ORIGINAL ARTICLE

Influence of general clinical parameters on the quality of life of chronic obstructive pulmonary disease patients*

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Background: There is currently no consensus regarding which factors influence the quality of life of patients suffering from chronic obstructive pulmonary disease (COPD). However, identifying such factors could orient approaches to improving the quality of the lives of these patients.

Objective: To evaluate factors that can interfere with quality of life in COPD patients selected for pulmonary rehabilitation.

Methods: Twenty-one patients with moderate to severe COPD were evaluated. Maximal inspiratory pressure (MIP), 6-minute walk test (6MWT), body mass index (BMI), pulmonary function, blood gases, grip strength (measured with a dynamometer), quadriceps strength and St. George's Respiratory Questionnaire (SGRQ) scores were assessed.

Results: Statistically significant negative correlations with quality of life were found for the following factors: "impact" scores of: forced expiratory volume in one second (FEV_1) (r = -0.68; p = 0.004), FEV_1 to forced vital capacity ratio (FEV_1/FVC) (r = -0.61; p = 0.014), peak expiratory flow (PEF) (r = -0.53 (p = 0.015), 6MWT (r = -0.63; p = 0.001) and BMI (r = -0.64; p = 0.002); "activity" scores for: MIP (r = -0.57; p = 0.007), baseline arterial oxygen saturation by pulse oximetry (SpO_2) (r = -0.52; p = 0.018) and 6MWT (r = -0.58; p = 0.007); "symptom" score for: BMI (r = -0.60; p = 0.005); and "total" scores for: FEV_1 (r = -0.64; p = 0.01), PEF (r = -0.47; p = 0.033) and BMI (r = -0.57; p = 0.009). Multiple linear regression revealed the primary factors influencing quality of life to be: BMI, which presented a significant influence on "symptom", "impact" and "total" scores (p = 0.002, p = 0.009 and p = 0.024, respectively); and 6MWT, which had a significant influence on "activity" and "impact" scores (p = 0.048 and p = 0.010, respectively).

Conclusions: The BMI and 6MWT were shown to have an influence on quality of life in the COPD patients studied. Therefore, therapeutic approaches to improving the quality of life of COPD patients should take these indices into consideration.

Key words: Lung diseases, obstructive/rehabilitation. Quality of life

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INTRODUCTION

There has been a recent upsurge in the number of studies assessing quality of life (QOL). Since it is often impossible to extend the life of patients suffering from incurable diseases, improving the QOL of such patients should be made a priority[1,2].

According to the American Thoracic Society (ATS)[3], QOL can be defined as satisfaction or happiness with life in relation to what the individual considers important. In addition, it can be defined as the relationship between what is desired and what is achieved or achievable. The definition of QOL is broad and complex, made more so by the highly subjective nature of the concept.

In the elderly, chronic obstructive pulmonary disease (COPD) affects QOL and is the leading cause of death[1]. Various aspects such as anxiety, depression, a sensation of dyspnea, exercise intolerance, compromised nutritional state, chronic cough and disease severity may interfere with QOL[1]. However, there is no consensus regarding the influence of each factor on the QOL of patients suffering from COPD[4].

Pulmonary function data and QOL indices must be taken into consideration when determining the severity of diseases such as COPD and asthma[5]. However, the correlation between spirometry findings and QOL is weak or virtually nonexistent[6-10]. In fact, the correlation between the development of the pulmonary obstruction and lower QOL has not been demonstrated with consistency. Therefore, patient QOL cannot be quantified based on spirometry data alone[6-10].

Body mass index (BMI) is another important indicator of the health status of patients suffering from COPD[11]. Those COPD patients presenting low BMIs also score poorly on the St. George's Respiratory Questionnaire (SGRQ)[7]. Other factors that have been related to QOL are age[6], exercise tolerance and muscle strength[12], as well as psychological aspects such as anxiety and depression[6].

Pulmonary rehabilitation programs that resulted in improved peripheral[12] and respiratory[13] muscle strength, as well as greater exercise tolerance[14] and higher BMI[11], also improved the QOL of COPD patients, suggesting that specific aspects influence QOL.

Taking into consideration the influence of various factors, such as those mentioned above, the objective of this study was to evaluate the main factors that may interfere with the QOL of patients suffering from COPD. The patients studied were selected for pulmonary rehabilitation at the Hospital das Clínicas of the Faculdade de Medicina de Botucatu (SP).

Abbreviations used in this paper:

6MWT – 6-minute walk test
ATS – American Thoracic Society
BDI – Baseline Dyspnea Index
BMI – Body mass index
COPD – Chronic obstructive pulmonary disease
CRQ – Chronic Respiratory Questionnaire
FEV_1 – Forced expiratory volume in one second
FVC – Forced vital capacity
MEP – Maximal expiratory pressure
MIP – Maximal inspiratory pressure
MOS – Medical Outcomes Study Short Form Survey
PaO_2 – Arterial oxygen tension
PEF – Peak expiratory flow
QOL – Quality of life
RQLQ – Respiratory Quality of Life Questionnaire
SF-20 – Medical Outcomes Study Short Form 20-item Questionnaire
SF-36 – Medical Outcomes Study Short Form 36-item Questionnaire
SGRQ – St. George's Respiratory Questionnaire
SpO_2 – Arterial oxygen saturation

METHOD

The study involved 21 patients of both genders diagnosed with COPD and selected for pulmonary rehabilitation, independent of disease severity[15]. The patients were clinically stable, without recent worsening of symptoms. None presented cardiovascular or osteoarticular involvement. Diagnosis was made through the analysis of clinical history of exposure to COPD risk factors and confirmed by spirometry. In accordance with the Global Initiative for Chronic Obstructive Pulmonary Disease, partially reversible airflow limitation is defined as post-bronchodilator administration forced expiratory volume in one second (FEV_1) lower than 80% of predicted value and FEV_1 as a percentage of forced vital capacity (FEV_1/FVC) lower than 70%[15].

Patients were informed of the procedures proposed in the study and gave written informed consent. The Ethics Research Committee of the *Faculdade de Medicina de Botucatu* approved the study. All patients were submitted to a variety of tests and evaluations.

Nutritional evaluation

Using anthropometry, height and weight were measured and BMI was calculated (weight/height^2). For body composition analyses, resistance was obtained with the use of 4 surface electrodes placed around the right fist and ankle, with the patient in a recumbent position, using a bioimpedance analyzer (BIA 101A /RJL systems, Detroit, MI, USA). Lean body mass was estimated in accordance with a model developed by Kyle et al.[16]: lean body mass = -6.06 + (height x 0.283) + (weight x 0.207) – (resistance x 0.024) + [gender (male = 1, female = 0)] x 4.036.

Assessment of respiratory muscle strength

Maximal inspiratory pressure (MIP) and maximal expiratory pressure (MEP) were measured in accordance with the method proposed by Black & Hyatt[17]. Both MIP and MEP were measured three times with a vacuum manometer and only the highest measurement was recorded for analysis. Values of MIP were obtained from residual volume, whereas MEP values were obtained from total lung capacity. Patients received verbal encouragement and second measurements were taken when there was a greater than 10% difference between one measurement and the next.

6-minute walk test

Patients were asked to walk at their fastest pace over a 30-meter course clearly marked in a corridor. Patients received verbal encouragement. Arterial oxygen saturation by pulse oximetry (SpO_2) was monitored throughout the test with a Biox 3700 Ohmeda oximeter (Ohmeda, Boulder, CO, USA). The distance covered was measured in meters. Heart rate and SpO_2 were recorded prior to and after the test, as were respiratory rate, arterial blood pressure (by sphygmomanometer) and Borg scale dyspnea index, which consists of a scale from 0 (insignificant effort) to 10 (exhaustive effort).

Quality of life

A validated version of the SGRQ was used[18]. It comprises three domains: "symptom" score assesses discomfort caused by respiratory symptoms; "impact" score assesses the global impact on daily life and perceived well-being of patients; and "activity" score assesses changes in physical activities. "Total" scores were also quantified. Results were expressed as percentages. High scores indicate worse performance in each domain.

Hand-grip dynamometer measurements

Muscle strength in the arms was estimated by quantifying grip strength exerted by the dominant hand, measured with a hand-grip dynamometer (TEC-60; Technical Products, Clifton, NJ, USA). While sitting, patients extended their dominant arm (shoulder flexion at 90°, forearm in neutral position) and gripped the dynamometer. The best of three trials was chosen for later analysis.

Quadriceps strength

A maximal repetition test was conducted. Patients were encouraged to attain maximal repetition in bench press. Three trials were allowed until a maximal repetition (in kg) was obtained for the muscle group in question. If this was not achieved after 3 trials, patients were allowed to repeat the test after resting for at least one day.

Pulmonary function and gas exchange

Pulmonary function tests included determination of FEV_1, FVC, and FEV_1/FVC. A computer-assisted system (model 1070; Medical Graphics, St. Paul, MN, USA) was used in accordance with ATS guidelines[19]. Values of FEV_1 were expressed in liters, as percentage of FVC and as percentage of reference values. The objective of the tests was to categorize the patients as having the mild, moderate or severe form of the disease. Subjects were classified in accordance with the criteria recommended by the Global Initiative for Chronic Obstructive Pulmonary Disease[15]. Blood was collected in room air and blood gas exchange was determined with a blood gas analyzer (Stat Profile 5 Plus; Nova Biomedical, Waltham, MA, USA).

Peak expiratory flow

Peak expiratory flow (PEF) was determined in three tests performed with an Assess peak flow meter (Assess, HealthScan Products, Cedar Grove, NJ, USA). The highest value was chosen as quantifiably representative of the degree of airway obstruction.

Statistical analysis

Pearson's correlation coefficient was used for the correlation between variables, and the level of significance was set at 5%. Multiple linear regression was used for independent variables that may be predictive of QOL components. The SGRQ domains ("symptoms", "impacts", and "activity") and SGRQ "Total" score were used as dependent variables.

RESULTS

Twenty-one patients diagnosed with moderate to severe COPD were studied. Basal patient characteristics are shown in Table 1. Results are summarized in Table 2.

The "Impact" domain was found to correlate negatively and significantly with FEV_1 (r = -0.68; p = 0.004), FEV_1/FVC (r = -0.61; p = 0.014) and PEF (r = -0.53; p = 0.015). In addition, PEF and FEV_1 both correlated negatively with SGRQ "total" score (r = -0.53; p = 0.015). Similarly, MIP and SpO_2 correlated negatively with the "Activity" domain (r = -0.57; p = 0.007 and r = -0.52; p = 0.018, respectively). There were no significant correlations between any SGRQ domain and MEP or arterial oxygen tension (PaO_2).

Patient BMI correlated negatively and significantly with "Impact" domain (r = -0.64; p = 0.002), "Symptom" domain (r = -0.60; p = 0.005) and "Total" score (r = -0.57; p = 0.009). There was no correlation between the percentage of lean body mass and QOL indices.

The 6MWT results correlated negatively and significantly with the "Activity" domain (r = -0.58; p = 0.007) and the "Impact" domain (r = -0.63; p = 0.001). Neither hand-grip dynamometer measurements nor quadriceps strength correlated with any SGRQ domain.

We used SGRQ domains as dependent variables in the analysis of multiple linear regression. We found the SGRQ "Total" score to be significantly influenced by BMI (p = 0.024). In addition, the "Impact" domain was significantly influenced by BMI and 6MWT (p = 0.009 and p = 0.010, respectively). Furthermore, the "Activity" domain was significantly influenced by 6MWT (p = .048), nd the "Symptom" domain was significantly influenced by BMI (p = 0.002).

DISCUSSION

The SGRQ "Impact" domain correlated significantly with pulmonary function parameters (FEV_1; FEV_1/FVC; PEF) and with BMI. The "Activity" domain was influenced by MIP, 6MWT, and SpO_2. The "Symptom" domain correlated significantly only with BMI. The "Total" score was influenced by FEV_1, PEF, and BMI. When SGRQ domains were used as dependent variables in the analysis of multiple linear regression, only BMI significantly influenced "Symptom", "Impact", and "Total" score, whereas 6MWT significantly influenced "Activity" and "Impact". Both BMI and 6MWT proved to be significant independent variables.

It is important to exercise caution when attempting to use spirometry data to predict QOL for COPD patients. It has been suggested in the literature that FEV_1 and FEV_1/FVC correlate only weakly with QOL indices[6].

In the present study, FEV_1, FEV_1/FVC and PEF were found to correlate negatively and significantly with the "Impact" domain and "Total" score. However, when the spirometry indices were submitted to multiple regression, none influenced any SGRQ components, confirming the supposition that disease severity has little effect on QOL[7,8,9,10].

Mahler et al.[7] compared the impact of dyspnea and pulmonary function on the QOL of 110

TABLE 1
Demographics, pulmonary function data and SGRQ domain values for the 21 patients studied

	Mean	Standard deviation
Age (years)	65	8
Gender M/F	17/4	--
BMI (kg/m²)	25	5
SpO_2 (%)	93	2
Symptoms (%)	52	17
Activity (%)	54	24
Impacts (%)	43	17
Total (%)	48	16
PaO_2 (mmHg)	73	8
FEV_1 (%)	46	15
FEV_1/FVC (%)	46	11

SGRQ: St. George's Respiratory Questionnaire; BMI: body mass index; SpO_2: arterial oxygen saturation by pulse oximetry; PaO_2: arterial oxygen tension; FEV_1: forced expiratory volume in one second; FVC: forced vital capacity

TABLE 2
Pearson's linear correlations of SGRQ domains and "Total" score in relation to the independent variables evaluated in the 21 patients analyzed

SGRQ	FEV_1	FEV_1/FVC	PEF	MIP	BMI	6MWT	SpO_2
Impacts	r = -0.68 p = 0.00486	r = -0.61 p = 0.0149	r = -0.53 p = 0.0151	--	r = -0.64 p = 0.00293	r = -0.63 p = 0.00197	--
Activity	--	--	--	r = -0.57 p = 0.00762	--	r = 0.58 p = 0.0074	r = -0.52 p = 0.0181
Symptoms	--	--	--	--	r = -0.60 p = 0.00587	--	--
Total	r = -0.64 p = 0.01	--	r = -0.477 p = 0.0334	--	r = -0.57 p = 0.00959	--	--

— No significant correlation

SGRQ: St. George's Respiratory Questionnaire; FEV_1: forced expiratory volume in one second; FVC: forced vital capacity; PEF: peak expiratory flow; MIP: maximal inspiratory pressure; BMI: body mass index; 6MWT: six-minute walk test; SpO_2: arterial oxygen saturation by pulse oximetry

patients with COPD. A generic instrument for assessing QOL, the Medical Outcomes Study 20-item short-form health survey (SF-20), and Mahler's Baseline Dyspnea Index (BDI) were used. Using multiple regression, only BDI significantly influenced QOL. Renwick & Connoly[8] evaluated the influence of FEV_1 on QOL (as assessed by SGRQ score) of 190 patients and reported significant correlations between FEV_1 and all SGRQ components. However, when submitted to multiple regression, the correlation between FEV_1 and SGRQ was weak. Hajiro et al.[9] categorized dyspnea in 194 patients as mild, moderate or severe and compared the impact of dyspnea with that of disease severity (as defined by the ATS) on QOL as assessed by the Medical Outcomes Study 36-item short-form health survey (SF-36). They concluded that the degree of dyspnea is a more relevant determinant of QOL than is disease severity. Hajiro et al.[10] studied 218 patients categorized as suffering from mild, moderate or severe COPD (as defined by ATS guidelines). The authors compared the influence of disease severity to that of dyspnea severity (defined by the Medical Research Council dyspnea scale) on QOL (as assessed by SGRQ score) and found strong correlations between FEV_1 and SGRQ only in those patients diagnosed with the severe form of the disease. However, the authors also found that the dyspnea index correlated better with all SGRQ components than did FEV_1.

Tsukino et al.[6] evaluated, among other factors, the influence of the degree of airway obstruction on the QOL of COPD patients and concluded that airflow limitation partially determined COPD patient QOL. Prigatano et al.[20] assessed 100 COPD patients using the Sickness Impact Profile, and Ketelaars et al.[21] employed the SGRQ to assess 126 COPD patients. The authors of both studies concluded that FEV_1 is one of the most important determinants of QOL among the factors evaluated, which included anxiety, depression and physical capacity.

There is evidence of a correlation between poor nutritional state and worsening of QOL in COPD patients, especially in those with emphysema[4]. In our study, BMI was found to correlated negatively with "Impact", "Symptom", and "Total" scores. However, we found no significant correlation between the percentage of lean body mass and any SGRQ category.

Shoup et al.[22] studied the effects of body weight, lean body mass (determined by dual-energy X-ray absorptiometry) and dyspnea (BDI) on the QOL (SGRQ score) of 50 COPD patients. The "Activity" and "Impact" domain scores, as well as the "Total" scores of patients with body weight below the norm (for their build, etc.) were significantly higher (worse) than those of patients with normal weight, whereas patients with body weight above the norm had higher "Impact" domain and "Total" scores. In addition, patients with a low lean mass index (lean mass/height^2) scored higher in all SGRQ categories. However, when BDI values were inserted in the statistical model, neither weight nor lean body mass significantly influenced the QOL.

Tsukino et al.[6] evaluated the effects of several variables, including body weight, on the QOL (as assessed by the Nottingham Health Profile and the Chronic Respiratory Questionnaire) of 132 COPD patients and concluded that the relative body weight of the subjects did not influence their QOL. They reported that the main determinants of QOL were airflow obstruction, diffusion capacity, age and life history of cigarette consumption. Yohannes et al.[4] stated that BMI had only a weak influence on Breathing Problems Questionnaire scores and no influence on Chronic Respiratory Questionnaire scores.

The weak or nonexistent influence of nutritional state on the QOL of patients diagnosed with COPD may be due to methodological problems, such as the fact that the samples were small in relation to the great number of variables studied. In addition, determining which variables ideally characterize the nutritional state of subjects is problematic.

There was a significant negative correlation between SpO_2 and the SGRQ "Activity" domain. This suggests that patients suffering from hypoxemia are less capable of performing physical activities. However, when SpO_2 values were submitted to multiple linear regression, no significant correlation was found between this variable and the "Activity" domain.

Stavem et al.[23] categorized 59 male and female COPD patients into two groups: mild COPD and moderate to severe COPD. They studied the correlation between PaO_2 (measured through radial artery puncture) and QOL. The authors used a modified version of the Respiratory Quality of Life Questionnaire (RQLQ; modified for COPD patients) as a specific instrument and used the SF-36 as a generic instrument. They reported that, in patients with moderate to severe COPD, there were significant correlations found between PaO_2 and four of the five RQLQ components. However, in the same group of patients, PaO_2 was found to correlate significantly with only one of the eight SF-36 domains in the same group. The authors concluded that PaO_2 is a moderate determinant of QOL for COPD patients. In our study, we found no significant correlation between PaO_2 and any SGRQ domain.

The effect of oxygen therapy on the QOL of COPD patients is controversial. Okubadejo et al.[24] made use of the SGRQ in order to evaluate the influence of a 6-month course of oxygen therapy on the QOL of COPD patients and concluded that there was no improvement in QOL during that period or any correlation between altered PaO_2 and QOL. However, Ferreira et al.[25] evaluated the QOL of low-income patients diagnosed with COPD and concluded that those submitted to long-term oxygen therapy had significantly lower QOL (higher SGRQ scores) than did nonhypoxic patients. Further investigation of this subject is warranted.

In the present study, we found indications that exercise tolerance affects the QOL of patients with COPD. The finding that MIP and 6MWT correlate with "Activity" domain score suggests that these variables influence the daily life of COPD patients. Mahler et al.[7], using a generic instrument (the SF-20) for assessing QOL found significant correlation between MIP and the physical activity component. Ketelaars et al.[21] also found significant negative correlations between MIP and the SGRQ "Activity" and "Impact" domain scores. Unlike Ketelaars et al.[21], showed a correlation between MIP and "Impact" domain score (a finding unconfirmed in our study) but (as in our study) reported no influence of MIP on the SGRQ when MIP was submitted to multiple regression.

We found that greater distances walked during the 6MWT had a positive influence on "Activity" and "Impact" domain scores, and we confirmed that influence through multiple linear regression. Significant correlations between exercise tolerance and QOL indices in COPD patients have been previously reported[7,10,20,21].

Ketelaars et al.[21] reported significant negative correlations between the 12-minute walk test and the "Activity" and "Impact" domain scores, a finding which was, as in our study, confirmed by multiple regression. When Hajiro et al.[10] studied factors determining the SGRQ "Total" score of COPD patients categorized according to disease severity, they concluded that maximal oxygen uptake influenced "Total" score only in patients with the mild form of the disease. Patients with severe COPD are usually older, and exercise intolerance can, in part, be associated with age.

Better performance on the 6MWT may indicate less difficulty in performing daily physical activities and, consequently, lower impact of the disease. Moreover, 6MWT may be an important clinical indicator of functional capacity. Distance walked during the 6MWT seems to be one of the factors that influence the QOL of COPD patients, although the extent of this relationship is still unclear.

It is well known that no correlation exists between increased distance walked during the 6MWT and improved QOL indices after pulmonary rehabilitation. This is probably due to the fact that, although both 6MWT and QOL indices improve, the beneficial effects of pulmonary rehabilitation on QOL are related to global aspects and not to isolated factors[26,27].

Some limitations, such as the sample size and the lack of evaluation of dyspnea sensation, may have influenced the results in the present study. The influence of dyspnea on the QOL of COPD patients has been previously reported[7,9,10,22]. These authors found that BMI and 6MWT were the factors exerting the most influence over the QOL of COPD patients selected for pulmonary rehabilitation. Although these factors may not be directly predictive of QOL, improved nutritional state, greater functional capacity and increased exercise tolerance may be conducive to an improved QOL for such patients, since their pulmonary function can only be partially enhanced.

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