Innovations

Evaluation of Bone Index in the Prognosis of COPD Patients Attending a Tertiary Care Centre

[1] Dr Senapathi Lavanya; [2] Dr. Archana Andhavarapu;
[3] Dr Gaddam Venkata Mohan; [4] Dr Vadde Vijaya Lakshmi;
[5] Dr Lakhinena Anusha
[1,3] Assistant Professor, [2] Associate Professor, [4] Senior Resident,
[5] Civil assistant Surgeon
[1] Department of Respiratory Medicine, NRI medical college, Tagarapuvalasa
[2,3,4] Department of Respiratory Medicine, Great Eastern Medical School, Ragolu, Srikakulam
[5] PHC Tadivalasa

Corresponding Author: **Senapathi Lavanya**

Abstract
Background: *The BODE index (Body mass index, Airflow obstruction, Dyspnea, Exercise capacity) is a multidimensional score that integrates pulmonary and extrapulmonary features to predict prognosis in COPD. Its utility for predicting hospitalisation duration and short-term exacerbations needs evaluation in Indian tertiary-care populations.* ***Aim Objective:*** *To evaluate the BODE index as a predictor of (1) hospital stay duration, (2) COPD severity, and (3) frequency of exacerbations over 6 months in patients attending a tertiary respiratory clinic.* ***Methods:*** *Prospective observational study of 80 clinically stable COPD patients enrolled at GEMS Hospital, Ragolu (2021–2022). Baseline assessment included BMI, pre- and post-bronchodilator spirometry (FEV_1%), MMRC dyspnea grade, and two 6-minute walk tests (mean recorded). BODE score (0–10) was calculated and categorised into quartiles (0–2, 3–4, 5–6, 7–10). Outcomes were hospital stay (days) and exacerbations within 6 months. Group comparisons used ANOVA and chi-square; ROC analysis evaluated predictive performance.* ***Results:*** *Mean age was 66.66 ± 9.56 years; 68 (85%) were male. Mean FEV_1% was 63.71 ± 15.7; mean 6-MWD was 304.8 ± 64.5 m. BODE quartiles: ≤2, 27 (33.8%); 3–4, 17 (21.3%); 5–6, 15 (18.8%); 7–10, 21 (26.3%). Mean hospital stay increased across quartiles (1.46 ± 2.40 vs 7.00 ± 2.00 vs 8.07 ± 3.99 vs 12.71 ± 2.15 days; ANOVA $p < 0.001$). Exacerbations clustered in higher quartiles: of 59 patients with ≥1 exacerbation, 21 (35.6%) were in quartile 7–10 (chi-square $p < 0.001$). Key physiological parameters (6-MWD, FEV_1%, post-BD FEV_1%) declined significantly with increasing BODE (all $p < 0.001$). ROC analysis for prediction of exacerbation at 6 months showed AUC 0.883 (95% CI 0.807–0.958) for BODE (best cut-off 2.5; sensitivity 84.7%, specificity 85.7%), outperforming MMRC and comparable to FEV_1%.* ***Conclusion:*** *In this tertiary-care cohort, the BODE index correlated strongly with COPD severity, duration of hospital stay, and short-term exacerbation risk. A BODE cut-off ≈2.5 identified patients at higher risk of exacerbation with good sensitivity and specificity. The BODE index is a practical, multidimensional prognostic tool that may aid triage and resource allocation in primary and secondary care settings.*

Keywords: *Chronic obstructive pulmonary disease; BODE index; exacerbation; hospitalisation; 6-minute walk test; MMRC dyspnoea scale*

Introduction

Chronic Obstructive Pulmonary Disease (COPD), one among the top three killers in the world today, kills 90% of its victims in low- and middle-income nations.[1] More than 3 million people (about the population of Arkansas) died with COPD in 2012, making about 6% of all fatalities globally. Worldwide, COPD is one of the most common causes of deaths and morbidity; many people with the condition experience years of untimely death due to the condition or its consequences. Worldwide, COPD burden is anticipated to rise in the further decades because of population ageing and ongoing exposure to risk factors for COPD.[2]

Chronic Obstructive Pulmonary Disease (COPD) is characterized as a condition that can be prevented and treated with certain important extra pulmonary effects that may increase the severity in specific patients. Its pulmonary component is defined by partially reversible airflow obstruction. The restriction of airflow is typically progressive and linked to an aberrant inflammatory response in the lungs to irritating particles or gases.[3]

The forced expiratory volume in one second is typically used to determine the severity of COPD (FEV1). The FEV1 doesn't, however, accurately reflect the systemic signs of COPD in patients. To predict the outcome in these patients, a multidimensional grading system that evaluated the pulmonary and systemic manifestations of COPD was developed.[4] Body mass index (B), the degree of dyspnea and airway obstruction (O), and exercise capacity (E), as determined by the six-minute walk test, were the four parameters such most accurately predicted the severity. The BODE index has been created using these data; it is a multidimensional 10-point scale with higher scores indicating a higher probability of mortality When a disease affects many people, it can be very challenging to allocate limited medical resources to the most critical individuals. To identify people who are a most in need of a diagnostic or therapeutic intervention within a healthcare budget constraint, decision-makers require a rational and reliable scoring system. BODE index was recommended to this purpose with a chronic obstructive pulmonary disease (COPD).[5]In this study, I examined the BODE index as a predictor of hospitalization, COPD severity, and the frequency of exacerbations in patients.

Aims and Objectives

Aim: The present study aims to predict the prognosis of COPD patients based on the BODE index

Objectives:

To calculate whether a higher BODE index is associated with more days of hospitalization.

To calculate whether a higher BODE index is associated with severity in COPD patients

To determine whether the BODE index predicts exacerbations

Definition

As per the revised GOLD guidelines [6]:Chronic Obstructive Pulmonary Disease (COPD) is defined as "a widespread, preventable illness that is described by chronic respiratory symptoms and airflow limitation caused by abnormalities within airways and/or alveoli, which are typically brought on by chronic exposure to irritant particles or gases and influenced by host factors such as abnormal lung development."

Epidemiology

The study conducted by the Global Burden of Disease calculated that the prevalence of COPD was 3.92% globally in 2017, using data from various sources. The estimated DALYs rate was 1068.02/100,000 and the estimated COPD-attributable death rate was 42/100,000. [12] According to BOLD and the other large-scale epidemiological research, there were 238 million cases of COPD worldwide during 2010, with a prevalence rate of 11.7%.[13] every yr. there are over 3 million fatalities worldwide. COPD prevalence is anticipated to increase during the next 40 years due to rising smoking rates in developing nations and ageing populations among high-income nations. By 2060, it's possible that more than 5.4 million people (about twice the population of Arkansas) would succumb each year to COPD and associated disorders. [14]There are disparities in sex-based prevalence across the World Health Organization (WHO) global burden of Disease sub-regions, according to a systematic review and meta-analysis of the worldwide prevalence of COPD. In North America and urban areas, females were more likely than males to have COPD. Using the World Bank's income categories, prevalence was highest for males in upper-middle-income nations (9.00%) and for females in high-income countries.

Risk Factors:

- **Genetics:** A severe hereditary alpha-1 antitrypsin deficiency (AATD), a significant circulating serine protease inhibitor, is the risk factor with the best documentation. 0.12% patients with COPD had the AATD PiZZ genotype, with prevalence ranging from 1 in 408 in Northern Europe to 1 in 1,274 in Eastern Europe, according to a systematic assessment of 20 studies in European populations. [15]
- **Age and Sex:** Age-related changes to the parenchyma and airways resemble a few of the structural modifications linked to COPD. however, more recent statistics from developed nations show that the frequency of COPD is now about equal in males and females most earlier studies have demonstrated that men are more likely than women to have COPD and to die from it.
- **Growth and Development of the Lung:** Lung growth is influenced by events that happen during gestation and birth, along with exposures received during childhood and adolescence. Each factor that affects lung development during pregnancy or infancy could raise a person's risk of developing COPD.

- **Exposure to Particles:** Tobacco smoke is one of the most prevalent potential risks for COPD found globally. Smokers had a higher rate of FEV1 decline, a higher incidence of respiratory illness and pulmonary function abnormalities, and a higher COPD death rate than non-smokers.[16] By increasing the burden of inhaled particles and gases on the lungs, passive inhalation to tobacco smoke, also known as environmental tobacco smoke (ETS), can cause respiratory symptoms and COPD. In several developing countries, there is mounting evidence that women are more prone to COPD because of indoor biomass exposure to both traditional and modern fuels used for cooking. Occupational exposures to chemicals, gases, and dusts, both organic and inorganic, constitute an unrecognized risk factor for COPD.
- **Socio-Economic Status:** Lower socioeconomic level is associated with a higher risk of developing COPD, and poverty is continuously linked to airway obstruction. However, it is unclear if this trend represents exposures to both outdoor and indoor air pollution, crowding, inadequate nutrition, illnesses, or other socioeconomic status-related issues
- **Airway Hyper reactivity and Asthma:** Chronic airflow restriction and COPD development may be influenced by asthma. In the absence of a clinical diagnosis of asthma, airway hyperres ponsiveness was found to be an independent prognostic factor of COPD and respiratory fatality in population studies, as well as a sign of an excessive risk of lung function decline in people with early COPD. [17]
- **Chronic Bronchitis:** The prevalence of chronic bronchitis has been linked to an increased risk of developing COPD in younger people who smoke, and many studies have discovered a correlation between mucus secretion and higher FEV1 decline. Additionally, chronic bronchitis has been linked to an increased risk for both severity and number of exacerbations.
- **Infections:** Reduced lung function and an increase in respiratory symptoms in adulthood have been related witha history of serious childhood respiratory infections. There is data that such individuals with HIV are more likely to acquire COPD. Tuberculosis has also been noted as a risk factor for COPD.

Bode Index

The BODE index was developed by Celli et al. in 2004. It is a multistage integrated scoring system that offers useful prognostic information for patients with COPD.[24] The BODE index has been demonstrated to be more accurate than the FEV1 at predicting mortality and exacerbations in COPD patients.[25] There are four variables in this multiple system grading index:

1. Body mass index (BMI)
2. Airway Obstruction (FEV1)
3. Dyspnea (MMRC dyspnea scale)
4. Exercise capacity (6 Min Walk test)

Every factor in the index correlates with the prognosis of COPD on its own, is readily quantifiable, and acts as a substitute for other potentially significant factors. They probably have some similar physiological determinants in common, but the six-minute walk contains a level of sensitivity that the body mass index does not.[26] The six-minute walk test has been standardized and is easy to carry out. The BODE index also included the body mass index, as it was an independent predictor of mortality risk. The American Thoracic Society and the Global Initiative for Chronic Obstructive Lung Disease advise that any new COPD staging system include a patient's perception of dyspnea. The most debilitating symptom of COPD is dyspnea; its severity may be assessed and can reveal information about the patient's perception of their condition. The MMRC dyspnea scale is easy to use, correlates with other dyspnea scales, and provides health status scores.[27] Furthermore, the MMRC dyspnea score was a better predictor of the risk of death than the FEV1 in a large cohort of prospectively observed patients with COPD using the threshold values included in the BODE index.

Exacerbation of COPD:

An acute worsening of respiratory symptoms that needs additional treatment is referred to as a COPD exacerbation.[28] They are significant occurrences in the management of COPD because they hurt disease progression, hospitalization and readmission rates, and health status. COPD exacerbations are complicated events that are frequently accompanied by increased mucus production, airway irritation, and gas trapping. The main symptom of exacerbation, increased dyspnea, is a result of these alterations. Along with increased cough and wheeze, other symptoms include increased sputum volume and purulence.29 Acute respiratory failure may be associated with severe exacerbations. A history of previously treated events is the best indicator of having frequent exacerbations. Additionally, deteriorating airflow limitation is associated with an increased risk of exacerbations, hospitalization,[30] and mortality risk[31].COPD exacerbation's hospitalization is associated with poor prognosis and higher mortality risk.[32]

Materials and Methods

Study Design: Observational prospective study

Study Sample: 80

Source of Sample: Patients diagnosed with COPD attending the department of Respiratory Medicine in GEMS Hospital.

Inclusion Criteria:

- Diagnosed COPD patients
- All clinically stable COPD patients who haven't experienced an exacerbation in the previous six weeks
- Age more than 18 years

Exclusion Criteria:

- Patient unable to perform Spirometry
- Patient unable to perform the 6-minute walk test.
- Patients with cardiac disease.
- Patients not willing to get involved in the study.
- Patients with Asthma COPD Overlap Syndrome
- Pregnancy

Methodology:

A total of 100 patients from the Respiratory Medicine department's inpatient and outpatient clinics at GEMS, Ragolu, were enrolled in the study. 80 of these patients with COPD-like symptoms were chosen as cases. A thorough medical history, including personal and family medical histories, was obtained for each enrolled subject. Height and weight were measured twice on the day of enrolment during the examination. Weight was gauged with a bare foot and recorded to the closest 100 grammes. Using a stadiometer, height was calculated to the nearest millimeter. Using the formula, the body mass index (BMI) was determined. BMI is calculated as follows: Weight in kg / (Height in mts)^2 On enrolment into the trial and 20 minutes after the delivery of salbutamol nebulization, spirometry was carried out in each patient using equipment that satisfied the American Thoracic Society performance requirements. The forced expiratory volume in 1 second (FEV1) and forced vital capacity (FVC) prediction equations were used, taking into account height, sex, age, and sex factors both FVC and FEV1 were calculated. The procedure was repeated twice, and the average value was calculated. The patient's history of dyspnea was thoroughly documented. The patients' dyspnea was measured using the MMRC dyspnea scale. The six-minute walk test was repeated twice, with a 30-minute break in between, and the average was calculated. Patients were instructed to walk as far as possible on level ground within six minutes. Rest breaks were also incorporated within the six-minute test duration.

MMRC (Modified Medical Research Counselling) Dyspnea scale:

Grade 0: No/minimal exertion-related dyspnea
Grade 1: Dyspnea when rushing or climbing a slope
Grade 2: Pauses when walking on level ground or moves more slowly than usual.
Grade 3: Stops to catch his breath after moving 100 yards or a short while on level ground.
Grade 4: Dyspnea while getting dressed and too out of breath to go outside.

The BODE index of each patient was determined using their Body Mass Index, FEV1 threshold, 6-minute walk distance, and Modified Medical Research Council dyspnea scale score. The points awarded to the patients ranged from 0 (the lowest rating) to 3 (the maximum value). Body Mass Index readings ranged from

0 (>21) to 1 (<21). The FEV1 scores were 0 (≥ 65%), 1(50–64%), 2 (36–49%), and 3 (≤ 35%). 6-minute walk test scores were categorized as follows: 0 (>350 ms), 1 (250-350 ms), 2 (150-249 ms), and 3 (<150 ms). class 0 and I - 0 points, Class II - 1 point, Class III - 2 points, and Class IV -3 points for the MMRC dyspnea scale. The points for each variable were summed together to create a Bode index for each patient, which ranged from 0 to 10.

Bode Index

Bode Score	**0**	**1**	**2**	**3**
FEV1	≥65%	50-64%	36-49%	≤35%
6-min walk test	>350 ms	250-349 ms	150-249 ms	<149 ms
Dyspnea scale	0-1	2	3	4
BMI	>21 kg/m^2	<21 kg/m^2		

The measured BODE index scores were separated into four quartiles, with quartiles 1 to 4 having scores of 0-2, 3-4, 5-6, and 7-10, respectively:

Quartile 1 0-2
Quartile 2 3-4
Quartile 3 5-6
Quartile 4 7-10

The length of the patient's hospital stay was documented. Information about hospitalizations for exacerbations over six months was obtained

Results

A total of 80 subjects with COPD were studied as part of the current study, and the following conclusions were made:

Table 1 — Baseline characteristics of study population (n = 80)

Variable	**Value**
Number of patients, n	80
Age, mean ± SD (years)	66.66 ± 9.56
Sex — Male n (%)	68 (85.0)
Sex — Female n (%)	12 (15.0)
Smoking status — Current/former/never, n (%)	73 smokers / 7 non-smokers
Smoking — mean pack-years ± SD	12.84 ± 7.82
BMI, mean ± SD (kg/m²)	21.36 ± 3.70
6-min walk distance, mean ± SD (m)	304.79 ± 64.5
FEV1 %, mean ± SD	63.71 ± 15.7

Variable	Value
MMRC score, mean ± SD	1.74 ± 0.55
Mean hospital stay, mean ± SD (days)	6.65 ± 2.69

Values are mean ± SD unless otherwise indicated.

Table 2 — Distribution of BODE components and BODE quartiles (n = 80)

Component/category	Frequency (n)	Percent (%)
BODE quartile		
≤ 2 (Quartile 1)	27	33.8
3 – 4 (Quartile 2)	17	21.3
5 – 6 (Quartile 3)	15	18.8
7 – 10 (Quartile 4)	21	26.3
FEV1 % categories		
≥ 65%	25	31.3
50 – 64%	23	28.8
36 – 49%	16	20.0
≤ 35%	16	20.0
6-min walk categories (m)		
≥ 350	24	30.0
250 – 349	22	27.5
150 – 249	18	22.5
≤ 149	16	20.0
MMRC grade distribution		
0 – 1	33	41.3
2	28	35.0
3	17	21.3
4	2	2.5
BMI category		
> 21 kg/m²	48	60.0
≤ 21 kg/m²	32	40.0

BODE quartile cutoffs: 0–2, 3–4, 5–6, 7–10.

Table 3 — Hospital stay (days) by BODE quartile

BODE quartile	Mean hospital stay ± SD (days)	p-value
≤ 2	1.46 ± 2.40	(<0.001}
3 – 4	7.00 ± 2.00	
5 – 6	8.07 ± 3.99	
7 – 10	12.71 ± 2.15	

One-way ANOVA across quartiles; multiple comparison post-hoc showed significantly higher mean stay in quartile 7–10 vs all lower quartiles ($p<0.05$), and significant stepwise increases between other groups as reported in results.

Table 4 — Exacerbations (within 6 months) by BODE quartile

BODE quartile	Number with ≥1 exacerbation (n)	Percent of exacerbation group (%)
≤ 2	9	15.3
3 – 4	15	25.4
5 – 6	14	23.7
7 – 10	21	35.6
Total with exacerbation	**59**	**100.0**

Chi-square = 35.071, $p < 0.001$.

A Higher proportion of exacerbations was observed in the highest BODE quartile.

Table 5 — Key physiological parameters by BODE quartile

Parameter	≤ 2 (n=27) mean ± SD	3–4 (n=17) mean ± SD	5–6 (n=15) mean ± SD	7–10 (n=21) mean ± SD	ANOVA F	p-value
6-min walk distance (m)	421.93 ± 65.98	311.18 ± 19.88	231.20 ± 40.72	143.05 ± 32.93	151.45	<0.001
FEV1 % (pre-BD)	86.37 ± 17.66	57.24 ± 4.25	48.33 ± 6.72	30.90 ± 6.91	97.79	<0.001
FEV1/FVC (%)	100.11 ± 14.51	105.24 ± 13.22	97.53 ± 26.56	80.29 ± 16.81	7.566	<0.001
Post-bronchodilator FEV1 %	90.22 ± 17.33	62.47 ± 4.02	55.13 ± 5.85	38.52 ± 11.23	76.476	<0.001

All comparisons by one-way ANOVA; multiple comparisons significant as detailed in results ($p<0.05$ for most pairwise contrasts).

Table 6 — ROC analysis for prediction of exacerbation (6 months)

Test	AUC	95% CI (Lower–Upper)	p-value	Best cut-off	Sensitivity (%)	Specificity (%)
BODE score	0.883	0.807 – 0.958	<0.001	2.5	84.7	85.7
MMRC grade	0.845	0.759 – 0.932	<0.001	1.5	76.3	90.5
FEV1 %	0.849	0.761 – 0.936	<0.001	61.5	85.7	84.7

AUC = area under the ROC curve. Cutoffs chosen by the Youden index

Discussion

One of the most common serious illnesses that affects many individuals is COPD. Recently, emphasis has been placed on developing a simple but useful index for determining the severity of COPD. Researchers discovered that the BODE index would meet this need. However, most studies have only looked at how well the index predicts death and hospitalization in COPD patients. In this study, I looked at how useful it was in predicting the severity of COPD in terms of hospitalization and exacerbations occurring frequently. The study has produced several findings that will significantly affect how COPD is managed going forward.80 participants diagnosed with COPD were categorized into 4 quartiles based on the BODE score. < 2 in 33.8% patients (Quartile 1), followed by 26.3% had BODE score between 7- 10 (Quartile 4), 21.3 % had BODE score between 3 – 4 (Quartile 2) and 18.8% had BODE score between 5 – 6 (Quartile 3).In a study by **Sangita Kamath et al. (2020)** using 60 stable COPD patients divided into 4 BODE quartiles.16 patients (26.7%) had a BODE score of 1, 27 patients (45%) had a BODE score of 2, 15 patients (25%) had a BODE score of 3, and 2 patients (3.3%) had a BODE score of 4. During a one-year follow-up, the BODE index also had a significant (P<0.0012) correlation with acute exacerbations which is like our study where 59% had exacerbations (more exacerbations among patients with BODE score 7-10) and 21% with no exacerbations for 6 months follow up which shows BODE index had a significant (P< 0.001) correlation with acute exacerbations.[10]

Chin-Ling-Li et al (2020) conducted a study on 396 patients with COPD who were categorized into 4 quartiles according to BODE index (Quartile 1: 47.5%; quartile 2: 27.5%; quartile 3: 17.9%; quartile 4: 7.1%). He compared the BODE score to the Charlson Comorbidity Index (CCI), a criterion of severity of 15 chronic diseases and a predictor of severity and mortality. Hospitalization expenses and CCI had a positive correlation (p<0.001). The higher the quartile, for the same CCI, the more money is spent on hospitalization which indicates increased hospital stay which is similar to our study where the

that mean duration of hospital stay has been considerably more in patients with bode score 7 – 10 when compared to patients with bode score 5-6, 3-4 and <2 (p <0.05).

mean duration of hospital stay has been substantially more in patients with bode score 5 – 6 when compared to patients with bode score < 2 (p <0.05).

mean duration of hospital stay has been much more in patients with bode score 3 – 4 when compared to patients with bode score < 2 (p <0.05).
Which shows that BODE index positively correlated with hospital stay.[7]
In our study, patients were followed for 6 months to watch for exacerbations after being divided into 4 quartiles based on their BODE scores.
The highest percentage of patients experiencing exacerbations have a BODE score of 7 to 10 (Quartile 4), followed by quartiles 2, 3, and 1, showing a positive correlation between the BODE index and exacerbation frequency which is similar to the study done by **Jose M Marin et al (2008)** on 275 patients who were asked to follow up every 6 months up to 8 months. They observed that all COPD patients with a BODE greater than 7 had a hospitalization-related exacerbation prior to the age of 4 years. For BODE quartiles of 0-2, 3-4, 5-6, and 7-10, respectively, the mean time to a first COPD hospitalization was 7.9 years, 5.7 years, 3.4 years, and 1.3 years. The BODE index outscored the FEV (1) alone as a predictor of exacerbation using ROC curves (p<0 .01). [8]
In our study patients were categorized into 4 quartiles according to BODE score. Mean age was 66.6 years. The age group was compared with the BODE score. It was observed that 74.1% patients with BODE score <2 had age between 51 – 60 years such has been significantly higher compared to BODE score 3 – 44 (11.8%), BODE score 5 – 6 (13.3%) and Bode score 7 – 10 (0%). 66.7% patients with BODE score 7 – 10 had age group of 71 – 80yrs and 19 % had age group > 80 years which was significantly higher than Bode score 5 – 6, 3 – 4 and <2. (p <0.05)
which is similar to the study conducted by **Bartolome R Celli et al (2004)** on 207 patients with 25 fatalities in which they found that BODE score increases with age. There were 25 fatalities in which he found patients with a higher BODE scores had a higher risk of dying which indirectly shows that BODE correlates positively with severity.[9]
In the study done by **Kian Chung et al., (2005)** on 175 patients in which 17% died, they observed that, after grouping the BODE scores into four quartiles, the BODE index is a more accurate predictor of hospital admissions than the Global Initiative for a Chronic Obstructive Lung Disease's COPD staging approach which is similar to our study that showed the positive correlation between BODE score and frequency of exacerbations.[33]
In our study, mean smoking packs per year were compared to Bode score by using one way ANOVA and inter group comparison has been done by using multiple comparison ANOVA. It was found that there was a significant difference in the smoking packs per year when compared to bode score. On multiple comparison Anova it was observed that mean smoking packs per yr. was significantly more in patients with bode score 7 – 10 when compared to patients with bode score 5-6, 3-4 and < 2 (p <0.05).mean smoking packs per yr. was significantly more in patients with bode score 5 – 6 when compared to patients with bode score < 2 (p <0.05). mean smoking packs per yr. was significantly more in patients with bode score 3 - 4 when compared to patients with bode

score < 2 (p <0.05) which is similar to study done by **Karoli et al., (2007)** smoking for a longer duration of time is linked to a higher BODE index. The study found that patients who had smoked for longer periods of time experienced a substantial increase in the BODE index.[34]In study conducted by **Aswini Kumar Mohapatra et al. (2019)** on 78 stable COPD patients, the number of exacerbations at 12 months and the BODE index at baseline showed a significant correlation (Spearman's Rho 0.738). At 12 months, there would be 1.25 times as many exacerbations for every unit change in the baseline BODE index (95% CI: 1.17-1.33) which is similar to our study where there is positive correlation between BODE index and frequency of exacerbations.[11]In a study that involved 246 patients (BODE quartiles 2-4), **B. R. Celli et al., (2005)** suggested pulmonary rehabilitation. The patients were separated into two groups: no PR (130 patients who chose not to get rehabilitation or quit receiving it), and PR (116 who completed PR). At entry, after PR, and at 1 and 2 years, BODE was determined. Mortality and duration of stay (LOS) for hospitalizations connected to the respiratory system were additional results. The BODE increased by 19% after PR, then stabilized after two years. In the no PR group, the BODE deteriorated by 4% after a year and 18% after two years. When compared to 39% when no PR was used, respiratory mortality at 2 years was 7%. In summary, involvement in pulmonary rehabilitation enhances BODE and is linked to improved results. After pulmonary rehabilitation, the BODE index changes offer helpful prognostic data, which is similar to our study that showed the BODE index predicts prognosis and smoking had a positive correlation with BODE score [35]In a study done by **Fanny W. S. Koet al., (2010)** on 243(208 men) COPD patients with acute exacerbations of COPD (AECOPD) who were hospitalized. Following hospital discharge, the BODE index was evaluated at 6 weeks (baseline), 6, 12, 18 and 24 months (about 2 years). The mean (SD) age and predicted FEV1% values were 74.2(7.8) years and 51.7(21.6) %, respectively. 25.1% of patients died within the three years, but 76.5% required at least one readmission for AECOPD. Baseline By using Cox regression analysis, the BODE index was found to be an accurate predictor of AECOPD patients' survival and readmission rates (p 0.001 for both outcomes). Over 24 months, the BODE index increased (>1point), remained unchanged (>1point), or declined (>1point) in 71 (40.1%), 94 (53.1%), and 12 (6.6%) individuals, respectively. Serial variations in the BODE index at 6 months had a negligible impact on mortality, but not at 12 months, 18 months (about 1 and a half years), or 24 months (about 2 years). When compared to the baseline, the BODE indices at 6, 12, and 24 months (about 2 years) were indicative of readmissions for AECOPD.243(208 men) COPD patients with acute exacerbations of COPD (AECOPD) were hospitalized. Following hospital discharge, the BODE index was evaluated at 6 weeks (baseline), 6, 12, 18 and 24 months (about 2 years). Although my study was not regarding comparison of variations of BODE index it was similar to above study in view of prediction of survival and readmission rates.[36]In a prospective study conducted by **Swapnil Thorveet al.,**

(2018)over two years on 60 stable COPD patients from were divided into 4 quartiles based on the BODE index value (scores 0-2, 3-4, 5-6 and 7-10).52% of patients had a BODE score in the first quartile, followed by 21% in the second, 15% in the third, and 12% in the fourth. The BODE index and the severity of COPD were significantly correlated (p 0.001). In our study, 8.3% of patients experienced no exacerbations; 8.3% of patients experienced a maximum of seven exacerbations; 21.7% of patients experienced three exacerbations in two years; and 16.7% of patients experienced just one exacerbation in two years. It was found that the severity of COPD and the number of exacerbations increase when the BODE index rises which is similar to our study that showed higher the BODE index, the higher the frequency of exacerbations and severity of COPD.[37]

Conclusion

According to the study's findings, the BODE index, which is a multi-dimensional scoring system

1. Can accurately predict the severity of COPD
2. Predicts future exacerbations in COPD patients
3. Predicts the duration of hospital stay

The BODE index is a comprehensive, user-friendly, and practical clinical scoring system used to evaluate patients with COPD. It considers both pulmonary and extrapulmonary effects simultaneously and provides a fuller picture of the illness. In a primary health care setting, the BODE index could be of considerable practical benefit in identifying people who need further examination in a higher center because it only takes a spirometer, which is affordable and easily made available. As a result, patients with COPD can be wisely recommended using the BODE index, preventing the waste of the limited resources available.

Bibliography

1. *Halpin DMG, Celli BR, Criner GJ, et al. The GOLD Summit on chronic obstructive pulmonary disease in low- and middle- income countries. Int J Tuberc Lung Dis 2019: **23**(11): 1131-41.*
2. *Mathers CD, Loncar D. Projections of global mortality and burden of disease from 2002 to 2030. PLoS Med 2006; 3(11): e442*
3. *Global initiative for chronic obstructive lung disease. Global strategy for the diagnosis, management and prevention of chronic obstructive pulmonary disease. 2007; available from www.goldcopd.com: accessed Oct 5, 2008.*
4. *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.*
5. *Sean D. Sullivan, Scott D. Ramsey, and Todd A. Lee. The Economic Burden of COPD. Chest. 2000; 117: 5S-9S.*

6. *Global initiative for chronic obstructive lung disease. Global strategy for the diagnosis, management and prevention of chronic obstructive pulmonary disease. 2022; available from www.goldcopd.com:*
7. *Li CL, Lin MH, Chen PS, Tsai YC, Shen LS, Kuo HC, Liu SF. Using the BODE Index and Comorbidities to Predict Health Utilization Resources in Chronic Obstructive Pulmonary Disease. Int J Chron Obstruct Pulmon Dis. 2020 Feb 19;15:389-395.*
8. *Marin JM, Carrizo SJ, Casanova C, Martinez-Camblor P, Soriano JB, Agusti AG, Celli BR. Prediction of risk of COPD exacerbations by the BODE index. Respir Med. 2009 Mar;103(3):373-8.*
9. *Celli BR, Cote CG, Marin JM, Casanova C, Montes de Oca M, Mendez RA, Pinto Plata V, Cabral HJ. The body-mass index, airflow obstruction, dyspnea, and exercise capacity index in chronic obstructive pulmonary disease. N Engl J Med. 2004 Mar 4;350(10):1005-12.*
10. *Kamath S, Kumar A, Panda SK, Samanta RP. Correlation of BODE index with quality of life in stable Chronic Obstructive Pulmonary Disease (COPD) patients - A prospective study. J Family Med Prim Care. 2020 Nov 30;9(11):5606-5613.*
11. *Praveen CK, Manu M, Mohapatra AK, Pentapati KC. Power of BODE Index in Predicting Future Exacerbations of COPD: A Prospective Observational Study in Indian Population. J Assoc Physicians India. 2019 Apr;67(4):14-16. PMID: 31311211.*
12. *GBD Chronic Respiratory Disease Collaborators. Prevalence and attributable health burden of chronic respiratory diseases, 1990-2017: a systematic analysis for the Global Burden of Disease Study 2017. Lancet Respir Med 2020;8(6):585-96.*
13. *Adeloye D, Chua S, Lee C, et al. Global and regional estimates of COPD prevalence: Systematic review and meta-analysis. J Glob Health 2015; 5(2): 020415.*
14. *Lopez AD, Shibuya K, Rao C, et al. Chronic Obstructive pulmonary disease: current burden and future projections. Eur Respir J 2006; 27(2): 397-412.*
15. *Blanco I, Diego I, Bueno P, Perez-Holanda, Casa-Maldonado F, Miravitlles M. Prevalence of α (1)-antitrypsin PiZZ genotypes in patients with COPD in Europe: a systematic review. Eur-Respir Rev 2020; 29(157):200014*
16. *Kohansal R, Martinez-camblor, Agusti A, Buist AS, Mannino DM, Soriano JB. The natural history of chronic airflow obstruction revisited: and analysis of the Framingham offspring cohort. Am J Respir Crit Care Med 2009; 180(1): 3-10*
17. *Tashkin DP, Altose MD, Connett JE, Kanner RE, Lee WW, Wise RA. Methacholine reactivity predicts changes in lung function over time in smokers with early chronic obstructive pulmonary disease. The Lung Health Study Research Group. Am J Respir Crit Care Med 1996; 153(6 Pt 1):1802-11*
18. *Barnes PJ. Inflammatory mechanisms in patients with chronic obstructive pulmonary disease. J Allergy Clin Immunol 2016;138(1): 16-27*
19. *Stockley RA. Neutrophils and protease/antiprotease imbalance. Am J Respir Crit Care Med 1999; 160(5 Pt 2): S49-52.*

20. *Sakao S, Voelkel NF, Tatsumi K. The vascular bed in COPD: pulmonary hypertension and pulmonary vascular alterations .Eur Respir Rev 2014; 23(133): 350-5.*
21. *Medical Research Council Committee on the Aetiology of Chronic Bronchitis. Definition and classification of chronic bronchitis for clinical and epidemiological purposes. A report to the Medical Research Council by their Committee on the Aetiology of Chronic Bronchitis. Lancet 1965;1(7389):775-9*
22. *Domigo-Salvany A, Lamarca R, Ferrer M, et al. Health-related quality of life and mortality in male patients with chronic obstructive pulmonary disease. Am J Respir Crit Care Med 00; 166:680-685.*
23. *Li, Benoit-Connors ML, Reardon JZ, ZuWallack RL. Variables related to increased mortality following outpatient pulmonary rehabilitation. Eur Respir J 1996; 9: 431-435.*
24. *Celli BR, Cote CG, Marin JM, Casanova C, Montes de Oca M, Mendez RA. The body-mass index, airflow obstruction, dyspnea, and exercise capacity index in chronic obstructive pulmonary disease. N Engl J Med 2004; 350:2308-10.*
25. *Shapiro SD, Reilly JJ, Rennard SI. Chronic bronchitis and emphysema. In: Mason RJ, Broaddus VC, Martin TR, King TE Jr, Schraufnagel DE, Murray JF, editors. Murray and Nadel's Textbook of Respiratory Medicine. 5th ed.. Philadelphia: Saunders Elsevier; 2010.p.919-76*
26. *Miyamato S, Nagaya N, Satoh T, et al. Clinical correlated and prognostic significance of six- minute walk test in patients with primary pulmonary hypertension: comparision with cardiopulmonary exercise testing . Am J Respir Crit Care Med 2000; 161: 487-492.*
27. *Marin, JM, Alonso, J, Sanchez, A, et al Value of current COPD classification versus a multiple component staging system (SCORE) as predictor of health care resource utilization (abstract). Am J Respir Crit Care , Med 2002; 165: A43*
28. *Wedzicha JA, Seemungal TA. COPD exacerbations: defining their cause and prevention. Lancet 2007; 370(9589): 786-96.*
29. *Anthonisen NR, Manfred J, Warren CP, Hershfield ES, Harding GK, Nelson NA. Antibiotic therapy in exacerbations of chronic obstructive pulmonary disease. Ann Intern Med 1987; 106(2): 196-204.*
30. *Mullerova H, Maselli DJ, Locantrone N, et al, Hospitalization exacerbations of COPD; risk factors and outcomes in the ECLIPSE cohort. Chest 2015;147(4): 999-1007.*
31. *Soriano JB, Lamprecht B, Ramirez AS, et al, Mortality prediction in chronic obstructive pulmonary disease comparing the GOLD 2007 and 2011 staging systems: a pooled analysis of individual patient data. Lancet Respir Med 2015; 3(6): 443-50.*
32. *Soler-Cataluna JJ, Martinez Garica MA, Roman Sanchez P, Salcedo E, Navarro M, Ochando R. Severe acute exacerbations and mortality in patients with chronic obstructive pulmonary disease. Thorax 2005; 60(11):925-31.*

33. *Kian Chung Ong, Arul Earnest, and Suat-Jin Lu. A multidimensional grading system (BODE INDEX) as a predictor of hospitalization for COPD. Chest 2005; 128: 3810-3816.*
34. *Karoli NA, Rebrov AP. The BODE index as a predictor of unfavourable prognosis in chronic obstructive pulmonary disease. Ter Arkh. 2007; 79(3): 11-4*
35. *35) Cote, C. G., and B. R. Celli. "Pulmonary rehabilitation and the BODE index in COPD." European Respiratory Journal 26.4 (2005): 630-636.*
36. *Ko, Fanny WS, et al. "A longitudinal study of serial BODE indices in predicting mortality and readmissions for COPD." Respiratory medicine 105.2 (2011): 266-273.*