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ORIGINAL PAPER

Evaluation of Dyspnea, Physical Activity, Muscle Strength, and Quality of Life in Frail Older Adults with COPD

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Abstract

This study aimed to assess dyspnea, physical activity, muscle strength, and health-related quality of life in older adults diagnosed with chronic obstructive pulmonary disease (COPD) who are also considered frail. The study included volunteers aged 65 and over, diagnosed with COPD according to GOLD criteria. Individuals with COPD were divided into two groups according to the FRAIL Frailty Scale: frail ($n=32$) and non-frail ($n=30$). At the assessment stage, various tools were used to evaluate different aspects for all individuals, including respiratory function test for assessing respiratory functions, Modified Medical Research Council Dyspnea Scale (MMRC) for evaluating dyspnea, Saint George's Respiratory Questionnaire (SGRQ) for assessing quality of life, FRAIL Frailty Scale and PRISMA-7 Frailty Scale for detecting frailty, Physical Activity Scale for Elderly (PASE) for evaluating physical activity, digital hand dynamometer for assessing quadriceps femoris muscle strength, and Jamar hand dynamometer for evaluating hand strength. Comparing the results of the Respiratory Function Test, SGRQ, PASE scores, and quadriceps femoris and handgrip strengths of frail and non-frail older adults with COPD was similar ($p>0.05$), while frail and non-frail older adults with COPD showed statistical differences in the MMRC scores results ($p<0.05$). MMRC score was worse in the frail group. Early diagnosis of COPD in frail older adults is very important for the health and quality of life of the patients. In order to prevent deterioration in frail COPD patients, both pharmacological and rehabilitative treatment methods should be started early.

Clinical trial number: NCT05811832.

Keywords COPD · Frail · Physical activity · Muscle strength

Background

COPD is a common, preventable, and treatable disease that is associated with an increased chronic inflammatory response of the airways and lungs to harmful gases and participles and is generally characterized by progressive, permanent airflow limitation [1].

COPD is a serious public health problem all over the world. According to the Global Burden of Disease Study, there are 300 million patients with COPD in the world and the prevalence of COPD varies greatly between countries and geographical regions, ranging between 3 and 21% [2].

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There are approximately 4 million COPD patients in Turkiye and it is thought that the burden of this disease will increase further in the coming years [3]. It is also the leading cause of mortality and morbidity worldwide. Eighty-one percent (3.941 million) of deaths from chronic respiratory diseases are due to COPD. It is the 3rd disease that causes the most deaths in Turkiye and roughly 30 thousand people die from this disease annually [4].

For COPD, smoking, genetic factors, airway hypersensitivity, occupational exposures, infections, age, gender, and socioeconomic factors play a role in the development of the disease [1].

The most prevalent symptoms of COPD are dyspnea, chronic cough, and phlegm production [5]. In individuals with COPD, in conjunction with respiratory failure, exertional dyspnea, and decreased physical capacity, patients have adversity performing daily living activities. Decreased phsycial activity and a sedentary lifestyle lead to negative effects on musculoskeletal systems of patients and cause postural disorders. This situation also causes psychosocial problems [6].

In today's societies, the increasing number of COPD patients across all communities, along with the secondary issues that arise during their lifetimes, not only escalates the need for medical care and rehabilitation but also increases healthcare expenditures [6].

Fragility is a concept that covers all the negative health consequences such as age-related decrease in physiological reserves, stress intolerance, slowness, weakness, low physical activity, burnout, and decrease in body mass index and is defined as increased sensitivity to external stresses and depletion of reserves in many systems in the human body [7, 8]. COPD and frailty share common risk factors including aging, smoking, endocrine dysfunctions, and irregular inflammation. The emergence of COPD symptoms after the age of 40, coupled with increased exacerbations in later ages leading to frequent repetitive hospitalizations, can further exacerbate the fragility of older adults. Moreover, COPD patients form a population at risk for frailty in terms of comorbid conditions such as dyspnea symptoms, accompanied by fatigue, lack of appetite, anorexia, weight loss, exercise intolerance, reduced walking distance, muscle weakness, osteoporosis, and balance issues. The increasing prevalence of COPD in older adults can similarly be a significant risk factor for frailty [9–12]. Ierodiakonou et al. reported that the prevalence of frailty in COPD patients is directly associated with age, COPD stage, ineffective disease control, high CAT and MMRC scores, exacerbation frequency, smoking status, and concurrent comorbidities [13]. Looking at these results, it can be considered that the state of frailty in older adults with COPD may impact their functional and physical conditions. Upon reviewing the literature, it has been observed studies examining parameters such as balance [9–12], physical activity [6], functional status [9–12], and daily life activities [6]. Yet, it is seen that there is limited research that collectively investigates these parameters in fraile older adults with COPD. Taking this into account, this study aimed to evaluation of dyspnea, physical activity, muscle strength, and quality of life in frail and non-frail older adults with COPD.

Method

Participant

The study consisted of older adults diagnosed with COPD who presented to the Chest Diseases Clinic at Kırıkkale Specialized Hospital between January and July 2023. Sixty-four individuals were reached. Two individuals were not included in the study because they were under the age of 65. A total of 32 frail and 30 non-frail, 62 older adults were voluntarily evaluated through random sampling methodology. Figure 1 shows the flow diagram of participants according to CONSORT. The 32 frail individuals with COPD included in the study were determined according to the FRAIL Frailty Scale. The study included volunteers aged 65 and over, diagnosed with COPD according to GOLD criteria, without any mental or hearing impairments that would hinder the completion of the questionnaires in the study, scoring 24 or higher on the Mini-Mental Test, and not experiencing an exacerbation in the last 2 months. Individuals in the exacerbation process of COPD, those with physical and mental illness, unstable COPD, unstable angina, previous myocardial infarction, uncontrolled hypertension, cancer, neurological or musculoskeletal diseases accompanied by functional limitations, current alcohol or substance dependence, severe visual or hearing problems, those who have undergone major surgery in the past few months, and individuals with a history of recurring significant clinical infections were excluded from the study. Sample Size Determination A total of 62 individuals, 32 frail and 30 non-frail, were included to achieve a 95% confidence level with a 95% power (0.05 margin of error). G*Power (version 3.1.9.7, Universitat Düsseldorf, Düsseldorf, Germany) was used for post hoc power analysis, and effect size was calculated from the MMRC Questionnaire between frail and non-frail individuals with COPD. According to the analysis, with a two-tailed hypothesis test, an alpha level of 0.05, and a confidence interval of 95%, the effect size was found to be 1.03, and the study's power (1-β) was 98%.

Measurements

All individuals in the study were queried regarding sociodemographic characteristics using the Patient Assessment

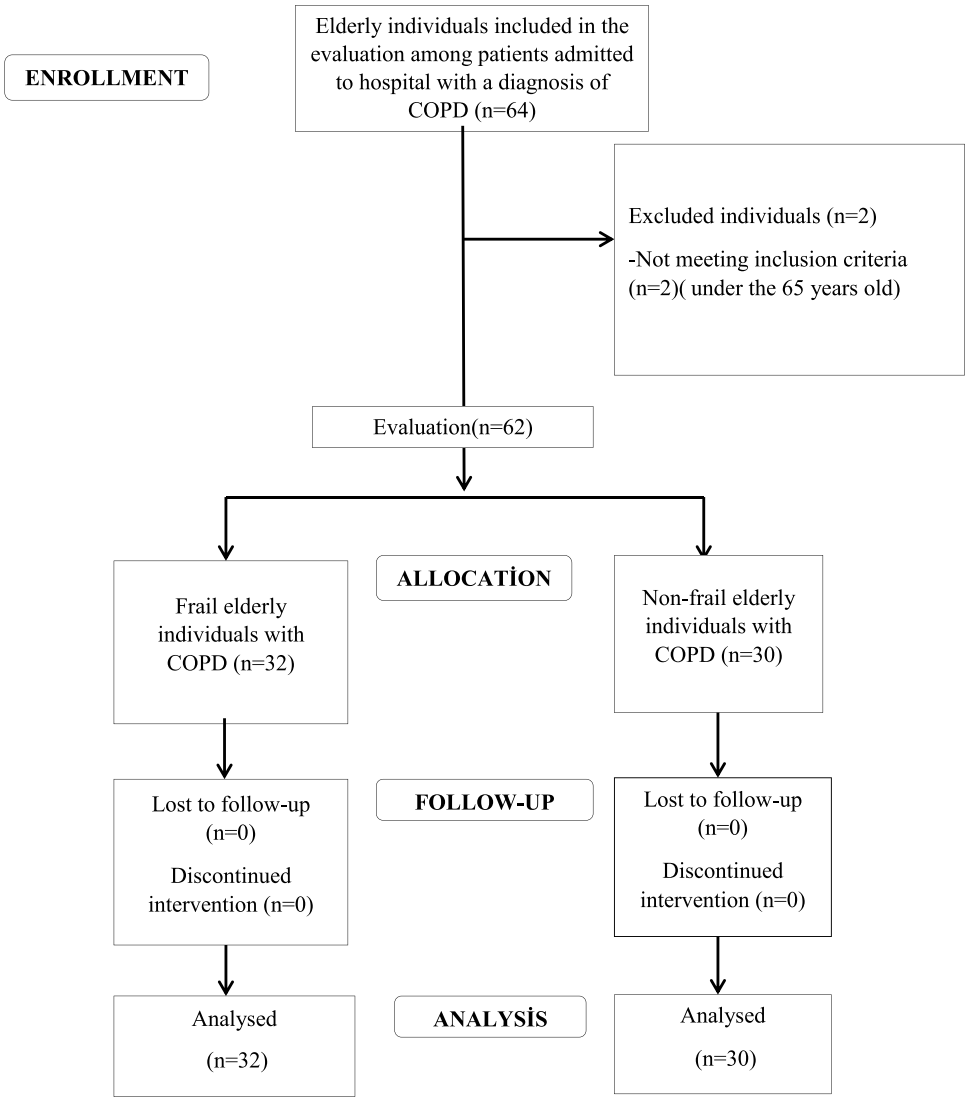


Fig. 1 Flow diagram of individuals

Form, including age, gender, weight, height, body mass index (BMI), occupation, marital status, social security status, any systemic diseases other than COPD, social security coverage, smoking habits, the presence of another COPD patient in the family, and inquiries related to aspects like ache.

At the assessment stage, various tools were used to evaluate different aspects for all individuals, including respiratory function test for assessing respiratory functions, MMRC Questionnaire for evaluating dyspnea, FRAIL Frailty Scale and PRISMA-7 Frailty Scale for detecting frailty, PASE for evaluating physical activity, digital hand dynamometer for assessing Quadriceps Femoris muscle strength, Jamar hand dynamometer for evaluating hand strength, and Saint George's Respiratory Questionnaire for assessing health-related quality of life.

Respiratory Function Test A spirometer should measure the maxmum amount of air exhaled with forced expiration from the point of maximum inspiration (forced vital capacity, FVC) and the volume of air exhaled in the first second of maneuver (forced expiratory volume in the 1st second, FEV1), and these two measurement ratios (FEV1/FVC) must be calculated. Typically, both FEV1 and FVC are low in patients with COPD. When FEV1/FVC is $< 70\%$, and post-bronchodilator FEV1 is $< 80\%$ of the expected value, it indicates the presence of irreversible airflow limitation. Pulmonary function of individuals was measured using a spirometer (Spirolab III, Spirolab, Medical International Research, Rome, Italy). Forced expiratory volume in the first second (FEV1), forced vital capacity (FVC), FEV1/FVC ratio, peak expiratory flow (PEF), and forced expiratory flow at 25–75% (FEF25-75) were recorded. Measured values were expressed as a percentage of expected reference values according to age, height, body weight, and gender [1, 14].

MMRC Scale Initially introduced by Fletcher, the MMRC scale was used to compare the severity of dyspnea during activity between individuals with and without lung disease (16). It requires the patient to choose the statement that best describes their perceived level of dyspnea among five expressions. It is a categorical scale and scores range from 0 to 4 points [15, 16].

PRISMA-7 Frailty Scale It is a questionnaire consisting of seven questions and is recommended by the British Geriatrics Society as a primary screening test. The PRISMA-7 questionnaire comprises a total of 7 questions. If the participant answers "yes" to 3 or more questions, it indicates an increased risk of frailty and the need for further clinical examination. PRISMA-7 categorizes older adults into two risk groups: low and high risk [17]. It possesses high sensitivity (81.5%) and specificity (88.2%) for frailty. PRISMA-7 is recommended as a highly accurate and reliable tool in the screening process for frailty in Turkiye [18].

The FRAIL Scale : Developed by Morley et al. in 2012, the FRAIL Scale is a 5-item scale [19]. The validation of the FRAIL Scale has been conducted in numerous countries, proving to be an effective method for detecting frailty [19–23]. It enables assessment by inquiring about the patient's fatigue status, resistance, mobility, weight loss, and other illnesses. The FRAIL Scale, consisting of 5 items, assigns a score of 0 or 1 based on the patient's response. A total score of 0 indicates non-frailty, 1–2 points suggest pre-frailty, and a score of >2 categorizes individuals as frail. In this study, individuals scoring 3 or above on the FRAIL Scale were classified as the frail group, while those scoring below 3 were categorized as the non-frail group. [19]. Its Turkish validity and reliability were established by Hymabaccus Muradi [24].

PASE The questionnaire assesses the physical activities of older adults in the past week and embodies components related to leisure time, household chores, and occupational physical activities. The participation in leisure time activities, including non-home walking activities and light, moderate, and vigorous sports and recreational activities, as well as muscle-strengthening exercises, are recorded as "never," "rarely" (1–2 days/week), "sometimes" (3–4 days/week), and "often' (5–7 days/week) while the duration of activities is classified as less than 1 h, 1–2 h, 2–4 h, and more than 4 h [25]. The Turkish validity and reliability of the Physical Activity Scale for the Elderly were conducted by Ayvat et al. [26].

Quadriceps Femoris Muscle Strength Measurement The quadriceps femoris muscle strength of the subjects was measured using a digital hand dynamometer. The device can provide data in kilograms or Newtons. For the quadriceps femoris strength measurement, the test began while participants seated in a position with their hips and knees at 90° flexion on a flat surface, with their feet free, and without any support. Before commencing the test, participants were verbally informed about the application technique of the test. The dynamometer was placed perpendicular to the leg, approximately 1–2 cm above the level of the malleoli. The "make test"' technique involving isometric contraction was applied during the test. (The "make test" protocol involves the measurement personnel holding the dynamometer steady while the participant applies maximum force against the device.) All measurements were taken twice from both legs of the participants using the same researcher and the same hand, and the averages were recorded [27].

Measurement of Hand Strength with JAMAR Dynamometer Hand strength is a simple measurement method used to assess upper extremity function [28]. In individuals with COPD, it is frequently used and considered a prognostic factor. During the test, the patient sits in a seated position with shoulder adduction, elbow flexed at 90°, and the forearm in a neutral position, and measurements are taken for three repetitions on the right and left sides. In the interpretation of measurements, reference values are used based on age, gender, height, and the side of measurement [29, 30]. In this study, the average of three measurements taken on the right and left sides was recorded in kilograms.

SGRQ It is a test designed to evaluate health-related quality of life specifically for individuals with respiratory diseases. It was developed in 1991 by Jones and colleagues [31]. It queries 50 items divided into three domains: symptoms (8 items), activities (16 items), and the impact of the disease (26 items). Each section of the test is scored separately, and a Ttotal score is calculated. Scores range from 0 to 100. A score of 0 indicates normal health status, while a score of 100 signifies the worst health condition [32]. In 2013, Polatlı and colleagues conducted a validity and reliability study on the questionnaire [33].

Statistical Analysis

Statistical analyses were performed using IBM SPSS Statistics 26.0 (SPSS Inc., Chicago, IL, USA) software package. The normality of variables was assessed through visual methods (histograms and probability plots) and analytical techniques (Kolmogorov–Smirnov/Shapiro–Wilk tests). Descriptive statistics were presented using frequence and percentage for nominal and ordinal variables, and mean and standard deviation for numeric variables demonstrating a normal distribution. It was preferred to use one of Pearson's chi-square, likelihood ratio, or

Table 1 Individuals' physical characteristics

Physical characteristics of individuals	Frail ($n=32$) Mean ± SD	Non-frail ($n=30$) Mean ± SD	t	p
Age (years)	73.50 ± 6.17	72.50 ± 6.95	−0.600	0.551
Height (cm)	162.28 ± 10.27	165.93 ± 7.82	1.566	0.123
Weight (kg)	72.75 ± 15.08	73.78 ± 13.22	0.285	0.777
BMI (kg/m^2)	27.71 ± 5.88	26.84 ± 4.74	−0.644	0.522

t, independent simple *T* test; *SD*, standard deviation; *BMI*, body mass index

$p < 0.05$

Fisher's exact test statistics, depending on the status of the values. In the comparison of numeric variables between groups, the "Mann–Whitney *U* test" was used as a non-parametric test, whereas the "independent samples *T* test" was employed as a parametric test. Cases where the type 1 error rate was below 5% were considered statistically significant. A 95% confidence level was taken into account in evaluating statistical significance.

Results

The average ages of frail older adults with COPD were 73.50 ± 6.17 years, while those non-frail were 72.50 ± 6.95 years. Age, height, weight, and BMI values were similar between individuals frail and non-frail COPD ($p > 0.05$) (Table 1). There were no statistically significant differences between the groups concerning gender, marital status, education level, occupation, smoking status, presence of COPD in the family, duration of COPD diagnosis, presence of pain, and presence of chronic diseases other than COPD ($p > 0.05$) (Table 2). When comparing the results of the Respiratory Function Test of frail and non-frail older adults with COPD, the values of FEV1/FVC, FEV1, FVC, PEF, and MEF25-75 were similar. Statistically, no differences were found ($p > 0.05$) (Table 3). While frail and non-frail older adults with COPD showed statistical differences in the MMRC scores ($p < 0.05$), MMRC score was worse in the frail group. No differences were detected in the results of SGRQ and PASE scores ($p > 0.05$) (Table 4). Additionally,

Table 2 Comparison of socio-demographic characteristics of frail and non-frail elderly COPD patients

Variables		Frail		Non-frail		x^2	p
		n	%	*n*	%		
Gender	Female	13	40.6	10	33.3		
	Male	19	59.4	20	66.7	0.353	0.553
Occupation	Unemployed	9	28.1	4	13.3	6.246	0.182
	Worker	2	6.3	0	0		
	Self-employed	1	3.1	0	0		
	Retired	19	59.4	23	76.7		
	Homemaker	1	3.1	3	10		
Is there COPD in the family?	Yes	11	34.4	10	33.3	0.008	0.931
	No	21	65.6	20	66.7		
Smoking	Yes	3	9.4	7	23.3	3.905	0.142
	No	14	43.8	7	23.3		
	Quit	15	46.9	16	53.3		
COPD diagnosis duration	3 months–1 year	2	6.3	2	6.7	1.298	0.730
	1–5 years	4	12.5	7	23.3		
	5–10 years	4	12.5	3	10		
	Over 10 years	22	68.8	18	60		
Chronic illness	Yes	**20**	**64.5**	**11**	**36.7**	**4.731**	**0.030***
	No	**11**	**35.5**	**19**	**63.3**		
Other chronic diseases	Diabetes	6	27.3	2	20	1.967	0.579
	Hypertension	8	36.4	6	60		
	Osteoporosis	2	9.1	1	10		
	Heart disease	6	27.3	1	10		
Presence of chest pain	Yes	19	59.4	12	40	2.325	0.127
	No	13	40,6	18	60		

x^2: chi-square test value; *COPD*, chronic obstructive pulmonary disease

*$p < 0.05$

Table 3 Comparison of respiratory function test results of frail and non-frail elderly COPD patients

Respiratory function test	Frail ($n=32$) Mean ± SD	Non-frail ($n=30$) Mean ± SD	t	p
FEV1/FVC	75.06 ± 1.68	75.23 ± 1.94	0.371	0.712
FEV1	49.75 ± 26.18	55.53 ± 27.74	0.844	0.402
FVC	49.84 ± 21.45	56.23 ± 23.73	1.113	0.270
PEF	40.62 ± 16.61	44.86 ± 19.10	0.935	0.354
FEF25-75	40.68 ± 28.47	47.86 ± 36.90	0.861	0.393

t, independent simple *T* test; *SD*, standard deviation; *FEV1*, forced expiratory volume in the 1st second; *FVC*, forced vital capacity; *FEV1/FVC*, FEV1/FVC ratio; *PEF*, peak expiratory flow; *FEF25-75*, forced expiratory flow at 25–75%

$p < 0.05$

there were no differences between the groups in quadriceps femoris and handgrip strengths ($p > 0.05$) (Table 5).

Discussion

This study, which was planned to evaluate physical activity, muscle strength, dyspnea, and health-related quality of life in frail and non-frail older adults with COPD, revealed that frail older adults with COPD experienced more severe dyspnea during activities. However, respiratory functions, levels of physical activity, quadriceps femoris and handgrip strengths, and health-related quality of life were found to be similar.

Though defined differently by various scientists, Buchner and Wagner provide the most general definition of frailty, suggesting that it involves neurological impairment (a decrease in the ability to perform complex tasks) as well as a decline in mechanical strength and energy metabolism (reduction in oxygen levels due to cardiac and/or pulmonary diseases) [34]. In this context, COPD, characterized by progressive airflow limitations, is thought of as a lung condition that could lead to frailty [34]. Dias et al. demonstrated in their study that an increased MRC (Medical Research Council) score in individuals with COPD correlates with an increased likelihood of frailty [35]. Park et al. found a frailty prevalence of 57.8% among 211 COPD patients and established a direct relationship between breathlessness and frailty [36]. In a study examining the physiological constraints experienced by COPD patients during engagement in daily life activities, it was emphasized that there is a reduction in patients' participation in daily life activities, which is associated with dyspnea [37]. Hanlon et al. conducted a meta-analysis of 16

Table 4 Comparison of Modified Medical Research Council Dyspnea Scale, Saint George Respiratory Questionnaire, and Physical Activity Scale for the Elderly results in frail and non-frail elderly COPD patients

Metric	Frail ($n=32$) Mean ± SD	Non-frail ($n=30$) Mean ± SD	t	p
MMRC	4.06 ± 0.80	3.23 ± 0.97	− 3.677	**0.001***
SGRQ SYMPTOMS	82.75 ± 12.82	82.43 ± 14.69	− 0.093	0.926
SGRQ ACTIVITY	89.24 ± 18.90	82.13 ± 15.89	− 1.599	0.115
SGRQ EFFECTS	69.88 ± 18.66	64.99 ± 19.65	− 1.005	0.319
SGRQ TOTAL SCORE	78.07 ± 15.26	73.07 ± 16.14	− 1.253	0.215
PASE Leisure-time Activities	63.89 ± 40.26	71.40 ± 43.62	0.705	0.483
PASE Household Activities	14.90 ± 33.56	14.56 ± 31.18	− 0.041	0.967
PASE Work-Related Activities	0.65 ± 3.71	0 ± 0	− 0.968	0.337
PASE Total Score	79.45 ± 62.81	85.97 ± 58.83	0.421	0.675

t, independent simple *T* test; *SD*, standard deviation; *MMRC*, Modified Medical Research Council Dyspnea Scale; *SGRQ*, Saint George Respiratory Questionnaire; *PASE*, Physical Activity Scale for the Elderly

*$p < 0.05$

Table 5 Comparison of right-left quadriceps femoris muscle strength and right-left hand strength values in frail and non-frail elderly COPD patients

Features	Frail ($n=31$) Meam ± SD	Non-frail ($n=30$) Mean ± SD	t	p
Right quadriceps femoris muscle strength (*N*)	45.72 ± 12.74	46.92 ± 12.12	0.377	0.708
Left quadriceps femoris muscle strength (*N*)	43.73 ± 11.37	45.79 ± 12.25	0.684	0.497
Right hand strength (*N*)	18.76 ± 9.96	20.28 ± 7.96	0.660	0.512
Left grip strength (*N*)	17.29 ± 8.08	20.84 ± 7.50	1.773	0.081

t, independent simple *T* test; *SD*, standard deviation; *N*, Newton

$p < 0.05$

studies, where among 12 studies, individuals identified as frail showed higher dyspnea scores compared to non-frail individuals. The remaining three studies reported a cross-sectional relationship between frailty and dyspnea as reported by the patients [38]. In individuals with COPD, frailty is associated with dyspnea, and as the severity of dyspnea increases, there is a necessity for the application of multiple bronchodilators, as outlined in the GOLD guidelines [36]. The MMRC dyspnea scale is handy in allowing patients to indicate the extent to which their breathlessness affects their mobility. Therefore, dyspnea was evaluated using the MMRC scale in this study. Consistent with the literatüre, this study's findings indicate that frail older adults with COPD experience higher levels of dyspnea compared to non-frail individuals.

Kağalı et al.'s study found that the duration of the Glittre Global Physical Activity test was longer in frail individuals with COPD compared to non-frail individuals [39]. Keskin et al.'s review reported that muscle weakness in older adults with COPD leads to a vicious cycle resulting in decreased functional capacity, functional limitations, and difficulties in daily life activities [40]. Langlois et al. included 36 frail individuals and 40 non-frail individuals in their study. Frail older adults received individually determined aerobic exercise training 3 days a week for 12 weeks, emphasizing an improvement in quality of life [41]. Gökçek et al.'s study revealed that the level of dyspnea affected quality of life. The negative impact of dyspnea severity has been found on all parameters of the SF-36. Individuals are compelled to restrict their daily life activities due to dyspnea, thereby adversely affecting their quality of life and their ability to fulfill their roles [42]. In this study, the health-related quality of life was found to be similar between frail and non-frail older adults with COPD. Similar to previous studies, the quality of life in individuals with COPD is negatively affected by the disease itself. We believe that adding frailty does not contribute negatively to the existing quality of life. In individuals with frail COPD, a decrease in mechanical power and energy metabolism (decrease in oxygen level due to cardiac and/or lung oxygen) caused an increase in the severity of dyspnea, while quality of life was not affected more than in individuals with non-frail COPD.

In COPD patients, physical inactivity is treatable (at least in principle). Despite the absence of a causal link between increased physical activity and improvements in health outcomes, there is a significant decline in physical activity over time among individuals with COPD, and this decline is notably greater compared to non-COPD individuals. It was upheld that sustained low levels of physical activity over time are associated with rapid progression of exercise intolerance and muscle depletion in individuals with COPD [43]. Silva et al. included 427 older adults aged between 60 and 97 in their study. Among these older adults, 8.8% were identified as frail [44]. Frailty was found to be associated with low physical activity and increased sedentary behavior. Baş' study included 300 sedentary older adults aged 65 and above, and 100 older adults who had done professional sports. It was found that the average levels of physical activity and quality of life of older adults engaged in professional sports were higher than sedentary older adults. The average frailty of older adults engaged in professional sports was significantly lower than sedentary older adults. The conclusion reached was that physical activity can prevent frailty [45].

In their study, Gephine et al. found that, on average, frail individuals were observed to have lower exercise tolerance, functional capacity, and higher levels of anxiety and depressive symptoms compared to non-frail individuals [46]. In the study conducted by Pegorari et al., it was revealed that among individuals aged 70 and above, those with lower functional capacity exhibited higher levels of frailty [47]. Ierodiakonou et al.'s study concluded that there is a prevalent occurrence of frailty among individuals with COPD, accompanied by a lack of physical activity, and the severity of the disease exacerbates this risk [48]. Valenza et al. included 104 stable, 108 with COPD exacerbation, totaling 212 individuals with COPD, and 100 healthy individuals in their study. They concluded that the level of physical activity could offer a prediction regarding whether individuals with stable and exacerbated COPD are frail or not [49].

In another study, Ulusoy showed that the average values of physical activity parameters, including moderate-intensity activity duration and energy expenditure, physical activity duration, active energy expenditure, step count, MET (Metabolic Equivalent), distance, and overall physical activity level, were lower in frail COPD individuals compared to non-frail COPD individuals [50].

In this study, we found similar levels of physical activity in both frail and non-frail individuals with COPD. Both groups exhibited low levels of physical activity. We believe that encouragement should be given for the participation of regular physical activity programs to control the severity of the disease and prevent frailty in older adults with COPD.

Fragility is a broader syndrome than just low handgrip strength and is characterized by a physiological condition of reduced reserves that renders vulnerability to adverse events [51, 52]. In the frail patient group, lower walking speed, decreased muscle strength, and reduced muscle mass have been observed [52]. Peripheral muscle weakness and atrophy have been associated with increased fatigue and use of healthcare services in people with chronic obstructive pulmonary disease (COPD) [53].

Reductions in leg muscle cross-sectional area have been noted to initiate during early adulthood and accelerate after the age of 50. In a study by Jeong et al., they found that handgrip strength was similar between individuals with COPD and healthy individuals [54]. In their study involving 50 COPD

patients, Fonseca et al. found that the assessment variations of hand strength (HS) and quadriceps femoris MVC (maximum voluntary contraction) did not create statistically significant differences among the evaluations (i.e., right, left, dominant, and highest values) [55]. Quadriceps muscle weakness has been related to physical disuse [56], the insertion allele of the angiotensin-converting enzyme gene polymorphism [57], and low systemic levels of insulin-like growth factor I, and to chronic low-grade systemic inflammation with COPD [58]. Bernabeu-Mora et al. aimed to describe the frailty status transition rates over a 2-year period and their associated clinical outcomes in stable 119 COPD patients. They reported after 2 years of follow-up, 21 (17.6%) patients had an improved frailty status, 14 (11.7%) had worsened, and 84 (70.5%) had maintained the same frailty status and the worsening group (vs no change group) had greater dyspnea and disability and lower handgrip strength. In contrast, the improved group (vs no change group) had greater handgrip and quadriceps strength. Furthermore, the improved group had greater handgrip strength, quadriceps strength, and physical activity, and lower disability than the worsening group [59]. Ulusoy included individuals aged 55 and above, comprising 20 frail and 28 non-frail COPD patients, in a study examining the impact of frailty levels on balance, cognition, and daily life activities in COPD. When comparing handgrip strength, one of the criteria for frailty, between both groups, individuals identified as frail exhibited significantly lower handgrip strength compared to non-frail individuals [50]. In the study conducted by Miyamoto et al., male COPD patients aged 50 and above were included. The study's outcome indicated that in pre-frail patients, values of upper extremity muscle volume, arm muscle area, and upper extremity muscle function assessed by handgrip strength were significantly lower compared to non-frail individuals. The observation showed that reductions in upper extremity muscle volume and function might occur earlier than those in the lower extremities. This condition was presumed to arise from thoracic hyperactivity such as dyspnea and challenging respiratory movements in COPD patients [60]. In this study, we found that Quadriceps Femoris and handgrip strengths were similar in both frail and non-frail older adults with COPD.

Limitations of the Study

This study consists of hospitalized COPD patients. Among these patients, there are individuals who have been hospitalized for an extended period. The majority of questions in the Physical Activity Scale for the Elderly (PASE), which we used to assess physical activity, covers the last 1 week. Therefore, patients consider their lives in the hospital environment when responding. We believe this situation might not distinctly differentiate between frail and non-frail groups in assessing physical activity. It is suggested to conduct studies that include individuals outside the hospital environment and involve a larger number of participants. Functional capacity was not measured in this study. Functional capacity can also be measured in these patients in future studies. In addition, parameters such as physical activity and functional capacity can be measured with devices that provide more objective results.

Conclusion

This study's outcome revealed that frail older adults with COPD had increased severity of dyspnea compared to non-frail ones. The heightened severity of dyspnea in frail older adults with COPD might stem from prolonged periods of sedentary living. In pulmonary rehabilitation programs for elderly COPD individuals, increased severity of dyspnea could be important in detecting frailty and enabling early intervention. A main problem with COPD is the delayed diagnosis. Early diagnosis of COPD in frail older adults is very important for the health and quality of life of the patients. In order to prevent deterioration in frail COPD patients, both pharmacological and rehabilitative treatment methods should be started early. The presence of frailty in individuals with COPD can adversely affect pulmonary rehabilitation programs. We believe that healthcare professionals being aware of the characteristics of frail older adults with COPD and how the presence of frailty affects them could lead to better outcomes in pulmonary rehabilitation programs by adopting a holistic approach to patients and preventing frailty-related risk factors associated with COPD.

Abbreviations *COPD*: Chronic obstructive pulmonary disease; *FEV1*: Forced expiratory volume in the 1st second; *FEV1/FVC*: FEV1/FVC ratio; *FEF25-75*: Forced expiratory flow at 25–75%; *MMRC*: Modified Medical Research Council Dyspnea Scale; *SGRQ*: Saint George Respiratory Questionnaire; *PASE*: Physical Activity Scale for the Elderly; *BMI*: Body mass ındex; *FVC*: Forced vital capacity; *PEF*: Peak expiratory flow; *SD*: Standard deviation.

Author Contribution MS: substantial contributions to conception and design of the study and the article, data analysis and interpretation, drafting the article, final approval of the version to be published. İK: data analysis and interpretation, drafting the article. YK: data analysis and interpretation, drafting the article. DNK: data analysis and interpretation, drafting the article. SD: substantial contributions to conception and design of the study. ETY: revising the article critically for important intellectual content, final approval of the version to be published. All authors discussed the results and commented on the manuscript.

Data Availability Data will be made available on request. The data that has been used is confidential.

Code Availability Not applicable.

Declarations

Ethical Approval The study received approval and written consent from the Kırıkkale University Non-Interventional Research Ethics Committee (Dated 21.12.2022, numbered 2022/15, Decision number: 2022.12.06) for its execution and obtaining participants' written consent.

Consent to participate All individuals declared consent before participating in the current study. They also state that the research reported in the paper was undertaken in compliance with the Helsinki Declaration and the International Principles governing research on people.

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Conflict of Interest The authors declare no competing interests.

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