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Body Mass Index, Fatigue and Dyspnea in Chronic Obstructive Pulmonary Disease

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ABSTRACT

Objective: *Chronic Obstructive Pulmonary Disease leads to dyspnea and fatigue by causing malnutrition and impaired respiratory muscle strength in patients. This study was conducted to determine the factors associated with body mass index, fatigue, and dyspnea levels in patients with Chronic Obstructive Pulmonary Disease.* ***Method:*** *This descriptive and relational study was conducted with 209 individuals in a clinic in Turkey. The data were collected using a questionnaire form, the Chronic Obstructive Pulmonary Disease, and Asthma Fatigue Scale, and the Dyspnea-12 Scale. In statistical analysis, standard deviation, independent group's t-test, one-way analysis of variance, correlation analysis, and multiple regression analysis backward method were used.* ***Results:*** *Our data confirmed that fatigue and dyspnea are the major problems in Chronic Obstructive Pulmonary Disease patients, with a strong relationship between dyspnea and fatigue. In addition, a significant relationship was found between body mass index and fatigue and dyspnea scores. It was determined that individuals in the normal weight-underweight group had the highest fatigue and dyspnea mean scores. Besides, the multiple regression analysis showed that 46% of the variance in fatigue was explained by the predictive variables.* ***Conclusions:*** *It is important for healthcare professionals to evaluate patients according to their body mass indexes and to consider variables that affect fatigue and dyspnea. Due to the limited number of studies in the literature, it may be suggested to conduct more studies on this topic.*

Keywords: Body mass index, Dyspnea, Chronic obstructive pulmonary disease, Fatigue

INTRODUCTION

Chronic Obstructive Pulmonary Disease (COPD) is an increasingly common disease with high morbidity and mortality. Currently, COPD is the fourth leading cause of death worldwide [1]. Depending on the stage of the disease, dyspnea and fatigue are the leading symptoms restricting the daily life activities of individuals and seriously affecting their social life [2-4]. It is reported in the literature that dyspnea has a prevalence between 69%-98% and fatigue between 43%-97% in individuals with COPD [4-7]. Dyspnea and fatigue are associated with such factors as airflow limitation, eating disorders, comorbidities, and a decrease in muscle strength and endurance [8-11].

A serious problem experienced by individuals with COPD is eating disorders. Studies have reported that excessive weight and obesity are common in the early stages of COPD, and malnutrition is common in moderate and severe COPD [8,12]. In COPD, as a result of malnutrition, muscle atrophy, and respiratory weakness are observed, and low Body Mass Index (BMI) values negatively affect the prognosis of the disease [1,8,9]. In addition, although the cause of obesity in the early stages of COPD is not known exactly, it is thought that the reason for the increase in obesity is the decrease in daily living activities due to fatigue [8]. Since obesity or malnutrition leads to fatigue in patients with COPD, it is predicted that the addition of dyspnea may aggravate the situation. Since malnutrition is a common complication in COPD and is a determinant factor of functional capacity, it needs to be addressed.

Individuals with COPD may experience malnutrition due to many symptoms such as fatigue and dyspnea [13]. Patients should be supported to improve gas exchange, facilitate breathing and increase activity tolerance so that they can manage their care. Although many studies have so far been conducted on fatigue and dyspnea in individuals with COPD, few studies have evaluated fatigue and dyspnea according to BMI [2,3,14,15]. Weight loss and low BMI

are associated with a poor prognosis regardless of other factors. This study is believed to contribute to the literature with new data by determining the relationship between BMI, fatigue, and dyspnea in COPD and thus by holistically evaluating COPD patients. It is further believed that it will contribute to the plans about helping individuals manage their disease.

Research Questions

- What are the fatigue and dyspnea levels of individuals with COPD?
- Do fatigue and dyspnea levels of individuals with COPD change depending on body mass index?
- Are BMI and dyspnea the predictive variables for the fatigue levels of individuals with COPD?

MATERIALS AND METHODS

Research Design

This study is descriptive and relational.

Participants

The target population of the study consisted of individuals admitted to a state hospital in Turkey. The sample size was determined as 209 by taking the number of independent variables as 17, with 95% power, 0.05 significance value, and 0.15 expected effects [16]. Individuals who were between the ages of 40-65, who were diagnosed with stage 2, 3, or 4 COPD according to the GOLD criteria, who were in a stable period of the disease, and who did not have any psychiatric disorder were included in the study. Those who were diagnosed with Chronic Fatigue Syndrome, who had non-COPD pulmonary disease, and who have diagnosed with stage 1 COPD according to the GOLD criteria were excluded from the study as they were newly diagnosed with the disease and symptoms were not common.

Instruments

The questionnaire form, the COPD and Asthma Fatigue Scale, and the Dyspnea-12 Scale were used to collect data.

The Questionnaire Form

The questionnaire includes questions about socio-demographic characteristics, health, and disease characteristics.

COPD and Asthma Fatigue Scale (CAFS)

The original scale was developed by Revicki, et al. [17]. It is a five-point Likert-type scale including 12 items. The minimum and maximum scores that could be obtained from the scale are 12 and 60, respectively. The score obtained is transformed with the help of the formula 100* (the total score-minimum value that can be obtained/change interval) so that the score has a value between 0 and 100. Higher scores indicate higher levels of fatigue. The Cronbach alpha of the original scale was found to be 0.95. The Turkish validity and reliability study of the scale was conducted by Arslan and Oztunc and the Cronbach alpha value was found to be 0.92 [10]. In our study, the Cronbach alpha value was 0.92.

Dyspnea-12 Scale (D-12)

The original scale was developed by Yorke, et al. [18]. The four-point Likert type scale evaluates the severity of dyspnea and includes 12 items and two sub-dimensions. The first seven items of the scale question the physical difficulties caused by dyspnea, while the remaining five items question the effect of dyspnea on emotional situations. The maximum score that can be obtained from the scale is 36, and the minimum score is 0. Higher scores indicate increased severity of dyspnea. The Cronbach alpha value was determined as 0.90 in the original scale. The Turkish validity and reliability study of the scale was conducted by Gok Metin and Helvaci, and the Cronbach alpha value was found to be 0.97 [19]. In this study, Cronbach's alpha value was 0.87.

Data Collection

The data were collected by the researchers using the face-to-face interview technique between July and December 2019 after obtaining consent from individuals with COPD. The data were collected in an empty room in the internal medicine and chest diseases clinic. While measuring the body weight, a digital scale calibrated at regular intervals was used, and the participants were asked to take their shoes off and have light clothes on them. While measuring

the height, a wall-mounted height measuring tape was used, and the participants were asked to take off their shoes. The body mass index of the participants was calculated with the formula of weight (kg)/height^2 (meter). Respiratory function test results were obtained from the patient file. The average time allocated for each patient during the data collection process was 10 minutes-15 minutes.

Statistical Methods

The statistical analysis of the data was performed using the SPSS 22 package program. In the analysis of the data, the normal distribution was evaluated with the Kolmogorov-Smirnov, Shapiro-Wilk analysis, and Skewness-Kurtosis values. During the analyses, t-test, one-way Analysis of Variance (ANOVA), Kruskal Wallis analysis, and correlation analysis were used in independent groups. While examining the strength of the relationships in correlation analysis, the following ranges were taken into consideration: 0.00-0.25=very weak, 0.26-0.49=weak, 0.50-0.69=moderate, 0.70-0.89=strong, 0.90-1.00=very strong. The Tukey HSD and Dunnett T3 tests were used to determine the significant group in ANOVA. In addition, the multiple regression analysis was performed using the backward method. This analysis was conducted using the variables that were found to be significant in the t-test, ANOVA, and correlation analyses in the independent groups. Before the analysis, the database was evaluated in terms of sample adequacy, autocorrelation, and multi-collinearity assumptions, and $p<0.05$ was considered to be statistically significant.

RESULTS

The average age of the individuals who participated in the study is 60.6 ± 4.00; 68.9% of them are male; 48.8% are primary school graduates; 38.8% are retired, and 63.7% perceive their economic situation as average. The average time for having COPD diagnosis is 8.98 ± 4.48 years; 57.9% of the participants have another chronic disease. 41.6% quit smoking, and 47.8% of the participants reported that there is a smoker at home. 88% stated that they do not do exercise, and 41.6% said they do not pay attention to their diet. 78.0% use drugs continuously. According to the respiratory function test, 57.9% of the patients are at Stage 2 of the disease and the average BMI is 28.4 ± 3.9 (BMI ranges: below 18.5 kg/m^2 underweight, between 18.5-24.9 kg/m^2 normal weight, between 25-29.9 kg/m^2 overweight, 30 kg/m^2 and above obese). The mean COPD and Asthma Fatigue Scale score of the patients was found to be 74.3 ± 15.5. The mean score for the Dyspnea-12 scale was found to be 25.8 ± 5.29. The skewness and kurtosis values indicate that the scales showed normal distribution.

The COPD and Asthma Fatigue Scale mean score revealed that the female participants, participants with low education level, housewives and retirees, and those who are single, who perceive their economic situation as poor, who have another chronic disease, who quit smoking, who have never smoked, who do not do exercise, who partially comply with or do not comply with their diet, and who have received training about COPD have higher fatigue scores ($p<0.05$). The Dyspnea-12 scale scores revealed that, unlike the fatigue scale, the mean scores of men were found to be higher than women ($p<0.05$). The Dyspnea-12 Scale scores indicate that participants with low education level and those who are single, who perceive their economic situation as poor, who smoke, who do not pay enough attention to their diet, and who have not received COPD training have a higher mean score ($p<0.05$). It was determined that fatigue and dyspnea levels increase in the later stages of the disease (Table 1).

Table 1 Score distribution of COPD and Asthma Fatigue Scale and Dyspnea-12

Scale by sociodemographic, health, and disease characteristics						
	COPD and Asthma Fatigue Scale			**Dyspnea-12 Scale**		
Gender	**Ort ± Ss**	**test value**	**p-value**	**Ort ± Ss**	**test value**	**p-value**
Female	79.3 ± 14.6	t=3.233	0.001	24.3 ± 5.2	t= -2.759	0.007
Male	72.0 ± 15.4			26.4 ± 5.2		
Educational status						
Literate/Illiterate	82.9 ± 11.9	t=7.013	<0.001	27.1 ± 5.3	t=2.733	0.007
Primary school and above	69.5 ± 15.3			25.0 ± 5.1		
Working status						

Housewife/retired	78.2 ± 14.3	t=5.552	<0.001	26.1 ± 5.4	t=1.501	0.135
Working	66.2 ± 15.0			25.0 ± 4.9		
Marital status						
Married	72.3 ± 16.0	t= -3.313	0.001	24.9 ± 5.2	t= -3.897	<0.001
Single	79.4 ± 12.9			27.9 ± 4.7		
Perceived economic status						
Good	65.9 ± 16.1	F=16.878	<0.001	23.8 ± 4.6	F=10.331	<0.001
Average	72.8 ± 14.8			25.2 ± 5.2		
Bad	84.4 ± 12.0			28.7 ± 4.6		
Other chronic disease presence						
Yes	77.1 ± 14.3	t=3.041	0.003	25.9 ± 5.2	t=0.529	0.598
No	70.4 ± 16.4			25.5 ± 5.3		
Smoking status						
Using	70.0 ± 14.3	F=3.774	0.025	26.7 ± 4.5	7.606	0.001
Quit smoking	75.6 ± 16.4			26.5 ± 5.6		
Not using	77.1 ± 14.7			23.5 ± 4.9		
Exercise status						
Yes	62.2 ± 15.3	t= -4.301	<0.001	24.6 ± 3.9	t= -1.464	0.151
No	75.9 ± 14.9			25.9 ± 5.4		
Nutritional level						
Yes	64.9 ± 15.3	F=16.034	<0.001	24.0 ± 4.4	F=6.367	0.002
No	79.7 ± 13.9			27.2 ± 5.3		
Partially	74.0 ± 14.6			25.2 ± 5.3		
Continuous medication use						
Yes	75.0 ± 15.3	t=1.321	0.188	25.7 ± 5.2	t=-0.547	0.585
No	71.6 ± 16.2			26.1 ± 5.3		
Training status about COPD						
Yes	70.4 ± 15.5	t= -2.933	0.004	24.7 ± 4.9	t= -2.423	0.016
No	76.7 ± 15.1			26.5 ± 5.4		
Respiratory function test result						
Stage II	66.4 ± 13.9	F=69.731	<0.001	22.8 ± 4.1	F=114.437	<0.001
Stage III	80.8 ± 11.0			27.8 ± 3.4		
Stage IV	91.4 ± 3.8			32.8 ± 1.3		

The correlation between some continuous variables and the COPD and Asthma Fatigue Scale and the Dyspnea-12 Scale was examined. While a moderate positive relationship was observed between age and the COPD and Asthma Fatigue Scale scores (r=0.507), a weak positive relationship was found between age and the Dyspnea-12 Scale scores (r=0.373). A weak positive relationship was observed between the COPD diagnosis time and the Fatigue (r=0.394) and Dyspnea Scale (r=0.415) (Table 2).

Table 2 The relationship between the COPD and Asthma Fatigue Scale and the Dyspnea-12 Scale with some continuous variables

	COPD and Asthma Fatigue Scale	**Dyspnea-12 Scale**
Dyspnea-12 Scale	r=0.591 p<0.001	
Age	r=0.507 p<0.001	r=0.373 p<0.001
COPD diagnosis time	r=0.394 p<0.001	r=0.415 p<0.001

It was found that the average score of COPD and Asthma Fatigue Scale and Dyspnea-12 Scale were different among the groups formed according to BMI. According to the Levene test result, the Dunnett T3 test was used to understand

from which group the difference originated. According to this evaluation, it is seen that individuals in the normal-underweight category, where the difference is among all groups, have the highest average score, followed by obese individuals, and lightweight individuals have the lowest average score (Table 3).

Table 3 Change of mean score of COPD and Asthma Fatigue Scale and Dyspnea-12 Scale according to BMI

		COPD and Asthma Fatigue Scale	Dyspnea-12 Scale
BMI (kg/m^2)	N	Ort ± sd	Ort ± sd
Weak/normal *	30	89.5 ± 8.3	31.4 ± 4.0
Slightly overweight	110	65.9 ± 14.2	23.7 ± 4.8
Obesity	69	81.1 ± 11.1	26.6 ± 4.3
	F	56.688	35.081
	p	p<0.001	p<0.001
*: Five of the patients are in the underweight group			

The determinants of the COPD and Asthma Fatigue Scale were evaluated using the multiple regression analysis backward method. In independent groups, this analysis was performed based on the variables that were found to be significant in t-test, one-way analysis of variance, and correlation analysis. The database was evaluated in terms of sampling adequacy, autocorrelation, and multicollinearity assumptions before the analysis. Since a high correlation was found between the stage of the disease and the duration of diagnosis, the stage of the disease was included in the analysis. As the assumptions were met with this arrangement, the researchers continued with the analysis. The independent variables, which were not continuous, were coded as 0 and 1. The variable coded as 1 was shown in parentheses in the table. The analysis revealed that the most important determinants of the fatigue scale are being female (β=0.397) and dyspnea (β=0.302). Disease stage (β=0.210), quitting smoking/not smoking (β=0.188), and normal BMI/being underweight (β=0.195) are other important determinants, respectively. These variables cause an increase in the fatigue score and account for 46% of the state of fatigue. It is seen that the model is significant (F=16.699, p<0.001) (Table 4).

Table 4 COPD and Asthma Fatigue Scale (Backward)

	COPD and Asthma Fatigue Scale		
	Beta	**t**	**p-value**
Gender (Female)	0.397	5.044	0
Smoking	0.188	2.409	0.018
(Quitting/not using)	-	-	-
Disease stage (Stage 3)	0.21	2.14	0.035
BMI (weak or normal)	0.195	2.214	0.029
Dyspnea	0.302	3.021	0.003
R: 0.676; R^2: 0.457; F: 16.699; p: <0.001			
The variables included in the model are dyspnea, chronic disease, exercise, smoking, cohabitation, nutrition, education about COPD, gender, occupation, BMI, education, disease stage, age, marital status			

DISCUSSION

Our findings confirm that fatigue and dyspnea are the major problems experienced by COPD patients. It has been reported in the literature that individuals with COPD have high levels of fatigue, and dyspnea [7,10,19,20-23]. Dyspnea is one of the most prominent symptoms in individuals with COPD, and there is a strong relationship between dyspnea and fatigue [2,11,13,24-26].

Our findings further revealed that these two common symptoms are related to age and the duration of the disease. Although studies are showing that age is associated with fatigue and dyspnea in individuals with COPD, there are also studies showing that there is no relationship between age and fatigue and age and dyspnea [2,3,11,24,27-30]. Fatigue and dyspnea levels are expected to increase with age. It is believed that individuals with COPD will experience difficulties in managing their diseases and performing their daily activities as they get older and accordingly, they will experience more fatigue and dyspnea. In individuals with COPD, an increase in the severity of dyspnea can be expected with age-related deterioration in lung functions, an increase in the COPD stage, an increase in other chronic diseases, and a decrease in quality of life due to these factors. The increase in the duration of illness is considered to be among the factors that may lead to an increase in fatigue and dyspnea due to decreased exercise tolerance and increased physiological and psychological distress. It has been reported in the literature that fatigue and dyspnea increase as the duration of the illness increases [7,27,29].

It is acknowledged that low BMI is largely associated with an increased risk of mortality among COPD cases [31]. A significant relationship was found between individuals' BMI and fatigue and dyspnea scores. Low BMI is interpreted as a risk factor for being diagnosed with COPD. It should be borne in mind that in this study, the number of overweight and obese individuals is more than that of normal and underweight individuals, and the exclusion of individuals with very severe COPD from the study may have led to this result. A study revealed that underweight and obese patients experience more severe fatigue compared to normal weight or overweight patients [26]. When there is insufficient energy, muscle proteins are destroyed, and weight loss and cachexia are experienced [32]. On the other hand, excessive energy and increased BMI causes excessive CO2 production and thus dyspnea [33]. The decrease in body weight occurs due to eating disorders, which causes an increase in muscle loss in later times. The development of malnutrition due to loss of body muscle and respiratory muscles leads to progressive respiratory disorders.

Fatigue in COPD patients is an important determinant of mortality; however, it is often overlooked despite its high prevalence and important consequences such as causing limitations in meeting the daily needs and affecting the quality of life negatively [4,24]. Our study revealed that female gender and dyspnea are the most important determinants of an increase in fatigue score. Dyspnea, one of the variables found to be significant in the analyses, seems to be important for the presence of fatigue. A significant relationship was found between fatigue and dyspnea in other studies and our study [34,35]. In their study with COPD patients, Chen, et al. reported that fatigue is related to dyspnea, pain, and age, and as these variables increase, fatigue increases as well [6]. According to the multiple regression analysis performed by Goertz, et al., gender, age, marital status, smoking status, pack-years, number of medications, comorbidity burden, degree of dyspnea, and the number of exacerbations in the previous year account for 29.7% of fatigue in COPD [26]. These findings show that fatigue is a complex symptom and results from not only demographic, clinical, and disease characteristics, but also physical, psychological, systemic, and behavioral factors. Based on our research findings and literature review, it can be stated that some prospective studies with a sampling procedure including a wider age range are needed to examine the relationship between individuals' body mass index, fatigue, and dyspnea.

Limitations

The limitation of this study is that it was conducted in a single-center, which prevents the generalization of the findings. A community-based study could further validate the impact of BMI. Another limitation is that female participants were few although the female gender was an independent variable. This reflects the insufficient diagnosis of COPD in women.

CONCLUSION

Our results confirmed that dyspnea and fatigue are two major problems in COPD patients, with a strong relationship between them. In addition, a significant relationship was found between BMI and fatigue and dyspnea scores. It is seen that individuals in the normal-underweight category according to the BMI have the highest average fatigue and dyspnea scale scores, followed by obese individuals. The multiple regression analysis showed that predictive variables account for 46% of the variance in fatigue. A better understanding of the factors that trigger or perpetuate fatigue in COPD patients is needed to reduce fatigue which is controversial because of its unclear etiology and to develop coping attempts.

DECLARATIONS

Conflicts of Interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Informed Consent

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

Ethical Approval

The study was approved by the clinical trials ethics committee of the Selcuk University Health Sciences Faculty (decision no: 2019/62) and performed in accordance with the Helsinki Declaration. All the potential participants were requested to submit a written informed consent. Data were collected and recorded in a manner that protected the anonymity of the participants.

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