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RESEARCH ARTICLE

INVESTIGATION OF THE RELATIONSHIP OF KINESIOPHOBIA AND PHYSICAL ACTIVITY LEVEL WITH DYSPNEA, MUSCLE STRENGTH, AND PROPRIOCEPTION IN PATIENTS WITH CHRONIC OBSTRUCTIVE PULMONARY DISEASE: A RETROSPECTIVE STUDY

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ABSTRACT

Purpose: This study aimed to examine the relationship of kinesiophobia and physical activity level with dyspnea, peripheral muscle strength and proprioceptive acuity in patients with chronic obstructive pulmonary disease (COPD).
Materials and Methods: A total of 36 patients with COPD were included in this retrospective cross-sectional study. The patients' demographics, kinesiophobia level, physical activity level, dyspnea severity, peripheral muscle strength, and proprioceptive level were recorded from the patient file.
Results: According to the current results, kinesiophobia level showed a significant relationship with physical activity level and sitting time ($p<0.05$). Additionally, the patients' kinesiophobia level showed a moderate significant relationship with dyspnea severity, quadriceps and tibialis anterior muscle strength ($p<0.05$). In addition, the physical activity level showed a moderate to strong significant correlation with sitting time, dyspnea severity, proprioceptive level, and muscle strength ($p<0.05$).
Conclusion: Dyspnea, peripheral muscle strength, and proprioceptive levels are important interrelated parameters that increase kinesiophobia and limit physical activity in COPD. Therefore, dyspnea, peripheral muscle strength, and proprioception should be evaluated within the scope of pulmonary rehabilitation from the early period, and therapeutic approaches aiming to minimize the effects of these symptoms should be included in the pulmonary rehabilitation program.

Keywords: Lung diseases; dyspnea; physical activity; kinesiophobia; peripheral muscle strength

INTRODUCTION

Chronic obstructive pulmonary disease (COPD) with pulmonary and systemic symptoms is a progressive and treatable disease. The course of COPD is complicated by developing systemic consequences and comorbidities (1). One of the most important pulmonary symptoms of COPD is dyspnea, which increases upon physical exertion (2). Patients with COPD attempt to compensate for the increased dyspnea by reducing their activity level or avoiding activities, resulting in peripheral muscle deconditioning (3). Although activity limitation in COPD is multifactorial, dyspnea related to acute derangements in dynamic respiratory mechanics is the primary activity-limiting factor in most patients with COPD (2, 3).

In addition to the pulmonary conditions, systemic effects of COPD, such as inflammation and hypoxia, also lead to peripheral muscle weakness via impairing neuromuscular activity (4). Approximately 32% of patients with COPD suffer from skeletal muscle weakness and decreased muscle endurance (5). Previous studies reported that the quadriceps muscle weakens most rapidly in patients with COPD, and quadriceps weakness in this patient population is a primary indicator of decreased functional capacity, deteriorated pulmonary function, and increased mortality (6). As a result, in addition to the pulmonary pathologies, extra-pulmonary conditions of COPD provoke physical activity avoidance, which increases fall risk and fractures (6, 7).

Kinesiophobia is an individual's excessive avoidance of physical movement and activity due to the fear of a painful injury or re-injury (8). Pulmonary and extrapulmonary conditions of COPD reduce physical activity levels by exaggerating the fear of movement and thus impair peripheral muscle strength, proprioception, and balance (7, 9, 10). Patients experience a progressive decrease in functional exercise capacity, pulmonary function, and peripheral muscle strength as a consequence of physical inactivity; these symptoms affect each other negatively, thus leading to a vicious cycle (3, 11). Additionally, physical inactivity seriously impairs the self-care and mobility functions, and social life of patients with COPD (3). In the existing literature, there are a limited number of studies examining the relation of COPD-specific pain- and dyspnea-related kinesiophobia to physical activity level (12-14). However, no study investigated the association between extrapulmonary conditions (i.e., peripheral muscle weakness, neuromuscular control, proprioception) and kinesiophobia in patients with COPD. Studies are needed to establish to what extent kinesiophobia, resulting from pulmonary and extrapulmonary conditions of COPD, is related to activity and functional limitation. Such studies can help to determine appropriate pulmonary rehabilitation for patients with COPD. Therefore, this study aimed to determine the relationship of kinesiophobia and physical activity level with dyspnea, peripheral muscle strength and proprioception in patients with COPD.

MATERIALS AND METHODS

Study Design and Participants

In this retrospective cross-sectional study, the files of patients with COPD included in pulmonary rehabilitation between 2017 and 2020 in the Pulmonary Rehabilitation Unit of the Department of Chest Diseases of Dokuz Eylül University were evaluated. The files of patients aged 40 years and over who were diagnosed with COPD according to the "Global Initiative for Chronic Obstructive Lung Disease (GOLD)" criteria were included in the study to obtain clinical data (15). Patients' files recorded incompletely regarding the evaluation parameters or files of patient with musculoskeletal or neuromuscular disorders, previous lung surgery, unstable angina, malignancy, congestive heart failure, uncontrolled hypertension, and a history of pulmonary diseases other than COPD were not included in the study.

Ethical Approval

Prior to the study, local ethics committee approval for the retrospective use of databases recorded in patients' files for the current study was obtained from the Non-Invasive Clinical Research Ethics Committee of Dokuz Eylul University (Date: 09.11.2022, Decision No: 2022/36-20). This study was conducted in accordance with the Declaration of Helsinki.

Assessments

The demographics and clinical data (age, gender, height, smoking history, disease duration) were recorded from patients' files. Additionally, forced expiratory volume in one second (FEV1), forced vital capacity (FVC), FEV1/FVC ratio, and their percentages according to predicted values according to the American Thoracic Society/European Respiratory Society criteria, the airflow limitation stage in COPD according to the GOLD criteria

(Mild/Stage 1; FEV1≥80%, Moderate/Stage 2; 50%≤FEV1<80%, Severe/Stage 3; 30%≤FEV1<50% and Very severe/Stage 4; FEV1<30%), the presence of respiratory symptoms (cough, sputum, and dyspnea severity) were recorded from the patients' files to be used in this study. Furthermore, the patients' kinesiophobia and physical activity levels, perceived dyspnea severity, peripheral muscle strength, and proprioception levels were also recorded from the patients' files.

The evaluating methods for these variables are explained below;

Kinesiophobia (fear of movement): The Tampa Scale of Kinesiophobia (TSK), a reliable and valid 17-item self-reported questionnaire with a 4-point Likert scale, was used to determine the kinesiophobia level (16). The TSK is based on the fear-avoidance, fear of movement, and fear of reinjury model. The total score of the TSK ranges from 17 to 68, with higher scores representing a high degree of kinesiophobia. A TSK score at or above the cut-off value (≥ 37) is considered a high degree of kinesiophobia (17).

Physical activity level: The short form of the International Physical Activity Questionnaire (IPAQ), a valid and reliable scale, is frequently used for assessing physical activity levels. This scale consists of 7 questions and provides information about the time spent in walking, moderate- and vigorous-intensity activities in the last 7 days (for last week). The total physical activity score is obtained by multiplying the duration (minutes) and frequency (days) values of walking, moderate and vigorous activity with the different metabolic equivalent of task (MET) coefficient values for each activity and then calculating a score of the "MET-minutes/week" type by adding these three activity scores. The time spent sitting is evaluated as a separate question and its score is calculated separately. The physical activity level is classified as inactive (<600 MET-min/week), low (600-3000 MET-min/week), and sufficient activity level (>3000 MET-min/week) (18).

Dyspnea level: The modified Medical Research Council (mMRC) dyspnea scale is frequently preferred for evaluating patients' perceived dyspnea levels during daily activities. This scale grades the patient's perceived dyspnea in various physical activities for five levels (range 0-4) (19).

Muscle strength: Isometric muscle strength measures using Hand-held dynamometer (HHD) is a reliable, valid, and simple method (20). The quadriceps, iliopsoas and tibialis anterior muscle strength scores that had been evaluated with HHD (MicroFET2®, Hoggan Health Industries, Inc., UT, USA) were recorded from the patients' files for analysis.

Proprioceptive measurement: The target angle reproduction test is a valid and reliable method to assess joint position sense acuity (21). For knee proprioception assessment, subjects are seated on a standard chair or examination table; then, the lower leg is passively placed at the target knee flexion angle to allow the subjects to memorize the target angle. Following the familiarization session, subjects are blindfolded and asked to replicate the target angle by actively moving their leg from the starting position to the target angle. The difference between the target and reproduced angles represents the knee proprioception acuity. Knee proprioception that had been measured for the knee flexion angle of 60˚ was recorded from patients' files.

Statistical Analysis

The IBM® SPSS® (ver. 26.0; IBM Corp., Armonk, NY, USA) package program for Windows software was used for analysis of data. The normal distribution of the data was determined using the Shapiro-Wilk test. Descriptive statistics were presented as mean (standard deviation) for parametric variables, median (interquartile range) for non-parametric variables, and frequencies and percentages for categorical variables. The correlations were assessed using the Pearson's and Spearman correlation coefficient for parametric and non-parametric conditions, respectively. The correlation level was considered negligible if the coefficient was less than 0.10, low if it was between 0.10 to 0.39, moderate if it was between 0.40 to 0.69, and strong if it was greater than 0.70 (22). A value of $p<0.05$ was considered statistically significant.

An a priori power analysis identified a sample size of 36 that was needed to achieve 90% statistical power with a probability of a 2-tailed type I error of 0.05 and an effect size of 0.50 in the correlation analysis (23). In order to reach the determined sample size, a total of 62 patients' files were screened for eligibility. A total of 26 patients' files were excluded because they did not meet the inclusion criteria.

RESULTS

The mean age of the patients was 66.94 ± 10.40 years, and 14 (38.9%) of the participants were female. Most of the patients (72.2%) in stage-2 according to GOLD, and they had FEV1% of 42.41 ±

Table 1. Demographic and clinical characteristics of patients with COPD

Variables	Mean ± SD Median (IQR_{25-75}) n (%)	Min. – Max.
Sex (male/female), n (%)	14 (38.9) / 22 (61.1)	–
Age (years)	66.94 ± 10.40	46.00 – 81.00
Height (cm)	162.00 (155.00/172.00)	150.00 – 190.00
Weight (kg)	71.41 ± 13.29	48.10 – 95.60
BMI (kg/m^2)	27.00 (22.50/30.38)	19.20 – 35.30
Duration of disease (years)	11.00 (10.00/16.50)	.25 – 20.00
GOLD stage		
Stage 1 (Mild), n (%)	2 (5.6)	–
Stage 2 (Moderate), n (%)	26 (72.2)	–
Stage 3 (Severe), n (%)	8 (22.2)	–
Smoking history		
No smokers, n (%)	6 (16.7)	–
Former smokers, n (%)	9 (25.0)	–
Current smokers, n (%)	21 (58.3)	–
Smoking consumption (pack/years)	20.00 (2.00/92.50)	.00 – 360.00
Regular exercise habit		
Yes, n (%)	7 (19.4)	–
No, n (%)	29 (80.6)	–
Respiratory symptoms		
Shortness of breath, n (%)	28 (77.8)	–
Cough, n (%)	26 (72.2)	–
Sputum, n (%)	25 (69.4)	–
Pulmonary function tests		
FEV1 (%pred)	42.41 ± 7.12	29.00 – 56.00
FVC (%pred)	60.00 ± 10.99	42.00 – 88.00
FEV1/FVC (%pred)	51.84 ± 7.34	36.45 – 63.39

COPD: chronic obstructive pulmonary disease, SD: Standard deviation, IQR: Interquartile range, n: number, Min: Minimum, Max: Maximum, BMI: Body Mass Index, pred: predicted, GOLD: Global Initiative for Chronic Obstructive Lung Disease, FEV1 forced expiratory volume in one second, FVC forced vital capacity

7.12 percent predicted. In addition, 77.8%, 72.2%, and 69.4% of participants had dyspnea, cough, and sputum, respectively. The median value of disease duration was 11.00 (10.00/16.50) years. Demographics and clinical characteristics of the patients are presented in Table 1.

Most of the patients with COPD (77.8%) had a high level of kinesiophobia (≥ 37 points) according to their mean TSK score (43.94 ± 11.12). The participants' physical activity level (66.00 (.00/240.00) MET-min/week) was low, and their sitting time (10.00 (6.00/18.00) hour/week) was considerably prolonged. In addition, the quadriceps, iliopsoas and tibialis anterior muscle strengths of the individuals were 7.47 ± 2.40 kg, 7.34 ± 2.06 kg, 8.93 (7.10/9.60) kg, respectively. The median value of the mMRC score was 4.00 (3.00/5.00), which is greater than the threshold value of mMRC ≥2. The knee proprioceptive acuity of participants was determined as 3.50 (1.33/4.16) degrees. The kinesiophobia, physical activity level, sitting times, muscle strength scores, dyspnea severity, and knee proprioception of patients with COPD are presented in Table 2.

According to the correlation analysis; a moderate correlation of kinesiophobia with physical activity level (r=-609 p<0.001), and with sitting time (r=674 p<0.001). The kinesiophobia level of the patients showed a significantly moderate association with the dyspnea severity (r=446 p=0.006), with quadriceps muscle strength (r=-519 p=0.001), and with tibialis anterior muscle strength (r=-413 p=0.012). A significant association of the physical activity level, ranging from moderate to strong, was found with sitting time, mMRC, proprioception, lower extremity muscle strength ($p<0.05$). A significant association of participants' sitting time, ranging from weak to moderate, was determined with mMRC, quadriceps and tibialis anterior muscle strength, proprioceptive scores ($p<0.05$). The relationship between kinesiophobia level, physical activity level, sitting time, dyspnea level, lower extremity muscle strength, and proprioception of patients with COPD are presented in Table 3.

DISCUSSION

According to our results, the majority of patients with COPD exhibited high levels of kinesiophobia, physical inactivity, and prolonged sitting times. Nevertheless, kinesiophobia, physical activity level, and sitting time showed a low to strong significant association with perceived dyspnea severity, peripheral muscle strength, and proprioception in patients with COPD.

Skeletal muscle deconditioning, as one of the common systemic effects of COPD, is associated with airflow limitation, exercise intolerance, physical inactivity, and mortality (24, 25). Lower extremity muscle weakness, due to the systemic effects of COPD, considerably increases exercise intolerance, fatigue, and fall risk, initiating a vicious cycle that limits physical activity participation (26). Therefore, exercise rehabilitation focusing on muscle strengthening is an important component of the pulmonary rehabilitation program. In COPD, muscle

Table 2. Scores of kinesiophobia, physical activity level, sitting time, perceived dyspnea level, muscle strength, and proprioception in patients with COPD

Variables	Mean ± SD Median (IQR_{25-75})	Min. – Max.
Kinesiophobia	43.94 ± 11.12	27.00 – 66.00
TPA (MET-min/week)	66.00 (.00/240.00)	.00 – 5892.00
Sitting time (hour/week)	10.00 (6.00/18.00)	3.00 – 18.00
mMRC score	3.00 (2.00/4.00)	.00 – 4.00
Quadriceps strength (kg)	7.47 ± 2.40	3.40 – 12.20
Iliopsoas strength (kg)	7.34 ± 2.06	3.70 – 12.27
Tibialis anterior strength (kg)	8.93 (7.10/9.60)	5.23 – 10.87
Proprioception (degree)	3.50 (1.33/4.16)	.67 – 7.33

COPD: chronic obstructive pulmonary disease, SD: Standard deviation, IQR: Interquartile range, Min: Minimum, Max: Maximum, kg: kilogram, TPA: total physical activity, MET-min/week: metabolic equivalent minutes per week, mMRC: modified Medical Research Council

Table 3. Correlation of kinesiophobia and physical activity level with perceived dyspnea level, muscle strength, and proprioception in patients with COPD

	Kinesiophobia (r)	Physical Activity Level	
		TPA (r)	Sitting time (r)
TPA (MET-min/week)	$-.609^{***}$	–	$-.783^{***}$
Sitting time (hour/week)	$.674^{***}$	$-.783^{***}$	–
mMRC score	$.446^{**}$	$-.477^{**}$	$.474^{**}$
Quadriceps strength (kg)	$-.519^{**}$	$.586^{***}$	$-.471^{**}$
Iliopsoas strength (kg)	-.306	$.436^{**}$	$-.375^{*}$
Tibialis anterior strength (kg)	$-.413^{*}$	$.612^{***}$	$-.496^{**}$
Proprioception (degree)	.258	$-.573^{***}$	$.419^{*}$

COPD: chronic obstructive pulmonary disease, r: Pearson's correlation coefficient, kg: kilogram, TPA: total physical activity, MET-min/week: metabolic equivalent minutes per week, mMRC: modified Medical Research Council *0,01<p≤0,05, **0,001<p≤0,01, ***p≤0,001

mass and strength loss are predominantly observed in the lower extremity muscles, especially in the quadriceps muscle (6, 27). The quadriceps muscle is the most commonly studied muscle group in patients with COPD because it is primarily affected compared to other muscle groups and determinant of ambulation and functioning and provides prognostic data (24). Studies have shown that patients with COPD experience a decrease in quadriceps strength ranging from 30 to 80% compared to healthy controls, depending on the severity of the disease (24, 28). Consistent with the literature, the mean value of quadriceps muscle strength of patients with COPD in the current study is similar to those reported in previous studies (28). In addition, the mean value of quadriceps strength of patients with COPD in the current study is considerably lower than those of healthy individuals presented in the previous study (28). In the existing literature, a limited number of studies evaluated lower extremity muscle groups other than the quadriceps specific to the COPD patient group (7, 27). Our findings are similar to the results of the previous studies regarding the tibialis anterior and iliopsoas muscle strength levels of patients with COPD. However, our patients' tibialis anterior and iliopsoas strength levels are considerably lower than those of healthy individuals presented in the previous study (7, 27).

Although quadriceps muscle weakness and associated factors in patients with COPD have been extensively studied, no study investigated the relationship between kinesiophobia and quadriceps muscle strength in patients with COPD in the existing literature. Additionally, a limited number of studies have evaluated lower extremity muscle groups (i.e., tibialis anterior, iliopsoas) other than the quadriceps muscle in patients with COPD and examined their relationship with COPD-specific symptoms (7, 27). Nonetheless, previous studies conducted on different patient populations have reported significant associations between kinesiophobia and lower extremity muscle strength (29, 30), and similarly, our findings showed a moderately significant association between kinesiophobia and lower extremity muscle strength in patients with COPD, as well. Consequently, our results suggest that including the kinesiophobia and peripheral muscle strength assessment into the routine clinical evaluations of patients with COPD from an early stage is necessary to determine an appropriate pulmonary rehabilitation program.

Kinesiophobia reduces compliance not only to musculoskeletal rehabilitation but also to pulmonary rehabilitation (9, 13) since it increases the tendency to avoid physical activity. Fear of movement complicates exercise and physical activity participation in patients with COPD (9, 13). According to the American College of Sports Medicine (ACSM) and the American Heart Association (AHA) guidelines, adults are recommended "to engage in at least 30 min of moderate-intensity physical activity for five days or at least 20 minutes of vigorous-intensity physical activity for three days in a week" (31). However, patients with COPD in our study represent considerably lower physical activity levels than indicated by these physical activity guidelines. According to the IPAQ scores of the patients with COPD in the current study, 77.8% were inactive (<600 MET-min/week), and 11.1% had a low physical activity level (600-3000 MET-min/week), which is an important finding indicating a decrease in their physical activity levels. Similar to our finding, previous studies have shown that patients with COPD have lower daily physical activity and higher kinesiophobia levels compared to healthy individuals (13, 32, 33). On the other hand, only one study, in the existing literature, examined the relationship between physical activity level and kinesiophobia in patients with COPD (33). Although authors of this study used the breathlessness beliefs questionnaire (BBQ) for the kinesiophobia assessment, they reported similar results to our findings (33). In addition, in line with the current data in the literature, 77.8% of the patients with COPD had high kinesiophobia (cut-off value ≥ 37 points) (17), and a significantly moderate and inverse correlation was observed between physical activity and kinesiophobia levels in the current study.

Patients with COPD reduce their exercise and physical activity participation due to concerns that symptoms will be triggered (9). In addition, compared to their healthy peers, patients with COPD perceive their disease as an obstacle to participating in physical activity and, therefore, reduce their daily physical activities, such as climbing stairs and walking, which increases the risk of comorbidities and leads to more inactivity (9, 13). In fact, a limited number of studies have shown that uncontrolled disease symptoms such as pain, fatigue, and dyspnea result in increased kinesiophobia in patients with COPD (13, 14, 32). On the other hand, searching the existing literature, according to our knowledge, no study examined the relationship between muscle strength and kinesiophobia level in patients with COPD; however, according to our findings, muscle strength (quadriceps and tibialis anterior) showed a moderately and inversely significant correlation with kinesiophobia level. Moreover, the positive significant relationship obtained in the current study between lower extremity muscle strength, especially the quadriceps muscle, and physical activity level suggests that muscle strength is important in maintaining functional independence in patients with COPD. Although cross-sectional correlational analysis, used in this study, limits our ability to comment on causality and effect, our findings support the view that adding muscle strengthening exercises, particularly in the lower extremity muscle group, to pulmonary rehabilitation from an early stage can improve physical activity level and kinesiophobia in patients with COPD.

Recent studies have reported that approximately one-third of patients with COPD have experienced at least one fall in the last six months due to loss of postural balance (34). Falls in patients with COPD lead to complications such as morbidity and mortality, increasing healthcare costs (34, 35). Adequate postural balance requires the interaction of visual, vestibular, and proprioceptive inputs, which provides appropriate processing time for motor responses (10). However, the most important determinant of postural control is accurate and appropriate proprioceptive sensory inputs. Proprioceptive sensory inputs, increasing body awareness, enable safer and more appropriate movements in daily life activities; such movement patterns are closely related to motor control and functional performance (10, 34). A few studies showed proprioceptive impairments in patients with COPD (10, 36); nonetheless, according to our knowledge, no study examined the association between proprioception and COPD-specific symptoms.

According to our findings, proprioceptive level showed a moderately significant correlation with physical activity level and sitting time, but no significant correlation was found between proprioceptive level and kinesiophobia. COPD-specific symptoms, such as increased respiratory demand and decreased activity level, debilitate proprioceptive sensory input and eventually impair postural stability (7, 34). In patients with COPD, the perceived dyspnea level and supplemental oxygen requirement increase with both vigorous physical activity and especially at the advanced stages of the disease. Increased dyspnea level and supplemental oxygen requirement oxygen are closely associated with reduced exercise capacity, increased postural imbalance, and falls (7). Regular and adequate physical activity increases the proprioceptive level and, therefore, neuromuscular control by contributing to morphological adaptations in muscle fibers, muscle spindles, and mechanoreceptors that provide proprioceptive sensory input (37). On the other hand, previous studies have shown evidence that patients with COPD have a sedentary lifestyle and tend to gradually reduce physical activity to cope with the increased respiratory demand (7, 37). This further increases inactivity and thus reduces lower extremity muscle strength and proprioceptive level. As a result, patients with COPD experience impairment in producing maximum voluntary contraction and in integration of sensory input compared to healthy peers (7, 10, 37). These suggestions are in line with our findings that proprioception showed a significant correlation with physical activity level and sitting time. Consequently, our findings postulate that proprioceptive exercises added to the pulmonary rehabilitation of patients with COPD can improve physical activity levels and, therefore, muscle strength and kinesiophobia.

Dyspnea, as a subjective experience and a core symptom of COPD, is a significant determinant of quality of life, exercise compliance and tolerance, and mortality (3). The mMRC is commonly used to evaluate dyspnea severity, and the cut-off point for severe dyspnea has been specified as mMRC score ≥ 2 (38). In the current study, the mMRC score of patients with COPD was above the specified cut-off value (mMRC ≥ 2) and showed a significant correlation with physical activity level and sitting time. Patients with COPD reduce their exercise/activity participation to diminish perceived dyspnea severity; this weakens the lower extremity muscles (especially the quadriceps) more than the upper extremity and respiratory muscles (39). The mechanism of activity avoidance due to respiratory symptoms in COPD may explain the findings of our study. More, in the current study, the median disease duration of COPD was 11 years; muscle strength might have been impaired as a result of long-term exposure to dyspnea and activity avoidance during this long period. Besides, dyspnea severity was significantly correlated with the kinesiophobia level, in the current study. Patients with COPD experience increased dyspnea during daily activities and even at rest, depending on the severity level of the disease. When individuals perceive breathless during activity or at rest, cortical regions associated with their previous dyspnea experience are activated, which stimulates cortical regions processing emotions, such as the insula, anterior cingulate cortex, and amygdala, through neural pathways, thereby triggering the dyspnea-related fear (40). Showing a low-to-moderate significant correlation between kinesiophobia and dyspnea severity, previous studies advocated that dyspnea-related fear in patients with COPD is the main reason for exercise and physical activity avoidance (14, 33). While the BBQ, which includes questions about dyspnea-related kinesiophobia, was used in these previous studies (14, 33), the TSK scale, most items of which are related to pain, was used for kinesiophobia assessment in the current study. Although a different questionnaire was used in the current study, our results were similar to those of previous studies. Dyspnea and pain are multidimensional and subjective experiences with common neural pathways stimulating similar cortical areas. Therefore, the perception of pain and dyspnea may trigger similar effects on kinesiophobia (40, 41). This mechanism could be a possible reason for our finding regarding the significant correlation between dyspnea and kinesiophobia.

Limitations

The main limitation is that no healthy controls were included in the current study. Nevertheless, we compared our findings with those of both patient and healthy groups of previous studies conducted in the same patient population and also interpreted our findings by considering the cut-off values of the evaluation parameters. Second, the retrospective design of the study is another limitation. Third, the generalizability of our results for all COPD stages is limited by the fact that not all GOLD stages were included into the current study. Additionally, conducting the current study in a single-centered clinic may also influence the generalizability of our findings. The fourth limitation is that the TSK questionnaire is not disease-specific, and its items mostly relate to pain. Using a dyspnea-specific kinesiophobia questionnaire in addition to the TSK could have provided more comprehensive inferences. Lastly, the parameters such as patients' anxiety which possibly affect kinesiophobia in patients with COPD were not evaluated. Therefore, future studies with a prospective design, including healthy controls and evaluating different parameters that may affect kinesiophobia (i.e., anxiety level) should be warranted. Despite these limitations, our study, comprehensively examining the relationship between kinesiophobia, physical activity, dyspnea, muscle strength, and proprioceptive level in patients with COPD, provided conclusive results, which can be a resource for clinicians and researchers.

CONCLUSION

Our study showed that increased kinesiophobia and decreased physical activity levels in COPD are associated with increased dyspnea severity, decreased muscle strength, and proprioceptive level. These findings obtained in the current study suggests that increased dyspnea severity, decreased muscle strength and proprioceptive level in patients with COPD may trigger activity avoidance. Therefore, our results emphasize the importance of evaluating these parameters from an early stage of pulmonary rehabilitation. In conclusion, a pulmonary rehabilitation program should include therapeutic approaches aiming to decrease kinesiophobia level and maintain physical activity participation in patients with COPD by improving dyspnea, muscle strength, and proprioceptive levels.

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