider COPD and perform spirometry if any of these indicators were present in an individual over age 40. These indicators were not diagnostic themselves but the presence of multiple key indicators increases the probability of a diagnosis of COPD.

Dyspnea that was: Progressive (worsens over time)

- Usually worse with exercise
- Persistent (present every day)
- Described by patient as an “increased effort to breathe”, “heaviness”, “air hunger” or “gasping”

- Chronic cough: May be intermittent or may be unproductive
- Sputum production: Any pattern of chronic sputum production may indicate COPD

History of exposure to risk factors: Tobacco smoke, occupational dust and chemicals, smoke from home cooking and heating fuels.

Inclusion criteria

1. Diagnosis of COPD consistent with recommendations of GOLD
2. A stable clinical state / Patient's not on oxygen therapy
3. Acceptable performance of spirometry as recommended by ATS
4. FEV_1/FVC ratio $\leq 70\%$
5. Chest radiograph PA showing no evidence of acute infection or any other pulmonary

Gold classification

The staging were done as per the GOLD criteria (2010).

Stage I : Mild $FEV_1/FVC < 0.70$

$FEV_1 \geq 80\%$ Predicted

Stage II : Moderate $FEV_1/FVC < 0.70$

$\geq 50\%$ $FEV_1 < 80\%$ Predicted

Stage III: Severe $FEV_1/FVC < 0.70$

$\geq 30\%$ $FEV_1 < 50\%$ Predicted

Stage IV: Very Severe $FEV_1/FVC < 0.70$

$FEV_1 < 30\%$ predicted or $FEV_1 < 50\%$ plus chronic Respiratory failure SPO_2

FEV_1 : Force expiratory volume in one second;

FVC : Forced vital capacity

A detailed history regarding number of days of hospital admission in the last two years was obtained from the patients response to the question "how many days have you been admitted in hospital in the past 2 years due to reasons related to COPD?" Patient's discharge cards were also reviewed.

Statistical Analysis

Data were examined for normality of distribution and homogeneity of variance. Appropriate

disease and compatible with a diagnosis of COPD.

Exclusion criteria

1. Patient with any other concurrent (or past) pulmonary or systemic disease (bronchial asthma, ILD, Active or inactive pulmonary TB)
2. Lactating and pregnant females
3. Any active neurological, rheumatological or peripheral vascular disease.
4. Patients with elevated systolic blood pressure ≥ 180 mmHg and diastolic BP ≥ 100 mmHg.
5. Resting tachycardia ≥ 120 beats/minute, Unstable angina
6. Inability to perform spirometry or six min walk test.

statistical tests (Parametric and non-parametric) were used depending upon the data and the questions to be answered. These were included student's t test and chi square test to compare means and proportions. GOLD and BODE index classification are compared and analyzed in descriptive statistics.

Results:

The present study show majority of cases at Stage II were in age group 46-55 years (55.6%) and at

stage III it was in >65 years (45.7%) and at stage IV they were in age group 46-65 years (48.5%). The data further reveals that mean age increases with increase in stage of severity and this difference was statistically significant (P <0.001) (Table 1). The data on the distribution of cases according to the GOLD severity and age of the patient is presented (Table 2). The data further reveals that mean age increases with increase in stage of severity this difference was statistically significant (P <0.001).

The results observed in Table no. 3, BODE stages I, III and IV had less BMI values in

comparison to GOLD stages. In table no. 3 when we compare FEV₁ between BODE and GOLD stages the difference was found statistically highly significant in all stages (I, II, III, IV) (p<0.001).

The present study show the mean values of hospital stay is less in BODE stages I and II where mean value of hospital stay is less in GOLD stage III and IV and observed that Bode index using as tool to access the severity of COPD in terms of hospitalization in BODE stages I, II (0.20, 0.37) is less as compared to GOLD stage I & II (0.56 & 2.36) (Table no. 5).

Table 1 Distribution of cases according BODE Severity Stages in relation to age group (years)

Age Group (years)	BODE Severity Stages								Total	
	I		II		III		IV			
	No.	%	No.	%	No.	%	No.	%	No.	%
≤45	2	40.0	4	14.8	4	11.4	1	3.0	11	11.0
46-55	2	40.0	15	55.6	5	14.3	7	21.2	29	29.0
46-65	1	20.0	3	11.1	10	28.6	16	48.5	30	30.0
>65	0	-	5	18.5	16	45.7	9	27.3	30	30.0
Mean	48.20		54.19		61.14		60.15			

Table 2 Distribution of cases according GOLD Severity Stages in relation to age group (years)

Age Group (years)	GOLD Severity Stages								Total	
	I		II		III		IV			
	No.	%	No.	%	No.	%	No.	%	No.	%
≤45	5	18.5	2	8.0	2	14.3	2	5.9	11	11.0
46-55	15	55.6	6	24.0	2	14.3	6	17.6	29	29.0
46-65	5	18.5	7	28.0	4	28.6	14	41.2	30	30.0
>65	2	7.4	10	40.0	6	42.9	12	35.3	30	30.0
Mean	52.11		60.32		60.00		61.00			
SD	7.50		8.44		9.17		8.27			
P	<0.001									

Table 3 Statistical comparison of BMI between GOLD and BODE Staging Criteria

BMI	Staging Criteria							
	I		II		III		IV	
	BODE	GOLD	BODE	GOLD	BODE	GOLD	BODE	GOLD
Mean BMI	17.60	22.22	19.47	21.71	20.01	21.10	19.71	19.57
SD	1.00	1.69	3.02	2.52	3.78	3.38	3.71	4.23
T	16.469		3.986		1.504		0.174	
P	<0.001		<0.001		>0.05		>0.05	

Table 4 Statistical comparison of FEV₁ between GOLD and BODE Staging Criteria

FEV ₁	Staging Criteria							
	I		II		III		IV	
	BODE	GOLD	BODE	GOLD	BODE	GOLD	BODE	GOLD
Mean FEV ₁	85.00	83.11	77.33	57.20	35.26	28.07	50.03	39.14
SD	2.74	2.50	11.44	6.73	11.19	10.19	12.51	8.47
T	3.567		10.616		3.325		5.046	
P	<0.001		<0.001		<0.001		<0.001	

Table 5 Statistical comparison of Hospital Stay between GOLD and BODE Staging Criteria

Parameters	Staging Criteria							
	I		II		III		IV	
	BODE	GOLD	BODE	GOLD	BODE	GOLD	BODE	GOLD
Hospital Stay	0.20	0.56	0.37	2.36	8.12	7.98	14.41	13.14
SD	0.00	1.48	0.79	3.21	2.85	4.08	4.31	4.45
T	1.703		4.214		0.197		1.435	
P	<0.05		<0.001		>0.05		>0.05	

Discussion:

COPD is predicted to be one among the most common killer diseases affecting a large number of

individuals by the year 2020. In the recent past, more stress has been given to formulate a simple but effective index for assessing the severity of

COPD. Researchers have found that BODE index would fulfil this necessity. But most of the research has been limited to finding the usefulness of the index in predicting the mortality and hospitalization in patients with COPD. Thus, although the FEV1 is important to obtain and essential in the staging of disease in any patient with COPD, it alone as the sole parameter of severity does not throw light on the systemic involvement and progression of the disease.

In this study we tried to compare the BODE Index and GOLD in predicting the severity of COPD in terms of hospitalization, systemic involvement and the level of systemic inflammation. The study has brought out many results which would have a significant impact in the management of COPD.

Kian-Chung et al¹⁶ and Celli et al¹¹ has shown in their studies that BODE score significantly increases with age. This study also shows a significant increase in BODE score and GOLD stage increases with age. This could be due to the progression of COPD with age. However results from a few other studies^{17,18} do not show significant progression with age.

Staging based solely on the FEV1 incompletely describes the complexity of COPD and that it has become desirable to evaluate the patient more comprehensively if we are to impact on outcomes. Dyspnea is the cardinal, most disabling symptom of COPD¹³ and the primary reason for patients to seek medical attention¹⁹. The perception of breathlessness differs from patient to patient, as it responds to the interaction of respiratory mechanics including airflow limitation, and other cognitive and non-volitional neuronal processes. The spirometric classification, though good in many ways is not full proof for the assessment of severity of COPD. The FEV1 is essential for the diagnosis and quantification of the respiratory impairment resulting from COPD^{20,21}. In addition, the rate of

decline in FEV1 is a good marker of disease progression and mortality¹⁷. However, the FEV1 does not adequately reflect all the systemic manifestations of the disease.

Our findings of the usefulness of the BODE index in predicting hospitalization for COPD are also supported by the findings of a prospective study²² of risk factors of hospital readmissions for COPD exacerbation. In that study, a strong association between the usual physical activity and reduced risk of COPD readmission was demonstrated. Moreover, the association did not change when adjusted for FEV1 or nutritional status. These results are in agreement with the increased risk of COPD hospital admission associated with a limited 6-min walking test reported by another group of investigators²³. Therefore, it may be speculated that the superior value of the BODE index compared to FEV1 in predicting hospital admissions for COPD that we have observed, is accounted for by the evaluation of physical performance status among the individual components of the BODE scoring system. Admission to the hospital and heavy use of health-care resources is a common feature of COPD. A clinical implication of the present study is that the BODE scoring system may prove to be helpful in health-care resource allocation and in guiding therapy for individual patients in the future. This multistage scoring system, which incorporates variables that can be evaluated easily in any office setting, should not be difficult or costly to implement routinely. As the BODE index can provide useful prognostic information of survival and hospitalization, the findings of the present study are in support of the utility of the BODE index as an assessment tool for COPD patients.

Conclusion:

Thus present study concludes that BODE index is reliable method to predict hospitalization and the

severity of systemic involvement in patients with COPD.

GOLD classification is unidimensional whereas BODE index is multidimensional. Being multidimensional BODE index include many parameters which are additive and better predictors of progression of disease, Exacerbation, Hospital admissions, morbidity, and mortality. BODE index

prove to be better, easy to perform and comprehensive system for use in COPD evaluation.

The BODE scoring system is a reliable index than GOLD staging to predict hospitalizations and the severity of systemic involvement in patients with COPD. This makes it a practical tool of potentially widespread applicability and for comprehensive evaluation of COPD and its systemic effects.

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