(RESEARCH ARTICLE)

Bode index in stable COPD patients at tangier university hospital

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Abstract

Introduction: Chronic obstructive pulmonary disease (COPD) is characterized by irreversible airflow limitation, leading to progressive respiratory dysfunction, exercise intolerance, and lean body mass loss. The BODE index, integrating body mass index, obstruction, dyspnea, and exercise capacity, provides superior prognostic accuracy compared to individual parameters alone. This study aimed to evaluate the prognosis of COPD patients using the BODE index as a multidimensional predictive tool.

Materials and methods: A prospective longitudinal descriptive and analytical study was conducted on 103 COPD patients in the stable phase. The BODE index combines four parameters: body mass index (B), airway obstruction measured by FEV_1 (O), dyspnea according to the mMRC scale (D), and exercise capacity assessed by the 6-minute walk test (E). Correlations between the BODE index and clinical parameters were analyzed by quartiles.

Results: The study population was predominantly male (96.1%) with a mean age of 63.6 ± 9.5 years. The mean BODE index was 3.7 ± 2. Distribution by quartiles showed: quartile 1 (score 0-2): 30%, quartile 2 (score 3-4): 33%, quartile 3 (score 5-6): 28.1%, and quartile 4 (score 7-10): 8.7%. Statistically significant correlations ($p<0.001$) were observed between the BODE index and GOLD severity, 6-minute walk test distance, and body mass index. Progressive and significant deterioration of clinical and functional parameters was demonstrated between the first and last quartiles: decrease in BMI (22 to 18.9 kg/m^2), FEV_1 (50.6% to 38%), and walking distance (392.7m to 260m), with increased dyspnea (2.69 to 3.7).

Conclusion: The BODE index proves to be a particularly relevant multidimensional assessment tool for monitoring COPD patients. Statistically significant correlations with essential clinical parameters confirm its value as a reliable prognostic tool, providing a comprehensive and accurate assessment of COPD severity.

Keywords: COPD; BODE Index; Prognosis; Multidimensional Assessment; Exercise Capacity; Dyspnea

1. Introduction

Chronic obstructive pulmonary disease (COPD) is characterized by airflow limitation that is not or incompletely reversible. This progressive chronic disease evolves towards impaired respiratory function, worsening exercise intolerance, and loss of lean body mass in COPD patients. All these parameters contribute to the evolution of the BODE score, which uses the following evaluation criteria: Body Mass Index (BMI), FEV_1, dyspnea, and the 6-minute walk test (6MWT), reflecting many of the impairments and disabilities affecting these patients. Each item corresponds to a certain number of points, and the total of all points determines the BODE index score, which ranges from 0 to 10. [1]

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Worldwide, there are approximately three million deaths from COPD every year. By 2060, COPD is expected to cause more than 5.4 million deaths annually, due to increased smoking in low and middle-income countries and aging populations in high-income countries. [2]

The BODE index, combining body mass index, respiratory obstruction, dyspnea, and exercise capacity, offers a more precise overall score for predicting patient survival than each of its parameters separately.

2. Materials et methods

2.1. Study Type

A prospective longitudinal descriptive and analytical study was conducted over a 2-year period from 2023 to 2025.

2.1.1. Study Population

- Patients with COPD evaluated during stable consultations for their disease.
- Inclusion criteria: Confirmed diagnosis of COPD and patient in stable phase of the disease.
- Exclusion criteria: Recent exacerbation and severe comorbidities incompatible with the study.

2.2. Main Objective

To evaluate the prognosis of COPD patients using the BODE index as a predictive tool.

2.2.1. Statistical Analysis

- Calculation of means and standard deviations.
- Correlation analysis between different parameters.
- Analysis of distribution according to BODE index quartiles using Jamovi software.
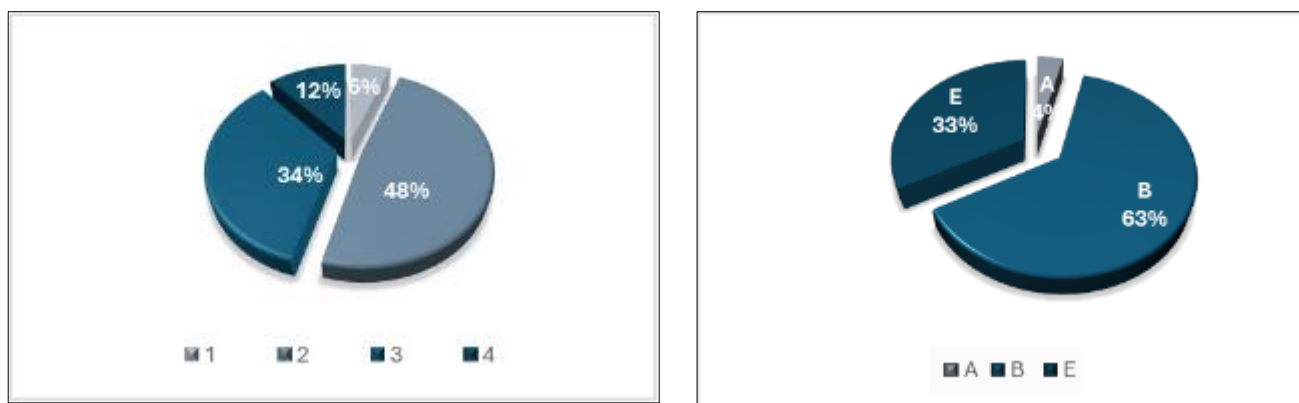
3. Results

We collected data on 103 COPD patients, with a clear male predominance: 96.1% men (99) and 3.8% women (4), with a mean age of 63.6 ± 9.5 years. The average tobacco consumption was 30 pack-years. Cannabis use was found in 37 patients (35.9%) and alcoholism in 27 patients (26.2%).

In our study, several comorbidities were identified among the patients. Malnutrition was the most common, affecting 35.9% of the population. This was followed by heart diseases (25.2%), diabetes (17.4%), anemia (11.6%), lung cancer (4.8%), and pulmonary embolism (3.8%).

Dyspnea, the cardinal symptom of COPD, was mainly present in our cohort. According to the mMRC classification, its severity varied: 7.7% of patients presented with stage I, 35.9% with stage II, 27.1% with stage III, and 29.1% with stage IV, illustrating the diversity and progression of dyspnea in these patients.

The spirometry analysis of the participants revealed three main profiles: a non-reversible obstructive ventilatory disorder in 47.5% of patients (49 cases), a mixed ventilatory disorder in 39.8% (41 cases), and a restrictive profile in 12.6% (13 cases).

According to the GOLD (Global Initiative for Chronic Obstructive Lung Disease) classification, which assesses COPD severity through spirometric stages (1-4) based on airflow limitation and clinical groups (A, B, E) based on symptom burden and exacerbation risk, the distribution of COPD patients was characterized by a predominance of group B (63%), followed by group E (33%), and a minority of patients in group A (4%), reflecting the diversity of the disease's clinical profiles. Most patients included had moderate-to-severe COPD, with stage I in 6%, stage II in 48%, stage III in 34% and stage IV in 12%. [Figure 1]

Left chart - GOLD stages: Stage 1 (6%), Stage 2 (48%), Stage 3 (34%), Stage 4 (12%); Right chart - GOLD groups: Group A (4%), Group B (63%), Group E (33%).

Figure 1 Distribution of COPD patients according to GOLD classification

Body mass index (BMI) in COPD patients averaged 21.8 ± 3.9 kg/m2 (14-31 kg/m2). During the 6-minute walk test (6MWT), the mean distance covered was 391 meters, with significant variability ranging from 150 to 620 meters. Patients' exercise capacity showed a significant distribution: 32% had minimal limitations, 66% moderate, and only 1.9% severe.

The mean BODE index in our population was 3.7 ± 2 with quartile 1 (score 0-2) in 30% of COPD patients and quartile 2 (score 3-4) in 33%, quartile 3 (score 5-6) in 28.1% and quartile 4 (score 7-10) in 8.7%, suggesting that extreme cases remained relatively rare in our population. [Figure 2]

- Quartile 1 (score 0–2): 30% of patients score in this category, indicating mild disease severity.
- Quartile 2 (score 3–4): 33% of patients with moderate disease severity.
- Quartile 3 (score 5–6): 28.1% of patients score in this range, indicating higher severity.
- Quartile 4 (score 7–10): Only 8.7% of patients have scores in this category, suggesting that few patients present with severe cases.
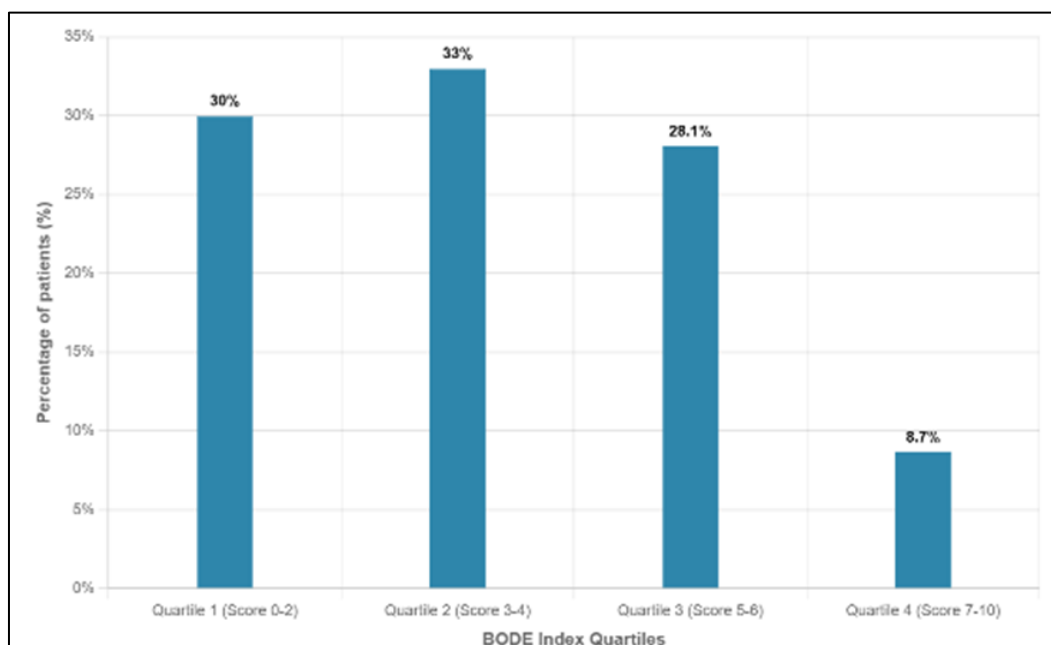

Figure 2 Distribution of COPD patients by BODE index quartiles

In our study, statistical analysis revealed significant correlations of the BODE index with three essential clinical parameters

3.1. Correlation with GOLD severity

The p-value <0.001 indicates a statistically significant relationship between the BODE Index and GOLD classification. This suggests that the BODE Index is an excellent indicator of the progression and severity of Chronic Obstructive Pulmonary Disease (COPD). The higher the BODE score, the more advanced the GOLD stage, confirming the reliability of this index as a prognostic tool.

3.2. Correlation with the 6-Minute Walk Test (6 MWT)

The p-value <0.001 demonstrates a statistically significant link between the BODE index and the distance covered during the walking test. In our study, this correlation allows for a precise evaluation of the patients' functional capacity and effort limitation. A higher BODE score corresponds to a shorter walking distance, reflecting the deterioration of physical capacity.

3.3. Correlation with Body Mass Index (BMI)

The p-value <0.001 reveals a significant relationship between the BODE index and patients' nutritional status. Our results highlight the impact of body composition on COPD progression. A higher BODE score is associated with a lower BMI, indicating an increased risk of malnutrition in patients with more severe COPD.

These results confirm that the BODE index is a powerful prognostic tool. It provides a multidimensional assessment of COPD, integrating clinical, functional and nutritional aspects with statistically significant accuracy.

Table 1 Clinical and functional characteristics of COPD patients according to the quartiles of the BODE Index

Characteristic	Total	Quartile 1 [0-2]	Quartile 2 [3-4]	Quartile 3 [5-6]	Quartile 4 [7-10]	P value
No Patients	103	31	34	29	9	
Sex ratio M/F	99/4	29/2	34/0	28/1	8/1	NS
Age	63,6	64,1±9	63±9,6	63,6±9,5	64,2±8,1	NS
BMI	21,8	22±3,8	22±3,8	20,7±3,9	18,9±4,1	0,001
Dyspnea	2,72	2,69±1	2,7±0,96	3,3±0,97	3,7±0,95	0,001
FEV$_1$	53,9	50,6±16,7	51,8±16,6	37,3±16,5	38±18,1	0,001
6MWT	391	392,7±94,8	396,4±93,7	347,4±95,5	260±91,3	0,001
BODE Index	3,7	1,54±1,9	3,64±1,9	5,44±1,9	7,33±2,1	
CAT	12	10,2 ± 6,4	12,3±6,4	15,6±6,4	18,5±6,9	NS
GOLD						
I	6	3	1	0	0	
II	50	26	14	6	2	
III	35	2	13	15	4	
IV	12	0	6	8	3	

Abbreviations: BMI: Body Mass Index, FEV$_1$: Forced Expiratory Volume in 1 second, 6MWT: 6-Minute Walk Test, GOLD: Global Initiative for Chronic Obstructive Lung Disease, CAT: COPD Assessment Test, NS: Non-Significative

3.3.1. BODE Index

The statistical analysis reveals a significant degradation (p=0.001) of clinical and functional parameters depending on the severity of the disease. There was a progressive and significant decrease in BMI (from 22 to 18.9 kg/m^2), FEV$_1$ (from 50.6% to 38%) and distance covered in the 6-minute walk test (from 392.7m to 260m), associated with a significant increase in dyspnea (from 2.69 to 3.7) between the first and last quartiles. The CAT score, which is the COPD Assessment Test - a short, simple and reproducible questionnaire designed to provide a rapid but reliable assessment of COPD's impact on the patient's daily life by evaluating symptoms such as cough, phlegm, chest tightness, breathlessness, activity limitations, confidence, sleep quality, and energy levels - shows an increasing trend (from 10.2 to 18.5) although not

statistically significant, possibly due to the small sample size in the last quartile (n=9). These results demonstrate a strong correlation between disease progression and deterioration of physiological parameters, particularly marked in the last quartile.

It is important to acknowledge that the significant correlations observed between the BODE index and its individual elements (BMI, 6MWT, and dyspnea severity) are expected, since these parameters are part of the index itself. These correlations do not represent new findings but rather serve as a validation of the index's internal consistency within our specific cohort. The primary value of our analysis lies in demonstrating that the BODE index maintains its expected correlations in our Moroccan COPD population, confirming its applicability across different demographic contexts, and providing valuable insights into the distribution patterns of BODE quartiles in our regional population.

4. Discussion

In 2004, Celli et al. introduced the BODE index, a prognostic score for estimating 52-month mortality in COPD patients. This innovative index integrates four key dimensions of the disease: B for Body mass index (BMI), O for Obstruction (FEV_1 in % of predicted), D for Dyspnea (MRC scale), and E for Exercise capacity (distance covered in 6-minute walk test), thus offering a multidimensional and more accurate assessment of patient health status. [1]

In our series, the observed population was predominantly elderly (average age of 63.6 years). This figure remains comparable to other studies. [4-6]

The distribution of patients according to the GOLD classification is very similar to the data reported by N. Fettal et al., with a relatively comparable distribution between stages: stage I (5% vs. 5.8%), stage II (64.4% vs. 48.5%), stage III (26.7% vs. 33.9%) and stage IV (3.7% vs. 11.6%). [4]

Our average BODE index was 3.7 ± 2, a result comparable to those of the studies by Loïc Péran et al. (4.16) and Anne Houssière et al. (4.0), but significantly different from that of the study by N. Fettal et al. (1.75 ± 2) as shown in table 2 below. The variability observed in the BODE index could be explained by significant differences in the characteristics of the studied population, particularly in terms of disease severity, demographic profile, and methodological criteria specific to each study. [4-6]

Regarding the distribution of the population according to the BODE index, our results showed notable similarities with the study by Anne Houssière et al., with a nearly comparable distribution among the different quartiles: we observed 30% vs 37% of patients with a score between 0 and 2, 33% vs 25% between 3 and 4, 28.1% vs 22% between 5 and 6, and 8.7% vs 16% between 7 and 10. [6]

Table 2 Comparison of clinical and functional characteristics of COPD patients with other reference studies

	N. Fettal et al	Loïc Péran et al	Anne Houssière et al	Our study
Age	61	63,2	64	63,6
BMI	22,5	27,1	25,5	21,8
Dyspnea	-	2,19	2,5	2,72
6MWT	366	346	410	391
FEV$_1$	-	42,1%	51%	53,9%
GOLD	-	2/15/26/23	-	6/50/35/12
BODE	1,75	4,16	4	3,7

Mortality risk is stratified into four quartiles, according to an ascending progression of risk. Quartile 4 represents the highest level of risk and therefore identifies patients with the most severe forms of the disease. [7] In her study, Medinas-Amorós [8] demonstrated that the BODE index is a relevant tool for assessing patients' quality of life. Her work showed an inverse correlation between the BODE index and quality of life: the higher the index, the worse the quality of life. Two studies [3, 9] have established that the BODE index is a reliable indicator for predicting the risk of hospitalization in patients. The work of Côte and Celli [10] highlighted a dual benefit of respiratory rehabilitation: an

improvement in the BODE index and a reduction in the risk of mortality. These results suggest that the BODE index can be used as a relevant assessment tool in the follow-up of respiratory rehabilitation programs.

The BODE index has been shown to be a better predictor of risk of death in COPD patients than the GOLD classification, which is based on FEV_1 [1-3]. However, in our cohort, the evaluation of the mortality rate has not yet been performed as this is an ongoing prospective study.

5. Conclusion

The BODE index proves to be a particularly relevant multidimensional assessment tool for monitoring COPD patients. Our study demonstrated statistically significant correlations (p<0.001) between the BODE index and essential clinical parameters: GOLD severity, exercise capacity (6MWT) and nutritional status (BMI).

The distribution of our population according to BODE index quartiles (mean 3.7 ± 2) is comparable to the literature, with most patients in the intermediate quartiles. Our detailed analysis revealed a progressive and significant deterioration in clinical and functional parameters based on disease severity, particularly marked in the last quartile.

These results confirm the value of the BODE index as a reliable prognostic tool, providing a comprehensive and accurate assessment of COPD severity. Its use in routine clinical practice could improve patient monitoring and adaptation of therapeutic strategies, particularly in the context of respiratory rehabilitation programs. Additional longer-term studies are needed to evaluate its impact on mortality prediction in our cohort.

Study limitations

Several limitations should be acknowledged in our study. The relatively modest sample size (n=103), particularly with only 9 patients in quartile 4, restricts statistical power for subgroup analyses. The exclusive inclusion of patients in stable phase may introduce selection bias, potentially underrepresenting severe cases. As our prospective study is ongoing, mortality prediction, the primary purpose of the BODE index has not yet been evaluated, and the absence of long-term follow-up prevents assessment of disease progression over time. Finally, the exclusion of patients with recent exacerbations and severe comorbidities may limit the applicability to the broader multimorbid COPD population.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict-of-interest to be disclosed.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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