Original research article

Relation between bode index and duration of hospital stay in chronic obstructive pulmonary disease

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 Abstract
The pathogenesis and clinical manifestations of COPD are not restricted to pulmonary inflammation and structural remodelling. Rather, this disorder is associated with clinically significant systemic alterations in biochemistry and organ function. There are a number of pathological alterations of the lung in COPD. A total of 130 patients were enrolled into the study. Of these, 100 patients with symptoms suggestive of COPD were selected as cases and 30 patients were selected as controls. The control group and the mild COPD group did not have any significant hospital admission during the past 2 years. The average duration of stay in the moderate study group was 4.26 days while it was 9.31 days in the group with severe COPD according to the BODE score.
Keywords: Bode index, hospital stay, chronic obstructive pulmonary disease

Introduction
Chronic Obstructive Pulmonary Disease (COPD) is an important public health challenge and a major cause of morbidity and mortality across the globe. COPD is currently the fourth leading cause of death in the world. According to World Health Organization estimates, 65 million people have moderate to severe COPD. More than 3 million people died of COPD in 2005 corresponding to 5% of all deaths globally and it is estimated to be the third leading cause of death by 2030. Most of the information available on COPD prevalence, morbidity and mortality comes from high- income countries [1]. Even in those countries, accurate epidemiologic data on COPD are difficult and expensive to collect. However, it is known that low-and middle-income countries already shoulder much of the burden of COPD with almost 90% of COPD deaths taking place in these countries. In this issue of *Lung India*, the joint ICS/NCCP (I) consensus guidelines for the diagnosis and management of COPD have been published to facilitate the Indian practitioner in burden reduction, diagnosis and management of COPD. Globally, the COPD burden is projected to increase in coming decades because of continued exposure to COPD risk factors and aging of the population.

The pathogenesis and clinical manifestations of COPD are not restricted to pulmonary inflammation and structural remodelling. Rather, this disorder is associated with clinically significant systemic alterations in biochemistry and organ function. There are a number of pathological alterations of the lung in COPD. These involve almost all of the lung

compartments, including the parenchyma, vasculature, and large and small airways. These changes can overlap the pathologic findings present in other diseases associated with airflow obstruction, or other diseases that are manifested in the lung [2].

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 the FEV1. Hence a multidimensional grading system that assessed the respiratory and systemic expressions of COPD was designed to predict outcome in these patients [3].

The four factors that predicted the severity most were the body- mass index (B), the degree of airflow obstruction (O) and 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 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 a 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) [4].

In our study we analyzed the BODE index as a predictor of hospitalization and severity in patients with COPD.

Methodology

A total of 130 patients were enrolled into the study. Of these, 100 patients with symptoms suggestive of COPD were selected as cases and 30 patients were selected as controls. The patients with the following diagnostic criteria (according to the GOLD guidelines) were defined as having COPD.

1. The presence of cough and sputum production for at least 3 months in each of the two consecutive years.
2. Exertional dyspnoea.
3. Physical examination showing.
a) Signs of airflow limitation like prolonged expiration and expiratory wheeze which is not fully reversible.
b) Signs of hyperinflation.
4. Spirometry showing post bronchodilator FEV1/FVC ratio < 0.70.

For each enrolled subject, detailed history of smoking, personal and family medical histories were obtained. On the day of enrolment, 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 stadiometer. Body mass index (BMI) was calculated by the formula.

BMI = Weight in Kgs/(Height in Ms)^2

Spirometry was performed with equipment that met the American thoracic society performance criteria, in each of the cases on enrolment into the study and 20 minutes following the administration of salbutamol nebulisation. To adjust for the height, sex, age and sex published prediction equations for forced expiratory volume in 1 second (FEV1) and forced vital capacity (FVC) were used. FEV1 and FVC were calculated. The procedure was repeated on 2 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 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, was also included in the 6 minutes test period.

The BODE index was calculated for each patient using the body mass index, the threshold value of FEV1, the distance walked in 6 min, and the score on the modified Medical Research Council (MMRC) dyspnea scale.

The patients scored points ranging from 0 (minimal value) to 3 (maximal value). For body mass index the values were 0 (>21) or 1 (<21). Similarly, the scores for FEV1 were 0 (more than or equal to 65%), 1 (50-64%), 2 (36-49%) and 3 (less than or equal to 35%).

The 6 minute walk test scores were 0 (> 350 ms), 1 (250-350 ms), 2 (150-249 ms) and 3 (< 150 ms). The MMRC dyspnea class 0 and I were given 0 points, class II-1 point, class III-2 points and class IV-3 points. The points for each variable were added, so that the BODE index ranged from 0 to 10 points in each patient. The BODE score of 0-2 was taken as mild COPD. Scores between the scale 3-5 was considered as moderate disease and more than or equal to 6 was considered as severe COPD.

Results

Table 1: Body Mass index

Group	N	Mean BMI	Std. Deviation	One-way ANOVA F Test	Multiple Comparison (LSD)
Control	30	22. 80	3. 908		
Mild	31	21. 13	3. 160	F=2.577	Control Vs Mode rate (p=0.004)
Moderate	34	20. 91	4. 608	p = 0.057	Control Vs Severe (p=0.009)
Severe	35	20. 4	2. 511	Significant	
Total	130	21. 26	3. 692		

The average BMI of the patients in this study was 21.26 kg/m^2. The control group had a BMI of 22.8 kg/^{2m} with a standard deviation of 3.908. It was 21.13 kg/m^2 (standard deviation-3.16) in the mild group,

20.91 (std. deviation-4.608) in the moderate group and 20.4 (std. deviation-2.511) in the severe group. On multiple comparisons the significance between moderate and severe groups was found to be significant. All other comparisons showed insignificant difference.
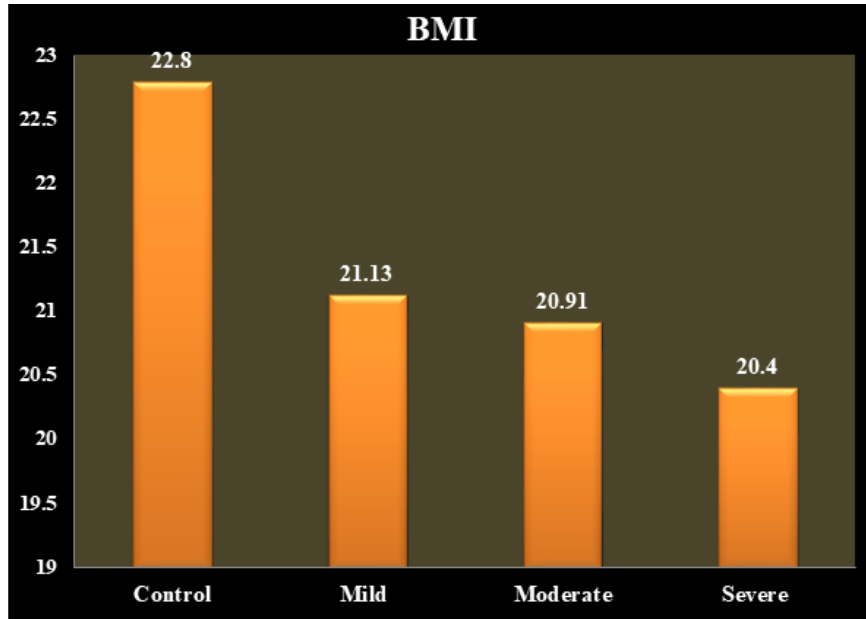

Fig 1: BMI

Table 2: Duration of hospital stay

Group	N	Mean Days of hospital stay	Std. Deviation	One-way ANOVA F test	Multiple Comparison (LS D)
Control	30	0.16	0.38		Control vs Mode rate (p=0.001)
Mild	31	2.16	4.71	F = 23.131	Control vs Severe ($p<0.000$)
Mode rate	34	4.26	4.49	$p<0.0001$	Mild vs Severe ($p<0.000$)
Severe	35	9.31	6.52	Significant	Mode rate vs Severe ($p<0.000$)
Total	130	4.17	5.78		

The study results showed that a higher BODE score was associated with a higher incidence of hospital stay due to reasons related to COPD, over the past 2 years. The control group and the mild COPD group did not have any significant hospital admission during the past 2 years. The average duration of stay in the moderate study group was 4.26 days while it was 9.31 days in the group with severe COPD according to the BODE score. Both these values were found to be significant on multiple comparisons to other groups.
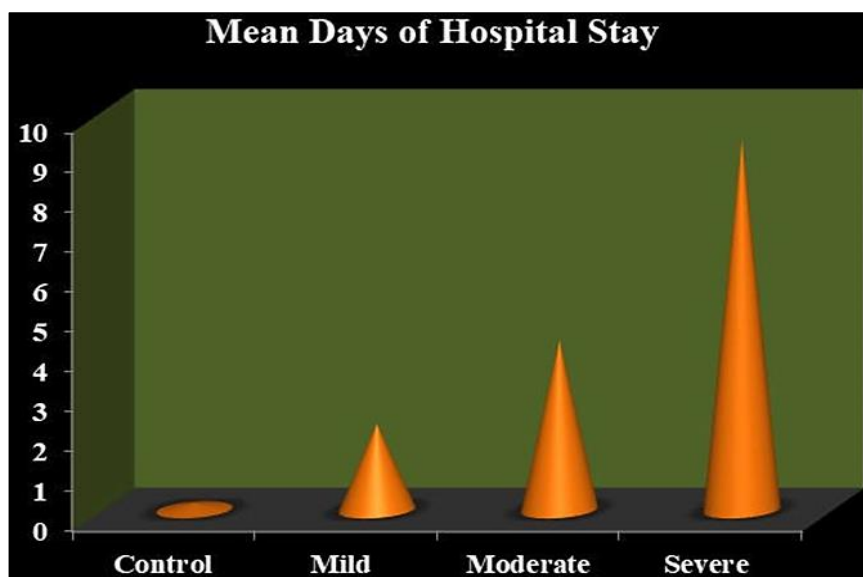

Fig 2: Hospital stay

Discussion

A multiple component staging system combining FEV1, 6-min walking distance, dyspnea scored with the MMRC scale and PaO_2 was reported to better describe health-care resources utilization among COPD patients in different geographic areas when compared to international COPD classifications (ATS, BTS, and GOLD) [5].

The BODE index was also reported to be a much better predictor of the severity in COPD acute exacerbations than FEV_1 [2]. Our findings of the usefulness of the BODE index in predicting hospitalization for COPD are also supported by the findings of a prospective study 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 investigators.

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 [6]. 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. While considering BMI as a criteria for BODE index scoring, significance is only given to whether it is more, or less than 21. In our study we found that the BMI progressively declines with severity among the patients with COPD. Emil *et al.* [7] had described the depletion of free fat mass and thereby a reduction in BMI in patients with COPD.

Results of the present study supports the results of Phaneendra *et al.* [8] conducted in Eluru (Andhra Pradesh), India. 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 check- up. With respect to the sample size, we analysed 100 cases and 30 as controls. The present study shows a significant decrease in BMI as BODE score increases. This study shows a significant association between smoking and BODE index. 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.

Conclusion

- BODE index can be used as a reliable index to assess the severity of chronic obstructive pulmonary disease.
- BODE index predicts hospitalization due to causes related to COPD.

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