ASSESSMENT OF SEVERITY OF COPD BASED ON "BODE" INDEX

K. S. Phaneendra Kumar¹, P. Yugandhar², C. A. Umesh Varma³, V. Frank Mohan⁴, S. Satya Sri⁵

HOW TO CITE THIS ARTICLE:

K. S. Phaneendra Kumar, P. Yugandhar, C. A. Umesh Varma, V. Frank Mohan, S. Satya Sri. "Assessment of Severity of COPD Based on "Bode" Index". Journal of Evolution of Medical and Dental Sciences 2015; Vol. 4, Issue 04 January 12; Page: 530-538, DOI: 10.14260/jemds/2015/79

ABSTRACT: Chronic Obstructive Pulmonary Disease (COPD), the third leading cause of death in the world, causes 3.1 million deaths worldwide¹ and represents an important public health challenge that is both preventable and treatable. Globally, the COPD burden is projected to increase in coming decades because of continued exposure to COPD risk factors and ageing of the population. The four factors that predicted the severity most were the body-mass index (B), the degree of airflow obstruction (0), dyspnea (D), and exercise capacity (E), 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 severe disease and higher risk of death.A total of 60 cases have been studied in ASRAM Medical College, Eluru, during the period between January 2013 and July 2014. A total of 20 controls were selected randomly from the patients who attended master checkup. This prospective study was conducted after the approval from the Ethical Committee of the institution. In this study 56.66% of cases are between age groups of 50 to 70. Mean age of severe disease group is 66 years (SD-11.8). This study also shows a significant decrease in BMI as BODE score increases. Smoking is a well-recognized risk factor for COPD. This study shows a significant association between smoking and BODE index. This study revealed that there was a significant increase in the BODE index in patients with a longer duration of smoking (Pack years). BODE index is a very good predictor of hospitalization. In this study there is a positive correlation between higher BODE index and longer period of hospitalization. This study also elaborates that the distance walked by patients with higher BODE scores is less when compared to other groups and controls. In this study FEV₁ levels of BODE score in severe COPD group correlates well. This study concludes that BODE index is a useful tool in assessing the severity of COPD in terms of hospitalization and mortality. As the variables included in BODE index are easy, economical and can be done with ease, it is a reliable method to classify COPD patients and treat them accordingly, especially in situations with resource constraints as in developing countries like India.

KEYWORDS: Bode, index, copd.

INTRODUCTION: Chronic Obstructive Pulmonary Disease (COPD), the third leading cause of death in the world, causes 3.1 million deaths worldwide¹ and represents an important public health challenge that is both preventable and treatable. Globally, the COPD burden is projected to increase in coming decades because of continued exposure to COPD risk factors and ageing of the population. The pathogenesis and clinical manifestations of COPD are not just restricted to pulmonary inflammation and structural remodeling. Rather, this disorder is associated with clinically significant systemic alterations in biochemistry and organ function. The systemic aspects of COPD include oxidative stress and altered circulating levels of inflammatory mediators and acute-phase proteins. As in other chronic inflammatory conditions, weight loss, muscle wasting and hypo proteinemia are commonly seen in COPD patients. Selective wasting of fat-free mass coupled with impaired respiratory

and peripheral muscle function and a reduced capacity for exercise occur in COPD patients. Indeed, weight loss may directly impact poor prognosis in COPD patients. The severity of COPD is usually assessed on the basis of a single parameter – forced expiratory volume in one second (FEV1).

However the patients with COPD have systemic manifestations that are not reflected by theFEV1. Hence a multidimensional grading system that assessed the respiratory and systemic expressions of COPD was designed to predict outcome in these patients.

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), 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 severe disease and higher risk of death. The process of allocating scarce medical resources to the most needed patients can be extremely difficult in diseases, which affect a large number of patients. Decision makers need a rational and consistent scoring system that is designed to identify those who are maximally in need of a diagnostic or therapeutic intervention under a health-care budget constraint. BODE index has been proposed to serve this purpose in patients with chronic obstructive pulmonary disease (COPD). In our study we analyzed the BODE index as a predictor of severity of COPD, Hospitalization, severity of systemic involvement, association between smoking and severity of disease.

AIMS: To validate BODE index as a reliable tool in assessing the severity of COPD.

OBJECTIVES:

- 1. To determine whether higher BODE index correlates with more severe COPD.
- 2. To determine whether higher scoring in BODE index in chronic obstructive pulmonary disease correlates with more years of cigarette smoking.
- 3. To determine whether higher scoring in BODE index is associated with more days of hospitalization.
- 4. To determine whether higher BODE index correlates with poor nutritional status.

METHODS AND MATERIALS: A total of 60 cases have been studied in ASRAM Medical College, Eluru, during the period between January 2013 and July 2014. A total of 20 controls were selected randomly from the patients who attended master checkup, representing the same population group from which the cases were selected after applying the same exclusion criteria irrespective of their smoking history. This prospective study was conducted after the approval from the Ethical Committee of the institution.

INCLUSION CRITERIA: As per GOLD guidelines2, any patient who has symptoms of chronic cough, sputum production or dyspnea. The values of Forced Expiratory Volume in first second (FEV1) less than 80% of the expected value and ratio of forced expiratory volume in first second to the forced vital capacity less (FEV₁%)than 0.7 (70%) after post bronchodilator inhalation were included in this study.

EXCLUSION CRITERIA: Recent myocardial infarction < 4months, Unstable angina. Congestive heart failure (NYHA class III or IV), Inability to perform spirometry or 6 minute walk test, Unrelated life threatening major illness, Liver disease, Patients with acute exacerbation and Female sex.

STUDY PROTOCOL: The patients with the following diagnostic criteria (according to the GOLD guidelines) were defined as having COPD: The presence of cough and sputum production for at least 3 months in each of the two consecutive years. Exertional dyspnoea. Physical examination showing: Signs of airflow limitation like prolonged expiration and expiratory wheeze. Signs of hyperinflation. Spirometry showing post bronchodilator FEV1/FVC ratio < 0.70.The present analysis was restricted to male patients only, who met the acceptability and reliability criteria of the American Thoracic Society to improve the diagnostic accuracy. As sex may be a confounding factor in many of the parameters assessed, female sex is excluded. For each enrolled subject, detailed history of smoking, personal and family medical history was obtained. On the day of enrollment, height and weight were measured twice during the examination. Weight was measured to the nearest 100 grams with bare foot. Height was measured to the nearest mm with the stadometer. Body mass index (BMI) was calculated by the formula. BMI = Weight in Kg / (Height in Mtrs square). Spirometry was performed with equipment that met the American Thoracic Society performance criteria. The test was done as per the ATS guidelines after giving salbutamol nebulization in all cases. Predicted FEV₁ and forced vital capacity (FVC) standardized for ethnicity, height, age and sex were used. FEV1 and FVC were calculated.

The procedure was repeated on two occasions and the average value was taken. A detailed history of the dyspnea experienced by the patient was taken. MMRC dyspnea scale was used to score the patients dyspnea. Six-minute walk test was performed as per ATS guidelines of 2002, twice with a gap of 30 minutes rest in between and the average was taken. Patients were asked to walk on a level ground for maximum possible distance within duration of 6 minutes. Periods of rest taken were also included in the 6 minutes test period. A detailed history regarding the hospital admissions in the past two years related to COPD was taken. BODE index is calculated from four variable FEV1, 6 min walk test, MMRC dyspnea scale and Body Mass Index. The patients received points ranging from 0 (lowest value) to 3 (maximal value). The points for each variable were added, so that the BODE index ranged from 0 to 10 points in each patient as per the table.

BODE score	0	1	2	.3
FEV1	≥65%	50 - 64%	36 - 49%	≤35%
6 min walk test	>350mtrs	250 - 349 mtrs	150 - 249 mtrs	<149 mtrs
Dyspnea scale	0-1	2	3	4
BMI	>21kg/m2	<21 kg/m2		
Table 1: BODE Variables and Scoring				

BODE INDEX:

SEVERITY OF COPD BASED ON BODE SCORE: Mild COPD (0 - 2), Moderate COPD (3 - 5), Severe COPD (≥ 6) .

STATISTICAL ANALYSIS: The Statistical software namely SPSS 11.0 was used for the analysis of the data and Microsoft word and Excel have been used to generate graphs, tables. Statistical significance was taken when the p value was less than 0.05.

J of Evolution of Med and Dent Sci/eISSN-2278-4802, pISSN-2278-4748/Vol. 4/Issue 04/Jan 12, 2015 Pa

OBSERVATIONS AND RESULTS: A total of 80 patients including 60 patients with COPD as cases and 20 healthy individuals as controls were enrolled in the study. All the cases and controls were males. Among patients with COPD, there were 16 (26.66%) patients who had mild COPD with a BODE score between 0 – 2. Moderate (BODE score of 3 – 5) and severe COPD (BODE score more than or equal to 6) groups had 22 patients (36.66%) each.

SEGREGATION OF CASES AS PER BODE INDEX:

Group	N	% of total sample	Mean BODE score	Standard deviation	
Control	20	25%	0.05	0.22361	
Mild(0-2)	16	20%	2	0	
Moderate(3-5)	22	27.5%	3.954	0.72225	
Severe(≥6)	22	27.5%	7.227	1.19251	
Table 2: Segregation of cases into Mild, Moderate and Severe by BODE index.					

AVERAGE AGE OF COPD CASES AND CONTROLS:

GROUP	Ν	MEAN AGE (years)	Std. deviation	One way ANOVA F-Test
Control	20	51.75	6.14	
Mild(0-2)	16	50.125	8.709	E - 1/ 1E0
Moderate(3-5)	22	53.636	7.52	r = 14.130 $n = 0.000 Significant$
Severe(≥6)	22	66.227	11.811	p – 0.000 Significant
Total	80	57.925	8.545	
Table 3: Age distribution of COPD cases and Controls				

BODYMASS INDEX AND COPD SEVERITY:

Group	N	Mean BMI Kg/mtr ²	Standard Deviation	One way ANOVA F Test	Multiple comparison (LSD)
Control	20	24.163	2.792		1 Vs 2, 3, 4
Mild	16	23.153	2.27	p-value=0.000	2 Vs 1, 3, 4
Moderate	22	22.31	1.527	F=12.137	3 Vs 1, 2, 4
Severe	22	20.07	2.422	Significant	4 Vs 1, 2, 3
Total	80	22.424			
Table 4: Body Mass Index of COPD cases and Controls					

SMOKING AND COPD SEVERITY:

Croup	N	Mean pack years	Standard	One way
Group	IN		Deviation	ANOVA F Test
Control	20	5.1	3.669	
Mild	16	16.375	5.897	p-0.000
Moderate	22	23.09	6.038	Significant
Severe	22	30.454	8.70	F-58.151
Total	80	18.754		
Table 5: Association of Smoking and COPD cases and Controls.				

SPIROMETRY AND COPD SEVERITY:

Group	N	Mean FEV ₁ %	Standard	One way
F		1.10	Deviation	ANOVA F Test
Control	20	87.3	6.383	
Mild	16	58.125	3.964	p-0.000
Moderate	22	57.72	11.183	significant
Severe	22	42.09	12.667	F-79.8
Total	80	61.30		
Table 6: Association between FEV1 and COPD severity				

6 MWT AND COPD SEVERITY:

Group	N	Mean 6 min. walk distance in Meters	Standard Deviation	One way ANOVA F Test
Control	20	498.5	54.19	
Mild	16	395.5	40.47	P-0.000
Moderate	22	289.31	60.53	Significant
Severe	22	176	36.6	F-163.18
Total	80			
Table 7: Association between 6 Minute walk test and COPD severity by BODE index				

DURATION OF HOSPITAL STAY OVER THE LAST TWO YEARS:

Group	N	Mean Hospital Stay in DAYS	Standard Deviation	One way ANOVA F Test	
Control	20	0	0		
Mild	16	6.5625	6.5622	p-0.000	
Moderate	22	15.181	4.3275	significant	
Severe	22	22.59	8.721	F-52.628	
Total	80				
Table 8: Association between COPD severity by BODE index and Hospital Stay					

DISCUSSION: Chronic obstructive pulmonary disease (COPD), a common disease characterized by a poorly reversible limitation in airflow, is predicted to be the third most frequent cause of death in the world by 2020. The risk of death in patients with COPD increases with the severity of disease, which is often graded with the use of a single physiological variable, the forced expiratory volume in one second (FEV₁).

However, other risk factors, such as the presence of hypoxemia or hypercapnia, a short distance walked in a fixed time, a high degree of functional breathlessness, and a low body-mass index (the weight in kilograms divided by the square of the height in meters), are also associated with an increased risk of death. A multi-dimensional grading system that assessed the respiratory, perspective, and systemic aspects of COPD is expected to better categorize the illness and predict the outcome than does the FEV₁ alone.

BODE index is useful because it includes one domain that quantifies the degree of pulmonary impairment (FEV1), one that captures the patient's perception of symptoms (the MMRC dyspnea scale), and two independent domains (the distance walked in six minutes and the body-mass index) that express the systemic consequences of COPD.

In this study BODE index is used to assess the severity of COPD and Categorize COPD cases into mild, moderate and severe cases. Studies by Celli et al and Kian Chung et al have proven that grouping COPD patients into three groups with BODE scores 0 - 2 as Mild COPD group, 3 - 5 as Moderate and 6 or more as the Severe group correlates well with severity in terms of hospitalization and morbidity. Hence, this study has adopted the same classification.

Moderate and severe cases of COPD have increased risk of exacerbations, which leads to increased chances for hospitalization and ICU admissions; hence they have high risk of morbidity and mortality.

Studies	Mean Age (years)	SD		
Joan B Soriano et al ³	66.8	14.6		
Fanny W.S. Ko et al ⁴	74.22	7.80		
B. R. Celli et al ⁵	66	9		
Kian-Chung Ong et al ⁶	70.9	8.2		
Present study	57.925	8.545		
Table 9: Mean age of COPD case in Various studies.				

Mean age of COPD case in Various Studies.

COPD is a disease of early adulthood. In this study 56.66% of cases are between age groups of 50 to 70.Mean age of severe disease group is 66 years (SD-11.8). Celli et al 5and Kian Chung et al 6 have shown in their respective studies that BODE score increases with age. In this study there is a significant correlation between age and BODE score. As the patient's age increases, the severity of disease increases. This could be due to progression of COPD with age and cumulative effect of smoking.

Annemie MWJ Schols et al ⁷ have shown in their study that fat-free mass is an independent predictor of mortality irrespective of fat mass. Kian-Chung Ong et al ⁶, Fanny W.S. Ko et al⁴ and B. R. Celli et al⁵ have shown that BMI and BODE score are inversely related. This study also shows a significant decrease in BMI as BODE score increases.

Studies on western COPD populations have reported higher prevalence of underweight. Landboet al⁸ from Denmark has reported that 9.6% of COPD patients were underweight (<20 kg/m2) in his study. PLATINO study⁹ conducted in five Latin American cities has reported 7% COPD patients to be underweight (<20 kg/m2). SAJAL DE et al ¹⁰ have reported 38% of COPD patients were underweight (BMI<18.5 kg/m2) in Indian population and mean BMI also was reduced significantly with progression of COPD severity.

Jayant Thomas Mathew et al¹¹ show that Indian patients with low BMI have bad prognosis with respect to recovery from an acute exacerbation and hospitalization.

Smoking is a well-recognized risk factor for COPD. This study shows a significant association between smoking and BODE index. Studies by Kian-chungetal, Celli etal, and Karoli et al¹² have proved that higher duration of smoking was associated with higher BODE index. This study revealed that there was a significant increase in the BODE index in patients with a longer duration of smoking (Pack years).

BODE index is a very good predictor of hospitalization. In this study there is a positive correlation between higher BODE index and longer period of hospitalization. Similarly studies done by Kian-chung et al clearly demonstrates that BODE scoring is superior in assessing risk of hospitalization compared to FEV1 alone. Fanny W.S. Ko et al⁴ show that a single measurement of BODE index could predict mortality and readmissions of COPD patients. Serial measurements of the BODE index Six monthly for 2 years were not useful for predicting mortality but appeared to have some predictive effect on readmissions in a group of patients treated with usual care.

B R Celli et al show that six-minute walk test is an independent predictor of mortality and morbidity in COPD patients; it reflects the systemic effects of COPD. It is a good predictor of the risk of death among patients with other chronic diseases, including congestive heart failure and pulmonary hypertension. Indeed, the distance walked in six minutes has been accepted as a good outcome measure after interventions such as pulmonary rehabilitation.

This study also elaborates that the distance walked by patients with higher BODE scores is less when compared to other groups and controls.

Shiv Sagar Gupta et al¹³ show that a significant association between COPD stage and SpO₂. Inour study there is no significant difference of SPO₂ between BODE groups, but significant difference between cases and controls were noted. This may be due to the fact that all cases were stable at the time these tests were done. More over SPO₂ is useful at the time of exacerbation and patient status in terms of respiratory failure can be assessed with SPO2 measurements.

In this study FEV₁ levels of BODE score in severe COPD group correlates well. But there is not much of significant difference between mild and moderate groups. Vestbo et al¹⁴ found a mean decline in FEV1 of 33±2 ml per year in patients with COPD. Huib A M Kerstjens et al¹⁵ show that there is a steady decline in FEV1 with increasing age (40-50ml per year), which is accelerated by smoking (15ml more than non-smokers per year). The FEV1 is essential for the diagnosis and quantification of the respiratory impairment resulting from COPD.2 In addition, the rate of decline in FEV1 is a good marker of disease progression and mortality. However, the FEV1 does not adequately reflect all the systemic manifestations of the disease.

BODE index is useful because it encompasses one domain that quantifies the degree of pulmonary impairment (FEV1), one that captures the patient's perception of symptoms (The MMRC dyspnea scale), and two independent domains (The distance walked in six minutes and the body-

mass index) that express the systemic consequences of COPD.

Besides its excellent predictive power with regard to outcome, the BODE index is simple to calculate and requires no special equipment. This makes it a practical tool with potential widespread applicability.

De Torres JP et al show¹⁶ that the BODE index had a better survival prediction than the ABCD GOLD categories.

A multiple component staging system combining FEV1, 6-min walking distance, dyspnea scored with the MMRC scale, and SPO2 was reported to better describe health-care resources utilization among COPD patients in different geographic areas than other international COPD classification systems suggested by (ATS, British Thoracic Society, and GOLD etc.). The BODE index was also reported to be a much better predictor of the severity in COPD acute exacerbations than FEV1.

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 by segregating patients with respect to severity of COPD 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. The findings of the present study are in support of the usefulness of the BODE index as an assessment tool for COPD patients in providing useful prognostic information of survival and hospitalization.

LIMITATIONS OF THE STUDY:

- The study was a hospital based study and may be limited in its application to general population.
- The size of sample is very small, and to be representative of general population, further studies with a larger or a wider sample may be needed.
- As female patients were excluded, this study was limited for application to male population only.

REFERENCES:

- 1. The global burden of disease: 2004 update, 2008 WHO. Prevention and control of noncommunicable diseases: guidelines for primary health care in low resource settings, 2012. World Health Organization.
- 2. Global initiative for chronic obstructive lung disease. Global strategy for the diagnosis, management and prevention of chronic obstructive pulmonary disease. 2014; available from www.goldcopd.com.
- 3. Joan B Soriano, William C Maier, Peter Egger- Recent trends in physician diagnosed COPD in Women and men in the UK-Thorax 2000; 55: 789-794.
- 4. Fanny W.S. Ko, Wilson Tam, Alvin H.M. Tung, Jenny Ngai, Susanna S.S. Ng, Kenneth Lai, Ka-Fai Au, David S.C. Hui- A longitudinal study of serial BODE indices in predicting mortality and readmissions for COPD- Respiratory Medicine (2011) 105, 266e273.
- 5. Celli BR, Cote CG, Marin JM, et al. The body-mass index, airflow obstruction, dyspnoea, and exercise capacity index in chronic obstructive pulmonary disease. N Engl J Med 2004; 350: 1005–12.

J of Evolution of Med and Dent Sci/ eISSN- 2278-4802, pISSN- 2278-4748/ Vol. 4/ Issue 04/Jan 12, 2015

- 6. Kian Chung Ong, FRCP; Arul Earnest, MSc; and Suat-Jin Lu, MBBS: A multidimensional grading system (BODE INDEX) as a predictor of hospitalization for COPD. Chest 2005; 128: 3810-3816.
- 7. Schols AM, Slangen J, Volovics L, Wouters EF. Weight loss is a reversible factor in the prognosis of chronic obstructive pulmonary disease. Am J RespirCrit Care Med 1998; 157: 1791-1797.
- 8. Landbo C, Prescott E, Lange P, Vestbo J, Almdal TP. Prognostic value of nutritional status in chronic obstructive pulmonary disease. Am J RespirCrit Care Med 1999; 160: 1856-1861.
- 9. Menezes AM, Perez-Padilla R, Jardim JR, Muiño A, Lopez MV, Valdivia G, Montes de Oca M, Talamo C, Hallal PC, Victora CG;-PLATINO STUDY- Chronic obstructive pulmonary disease in five Latin American cities (The PLATINO study): a prevalence study-Lancet. 2005 Nov 26; 366 (9500): 1875-81.
- 10. Sajal de et al Indian J PhysiolPharmacol 2012; 56 (4): 353–358.
- 11. Jayant Thomas Mathew, Veena GV, Anura V Kurpad, George A D'Souza- NUTRITIONAL STATUS PREDICTS OUTCOME IN PATIENTS HOSPITALISED WITH EXACERBATION OF COPD- Lung India 2006; 23: 143-146.
- 12. Karoli NA, Rebrov AP. The BODE index as a predictor of unfavourable prognosis in chronic obstructive pulmonary disease. TerArkh. 2007; 79 (3): 11-4.
- 13. Shiv Sagar Gupta, DiptiGothi -Correlation of BMI and oxygen saturation in stable COPD in Northern India-Lung India 2014 Jan-Mar.
- 14. Vestbo and colleagues -Change in FEV1 over Time in COPD- N Engl J Med 2011; 365: 2540-2541 December 29, 2011DOI: 10.1056/NEJMc1112576.
- 15. Huib A M Kerstjens, Bert Rijcken, Jan P Schouten, Dirkje S Postma -Decline of FEV1 by age and smoking status: facts, figures, and fallacies- Thorax 1997; 52: 820–827
- 16. de Torres JP1, Casanova C2, Marín JM3, Pinto-Plata V4, Divo M4, Zulueta JJ1, Berto J1, Zagaceta J1, Sanchez-Salcedo P1, Cabrera C4, Carrizo S3, Cote C5, Celli BR6.- Prognostic evaluation of COPD patients: GOLD 2011 versus BODE and the COPD comorbidity index COTE.-Thorax. 2014 Sep; 69 (9): 799-804.

AUTHORS:

- 1. K. S. Phaneendra Kumar
- 2. P. Yugandhar
- 3. C. A. Umesh Varma
- 4. V. Frank Mohan
- 5. S. Satya Sri

PARTICULARS OF CONTRIBUTORS:

- Post Graduate, Department of Pulmonary Medicine, Alluri Seetharama Raju Academy of Medical Sciences, Eluru.
- 2. Professor, Department of Pulmonary Medicine, Alluri Seetharama Raju Academy of Medical Sciences, Eluru.
- 3. Post Graduate, Department of Pulmonary Medicine, Alluri Seetharama Raju Academy of Medical Sciences, Eluru.

- 4. Post Graduate, Department of Pulmonary Medicine, Alluri Seetharama Raju Academy of Medical Sciences, Eluru.
- 5. Professor & HOD, Department of Pulmonary Medicine, Alluri Seetharama Raju Academy of Medical Sciences, Eluru.

NAME ADDRESS EMAIL ID OF THE CORRESPONDING AUTHOR:

Dr. K. S. Phaneendra Kumar, # 16-2-37, Kota Street, Gavarapalem, Anakapalli, Vizag Dt. E-mail: drkonathala@yahoo.co.in

> Date of Submission: 24/12/2014. Date of Peer Review: 26/12/2014. Date of Acceptance: 02/01/2015. Date of Publishing: 09/01/2015.