

Bode index as a predictor of severity in patients with chronic obstructive pulmonary disease.

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Abstract:

Background And Objectives: Chronic Obstructive Pulmonary Disease as defined by the Global initiative for chronic obstructive lung disease is a common preventable and treatable disease, is characterized by persistent airflow limitation that is usually progressive and associated with an enhanced chronic inflammatory response in the airways and the lungs to noxious particles or gases. Exacerbation and comorbidities contribute to the overall severity in individual patients.

As the global population ages, the burden of COPD increases in years to come. It continues to be an important cause of morbidity, mortality and health care costs worldwide. According to WHO, COPD was the 6th major cause of death in 1990 and is estimated to be the 3rd major cause by 2020.

The present study has been undertaken to determine the factors other than the lung function that affect the outcome in COPD patients. The original BODE index is a simple multidimensional grading system which is superior to FEV1 alone for prediction of mortality and hospitalization rates among COPD patients.

Method: In this study 100 male patients who attended the Department of Respiratory Medicine, with the symptoms suggestive of COPD were included in the study and the study was done to evaluate the BODE index as a predictor of hospitalization and severity in patients with COPD.

Result: A total of 100 patients with symptoms suggestive of COPD as cases and were enrolled in the study. Among patients with COPD, there were 34 (34%) 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 33 patients (33%) each. The average age of participants in the study was 56.13yrs. Among the COPD patients, BODE index was found to increase with age. The BODE score was significantly associated with the number of pack years of smoking. The average number of pack years of smoking is 16.46, It was 7.42 pack yrs in mild cases, 15.07 in moderate and 26.90 in severe cases.

The average BMI of the patients in this study was 21.48233 kg/m². The BMI was found to be significantly lower in patients with COPD. It was 22.476 kg/m² (standard deviation –2.455) in the mild group, 21.711 kg/m² (std. deviation – 2.552) in the moderate group and 20.260 kg/m² (std. deviation – 3.212) in the severe group. 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 average duration of hospital stay over the last 2 years is 6.43 days. The mild COPD group did not have any significant hospital admission during the past 2 years, it was 0.13 days. The average duration of stay in the moderate study group was 3.17 days while, It was 16 days in the group with severe COPD according to the BODE score.

Conclusion: BODE index is reliable method to predict hospitalization and the severity in patients with COPD. Since the assessment of BODE index requires only a spirometer, which is relatively inexpensive and can easily be made available, this index could be of great practical value in a primary health care setup to identify individuals who are at need for further evaluation in a higher center. Thus, the BODE index can be used for judicious referral of patients with COPD. There by preventing the wastage of the limited resources available.

Keywords: BODE index; COPD; Dyspnea; Extrapulmonary; Emphysema.

I. Introduction

Chronic obstructive pulmonary disease (COPD) is a major cause of morbidity and mortality throughout the world. 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 3rd in 2020 in burden of disease caused worldwide, according to a study published by the World Bank/World Health Organization.^[1] The disease causes a heavy burden on the global health care resources. The costs involved in the treatment and evaluation is directly proportional to the pulmonary and the extrapulmonary components of the disease. ???

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 enhanced chronic inflammatory response in the airways and the lung to noxious particles or gases.^[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 healthcare budget constraint. BODE index has been proposed to serve this purpose in patients with chronic obstructive pulmonary disease (COPD).^[4]

In this study, we tried to find out the usefulness of BODE index as a predictor of hospitalization and severity in patients with COPD.

II. Material And Methodology

Setting

Department Of **Respiratory Medicine**, S.B.K.S Medical Institute And Research Centre, Piparia, Vadodara.

Institutional Ethics Committee Approval: Obtained

Study Design

This is a prospective , observational , cross sectional study. Appropriate consent to carry out this study was taken from the institutional ethical committee before enrolment of patients.

Sample Size: Cases: 100

Inclusion Criteria

- With Informed & Written Consent Male patients with symptoms suggestive of COPD as cases were included.
- Smokers aged between 40-70 years suffering from COPD.

Exclusion Criteria

- Patients with Spirometry proved bronchial asthma defined as an increase in the FEV₁ of more than 15 percent above the baseline value or of 200 ml after the administration of a bronchodilator.
- Recent myocardial infarction < 4months.
- Coronary Artery Disease.
- Diabetes Mellitus.
- Hypertension.
- Inability to perform spirometry or 6 minute walk test.
- Unrelated life threatening major illness.
- Lung Cancer
- Patients with acute exacerbation.

Study Protocol

A total of 100 patients with symptoms suggestive of COPD who attended the Department of Respiratory Medicine, S.B.K.S Institute of Medical Science and Research Centre, Piparia ,Vadodara, were selected as cases and were enrolled into the study.

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 dyspnea.
3. Physical examination showing:

- Signs of airflow limitation like prolonged expiration and expiratory wheeze which is not fully reversible.
- 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.

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

$$\text{BMI} = \text{Weight in Kgs} / (\text{Height in Mts})^2$$

Spirometry was performed with equipment that met the American Thoracic society performance criteria, in each of the cases on enrollment 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 received points ranging from 0 (lowest value) to 3 (maximal value). For body mass index the values were 0 (>21) or 1 (<21). 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 3-5 was considered as moderate disease and those more than or equal to 6 was considered as severe COPD.

MMRC dyspnea scale (MODIFIED MEDICAL RESEARCH COUNCIL CLASSIFICATION):-

- Grade 0: Breathlessness with strenuous exercise.
- Grade 1: Shortness of breath when hurrying on the level or walking up a slight hill.
- Grade 2: Patient walk slower than people of the same age on the level because of breathlessness, or patient has to stop for breath when walking on his own pace on the level.
- Grade 3: Stops for breath after walking 100 yards/few minutes on level ground.
- Grade 4: Too breathless to leave the house/or he gets breathlessness on routine household activities.

BODE INDEX

	0	1	2	3	Score
BMI kg/m ²	<21 kg/m ²	>21 kg/m ²			
FEV₁	>65%	50-64%	36-49%	<35%	
MMRC	0-1	2	3	4	
6MWD	>350m	250-349m	150-249m	<149m	
				TOTAL	

Mild COPD: BODE score 0-2

Moderate COPD: BODE score 3-5

Severe COPD: BODE score ≥ 6

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.

III. Results And Observations

A total of 100 patients with COPD as cases were enrolled in the study. Among patients with COPD, there were 34 (34%) 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 33 patients (33%) each as shown in Figure 1.

Table 1 shows that, The average age of participants in the study was 56.13 years (Std deviation-7.869). Among the COPD patients, BODE index was found to increase with age with the mild group having a mean age of 53.47 years (std deviation -7.362), moderate group 55.00 years (std deviation-8.627) and the severe group with 59.93 years as the mean age (std deviation-7.606). The difference was statistically significant with a p value of 0.005, as shown in Figure 2.

The study revealed that the BODE score was significantly associated with the number of pack years of smoking. It was 7.42 pack yrs in mild cases (std deviation-7.62), 15.07 pack years in moderate (std deviation-8.627) and 26.90 pack years in severe cases (std deviation-7.606). The average pack years is 16.46 (std deviation-7.951). The difference was statistically significant with a p value of 0.000, which has been displayed in Table 2 & Figure 3.

The average BMI of the patients in this study was 21.48233 kg/m² (std. deviation – 2.73). The BMI was found to be significantly lower in patients with COPD. It was 22.476 kg/m² (standard deviation –2.455) in the mild group, 21.711 kg/m² (std. deviation – 2.552) in the moderate group and 20.260 kg/m² (std. deviation – 3.212) in the severe group. The difference was statistically significant with a p value of 0.000, as shown in Table 3 & Figure 4.

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 average duration of hospital stay is 6.43 days (std. deviation -4.19), and in the mild study group was 0.13 days (std. deviation – 0.492), 3.17 days in the moderate group (std. deviation -2.929), while it was 16 days in the group with severe COPD (std. deviation – 9.177) . The difference was statistically significant with a p value of 0.000, which has been displayed in Table 4 & Figure 5.

IV. Figures And Tables :-

Legends to figure:

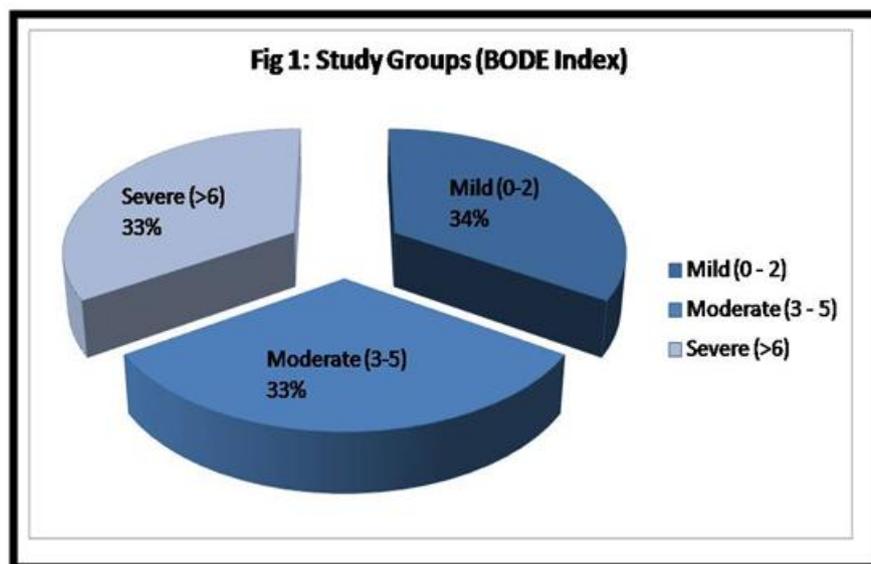
Figure 1: Study Group (Bode Index)

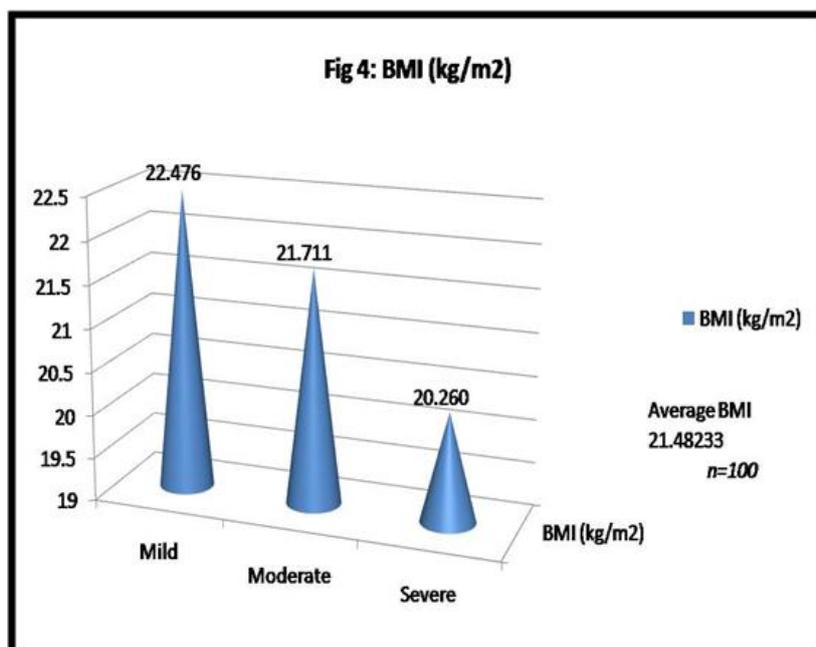
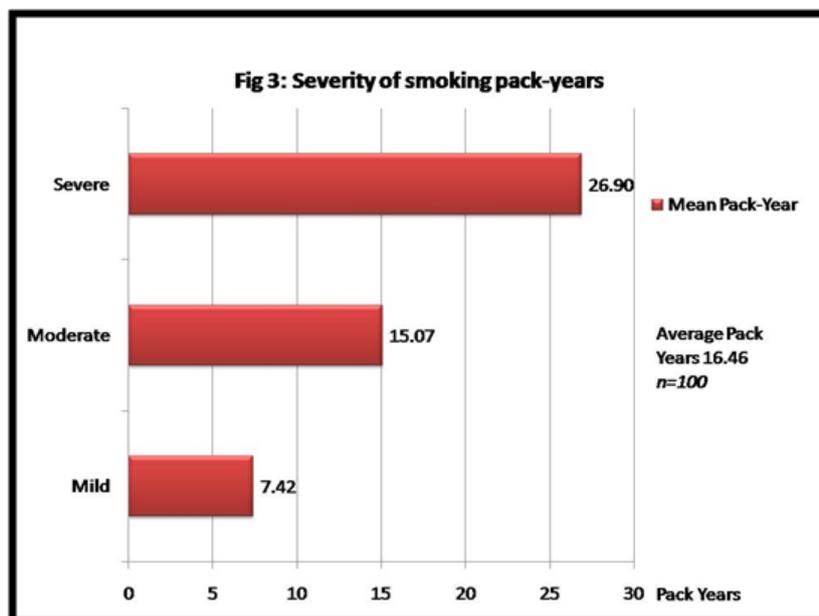
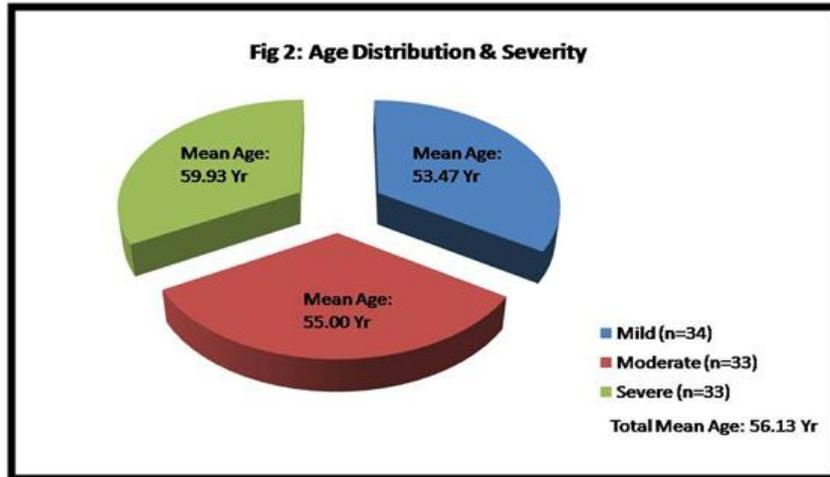
Figure 2: Age Distribution & Severity

Figure 3: Severity Of Smoking Pack-Years

Figure 4: Body Mass Index

Figure 5: Duration of Hospital Stay Over last 2 Yrs(days)





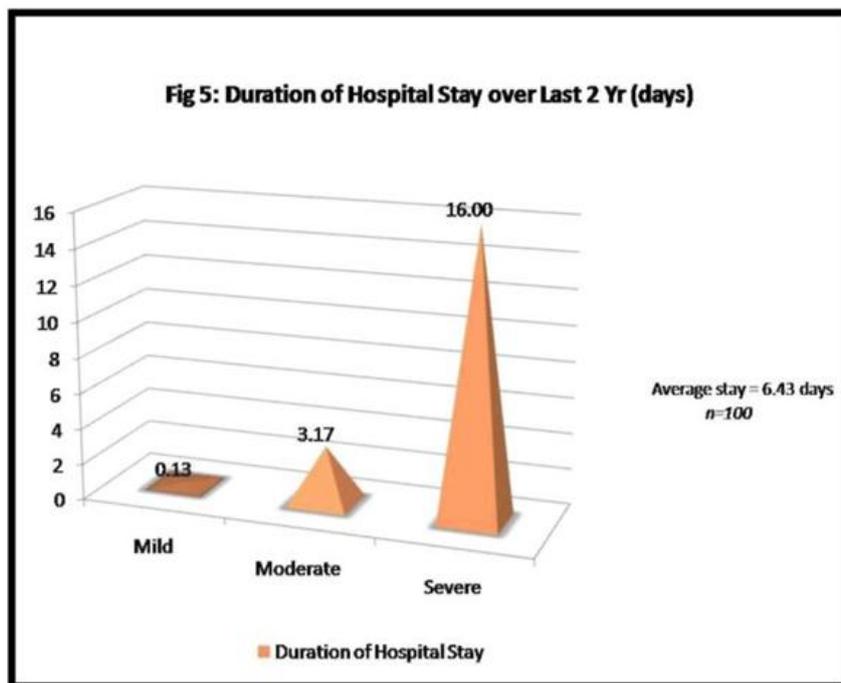


Table 1: Age wise distribution in years

GROUP	N	MEAN (yrs)	Std. deviation	One way ANOVA F-Test
Mild(0-2)	34	53.47	7.362	F = 4.440 p = 0.005 Significant
Moderate(3-5)	33	55.00	8.627	
Severe(□6)	33	59.93	7.606	
Total	100	56.13	7.869	

Table 2: Smoking in pack years

GROUP	N	Mean (yrs)	Std. Deviation	One way ANOVA F test
Mild	34	7.42	7.62	F= 26.936 p = 0.000 Significant
Moderate	33	15.07	8.627	
Severe	33	26.90	7.606	
Total	100	16.46	7.951	

Table 3: Body Mass Index

GROUP	N	Mean (yrs)	Std. Deviation	One way ANOVA F Test
Mild	34	22.476	2.455	F – 11.431 p = 0.000 Significant
Moderate	33	21.711	2.552	
Severe	33	20.260	3.212	
Total	100	21.48233	2.73	

Table 4: Duration of hospital stay over last 2 years (days)

GROUP	N	Mean (days)	Std. Deviation	One way ANOVA F test
Mild	34	0.13	0.492	F = 75.340 p = 0.00 Significant
Moderate	33	3.17	2.929	
Severe	33	16.00	9.177	
Total	100	6.43	4.19	

V. 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 fulfill this necessity. But most of the research has been limited to finding the usefulness of the index in predicting the mortality an

hospitalization in patients with COPD. In this study I tried to evaluate its usefulness in predicating the severity of COPD in terms of hospitalization. This study has brought out many results which would have a significant impact in the management of COPD in the future.

Only male patients were included in this study, since COPD is more common among male patients. This was aimed at making the study group as uniform as possible. Such a selection would negate the differences in the BODE index among various patients studied, by removing the gender related differences in FEV₁, BMI and patient perception of dyspnea.

Studies by Celli et al^[3] and Kian Chung et al^[5] has proven that grouping COPD patients into three groups with BODE scores 0 – 2 as first group, 3 – 5 as second and 6 or more as the third group correlates well with severity in terms of hospitalization and mortality. Hence, this study has accepted the same classification and grouped the above groups as mild, moderate and severe COPD. In this study individuals were almost equally distributed in the various groups.

Kian Chung et al^[5] and Celli et al^[3] has shown in their respective studies that BODE score increases with age. This study also shows a significant increase in the severe and moderately severe group. This could be due to the progression of COPD with age. However, results from a few other studies^[6,7] do not show significant progression with age. This difference is mainly due to the fact that duration of smoking was not proportional to age in those groups unlike in this study.

Results from this study go along with most other studies, in the relationship of smoking to BODE index. Studies by Kian Chung et al^[5], Celli et al^[3], and Karoli et al^[8] have all proven beyond doubt that higher duration of smoking is associated with higher BODE index. The study revealed that there was significant increase in the BODE index in patients with a higher duration of smoking. The difference was not statistically significant among the control group and those in the mild COPD group. This probably means that the disease could still be reversed with the cessation of smoking.

A multiple component staging system combining FEV₁, 6-min walking distance, dyspnea scored with the MMRC scale, and PaO₂ was reported to better describe healthcare resources utilization among COPD patients in different geographic areas when compared to international COPD classifications (ATS, British Thoracic Society, and GOLD).^[9] The BODE index was also reported to be a much better predictor of the severity in COPD acute exacerbations than FEV₁. This study has found the usefulness of the BODE index in predicting hospitalization for COPD are also supported by the findings of a prospective study^[10] of risk factors of hospital readmissions for COPD exacerbation. In the 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.^[11] Therefore, it may be speculated that the superior value of the BODE index compared to FEV₁ in predicting hospital admissions for COPD that this study has 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.

While considering BMI as a criteria for BODE index scoring, significance is only given to whether it is more, or less than 21. This study has found that the BMI progressively declines with severity among the patients with COPD.

VI. Limitations Of The Study

- I would like to acknowledge that a relatively small number of patients were evaluated and that the number of patients required to detect a significant difference in the predictive power of the BODE index and FEV₁ were not been prospectively determined.
- The study is a hospital based study and may not be representative of the general population.
- Caution is required while using the results in populations outside India because there have been no systematic comparisons of the regional manifestations of COPD.
- Only males were inducted into the study. Hence, the results of the study cannot be used in female patients with COPD.
- As a cross-sectional study, the present analysis is limited in its ability to elucidate, whether improving the BODE index reverses the various parameters analyzed.
- Alternate causes and medication effects influencing the parameters analyzed should also be considered.

VII. Conclusion

Thus, this study concludes that BODE index is reliable method to predict hospitalisation and the severity in patients with COPD. Since the assessment of BODE index requires only a spirometer, which is relatively inexpensive and can easily be made available, this index could be of great practical value in a primary health care setup to identify individuals who are at need for further evaluation in a higher centre.

Thus, the BODE index can be used for judicious referral of patients with COPD, There by preventing the wastage of the limited resources available

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