

Dyspnea, general health, and voice in Chronic Obstructive Pulmonary Disease

Dispneia, saúde geral e voz da Doença Pulmonar Obstrutiva Crônica

Disnea, salud general y voz en la Enfermedad Pulmonar Obstrutiva Crónica

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Abstract

Introduction: The chronic irreversible and progressive airflow limitation that occurs in Chronic Obstructive Pulmonary Disease (COPD) may impair breathing, and harm one's general health and voice. **Objective:** To verify the correlation between degree and impact of the disease on the general health status of individuals with COPD, their dyspnea sensation and voice-related quality of life. **Methods:** The sample consisted of a group of 37 subjects diagnosed with COPD, of both sexes, aged between 35 and 89 years. Modified Medical Research Council scale (mMRC), COPD Assessment Test (CAT), Voice-Related Quality of Life questionnaire, and determination of the severity of the disease by limiting airflow according to the Global Initiative for Chronic Obstructive Lung Disease (GOLD) were performed. **Results:** Most of the individuals showed disease grade and CAT results as moderate to severe; mMRC from 1 to 3; total and physical domain scores below the cutoff point for the Voice-Related Quality of Life. There was a significant inverse correlation between total/physical domain scores of V-RQOL and CAT. **Conclusions:** The subjects with COPD were homogeneously distributed between the sexes, were older, and presented an impact of the disease on general health and sensation of dyspnea in moderate and severe degrees. Voice-Related Quality of Life was below the cutoff point. We found that the worse the results of the Voice-Related Quality of Life questionnaire, the greater the impact of the symptoms of chronic obstructive pulmonary disease on the general health status.

Keywords: Dyspnea; Chronic obstructive pulmonary disease, Quality of life; Voice.

Resumo

Introdução: A limitação crônica irreversível e progressiva do fluxo aéreo que ocorre na Doença Pulmonar Obstrutiva Crônica pode prejudicar a respiração, a saúde geral e a voz do sujeito. **Objetivo:** Verificar a correlação entre grau e impacto da doença no estado de saúde geral de indivíduos com Doença Pulmonar Obstrutiva Crônica (DPOC), sensação de dispneia e qualidade de vida em voz. **Método:** A amostra foi composta por um grupo de 37 sujeitos diagnosticados com Doença Pulmonar Obstrutiva Crônica, de ambos os sexos, entre 35 e 89 anos de idade. Foram realizados: Escala *Modified Medical Research Council* (mMRC); *COPD Assessment Test* (CAT); questionário Qualidade de Vida em Voz e determinação da gravidade da doença pela limitação ao fluxo aéreo, conforme *Global Initiative for Chronic Obstructive Lung Disease* (GOLD). **Resultados:** A maioria apresentou grau da doença e CAT moderado e grave; mMRC 1 a 3; além de Qualidade de Vida em Voz, com escore total e domínio físico, abaixo do ponto de corte. Esta última variável foi correlacionada, significativa e inversamente, com o CAT. **Conclusões:** Os

sujeitos com DPOC se distribuíram homoganeamente entre os sexos, eram mais velhos, com impacto da doença na saúde geral e sensação de dispneia situadas em graus moderado e grave, e a qualidade de vida em voz abaixo do ponto de corte. Verificou-se que, quanto menores os resultados do questionário de qualidade de vida em voz, maior foi o impacto dos sintomas da doença pulmonar obstrutiva crônica no estado de saúde geral.

Palavras-chave: Dispneia; Doença pulmonar obstrutiva crônica, Qualidade de vida; Voz.

Resumen

Introducción: La limitación crónica irreversible y progresiva del flujo aéreo que se produce en la Enfermedad Pulmonar Obstrutiva Crónica puede perjudicar la respiración, la salud general y la voz del sujeto. **Objetivo:** Verificar la correlación entre el grado e impacto de la enfermedad en el estado de salud general de los individuos con Enfermedad Pulmonar Obstrutiva Crónica (EPOC), la sensación de disnea y la calidad de vida de la voz. **Método:** La muestra estuvo compuesta por un grupo de 37 sujetos diagnosticados con Enfermedad Pulmonar Obstrutiva Crónica, de ambos sexos, entre 35 y 89 años de edad. Fueron realizadas las siguientes pruebas: Escala *Modified Medical Research Council (mMRC)*; *COPD Assessment Test (CAT)*; cuestionario de calidad de vida en la voz y determinación de la gravedad de la enfermedad mediante la limitación del flujo aéreo, según la *Global Initiative for Chronic Obstructive Lung Disease (GOLD)*. **Resultados:** La mayoría presentaba un grado moderado y severo de la enfermedad y el CAT; Consejo de mMRC 1 a 3; además de Calidad de Vida en Voz, con puntuación total y dominio físico, por debajo del punto de corte. Esta última variable fue correlacionada, significativa e inversamente con el CAT. **Conclusiones:** Los sujetos con EPOC se distribuyeron homoganeamente entre los géneros, eran de mayor edad, con un impacto de la enfermedad en la salud general y la sensación de disnea situados en grados moderados y severos, la calidad de vida de la voz por debajo del punto de corte. Se descubrió que cuanto más bajos eran los resultados del cuestionario de calidad de vida de la voz, mayor era el impacto de los síntomas de la enfermedad pulmonar obstrutiva crónica en el estado de salud general.

Palabras clave: Disnea; Enfermedad pulmonar obstrutiva crónica; Calidad de vida; Voz.

1. Introduction

The Chronic Obstructive Pulmonary Disease (COPD), considered a chronic irreversible and progressive airflow limitation, is associated with the abnormal inflammatory process of the lungs as consequence of inhaling harmful particles and gases. Airflow limitation occurs due to loss of lung tissue elasticity, alveolar destruction, thickening and chronic inflammation of the airways and increased pulmonary secretion, which may lead to airway obstruction (Melo et al., 2018; Almeida & Schneider, 2019; Mancopes et al., 2020).

With the onset of the disease, the individual may present signs and symptoms such as dyspnea, persistent cough, ventilatory alteration, expectoration, pulmonary hypersecretion, fatigue during physical activity practices, and loss of elastic retraction, among others (Freitas et al., 2017; Almeida & Schneider, 2019; Mancopes et al., 2020). The symptomatic burden of COPD reduces the individual's physical and psychological functioning, with a great impact on health-related quality of life (Lee et al., 2017).

People with COPD present a reduction in exercise capacity, what is considered the main limiting factor of daily life activities and is directly related to the greater risk of exacerbations. Such implication on exercise capacity results in factors such as impaired lung function, limited gas exchange, and skeletal muscle dysfunction it is directly related to the severity of the disease. When dyspnea is also present, these changes lead to greater interference with physical activity, which starts a vicious circle (Costa et al., 2015).

Dyspnea is one of the first symptoms to appear in this context and is directly associated with a worsening in quality of life, regardless of the severity of airflow limitation (Lee et al., 2017). The manifestation of such symptom suggests that about 50% of the lung capacity is compromised, negatively affecting oral communication due to impaired voice production, which depends on breathing (Soares et al., 2010; Gonçalves et al., 2015).

Pulmonary disorders cause changes in the airflow and unbalance the basic relationship between the pulmonary and myoelastic aerodynamic forces of the larynx, causing dysphonia. There are several ways to evaluate the voice, but nowadays the impact it has on quality of life has been taken into account and, hence, the importance of evaluating such aspect: voice-related quality of life is directly related to the individual's general health quality (Costa et al., 2015; Gonçalves et al., 2015).

The worsening of health status and the reduction of exercise tolerance, characteristics of the disease, are directly linked to skeletal muscle dysfunction. Considered one of the main systemic effects, the loss of muscle mass contributes to a worse prognosis and worsening of the general health status (Rocha et al., 2018). Measuring the impact of COPD symptoms allows the comparison between patients and helps to quantify changes in health status during clinical follow-up. Thus, health status analysis is an important measure to assess the severity of the disease in COPD (Lee et al., 2017).

Analyzing the relationship between the different aspects of the Voice-Related Quality of Life, the feeling of dyspnea, and general health of subjects with COPD will allow a better understanding of such factors. This will help towards more effective performances directed to this population based on the understanding of the limitations due to COPD, as well as deepening the speech therapy and physiotherapy interface in the treatment of these patients. Therefore, the objective of this study was to verify the correlation between degree and impact of the disease on the general health status of individuals with COPD, their dyspnea sensation and voice-related quality of life.

2. Methods

2.1 Bioethical aspects

This was an original, observational, cross-sectional, prospective and quantitative study, approved by the Ethics Committee of Research with Human Beings from the institution of origin (1,967,549), in accordance with the ethical criteria proposed by Resolution 466/2012 of the National Health Council. All individuals signed the Free and Informed Consent Form as recommended in the aforementioned resolution. Data were collected at the pulmonary rehabilitation unit of a university hospital, from November to December 2019.

2.2 Sampling Criteria and Process

In the present study, the inclusion criteria were: individuals of both sexes, adults (> 35 years), clinical and spirometric diagnosis of COPD through the Global Initiative for Chronic Obstructive Lung Disease (Gold, 2020); present FEV1/FVC < 0.70 (Forced Expiratory Volume in the 1st second/Forced Vital Capacity) after bronchodilator administration; be clinically stable at the time of the evaluations, without exacerbating the disease or hospitalizations (in the previous three months); no changes in dosage or frequency of medications; and who signed the Informed Consent Form. The Tiffeneau index (FEV1/FVC ratio), considered the gold standard, was used for diagnosis. In order to define the degree of the disease, the degree of airflow limitation, i.e., the FEV1 was used.

The exclusion criteria were: history of neurological impairment; tracheostomized individuals; use of probes for feeding; head and/or neck cancer; active smokers; presence of uncontrolled hypertension; recent abdominal or thoracic surgery; osteoporosis; and result of the Mini Mental State Examination (MMSE) below expectations (≤ 13 points).

In order to meet the sample selection criteria, an anamnesis was applied containing questions related to age, marital status, education, smoking history and health history. The subjects' medical records were consulted in order to obtain the spirometric data, which is calculated by the post-bronchodilator FEV1/FVC ratio and when lower than 70% of the predicted indicates the degree of obstruction to the current airflow of each individual. The severity of COPD was determined through airflow limitation (FEV1)¹⁰ and was considered as: Mild if $FEV1 \geq 80\%$; Moderate if $50\% \leq FEV1 < 80\%$; Severe if $30\% \leq FEV1 < 50\%$ and Very Severe when $FEV1 < 30\%$ (GOLD, 2020).

After the application of the inclusion and exclusion criteria, the sample consisted of 37 individuals of both sexes with a diagnosis of COPD, aged between 35 and 89 years (mean of 63.7 years). The demographic characteristics of the sample are presented in Table 1.

Table 1–Characterization of the sample.

Variables	
<i>Sex n (%)</i>	
Male	18 (48.6)
Female	19 (51.4)
<i>Age (years)</i>	
Mean ± SD	63.7 ± 13.1
<i>Education (%)</i>	
Incomplete elementary school	25 (67.6)
Elementary school	6 (16.2)
High school	6 (16.2)
<i>Marital status n (%)</i>	
Not married	7 (18.9)
Married	18 (48.6)
Divorced	5 (13.5)
Widow(er)	7 (18.9)

Label: SD – standard deviation; n – number of subjects.
Source: Authors

2.3 Data collection

From the application of the inclusion and exclusion criteria, the selected subjects started the data collection process for the research, performing the evaluations described as follows.

The Modified Medical Research Council (mMRC) scale was the instrument used for dyspnea self-assessment in daily activities. It is considered an instrument of easy applicability and understanding, and is composed of five items. The patient reported his subjective degree of dyspnea choosing a value that ranged from 0 to 4, considering: 0 – dyspnea only with great efforts; 1 – dyspnea if walking fast or going uphill; 2 – walks slower than people of the same age due to shortness of breath or, when walking on the plane, at their own pace, has to stop to breathe; 3 – after walking less than 100 meters or a few minutes on the plane must stop to breathe; 4 – not able to leave home due to dyspnea (Kovelis et al., 2008).

The COPD Assessment Test (CAT) questionnaire was used in order to quantify the impact of COPD symptoms on the individual's health status. It is a self-administered, easy-to-apply questionnaire with objective questions and with a score included in the new classification of COPD patients (Jones et al., 2009; Silva et al., 2013). The CAT questionnaire comprises 8 questions addressing the COPD symptoms that most affect the patients: cough, phlegm, chest tightness, breathlessness when going uphill, limitations in daily activities, confidence in leaving the house, sleep, and energy. Scores vary from 0 to 5 points on each item – total of 40 points – where lower scores correspond to a low impact of the disease on health status. The impact classification occurs according to the scores obtained as follows: from 6 to 10 points – light; 11 to 20 points – moderate; 21 to 30 points – severe; and from 31 to 40 points – very severe (Jones et al., 2009).

The self-assessment of the voice's influence on quality of life was performed using the Voice-Related Quality of Life (V-RQOL) questionnaire. The protocol is composed by 10 questions, from which, four comprise the socioemotional domain

(cutoff point 90.65) and six the physical domain (cutoff point 89.60). The items in this protocol also provide a total score (cutoff point 91.25). The score in the three aspects evaluated ranges from 0 (worst quality of life) to 100 (best quality of life). The questions are related to information regarding the use of the voice and its possible impacts on quality of life (Gama et al., 2009; Madazio et al., 2014; Behlau et al., 2017).

In order to complete the V-RQOL protocol, responses should be marked on a scale of 1 to 5, with the lowest corresponding to "it never happens and it is not a problem", and the highest corresponds to "it always happens and it really is a bad problem". The individual should take into account the intensity of the problem and its frequency of appearance, in order to properly answer the questionnaire (Madazio et al., 2014; Behlau et al., 2017).

2.4 Statistical analysis

The data were tabulated and received statistical treatment using the two-way ANOVA, Pearson's Correlation, and the Chi-square test using the SPSS Software, version 26.0 (IBM Corporation, Armonk, NY, EUA). The level of significance was set at 5% ($p < 0.05$). Data were expressed using absolute and relative frequencies, mean and standard deviation.

3. Results

Table 2 shows the descriptive results of the mean scores of the group evaluated regarding the degree of COPD, sensation of dyspnea, impact of the disease on general health and V-RQOL in COPD. The majority presented moderate (11 individuals, 29.7%) and severe (12 individuals, 32.4%) COPD degree; moderate (17 individuals, 45.9%) and severe (13 individuals, 35.1%) CAT; mMRC mostly in grades 1 (10 individuals, 27%) and 3 (11 individuals, 29.7%); and physical domain of V-RQOL below the reference (20 individuals, 54,1%). The means of the total score (84,8) and of the physical domain (96,6) of the V-RQOL were below the cutoff point.

Table 2 –Descriptive Results of the degree of Chronic Obstructive Pulmonary Disease, sensation of dyspnea, impact of the disease on general health, and Voice-Related Quality of Life questionnaire on Chronic Obstructive Pulmonary Disease.

Variable	Cutoff Point	n (%)	Mean	SD	
GOLD [§]	Mild	8 (21.6)	56.6	±24.9	
	Moderate	11 (29.7)			
	Severe	12 (32.4)			
	Very Severe	6 (16.2)			
CAT	Mild	4 (10.8)	19.4	±8.9	
	Moderate	17 (45.9)			
	Severe	13 (35.1)			
	Very Severe	3 (8.1)			
mMRC	0	4 (10.8)			
	1	10 (27)			
	2	8 (21.6)			
	3	11 (29.7)			
	4	4 (10.8)			
V-RQOL	SED	Within the reference	34 (91.9)	96.6	±16.6
		Below the reference	3 (8.1)		
	PD	Within the reference	17 (45.9)	77.5	±24.9
		Below the reference	20 (54.1)		
	TS	Within the reference	19 (51.4)	84.8	±19.3
		Below the reference	18 (48.6)		

Label: GOLD – Global Initiative for Chronic Obstructive Lung Disease; mMRC – Modified Medical Research Council scale; CAT – COPD Assessment Test; V-RQOL – Voice-Related Quality of Life; SED – Socioemotional Domain; PD – Physical Domain; TS – Total Score; n – number of subjects; SD – Standard Deviation; [§] – based on FEV1 (Forced Expiratory Volume in the 1st second).

Source: Authors.

Table 3 presents the distribution and comparison between the V-RQOL domains and the degrees of COPD. No statistical significance was found.

Table 3– Distribution (mean and standard deviation) and comparison between the degrees of Chronic Obstructive Pulmonary Disease and the domains of the Voice-Related Quality of Life questionnaire.

Variables	GOLD				p-value
	Mild (mean±SD)	Moderate (mean±SD)	Severe (mean±SD)	Very Severe (mean±SD)	
V-RQOL – SED	87.5 ± 35.3	100.0 ± 0	97.9 ± 4.8	100.0 ± 0	0.373
V-RQOL – PD	81.2 ± 30.3	78.4 ± 21.2	78.8 ± 21.9	68.0 ± 32.9	0.793
V-RQOL – TS	83.7 ± 31.1	86.5 ± 13	85.8 ± 16	80.8 ± 19.7	0.945

Label: SD – Standard Deviation; GOLD – Global Initiative for Chronic Obstructive Lung Disease; V-RQOL – Voice-Related Quality of Life; SED – Socioemotional Domain; PD – Physical Domain; TS – Total Score.

Two-Way ANOVA Test; * Significant values.

Source: Authors

Information on the association between the degrees of COPD and the impact of COPD on general health (CAT) are shown in Table 4. No statistical significance was observed between the variables.

Table 4– Distribution and association between the degrees of Chronic Obstructive Pulmonary Disease and the impact of Chronic Obstructive Pulmonary Disease on general health.

Variables	GOLD				p-value
	Mild	Moderate	Severe	Very Severe	
CAT 1 – Mild	0	1 (25)	3 (75)	0	0.237
CAT 2 – Moderate	4 (23.5)	5 (29.4)	6 (35.3)	2 (11.8)	0.915
CAT 3 – Severe	3 (23.1)	4 (30.8)	3 (23.1)	3 (23.1)	0.765
CAT 4 – Very Severe	1 (33.3)	1 (33.3)	0	1 (33.3)	0.629

Label: GOLD – Global Initiative for Chronic Obstructive Lung Disease; CAT – COPD Assessment Test.

Chi-Square Test; * Significant values.

Source: Authors.

The correlation between V-RQOL domains with the degrees of COPD (considering forced expiratory volume in the 1st second – FEV1) and CAT degree is presented in Table 5. There was a significant inverse correlation between total score/physical domain of the V-RQOL and CAT.

Table 5– Correlation between the domains of the Voice-Related Quality of Life questionnaire, degree of Chronic Obstructive Pulmonary Disease, and impact of the Chronic Obstructive Pulmonary Disease on general health

Correlation	R	p-value
V-RQOL – TS versus FEV1	0.127	0.454
V-RQOL – TS versus CAT	-0.591	<0.001*
V-RQOL – SED versus FEV1	-0.154	0.364
V-RQOL – SED versus CAT	-0.245	0.143
V-RQOL – PD versus FEV1	0.227	0.177
V-RQOL – PD versus CAT	-0.648	<0.001*

Label: V-RQOL – Voice-Related Quality of Life; SED – Socioemotional Domain; PD – Physical Domain; TS – Total Score; CAT – COPD Assessment Test; FEV1 (Forced Expiratory Volume in the 1st second).

Pearson's Correlation Test; * Significant values.

Source: Authors.

4. Discussion

The sample profile in the present study is, in part, in line with the one found in the literature, since there was a predominance of adults (Gonçalves et al., 2015), but a similar distribution between genders, while references from other studies show a predominance of male subjects (Gonçalves et al., 2015; Cassiane et al., 2013; Soares et al., 2010). The majority of the individuals in the sample presented both COPD degree and CAT questionnaire classification between moderate and severe. mMRC scale results ranged from 1 to 3, and, regarding the V-RQOL questionnaire, most individuals remained below the cutoff point in the physical domain. Such finding may be explained by the fact that individuals with COPD present changes related to exercise intolerance, compromised life and increased mortality. Furthermore, the reduction in exercise capacity is the main limiting factor in daily activities and is directly related to the increased risk of exacerbation (Costa et al., 2015).

In this sense, the airflow limitation in individuals with COPD is associated with abnormal lung inflammatory responses to harmful particles or gases (Mancopes et al., 2020). The studied sample presented an average age range close to that considered elderly (MeSH, 2020), what may have had an impact on the disease picture. Differences in the perception of dyspnea and ventilatory loads, with increasing age, could explain a lesser impact on the level of dyspnea in the elderly, since higher levels of mMRC were observed – between 1, 2 and 3. Even though the literature provides data on the prevalence of the disease increasing with advancing age (Costa et al., 2015), it is also possible that changes in personality, expectations, and adaptations concerning aging result in a more optimistic overview of the quality of life in daily activities (Martinez et al., 2015).

Respiratory symptoms are important presentations in COPD. In a study on quality of life, dyspnea was a significant factor associated with the high score in the questionnaire used, regardless of the severity of airflow limitation (Lee et al., 2017).

As for the impact of the disease on general health, with most subjects in moderate and severe degrees several comorbidities may be associated with the decrease in quality of life, causing restriction of daily physical activity and an increase in exacerbations and mortality in COPD (Lee et al., 2017). We observed that in COPD the deterioration in quality of life can also be associated with age, as observed in a study with younger adults who scored consistently worse in a questionnaire related to quality of life (Martinez et al., 2015).

No significant association was found between the V-RQOL domains and the degrees of COPD, nor between the degrees of COPD and the impact of the disease on the general health status, however, there was a significant inverse correlation between the physical domain/total score of the V-RQOL and CAT. This means that in the present study, the higher the CAT score, i.e., the worse the general health conditions, the lower the V-RQOL score, what indicates a worse voice-related quality of life. Hence, given the divergent approach in the analysis of the scores of these two questionnaires, it can be understood that this situation would be physiologically acceptable in the population of our study.

People with COPD may have difficulties in communication, as phonation tasks impose considerable respiratory requirements for speech performance in terms of expiratory flow and expiratory excursions of lung volume (Cassiani et al., 2013). In addition, changes in the airstream cause destabilization between the aerodynamic forces of the lungs and the myoelastic forces of the larynx (Gonçalves et al., 2015). Thus, individuals with COPD present airflow obstruction that may lead to an imbalance between breathing and phonation, making adequate oral communication impossible. The maximum phonation time of subjects with COPD was considerably reduced when compared to the control group. This suggests that they need numerous air recharges for maintenance and ending a sentence during conversation (Cassiani et al., 2013), which may impact their voice-related quality of life.

Although this variable was not analyzed in the present study, it is found in the literature that the main cause of COPD is related to the inhalation of cigarette smoke (smoking). About 90% of carriers acquire COPD due to long-term use of cigarettes, usually more than twenty years (Almeida & Schneider, 2019). The frequent use of tobacco can increase the risk of laryngeal pathologies, since it is a chronic factor that affects the mucosa of the vocal folds (Moreira et al., 2015) and repercussions on the voice. In the V-RQOL assessment in users of psychoactive substances, it was found that users of illicit drugs had lower scores in all domains when compared to users of licit drugs (Moreira et al., 2015). All of these findings are in agreement with what was found in the present research.

On the other hand, another study on the comparison between the V-RQOL domains and medical diagnosis in individuals with chronic lung disease, no statistical significance between the variables analyzed was found. The authors stated that vocal quality represents a set of skills and functions and does not only concern breathing, which would explain the lack of vocal complaints in the analyzed sample (Gonçalves et al., 2015).

Possible limitations of our study were the absence of sample distribution in different age groups and the lack of studies that related the variables we addressed. Thus, we suggest further research to address larger samples and to differentiate the measurements between distinct age groups, as well as to include more variables for analysis, e.g., tobacco use.

5. Conclusion

In this research, the subjects with COPD presented both impact of the disease on general health and sensation of dyspnea in moderate and severe degrees, and a Voice-Related Quality of Life below the cutoff point. We found a significant inverse correlation between physical domain/total score of the V-RQOL and CAT, what shows that the worse the V-RQOL results, the greater the impact of COPD symptoms on the general health status.

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