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Research Article

# Pulmonary Rehabilitation and BODE Index in Patients with COPD

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## Abstract

The BODE index is an important component that assesses the systemic manifestations of COPD. Patients with this disease have impaired quality of life; an important component that measures the quality of life is the SF-36 Questionnaire. This study aimed to verify the changes of the index BODE occurred in the period of 1 year in Pulmonary Rehabilitation and current analysis of their quality of life. The study was attended by ten patients with COPD in staging me, II, III and IV, of both gender, average age 71.6 ± 9.1, participants of the PRP in the period of 1 year. The results showed that BMI, BDI and DP6 had a small increase, the FEV1 and handgrip a small reduction, but without significant difference. The index BODE and values on the scale of the MMRC decreased, but this decline is a factor for improvement. Patients with severe disease III and IV received greater airflow obstruction, BODE index higher quality of life and more damaged. Reconnecting the index BODE with areas of the SF-36 Questionnaire, we found that the larger the field SA, the more peripheral muscle strength, and how much better mental health, lower intensity of dyspnea. A lower score in the BODE index showed relationship with greater functional capacity. We conclude that patients with more advanced staging of the disease (III and IV) have bigger commitments spirometry and scores of the index BODE and impaired quality of life more than patient with staging II and I.

## Introduction

Chronic Obstructive Pulmonary Disease (COPD) falls between the fourth leading cause of morbidity and mortality in the world [1]. Estimated that by 2020 COPD will be the third place of the most frequent causes of death worldwide [2]. COPD is defined by airflow limitation that is not fully reversible, usually progressive and associated with an inadequate inflammatory response of the lungs before noxious particles and gases [1]. The diagnosis of this disease is productive cough, dyspnea or history of exposure to risk factors for the disease. The diagnosis must be confirmed by spirometry, when the forced expiratory volume in 1 second (FEV1) post bronchodilator remain <80% predicted in combination with forced expiratory volume in 1 second to forced vital capacity (FEV1 / FVC) <0.70 L [3].

Smokers have a high prevalence of respiratory problems and abnormalities in lung function decline in FEV1 and great COPD mortality rate compared with nonsmokers. The tobacco initial age, full of packs smoked per year, and status are mortality indicators for COPD [4].

With the progression of the disease, they develop systemic manifestations, including exercise limitation [5,6] peripheral muscle dysfunction [7,5] pulmonary hypertension [8,9] malnutrition, recurrent exacerbations and hospitalizations [10].

Because COPD is a disease with systemic changes, you need more than one component to the evaluation of the weaknesses that have occurred due to illness. . For this reason Celli *et al*, 2004 [11], developed the BODE index (Body Mass Index, Airflow Obstruction, Dyspnea, Exercise Capacity) which includes four factors that predict the risk of death: Body Mass Index (BMI), the degree of airflow obstruction with FEV1, dyspnea, and exercise capacity, measured distance walked in 6 minutes (6MWD). The study showed that the BODE index is the best indicator of mortality for respiratory causes that FEV1 alone. FEV1 is essential to diagnose and quantify respiratory weakness in COPD [12,13].

The BODE index analyzes the effects obtained in patients participating in the Pulmonary Rehabilitation Program (PRP) [14]; therefore, the present study aims to determine the changes of the BODE index in the period of 1 year in Pulmonary Rehabilitation (PR) and the current analysis of quality of life in PRP patients participating.

Studies have shown that although the Pulmonary Rehabilitation has minimal effects on lung function, it provides improved degree of dyspnea, exercise tolerance, in health status and reduces costs with hospitalizations.

The research took place in Unisalesiano lines in patients with COPD undergoing PRP, in the period of 1 year.

**Table1:** Baseline characteristics and end of the subject in the corresponding period one year.

| Characteristics | BASELINE N=10 | Evaluation after one year N=10 | p |
|---|---|---|---|
| $FEV_1$ (%) | 56,6 ± 28,7 | 32,2 ± 30,8 | 0,69 |
| BMI (Kg/m$^2$) | 22,6 ± 3,4 | 22,9 ± 3,6 | 0,82 |
| MMRC | 1,9 ± 1,3 | 1,7 ± 1,1 | 0,71 |
| BDI | 8,1 ± 2,6 | 9,1 ± 2,6 | 0,41 |
| 6MWD (m) | 427,4 ± 84,7 | 428,3± 93,8 | 0,97 |
| HANDGRIP (KF) | 34,1 ± 7,0 | 30,8 ± 6,3 | 0,28 |
| BODE index | 3,1 ± 2,2 | 2,8 ± 2,1 | 0,75 |

FEV1 = forced expiratory volume in the first second (% of predicted ;) BMI = body mass index; BDI = baseline dyspnea index; MRC = scale of the Medical Research Council; MMRC = Medical Research Council modify, 6MWD: 6-min walking distance; BODE index = BMI/airflow obstruction/dyspnea/ Exercise capacity.

## Patients and Methods

The study had the participation of ten patients with COPD in stages I, II, III and IV of the disease, of both genders, with a mean age of 71.6 ± 9.1, PRP participants in the period of 1 year. For the classification of disease staging, the criteria used were the GOLD 2006 (update the reference) by spirometry. For this analysis, we used the spirometer Spiro bank G and verified by Software Winspiro 2.0. The patients were submitted to evaluations of all components analyzed the BODE Index and the SF Quality of Life Questionnaire - 36 BMI was assessed in the Physical Effort Evaluation Laboratory (LAEF). Height measured by stadiometer and body weight on the scale Tanita. Patients instructed to remove heavy metals (rings, watches, shoes, belts, etc.). Once collected all the data, BMI was calculated using the classical Quetelet index (BMI = weight / height 2).

Spirometry assessed for the classification of the disease staging and to check the degree of airway obstruction. To perform the test, the patient instructed to stand approximately 5 to 10 minutes before the test. Next instructed to use a nose clip, inspire to Total Lung Capacity (TLC) and exhale forcefully on the device mouthpiece. To check the forced expiatory volume in 1 second the patient instructed to stand about 5 to 10 minutes before the test. Next instructed to use a nose clip, inspire to Total Lung Capacity (TLC) and exhale forcefully on the device mouthpiece. The values of FEV1 and FEV1 / FVC used for the classification of COPD.

The Medical Research Council Dyspnea Scale Modified (MMRC) and Baseline Dyspnea Index and Basal dyspnea (BDI) analyzed the intensity of dyspnea. The MMRC dyspnea scale used to establish the degree of dyspnea in daily life of the patient. This 5-point scale (0-4) is based on the degree of the different activities that lead to shortness of breath, ranging from "0" (the patient is not troubled with breathlessness to be in when subjected to rigorous exercise) to "4" (the patient has a lot of shortness of breath to leave the house or even when changing clothes). Individuals should select the scale number that best relates to their lack of air. Higher numbers reported by patients referred to a greater disability [16].

The BDI was developed by Malher *et al*, 1984 [17] and the version translated to Portuguese by Martinez, Padua, 2001 [18]. This scale consists of three factors that evaluate dyspnea: functional impairment, magnitude of task and magnitude of effort. Each evaluated component varies in a score of 0 to 4. A higher score represents better performance as the symptom. The total score obtained by adding the scores of 3 factors (0-12).

Exercise capacity assessed by 6MWD minutes. The test performed on the sports court of the Unisalesiano, following the standards of the ATS 2002 in a path 30 meters marked by two cones. The patient was instructed to walk at full speed in 6 minutes, and allowed to stop and rest during their implementation, but the clock starts the clock was not stopped. During execution test was the monitoring of Blood Pressure (BP), Heart Rate (HR), Pulse Oxygen Saturation (SpO2), respiratory rate (f) before and after the test, and subjective dyspnea analysis and fatigue of members lower the Borg scale at the beginning and end of 6MWD ,. Analysis of peripheral muscle strength performed by dynamometry, where we used the manual dynamometer brand Jamar Bolingbrook IL 60440, evaluating the strength of handgrip, in the dominant hand. The patient evaluated in the upright position, leaning against the wall with his shoulder examined in flexion, and the other member on the body; this told to use the full force of handgrip. This handgrip test performed three times, and used the highest value in measuring unit in Kilogram Fource (KF).

Statistical analysis performed using Student's t test, to see if there were differences between the initial and final evaluations. The analysis of variance (ANOVA) used to detect differences between groups. Pearson's coefficient was used for variables correlation analysis with 5% significance ($p < 0.05$).

## Results

We selected 10 patients, all male, PRP participants with a mean age was 71.6 ± 9.1. All patients underwent an evaluation in the period between February and March 2006, considered the initial assessment, and another in February and March 2007, one year after the first evaluation, which considered final evaluation. The parameters evaluated were the ones that include the BODE index (BMI, FEV1, MMRC and DP6 dyspnea scale), and the BDI and peripheral muscle strength by dynamometry. We also analyzed the quality of life through the SF-36 questionnaire, but this survey conducted only in the final period of the evaluation, it is not possible to make a comparison between initial and final (Tables 1 and 2).

**Table 2:** Mean and standard deviation of the patients analyzed using the Questionnaire SF-36.

| Questionnaire domains SF36 | N=10 |
|---|---|
| SF36-FC | 60,5 ± 26,7 |
| SF36-PAL | 57,5 ± 39,2 |
| SF36-Pain | 85,9 ± 20,9 |
| SF36-GH | 58,7 ± 21,8 |
| SF36-V | 64,0 ± 12,6 |
| SF36-SA | 76,3 ± 29,7 |
| SF36-EA | 70,0 ± 40,7 |
| SF36-MH | 69,2 ± 20,0 |

SF36-FC = Short-form functional capacity; SF36-PAL = Short-form physical aspects limitation; SF36-Pain = Short-form pain; SF36-GH = Short-form general health; SF36-V = Short-form vitality; SF36-SA =Short-form social aspect; SF36-EA = Short-form emotional aspects; SF36-MH = Short-form mental health.

**Table 3:** Analysis of the variables according to the staging of COPD.

| Variables | DPOC I e II | DPOC III e IV | P |
|---|---|---|---|
| $FEV_1$ (%) | 60,0 ± 30,1 | 50,1 ± 26,3 | <0,05 |
| $FEV_1FVC$ (%) | 48,4 ± 11,8 | 45,0 ± 10,3 | <0,05 |
| BODE index | 2,8 ± 1,9 | 3,6 ± 1,7 | <0,001 |
| SF36-FC | 60,5 ± 26,7 | 53,6 ± 26,4 | <0,05 |
| SF36-PAL | 70 ± 32,6 | 45 ± 44,7 | NS |
| SF36-Pain | 86,6 ± 18,7 | 85,2 ± 25,1 | NS |
| SF36-GH | 67,6 ± 16,1 | 49,8 ± 24,7 | NS |
| SF36-V | 68,0 ± 15,2 | 60,0 ± 9,3 | NS |
| SF36-SA | 65,0 ± 34,7 | 87,5 ± 21,6 | NS |
| SF36-EA | 53,3 ± 50,5 | 86,6 ± 30,0 | NS |
| SF36-MH | 79,2 ± 18,4 | 59,2 ± 17,3 | NS |

FEV1 = forced expiratory; volume in the first second (% of predicted); FVC = forced vital capacity (% of predicted); BODE index = BMI/airflow obstruction/ dyspnea/ exercise capacity.; SF36-FC = Short-form functional capacity; SF36-PAL = Short-form physical aspects limitation; SF36-Pain = Short-form pain; SF36-GH = Short-form general health; SF36-V = Short-form vitality; SF36-SA = Short-form social aspect; SF36-EA = Short-form emotional aspects; SF36-MH = Short-form mental health; NS = Not significant.

The results showed that the BMI, BDI and DP6 had a small increase however there was a statistically significant difference. FEV1 and dynamometry had a small reduction, but no significant difference. We note that the BODE index and MMRC scale values also decreased, but these, the lower the better found the prognosis of the patient, i.e., the decrease is a factor of improvement.

Patients analyzed according to severity of COPD. Five patients fulfilled in stages I, II, five in stage III, and IV (Table 3). We found that patients III and IV had higher airflow obstruction, higher BODE index and more impaired quality of life.

The domains of the SF-36 questionnaire to correlate with the parameters of the BODE index, showed significant correlations. (Figures 1-3).

In the list of variables of the BODE index with the domains of the SF-36 questionnaire was verified that the higher the AS domain, i.e., the social, the patient has an increased peripheral muscle strength, and the better mental health, the greater the BDI, or lower intensity

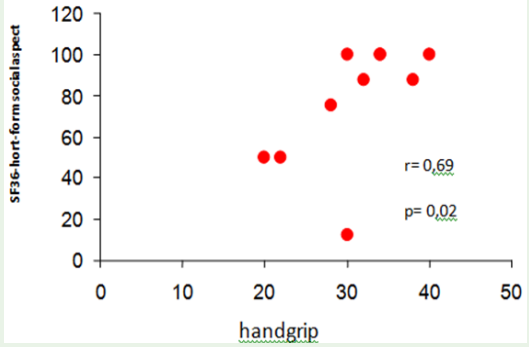


**Figure1:** Relationship between handgrip and domains of the SF-36 questionnaire.

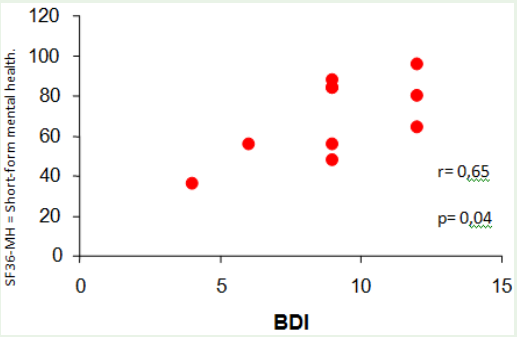


**Figure 2:** Relationship between BDI and MH domain of the SF-36 questionnaire.

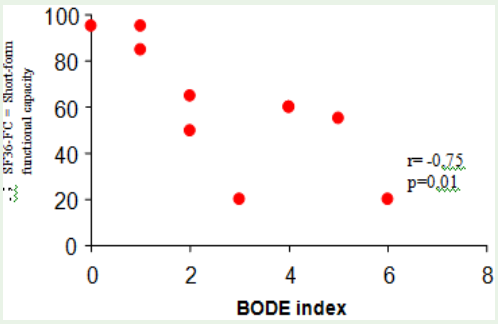


**Figure 3:** Relationship between BODE and FC Domain index of the SF-36 questionnaire.

of dyspnea. This analysis also showed that a lower score on the values of the BODE index, which is a factor of the patient, greater functional capacity a person has.

## Discussion

COPD has local and systemic manifestations. Because of the disease, patients have limitations that interfere with their day-to-day. RP aims to reduce the deleterious effects of the disease, providing an improved quality of life of these patients. The BODE index analyzes the effects produced by the PRP and is being considered as a predictor of mortality [21]. The importance of this study is to analyze the variables of this index in the 1-year period RP and relate it to the quality of life of the participants.In this study there was a significant difference between baseline and final evaluation, even showing improvement in some of the variables of the BODE index as 6MWD, BMI, MMRC and BDI. In a study by Cote; Celli, 2005 [21] showed a significant improvement in the BODE index, but this study was conducted in two years period in RP, and the comparison between participants and non-participants RP patients and the number of patients was high in relation to this study.

With the progression of the disease, airflow obstruction increases 1, BMI decreases due to nutritional depletion and metabolic changes [22]; increases the intensity of dyspnea and decreases muscle strength due to muscle dysfunction, which also caused by the use of corticosteroids [23]. Pulmonary RP aims to improve the general condition of patients with COPD. Only three of the patients analyzed had FEV1 decreased during the evaluation period, the other had an increase in FEV1 values, but no significant difference. This result is

consistent with the study conducted by Emtner *et al*., 2003 [24], which showed a significant improvement in FEV1 after exercise training.

Study by Heijdra *et al*., 2006 [25], the authors showed that malnutrition may not be the largest contributor to the decrease in exercise performance. It also showed that the strength achieved by the dynamometer does not differ between healthy subjects and COPD patients. What is the opposite of the results found by Engelen *et al*., 1994 [26], but these had a nutritional depletion. This study examined only patients with COPD, it is not possible to compare these patients with healthy subjects. What can analyze was an improvement in BMI, but this fact also not associated with statistical significance.

In a study by Verrill *et al*; 2005 [27], showed an increase in 6MWD after 12 to 24 weeks, with also an improvement in FC area with an increase of five points in the SF-36 questionnaire; MH area slightly improved between 12 to 24 weeks of PR. The authors consider that an increase of five points in the SF-36 indicates minimal change, but significant. Other studies show a significant improvement in quality of life of participants PRP patients showing an improvement in physical and psychosocial aspects [28]. This work paves the way for a future comparison of the aspects related to quality of life in patients participating in the city PRP Lins, checking the quality of life improved after a certain time.

Boueri *et al*., 2001 [29], showed a difference of more than 30 meters in 6MWD between pre and post rehabilitation, a value suggested by McGavin *et al.,* 1978 [30]. In the same study, there was no correlation between FEV1 and 6MWD and the 6MWD with SF36-FC domain, a result also found in our work. Regarding FEV1, Mahler *et al*., 1992 [31] only correlation between three of the SF-36, the latter being SF36- FC, SF36-PAL, and SF36-GH. Showing that the degree of air restriction may not be the most important determinant of quality of life. Suggesting that the quality of life of these patients correlated with the degree of dyspnea than with the severity of airflow limitation.

Baddini *et al*., 2002 [32], showed a significant relationship between dyspnea and SF36-FC areas, SF36-SA and SF36-MH of the SF-36. The MMRC scale that assesses dyspnea correlated with the SF36-FC areas, SF36-MH, SF36-V and SF36-SA. The BDI dyspnea scale showed better correlation with the domains of the questionnaire spirometry and blood gas parameters. Correlating the BDI with the SF-36, this best correlated with the SF36-FC, SF36-MH, SF36-V, SF36-EA and SF36-GH, during the period RP. Our study is in agreement with these results, but the correlated parameters were only the end as there was no initial assessment of the SF-36 questionnaire.

It is also important to analyze the subjects affected by COPD with healthy subjects, to check the degree of commitment. RP improves the quality of life of these patients, an increase in the areas SF36-FC, SF36-V, SF36-EA, SF36-MH, SF36-GH, although these values still are below those obtained in healthy subjects [29].

Study by Ong; Earnest; Lu 2005 [33] showed that patients in more serious disease stage (III and IV) have higher scores on the BODE index, performing with major local and systemic involvement. This result was similar to ours, which was also found that patients with more severe stage of the disease have higher scores on the BODE index.

In a study by Cote; Celli, 2005 [21] individuals who did not participate in the PRP showed a greater decline in FEV1, more intense dyspnea, lower BMI, higher scores on the BODE index and lower 6MWD.

The variables related to the intensity of dyspnea (MMRC and BDI) and functional capacity (6MWD and grip strength) did not achieve a significant improvement in this study.

## Conclusion

The study shows that despite the short time of the study, there was an improvement in some of the variables of the BODE index, however, these were not statistically significant. We conclude that patients with more advanced disease stage (III and IV) have higher commitments spirometry and scores of BODE index and more impaired quality of life than patients with stage I and II.

In this study, there was an association between the psychosocial aspect, peripheral muscle strength and intensity of dyspnea. The BODE index was associated with functional capacity. Despite the short time analysis, you can check that pulmonary rehabilitation provides patients improve their physical and psychosocial aspects.

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