Does the BODE index correlate with quality of life in patients with COPD?*

O índice BODE correlaciona-se com a qualidade de vida em pacientes com DPOC?

Zênia Trindade de Souto Araujo, Gardenia Holanda

Abstract

Objective: To determine whether the Body mass index, airway Obstruction, Dyspnea, and Exercise capacity (BODE) index correlates with health-related quality of life in patients with COPD. **Methods:** We evaluated 42 patients with COPD, quantifying the following: lung function parameters; anthropometric variables; exercise capacity, with the six-minute walk test; dyspnea, with the modified Medical Research Council (MRC) scale; the BODE index; and quality of life, with the modified Saint George's Respiratory Questionnaire (mSGRQ). Patients were divided into two groups by disease severity: $FEV_1 \geq 50\%$ and $FEV_1 < 50\%$. **Results:** The mean BODE index was 2.58 ± 1.17 and 4.15 ± 1.81, respectively, for the $FEV_1 \geq 50\%$ and $FEV_1 < 50\%$ groups. There was a significant difference between the groups in terms of FEV_1 and the FEV_1/FVC ratio. There were moderate to significant correlations between the BODE index scores and all of the mSGRQ domains in the group of patients with $FEV_1 < 50\%$. **Conclusions:** The BODE index score correlated with the scores of all of the mSGRQ domains in COPD patients with $FEV_1 < 50\%$. Therefore, COPD patients with $FEV_1 < 50\%$ die sooner and have a poorer quality of life.

Keywords: Pulmonary disease, chronic obstructive; Quality of life; Severity of illness index; Prognosis.

Resumo

Objetivo: Determinar se há uma correlação entre o índice B*ody mass index, airway O*bstruction, D*yspnea, and* E*xercise capacity* (BODE; IMC, obstrução das vias aéreas, dispneia e capacidade de exercício) e a qualidade de vida relacionada à saúde em pacientes com DPOC. **Métodos:** Foram avaliados 42 pacientes com DPOC quanto a parâmetros de função pulmonar; variáveis antropométricas; capacidade de exercício através da distância máxima percorrida no teste de caminhada de seis minutos; dispneia através da escala modificada Medical Research Council (MRC); índice BODE; e a qualidade de vida através do questionário do *Saint George's Respiratory Questionnaire* modificado (SGRQm). Os pacientes foram alocados em dois grupos de acordo com a estratificação de gravidade da doença: $VEF_1 \geq 50\%$ e $VEF_1 < 50\%$. **Resultados:** Os valores médios do índice BODE para os grupos $VEF_1 \geq 50\%$ e $VEF_1 < 50\%$ foram, respectivamente, $2,58 \pm 1,17$ e $4,15 \pm 1,81$. Houve diferença significativa na comparação das variáveis VEF_1 e VEF_1/CVF entre os grupos. Houve correlações moderadas e significativas entre os escores do índice BODE e todos os domínios do SGRQm no grupo de pacientes com $VEF_1 < 50\%$. **Conclusões:** Houve correlação entre o escore do índice BODE e os escores de todos os domínios do SGRQm nos pacientes com DPOC com $VEF_1 < 50\%$. Portanto, os pacientes DPOC com $VEF_1 < 50\%$ morrem mais rápido e têm pior qualidade de vida.

Descritores: Doença pulmonar obstrutiva crônica; Qualidade de vida; Índice de gravidade de doença; Prognóstico.

Introduction

Worldwide, COPD is one of the leading causes of morbidity and mortality, as well as having a substantial and growing negative socioeconomic impact.[1] This disease is characterized by progressive deterioration of respiratory function over time, with systemic effects that lead to permanent disability, as evidenced by fatigue, limited exercise capacity, and a resulting negative impact on quality of life.[2]

The major manifestation of airflow obstruction in COPD is the reduction in FEV_1.[3] However, the European Respiratory Society and the American Thoracic Society (ATS) state that "the measurement of FEV_1 alone does not

represent the complex clinical consequences of COPD", and that additional parameters should be determined.[4]

In 2004, Celli et al. created a mortality prediction index, known as the Body mass index, airway Obstruction, Dyspnea, and Exercise capacity (BODE) index, which systemically determines the degree of mortality in individuals with COPD. This index includes not only the determination of the degree of obstruction but also incorporates factors such as exercise tolerance, BMI, and dyspnea of individuals in a single index.[5]

The BODE index is a multidimensional classification system that provides useful prognostic information in patients with COPD and might be able to measure health status. However, it is unknown whether the BODE index is a sensitive tool for predicting the impact of quality of life in such patients.

The chronic symptoms of COPD (dyspnea, wheezing, cough, expectoration, exercise intolerance, anxiety, and depression) are the major factors responsible for altering the relationship between health and quality of life.[6] Studies of health-related quality of life (HRQoL) in patients with COPD with varying degrees of severity have consistently shown that these patients have significant decrements in HRQoL. [7,8] Therefore, HRQoL is an important clinical outcome in COPD.

In the Brazilian population, COPD is highly prevalent,[9] being considered a major public health problem.[1] It is crucial to identify the factors that cause the persistent deterioration of HRQoL. However, in Brazil, there have been no studies relating the BODE index to HRQoL in COPD patients. Therefore, the objective of this study was to verify the correlation between the BODE index and HRQoL in COPD patients in Brazil.

Methods

This was a descriptive, observational study of 42 patients at a pulmonology outpatient clinic who were diagnosed (clinical and functional diagnosis) with moderate to very severe COPD[1] by a pulmonologist. The patients were clinically stable (no exacerbations within the last eight weeks), were nonsmokers or had stopped smoking at least three months prior, and were free of pulmonary infection at the time of the assessment. Patients with cardiovascular, osteoarticular, neuromuscular, or renal diseases were excluded, as were those who were unable to perform the functional tests safely or who did not perform all of the functional tests.

In accordance with Brazilian National Health Council Resolution 196/96, this study was approved by the Research Ethics Committee of the Federal University of Rio Grande do Norte (ruling no. 124/2007). All of the individuals who agreed to participate in the study gave written informed consent.

For each of the patients selected, the clinical history was analyzed and a complete physical examination was performed.[9] Subsequently, the patients underwent functional tests.

Anthropometric data were recorded by a previously calibrated digital scale with a stadiometer (Soehnle, Murrhardt, Germany). The measurements were performed with patients wearing light clothing and no shoes, with both ankles together, and standing as erect as possible, with their ankles, calves, buttocks, and back against the anthropometer. Subsequently, body weight (kg) and height (m) were measured, and the BMI was calculated.

Pulmonary function was measured with a spirometer (Pulmowin version 2.30E; DTLI Datalink Instruments, Grabels, France). In accordance with the ATS recommendations,[10] the following spirometric variables were analyzed: FVC; FEV_1; and the FEV_1/FVC ratio. The relative values were calculated by the reference equations proposed by Knudson et al.[11]

Functional exercise capacity was measured with the six-minute walk test (6MWT), in accordance with the ATS recommendations,[12] and the reference values were those described by Enright & Sherril.[13] The test was performed in a level, covered corridor of approximately 30 m in length. At the beginning and end of the test, $SpO_2\%$, HR, and arterial pressure were determined, as were the perception of respiratory effort (Borg scale; dyspnea) and the perception of lower limb fatigue (Borg scale; lower limbs). The 6MWT was conducted by the same investigator, without monitoring, and standard phrases of encouragement were used at the end of each minute.

The degree of dyspnea was measured with the modified Medical Research Council (MRC)

dyspnea scale, which correlates well with the prognosis of COPD.[9]

The BODE index was calculated for each patient based on the following variables: FEV_1; six-minute walk distance (6MWD); MRC scale score; and BMI. The scores obtained for each variable were summed, and the BODE score was calculated. The BODE score ranges from zero (minimum) to ten points (maximum). A higher score translates to a greater likelihood of mortality in individuals with COPD.[5]

The Saint George's Respiratory Questionnaire (SGRQ), modified for the assessment of the last three months (mSGRQ), was used in order to assess HRQoL. This questionnaire, specific to COPD patients, has been validated for use in Brazil.[14] It consists of 76 items divided into three domains: symptoms (problems caused by respiratory symptoms); activity (activity restrictions caused by dyspnea); and psychosocial impact (impact of the disease on daily life). The score ranges from 0 (no reduction in quality of life) to 100 (maximum reduction in quality of life). The questionnaire was administered as an interview, during which the questions in each domain of the questionnaire were read in a clear and understandable manner so that the patients could give their responses without any external influences. If the patients did not understand the question, the researcher repeated it until the patients were able to choose the alternative they considered correct.

After the assessment procedure, the patients were stratified into two groups by disease severity: $FEV_1 \geq 50\%$ and $FEV_1 < 50\%$.

For descriptive statistical analysis and inferences, we employed the Statistical Package for the Social Sciences, version 16.0 for Windows (SPSS Inc. Chicago, IL, USA), and the level of significance was set at 5% (p < 0.05). The Kolmogorov-Smirnov test was used in order to evaluate the normality of the data. Data are expressed as mean ± SD. Unpaired t-tests were used in order to compare the $FEV_1 \geq 50\%$ and $FEV_1 < 50\%$ groups. Pearson's coefficient was used in order to study the correlation between the BODE index and HRQoL.

Results

Of the 42 patients who were referred to the department of physical therapy, 10 were excluded from the study: 2 because they presented with exacerbations; and 8 because they did not complete all of the tests proposed.

The study population comprised 32 patients, of whom 12 (38%) were allocated to the $FEV_1 \geq 50\%$ group and 20 (62%) were allocated to the $FEV_1 < 50\%$ group. The characteristics of the study sample are shown in Table 1.

The study revealed no significant differences between the $FEV_1 \geq 50\%$ and $FEV_1 < 50\%$ groups in terms of the following variables: age; gender; BMI; FVC; 6MWD; dyspnea as measured by the MRC scale; or the BODE index. However, there was a significant difference between the two groups in terms of FEV_1 and the FEV_1/FVC ratio (Table 1).

Measurement of the 6MWD revealed no differences between the $FEV_1 \geq 50\%$ group and $FEV_1 < 50\%$ groups (464.6 ± 133.5 vs. 401.6 ± 111.0 m, respectively; p = 0.60). The comparison of predicted 6MWD values with the 6MWD values obtained revealed a difference of 48.8 m in the $FEV_1 \geq 50\%$ group and a difference of 74.4 m in the $FEV_1 < 50\%$ group. The mean 6MWD values are also shown in Table 1.

Figure 1 shows the reduction in quality of life as assessed by the mSGRQ symptoms, activity, and impact domains, as well as by the mSGRQ total score, in the study groups. However, there were no significant differences between the two groups in terms of any of the mSGRQ domains.

Table 1 – Characteristics of the study population.[a]

Characteristic	$FEV_1 \geq 50\%$ (n = 12)	$FEV_1 < 50\%$ (n = 20)	p
Age, years	60.3 ± 9.32	64.9 ± 11.6	0.45
Gender, M/F	08/04	12/08	0.45
BMI, kg/m²	27.6 ± 8.73	27.6 ± 8.80	0.90
Pulmonary function			
FEV_1, % of predicted	54.4 ± 5.04	35.2 ± 7.40	0.03*
FVC, % of predicted	84.3 ± 7.67	50.8 ± 11.1	0.12
FEV_1/FVC, % of predicted	62.0 ± 3.44	62.7 ± 7.40	< 0.01*
Exercise capacity			
6MWD, % of predicted	90.2 ± 22.5	85.8 ± 26.3	0.56
6MWD, m	464.6 ± 133.5	401.6 ± 111.0	0.60
MRC	2.08 ± 1.00	2.00 ± 1.21	0.34
BODE index	2.58 ± 1.17	4.15 ± 1.81	0.19

6MWD: six-minute walk distance; MRC: Medical Research Council Dyspnea Scale; and BODE: Body mass index, airway Obstruction, Dyspnea, and Exercise capacity. [a]Values expressed as mean ± SD, except for gender (n). *p < 0.05 (unpaired t-test).
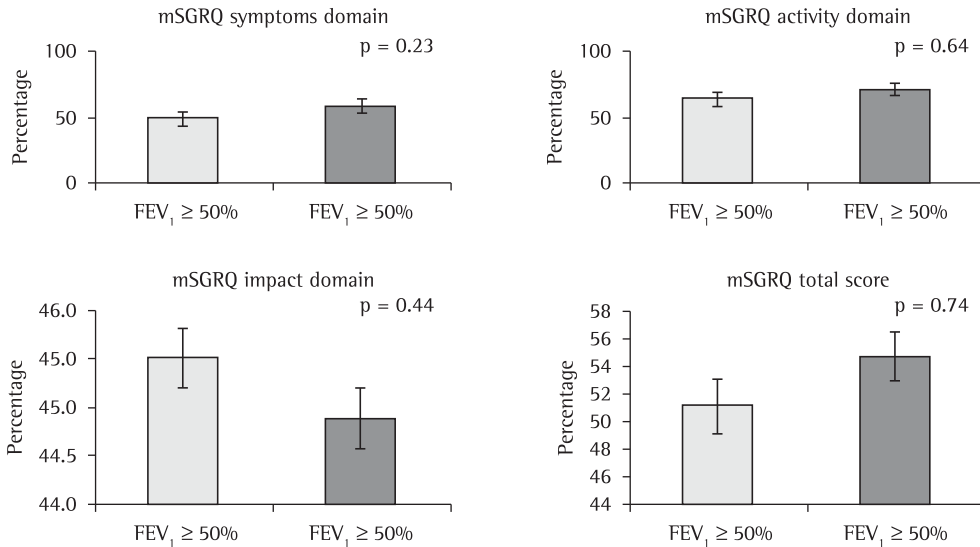
Figure 1 – Means and standard deviations from the assessment of health-related quality of life performed with the modified Saint George's Respiratory Questionnaire (mSGRQ) in the study groups. The unpaired t-test was used in order to compare the groups.

In the $FEV_1 \geq 50\%$ group, the BODE index did not correlate significantly with any of the mSGRQ domains (symptoms: r = 0.27; p = 0.39; activity: r = 0.30; p = 0.22; or impact: r = 0.35; p = 0.27) or with the mSGRQ total score (r = 0.25; p = 0.43).

However, as shown in Table 2, in the $FEV_1 < 50\%$ group, the BODE index showed moderate to significant correlations with all of the mSGRQ domains (symptoms: r = 0.51; p = 0.02; activity: r = 0.58; p = 0.01; and impact: r = 0.53; p = 0.02) and with the mSGRQ total score (r = 0.56; p = 0.01).

Discussion

In our study, a correlation analysis was used in order to determine the relationship between the

Table 2 – Correlation between the Body mass index, airway Obstruction, Dyspnea, and Exercise capacity (BODE) index and the modified Saint George's Respiratory Questionnaire domains in the group of patients with FEV1 < 50%.

mSGRQ domain	BODE	p
Symptoms	r = 0.51	0.02*
Activity	r = 0.58	0.01*
Impact	r = 0.53	0.02*
Total score	r = 0.56	0.01*

mSGRQ: modified Saint George's Respiratory Questionnaire.
*p ≤ 0.05 (Pearson's correlation coefficient).

BODE index and quality of life in patients with moderate to very severe COPD.[1] In addition, the BODE index, which is a predictor of mortality in COPD, was found to be associated with quality of life in patients with greater disease severity ($FEV_1 < 50\%$), which is therefore prognostic of decreased survival and poorer quality of life.

The BODE index was chosen for its use of multiple factors to determine prognosis in COPD patients. The BODE index associates four variables (BMI, airway obstruction, dyspnea, and exercise capacity) that, together, characterize the major alterations found in such patients.[5]

Among the variables analyzed in the present study, significant differences between the two groups were found only for FEV_1 and the FEV_1/FVC ratio. It is likely that the differences presented here are attributable to the fact that COPD patients show deterioration of pulmonary function caused by hyperinflation, with a consequent increase in functional residual capacity and decrease in FVC, factors that are responsible for the development of dyspnea, which has a major (negative) impact on exercise capacity.[15] Dyspnea is also a major predictor of mortality in COPD.[5]

When the study groups were compared in terms of the BODE index, which is a predictor of mortality, we found that the mortality rate was higher among the individuals with FEV_1

< 50%. Knowing that FEV_1 is directly related to mortality in COPD, we can presume that patients who have a high degree of pulmonary obstruction would have limited physical activity, although physical activity has no effect on FEV_1 in individuals with COPD.[16] This is in accordance with the literature, which states that individuals with FEV_1 < 50% of predicted are likely to have significantly lower health status.[17] However, FEV_1 is not identified as a predictor of HRQoL in COPD patients.[18]

An interesting finding in our study was that related to exercise capacity: the mean 6MWD in our COPD patients (> 400 m) was greater than that observed in COPD patients evaluated in a study conducted in Europe, in which the mean 6MWD was < 400 m.[19] This can be explained, at least in part, by the higher level of physical activity in the patients in Brazil in relation those other countries.[20]

However, it is important to emphasize that, in the present study, the patients in the groups analyzed were overweight for COPD patients (mean BMI = 27.6 kg/m^2), a fact that can explain the low dyspnea scores (MRC scale) obtained since it is known that a low BMI also promotes the onset of dyspnea.

Some authors have stated that there is a relationship between a low BMI and peripheral muscle impairment and that, consequently, this is also related to low exercise capacity in individuals with COPD.[21,22] However, in the opinion of other authors, BMI might not reliably identify loss of muscle mass in COPD patients.[23,24]

The results of the mSGRQ domains presented in this study are in accordance with those reported in other studies,[25,26] which showed impaired HRQoL in all of the mSGRQ domains. Values greater than 10% indicate altered quality of life, and a greater mSGRQ score translates to poorer HRQoL.[6]

In this study, the higher BODE index scores and higher mSGRQ activity domain scores for the COPD patients with FEV_1 < 50% suggests that these patients are physically inactive, since the activity domain specifically assesses activity restrictions caused by dyspnea, and such inactivity can increase the risk of death.

In our study, we found that a high BODE index score—the BODE being an integrated index strongly related to morbidity and mortality in COPD patients—negatively affected quality of life in the individuals with FEV_1 < 50%, since there was a relationship between the BODE index and all of the mSGRQ domains. In agreement with our findings, other studies have also shown that the BODE index correlates significantly with quality-of-life scores and that the SGRQ score is an independent predictor of HRQoL.[27]

One limitation of the present study is that the levels of anxiety and depression, which are known to be significantly associated with quality of life in COPD patients, were not determined in the present study. It would be desirable to conduct a cross-sectional study to determine the relationship between the BODE index and selected measures of health status at the beginning and end of the follow-up period. Another limitation of our study was the small sample size, which would have precluded other subanalyses.

Despite these limitations, the present study showed that the BODE index score was associated with the scores of all of the SGRQ domains in COPD patients with FEV_1 < 50%. Therefore, COPD patients with FEV_1 < 50% have lower survival a greater impairment of HRQoL.

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About the authors

Zênia Trindade de Souto Araujo
Professor. Federal University of Rio Grande do Norte, Natal, Brazil.

Gardenia Holanda
Adjunct Professor III. Federal University of Rio Grande do Norte, Natal, Brazil.