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Evaluation of Balance, Walking Speed, Quadriceps Femoris Muscle Strength and Quality of Life in Individuals with COPD with and Without Falls

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Abstract

Backgound and Aim: Balance disorders are associated with falls in individuals diagnosed with Chronic Obstructive Pulmonary Disease (COPD). The aim of this study is to evaluate walking speed, QF muscle strength, fatigue and quality of life in individuals with falling and non-falling COPDs.

Method: This study consisted of 74 individuals diagnosed with COPD (30 falling and 44 non-falling elderly individuals). The frequency of falls in the last six months was questioned to divide individuals into groups, falling and not falling. The Berg Balance Test (BBS) was used to evaluate the balance, the 2-minute walking test to assess walking speed, the digital dynamometer to measure QF muscle strength, and the Saint George Quality of Life Survey (SGRQ) to assess quality of life.

Result: The mean age of the patients who fell was 74.77 ± 5.78 years. The mean age of the individuals who did not fall was 71.25 ± 6 years. As a result of the study, a statistical difference was found between the results of Berg balance test and 2-min walk test according to the groups ($p<0.001$). There was a statistical difference between the left QF muscle strengths according to the groups ($p=0.003$). There was a statistical difference between SGRQ scores according to the groups ($p=0.027$). There was a statistical difference between the Tinetti Fall Efficacy Scale scores according to the groups ($p<0.001$). The Tinetti fall efficiency score of the falling group was found to be higher than the non-falling group.

Conclusion: According to the data obtained, the evaluation of individuals with COPD, along with the symptoms of dyspnea, cough, sputum, etc., which are common in COPD is proof that the risk of falling, balance, walking speed and muscle strength must be taken into account.

Keywords: COPD; Balance; Falling; Walking Speed; Muscle Strength; Quality of Life

Introduction

Respiratory diseases play an important role in the health system worldwide. The vast majority (65%) of respiratory diseases are chronic airborne diseases, i.e. asthma and chronic obstructive pulmonary disease (COPD). The most common chronic respiratory disease is COPD [1]. Chronic obstructive pulmonary disease (COPD) is a preventable and curable disease common in the elderly population, one of the main causes of morbidity and mortality, associated with a chronic inflammatory response to increased harmful particles or gases in the airways and lungs, and characterized by constant restriction of air flow [2].

While the course of the disease varies among individuals in COPD, the most common risk factor for the development of COPD is smoking. Smoking is responsible for 90% of all deaths from COPD. Other risk factors include exposure to work dust, chemicals and air pollution caused by the combustion of wood and biofuels in many countries. In addition, in some individuals, other factors such as early infection, genetic predisposition, and pre-existing asthma can contribute. In general, COPD is a progressive disease [3]. Symptoms of COPD include dyspnea, cough, sputum, shortness of breath, chest pain, etc. Other problems focused in individuals with COPD are the influence of balance and cognitive functions. Possible mechanisms in the development of postural control and balance effect are: increased respiratory workload, due to which more than normal changes in the tonic activity of the diaphragm, abdominal and body muscles may increase the stiffness of the body muscle, respiratory and peripheral muscle weakness, physical activity, functional capacity and decrease in cognitive functions. The exact pathogenesis of the decline incognitive functions is unknown; tissue hypoxia, decreased blood flow to the brain, physical inactivity, oxidative stress, systemic inflammation, smoking and age are likely pathophysiological causes [4].

In individuals with COPD, imbalance is associated with falls [10]. The well-known risk factors for falls in individuals with

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COPD include old age, increased comorbidities, dyspnea, physical immobility, muscle weakness, fear, and decreased confidence in balance, and lower limb muscle fragility, as well as functional deficiencies, performance and lack of postural control [11]. A recent study format that in chronic cases with the highest prevelans of falls, COPD is the second most common after osteoarthritis. In individuals with COPD, the prevalence of falls is estimated to vary between 25% and 46% [12]. When the literature is examined, studies have shown that individuals with COPD have parameters such as fall, QF muscle strength, quality of life, fatigue, balance and walking speed studied separately. However, the study did not find that the parameters of QF muscle strength, quality of life, balance, walking speed and fatigue of individuals with falling and non-falling COPD were studied together. Therefore, our study aims to evaluate QF muscle strength, quality of life, balance, walking speed and fatigue in individuals with falling and non- falling COPD.

In our study, we have five hypotheses, namely, that individuals with falling COPD have worse balances, people with fallen COPD have lower walking speeds, individuals with fallen COPD, have weaker QF muscle strength, people who have fallen Koah, have lower quality of life, and those with fallen COPD have higher levels of fatigue.

Method

Participant

This study was carried out between July 2023-March 2024 in individuals who applied to the Chest Polyclinic of Kirikkale High Ihtisas Hospital and had been diagnosed with GOLD stage I and II COPD.

The study was started by obtaining the necessary permits from the Board of Ethics for Non-Interventional Studies at the University of Kirikkale (Decision no: 2023.06.10, Issue: 2023/06). The aim of the study to all the individuals included in the study was to be informed by explaining the evaluation methods to be used and signed a voluntary consent form. The study was completed taking into account the Helsinki declaration. The clinical trial was registered at ClinicalTrials.gov with ID NCT06099002. In addition, this work was produced from the master thesis work.

According to the GOLD criteria in the study, who had been diagnosed with stage I and II COPD, who had not had an attack in the last 2 months, who volunteered to participate in the study, and, Individuals who were 60 years of age and older and did not have an obstacle mental and communication problem to fill out surveys to be used in the research were included. Study of non-stable COPD, having undeveloped, undeveloped MI, uncontrolled hypertension, cancer, functional neurological or musculoskeletal system diseases, currently dependent on alcohol or substances, is, having serious cognitive impairment that is in the process of COPD exacerbation, which may not affect its performance, has not undergone lower extremity and/or lumbar region surgery, has serious vision and hearing problems, individuals who had undergone major surgery in the last few months were not included in the Turkish language reading and writing disability.

The study was planned as a cross-sectional study of individuals diagnosed with COPD by a chest disease specialist. The number of individuals was determined by power analysis. For post-hoc power analysis, G*Power (version 3.1.9.7, Universitat Dusseldorf, Dusseldorf, Germany) was used and calculated from the Berg Balance Test score among COPD-aged individuals whose effect size was declining and not falling. According to the analysis, the significance of the bi-directional hypothesis test alfa was 5% and the effect size was 95% when the confidence interval was taken 0.84, while the strength of the study (1-) was 97% statistical. The frequency of falls over the past 6 months has been questioned to divide individuals into groups as falling and not falling. Individuals with a history of falls 6-5 times and above in the last 6 months were included in the falling group [13]. A total of 81 individuals agreed to participate in the study. Of the 39 fallen COPD individuals who agreed to participate in the study, 9'i were excluded from the study due to the low SMMT score. Of the 46 non-falling COPD individuals who agreed to participate in the study, 2's stopped working. A total of 30 COPD individuals, including 44 non-falling COPD individuals, were evaluated within the scope of the study. Clinical trial conforms to the CONSORT 2010 Statement (Figure 1).

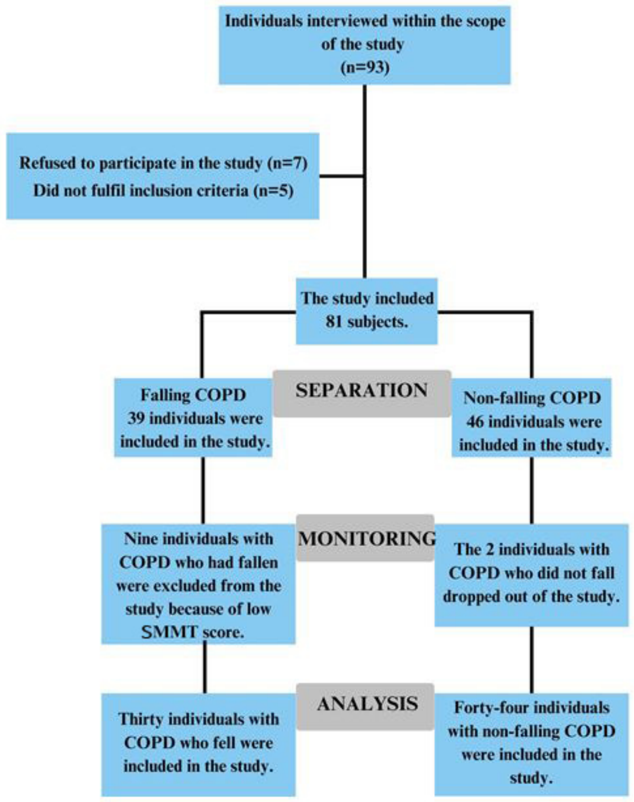

Figure 1: Flow Diagram of the Individuals Included in the Study.

Assessment Tools

The socio-demographic characteristics of all individuals involved in the study were queried with the Patient Assessment Form (name, address, telephone, age, sex, weight, height, body mass index, occupation, civilian status, social security, whether they had any systemic disease other than COPD, smoking or not, if they had other COPD patients in the family, chest pain, vision problems, history of falls, urinary incontinence).

Modified Medical research Council Survey (MMRC) to evaluate dyspnea in all individuals, Standardized Mini Mental Test (SMMT) to assess cognitive states, Berg Balance Test to assess equilibrium, etc, a 2-minute walking test was used to assess walking speed, a Fall risk self-assessment scale was used to assess drop states, and drop states were questioned over the past 6 months. All individuals were evaluated by the same physiotherapist experienced in the clinic.

The Respiratory Function Test (SFT)

It is a test that objectively shows the capacity of the lungs. Respiratory function testing was performed with the Flowhandy Zan 100 (Nspire Health GmbH, Germany) spirometer.

Spirometry should measure FEV_1'i and FVCutyi, and FEV_1/FVC should be calculated. In individuals with COPD, it is typical that both FEV_1'in and FVCarnetine are low. FEV_1 /FVC is < 70%, while the expectation after bronchodilator is FEV_1 < <TAG1> 80%, indicates the availability of a full irreversible airflow limitation [14].

MMRC (Modified Medical Research Council Dispne Scale)

The perception of shortness of breath in the daily life activities of individuals was assessed using the MMRC scale. The MMRC (Modified Medical Research Council Dyspnea Scale), which was first used by Fletcher to assess shortness of breath, was used to compare the degree of dyspnea during movement of individuals with and without lung disease. The British medical research board (Medical Research Council: MRC) developed this scale further to monitor the normal progression of the disease. MMRC is a scale rated from 0' to 5', based on various factors that cause shortness of breath [15].

The Standardized Mini Mental Test (SMMT)

Test is a short, convenient and standard method that can be used globally in the detection of cognitive levels, although it has a limited specificity in the separation of clinical syndromes [16]. It is the most popular method of cognitive evaluation used by 9 out of 10 people worldwide [17]. The test consists of 11 subjects grouped under five headings. The main titles consist of orientation, recording memory, attention and calculation, remembering and language. The test consists of a total of 30 points and 23/24 points are accepted as the maximum value of the test. In his study, Güngen et al. found that the Turkish standardized version of SMMT has sufficient validity and reliability as a scan test [18].

The Berg Balance Scale (BBS)

It is a scale containing 14 directives and given 0-4 points by observing the patient's performance for each directive. In cases where the patient has never been able to do the activity, 0 points are awarded, while 4 points are awarded when the patient completes the activity independently. The highest score is 56 and shows 0-20 points balance disorder, 21-40 points indicates an acceptable balance, 41-56 points indicates the presence of a good balance. It takes between 10 and 20 minutes to complete the scale. The validity and reliability of this scale in Turkish was made by Sahin and his friends [19].

Two Minute Walking Test (2 MWT)

The two-minute walking test was developed by Butland as an alternative to the 6-minute walking test. A test with a shorter duration, 2MWT aims to be used as an attractive alternative in clinical and therapeutic environments where time is very limited. It was reported that there was a valid test for repeatability in subjects with COPD [20]. The reliability, validity and responsiveness of the 2-minute walking test was attributed to Amy SY Leung, Kam Keung Chan, Kevin Sykes, and others, In 2006, KS Chan demonstrated that 2MWT was a reliable and valid test for the assessment of exercise capacity in moderate-severe COPD subjects and post-rehabilitation response. It was concluded that it was well tolerated by patients with practical, simple and severe symptoms of COPD [21].

Decline Risk Self-Evaluation Scale

Z. Wang and colleagues conducted a study in 2022 that investigated the validity and reliability of the Risk of Falling in China Self-Assessment Scale. "Did you have any falls, including slippage or hanging out in the last 6 months, have you lost your balance and fallen to the ground or ground or how many times have you fallen "and" have a fear of falling? there are 13 articles consisting of such questions. The answers are yes – no. The research resulted in relatively good feasibility as well as satisfactory results in internal consistency, test-to-repeat reliability and distinctive validity [22]. Sertel et al.'i made the validity and reliability in Turkish [23].

Quadriceps Muscle Strength Measurement

The individuals' quadriceps muscle strength was measured using a hand dynamometer (Medical Commander Powertrack II, USA). Participants were verbally informed about the technique of applying the test before starting the test. The test began to be performed while the feet were in a position to sit freely and without support. The dynamometer was placed perpendicular to the leg, which is 1-2 cm above the level of the malleols. During the test, "make test" technique was applied, which required isometric contraction. (Make test is the protocol of maximum power application of the measured person against the device while the measuring person keeps the dynamometer stable). All measurements were repeated three times by the same researcher with the same hand, and the highest value was recorded as Newton (N) [24].

Tinnetti Falling Activity Scale (TFAS)

Tinetti and his colleagues developed TDEEU in 1990 to assess a person's own effectiveness or safety associated with falling while performing daily activities. The Cronbach alpha coefficient of the scale is 0.71'[25]. With various modifications, the Tinetti scale is a well-known and widely used tool. Studying the walk can give an idea of the risk of falling [26].

The Saint George Respiratory Survey (SGRQ)

St. The George Respiratory Survey was developed by Jones et al. in 1991 to assess the quality of life of individuals with respiratory diseases (Jones et al. 1991). Polatli et al. in 2013 carried out the validity and reliability study in Turkish [27].

Of tests that measure health-related quality of life, specifically St. George Respiratory Survey (St. George's Respiratory Questionnaire, SGRQ) is a test specific for respiratory diseases. SGRQ queries 50 substances divided into three areas in the patient: symptoms (8 substances), activities (16 substances), effects of the disease (26 substances). When the symptoms are questioned, the patient's level of respiratory discomfort and coughing, sputum, wheezing in the chest and shortness of breath are investigated [28].

Fatigue Severity Scale (FSS)

In our study, we used the Fatigue Violence Scale to assess fatigue in individuals. The validity and reliability of this scale in our country was made in 2007 by Armutlu et al. FSS assesses fatigue severity with 9 questions. Each question is scored between 7' likert type 1 (do not agree at all)-7 (completely agree). High score indicates increased fatigue severity. The total score is scored as the sum or average of all answers [29].

Statistical Analysis

The data were analysed with IBM SPSS 27.0.1 Compliance with normal distribution was analysed by Kolmogorov-Smirnov test and kurtosis-skewness values (kurtosis-skewness= +2:-2). Analysis of covariance (ANCOVA) was applied to examine the effect of quantitative variables that met the assumptions according to the groups, where age was controlled as a covariate. Mann Whitney U test was used to compare non-normally distributed data according to binary groups.

Yates correction, Fisher's exact test and Pearson chi-square test were used to analyse categorical demographic characteristics according to groups. Pearson chi-square test with Bonferroni correction was used for comparisons according to multiple responses. The results of the analyses were presented as mean ± standard deviation, median (minimum - maximum) and adjusted mean ± standard error for quantitative data and as frequency and percentage for categorical data.

Results

The study included 34 falling and 40 non-falling individuals with COPD. It was observed that 50% of the individuals who fell were female and 50% were male, while 27.3% of the individuals who did not fall were female and 72.7% were male. The physical characteristics of COPD individuals with and without falls are shown in Table 1. occupational education status, presence of chronic disease, smoking, chest pain, urinary incontinence, visual and sleep problems of COPD patients with and without falls are shown in Table 1. A statistically significant difference was found in the ages of patients according to groups (p=0.014). The average age in the group of patients who fell was 74.77, while the average age in the group of patients who did not fall was 71.25.

In addition, when the Fall Risk Self-Assessment Scale was analysed, it was found that 10% of the individuals who fell had a score of 4 and below and 90% had a score of 5 and above, while 61.4% of the individuals who did not fall had a score of 4 and below and 38.6% had a score of 5 and above. It was found that 96.7% of the individuals who fell and 47.7% of the individuals who did not fall had fear of falling. A statistically significant difference was found between the Tinetti fall effectiveness scale scores according to the groups (p<0.001). The fall efficacy scale score of the fall group was higher and the median value was 74, while the median value of the non-fall group was 56 (Table 1).

There was a statistical difference between the distribution of sleep problems of the individuals according to the groups (p=0.020). The rate of individuals with sleep problems was higher in the individuals who fell than in the individuals who did not fall, and while the rate of individuals with sleep problems was 40% in the individuals who fell, this rate was 13.6% in the individuals who did not fall. No statistically significant difference was found between the distributions of other variables according to the groups (p>0.050) (Table 1). Statistically no difference between FEV1, FVC, FEV1/FVC and BMI variables (p>0.050) (Table 2).

According to the groups, the MMRC dyspnea scores were not

Table 1: Socio-demographic characteristics of individuals with COPD.

	Group		p
	Falling (n:34)	**Non Falling(n:40)**	
Gender			
Female	15 (50)	12 (27.3)	0.080^c
Male	15 (50)	32 (72.7)	
Age	74.77 ± 5.78	71.25 ± 6	0.014
BMI	27.68 ± 5.09	27.39 ± 5	0.744
Occupation			
Not working	6 (20)	13 (29.5)	0.514^c
Retired	24 (80)	31 (70.5)	
Marital status			
Married	18 (60)	32 (72.7)	0.371^c
Single	12 (40)	12 (27.3)	
Education Status			
Reader Author	11 (36.7)	9 (20.5)	0.301^p
Primary school	16 (53.3)	30 (68.2)	
Middle School	3 (10)	5 (11.4)	
Chronic Disease Status			
Var	17 (56.7)	21 (47.7)	0.604^c
Yok	13 (43.3)	23 (52.3)	
Chronic Disease*			
DM	10 (62.5)	11 (52.4)	0.854^p
HT	7 (43.8)	11 (52.4)	
Other	3 (18.8)	3 (14.3)	
Is there an auxiliary device used?			
Yes	11 (36.7)	9 (20.5)	0.202^c
No	19 (63.3)	35 (79.5)	
Is there COPD in the family?			
Yes	8 (26.7)	14 (31.8)	0.828^c
No	22 (73.3)	30 (68.2)	
Smoking Status			
Yes	3 (10)	7 (15.9)	0.338^p
No	13 (43.3)	12 (27.3)	
Dropped out	14 (46.7)	25 (56.8)	
Pain Status			
Yes	22 (73.3)	21 (47.7)	0.051^c
No	8 (26.7)	23 (52.3)	
Eyewear Use			
Yes	3 (10)	4 (9.1)	1.000^f
No	27 (90)	40 (90.9)	
Sleep Problems			
Yes	12 (40)	6 (13.6)	**0.020^c**
No	18 (60)	38 (86.4)	
Urinary Incontinence			
Yes	5 (16.7)	3 (6.8)	0.257^f
No	25 (83.3)	41 (93.2)	
Fall Self-Assessment			
4 and Under	3 (10)	27 (61.4)	**$<0.001^c$**
5 and Over	27 (90)	17 (38.6)	

*Multiple responses, c: Yates continuity correction test, p: Pearson chi-square test, f: Fisher's exact test, ---: No test statistic available. n: number of individuals. BMI: Body mass index

Table 2: Comparison of demographic and clinical characteristics according to the groups by controlling the age values of the individuals.

	Group		F	p*
	Falling(n:34)	**Non Falling(n:40)**		
Pain Severity	5.79 ± 0.41	6.36 ± 0.42	0.902	0.348
FEV1	56.98 ± 2	52.06 ± 1.64	3.492	0.066
FVC	56.95 ± 2.14	54.83 ± 1.76	0.567	0.454
FEV1 FVC	48.66 ± 2.32	44.07 ± 1.9	2.243	0.139
PEF	48.66 ± 2.32	44.07 ± 1.9	2.243	0.139

*Analysis of Covariance, (Adjusted Mean ± standard error), n: number of individuals, p: Pearson chi-square test, FEV1: Volume of air extracted in the 1st second, FVC: Challenging vital capacity, PEF: Peak expiratory flow rate.

Table 3: Comparison of MMRC and SGRQ scores according to groups after controlling for age of individuals.

	Group		F	p
	Falling(n:34)	Non Falling(n:40)		
MMRC Dyspnea	3.85 ± 0.17	3.65 ± 0.14	0.847	0.360
SGRQ Activity	92.16 ± 3.14	83.07 ± 2.57	4.808	**0.032**
SGRQ Impact	77.19 ± 3.5	66.47 ± 2.87	5.386	**0.023**

*Analysis of Covariance, (Adjusted Mean ± standard error), n: number of individuals, p: Pearson chi-square test, SGRQ: Saint George Respiratory Questionnaire; SMMT: Standardized Mini Mental Test.

Table 4: Comparison of SMMT scores, Berg balance test, 2 MWT, QF muscle strength, Tinetti Falling Activity Scala, SGRQ and fatigue of individuals with COPD with and without falls.

	Group				
	Falling(n:34)		Non Falling(n:40)		
	Average± SS	Middle (min. - maks.)	Avarage ± SS	Middle (min. - maks.)	p*
SMMT	26.07 ± 1.82	26 (24-30)	26.41 ± 2.28	26 (24-30)	0.702
BERG Balance Test	25.47 ± 10.26	21 (14-53)	43.14 ± 9.2	45 (18-56)	<0.001
2 Min. Walks Test	66.27 ± 18.29	64.5 (20-100)	84.61 ± 37.63	78.5 (20-210)	0.024
QF Muscle Strength Left	37.61 ± 9.36	39.6 (22.4-61)	46.39 ± 12.69	43.45 (22.53-74.7)	0.003
Tinetti Falling Activity Scale	72.17 ± 10.61	74 (30- 85)	52.55 ± 19.98	56 (15-100)	<0.001
SGRQ Symptom	88.16 ± 7.97	90.42 (61.16-97.8)	80.66 ± 14.27	83.93 (44.94-100)	0.027
SGRQ Total	83.25 ± 12.67	85.93 (42.79-98.16)	74.21 ± 16.27	75.28 (21.28-97.92)	0.011
Fatigue	4.34 ± 0.84	4.45 (1.3-7)	3.77 ± 1.01	4.15 (1.3-4.6)	0.006

*Mann Whitney U test, s.deviation: standard deviation, min: minimum, max: maximum, n: number of individuals, SGRQ: Saint George Respiratory Questionnaire; 2MWT: 2-min Walking Test; SMMT: Standardised Mini Mental Test

statistically significant (p=0.360). According to the groups, SGRQ was statistically significant among the activity scores (p=0.032). The declining group's SGRQ activity score was higher and the non-decreasing group was lower. According to the groups, SGRQ was statistically significant among the impact scores (p=0.023). The falling group's SGRQ impact score was higher, while the non- falling group was lower. (Table 3).

There was a statistical difference between the right and left QF muscle strengths according to the groups (p<0.05). Right and left QF force values were found to be lower in the fall group. There was a statistical difference between the Tinetti Fall Efficacy Scale scores according to the groups (p<0.001). There was a statistical difference between the fatigue scores according to the groups (p=0.006). Fatigue severity was found to be higher in the fall group. There was a statistical difference between the SGRQ scores according to the groups (p=0.027). There was a statistically significant difference between the Berg balance test scores according to the groups (p<0.001). There was a statistically significant difference between the 2MWT scores according to the groups (p=0.024). There was no statistically significant difference between the SMMT scores according to the groups (p=0.702) (Table 4).

Discussion

In this study, we aimed to evaluate balance, walking speed, QF muscle strength, quality of life and fatigue in individuals with COPD with and without falls. As a result of our study, it was observed that there was no difference between the pain severity, FEV1, FVC, FEV1/FVC, PEF and BMI variables according to the groups. There was also no difference between MRC dyspnoea scores according to the groups. Accordingly, it can be said that MMRC, FEV1, FVC, FEV1/FVC, PEF, BMI have no significant effect on the history of falls in individuals with COPD. BERG balance test and 2 min walk test scores of the fall group were lower than the non-fall group. According to the groups, Tinetti fall effectiveness scale scores were higher in the falling group than in the non-falling group. Right and left QF muscle strength values were found to be lower in the falling group. According to the groups, SGRQ activity score of the falling group was found to be higher. As a result, individuals with COPD who fell were found to have higher fall risk, higher fatigue values, weaker QF muscle strength, lower balance performance and walking speed than non-falling individuals. As a result of our study, balance, walking speed, QF muscle strength, quality of life and fatigue levels were found to be low in individuals who fell and all our hypotheses were supported.

Respiratory Functions

The perception of COPD as an intermittent, progressive disease characterized by increased levels of symptoms associated with deteriorating lung function and limited variability in symptom presentation was distorted by the increasing evidence base and better understanding of the disease. Beyond the weak correlation now detected between symptom detection and hard exhalation volume (FEV1) in 1 second, it is now believed that COPD symptoms show high seasonal, weekly and daily variability [30].

A five-year SFT follow-up of 1888 healthy, asymptomatic men aged 35-74 showed that smokers who continued smoking had a faster FEV1 decline than non-smokers, while those who quit smoked had a decrease in Fev1. Quitting smoking benefits women more than men. A study in the United States and Canada that followed 3,348 men aged 35-60 and 1998 women for 5 years showed that women who quit smoking had a greater increase in FEV1 than men [31].

In a study conducted by Yenilmez and Ark (2018) with individuals with COPD, as the severity of dyspnea increases, social participation, self-determination, physical, homework and religious activities are to be affected and significantly decreased. The study also found that individuals who did not participate in social activities were more likely to experience severe dyspnea than those who participated. It is believed that the increased severity of dyspnea may be due to increased symptom burden in individuals with increased levels of adverse effects of the disease, and that participation in social activities may be reduced as a result of increased sensitivity to dyspnoe severity [32]. In his first and last study, he showed that the perceived level of shortness of breath experienced during GYA was higher in those who did not fall [33].

The current study found no distinction between the variables FEV1, FVC, FEV1/FVC and PEF by group. Furthermore, no significant difference was found between MMRC dyspnea scores by group. Because the prognosis of COPD is determined by the degree of respiratory obstruction, we believe that respiratory functions will decrease as a result of factors that cause COPD, such as increased age, smoking and genetic factors.

Balance

Individuals with COPD are well-known for respiratory dysfunction, as well as muscle function disorders, reduced exercise capacity, and imbalance disturbances. Recently, the prevention of falls has gained great importance due to increased evidence of imbalance in this population and increased fall rates [34]. According to his study, hypoxemia, dyspnea and fatigue are factors associated with diseases related to imbalance and falls in people with COPD [35]. Studies have shown that in individuals with COPD, there are probably multiple systemic symptoms of the disease plus age-related loss of balance, which potentially increases the risk of falling down and a disturbance of body balance that enhances the consequences [36]. Individuals with COPD have been found to have worse functional balance and static balance scores compared to the healthy control group [4].

Aymir et al. carried out a study involving 24 healthy individuals, age-matched with 24 individuals with moderate to severe COPD, and found that imbalance in the patient group was significantly associated with extrapulmonary conditions such as physical activity levels, exercise capacity, muscle strength in the lower limbs and a history of falls [37]. In another study, individuals with COPD had a higher incidence of imbalance and falls [38]. Tudorache et al., in a study of 41 COPD individuals and 20 healthy individuals with no significant differences in anthropometric data, associated advanced and acute COPD with an increased history of falls, systemic inflammation, imbalance and lower extremity muscle weakness [39].

In a sample of individuals with COPD and healthy counterparts, a prospective analysis was conducted over the first 12 months of the study to examine the formation of falls and associated risk factors. Participants were categorized into non-falling and falling groups. The findings indicated that loss of balance was the most common cause of falls. Notably, individuals with COPD exhibited a higher prevalence and incidence rate of falls compared to the general older adult population. This highlights the heightened risk of falls in this demographic, underscoring the need for targeted interventions to improve balance and reduce fall risk in patients with COPD [40].

In the study by Oliveira et al., the fear of falling was assessed using the Falls Efficacy Scale-International (FES-I) among 40 individuals with COPD and 25 age- and gender-matched controls. The evaluation of physical function included measurements with a quadriseptic hand dynamometer, the Berg Balance Scale, and the Six-Minute Walking Test. The results indicated that a heightened fear of falling correlated with decreased quadriseptic strength and impaired balance [41].

In the current study, it was observed that individuals with COPD who experienced falls had significantly lower scores on the Berg Balance Test.

Additionally, these falling individuals exhibited poorer balance performance and slower walking speeds. These findings underscore the importance of not only addressing common COPD symptoms such as dyspnea, cough, and sputum production but also evaluating and improving balance in this population. Incorporating balance training and walking exercises into the exercise regimens of individuals with COPD could be vital in reducing their risk of falls and enhancing overall safety and mobility.

Walking Speed

Walking speed serves as a crucial indicator of exercise capacity (6MWT) rather than merely daily physical activity in individuals with COPD. Utilizing the 6-minute walking test (6MWT), recognized as the predominant field test for assessing exercise capacity in cardiopulmonary diseases, researchers examined factors influencing walking speed in a cohort of 130 stable COPD patients using two walking speed protocols (normal maximum and tempo). The findings indicated that while walking speed was independently associated with 6MWT, it did not correlate with daily physical activity levels [42].

Exercise intolerance is a predominant symptom in COPD patients. In a study by Sanseverino et al., involving 22 subjects (11 with COPD, FEV1 = 45 ± 17% of predicted, and 11 matched healthy individuals), the researchers aimed to compare transportation costs and walking variability at different speeds. The results suggested that interventions targeted at alleviating shortness of breath and modifying walking patterns could enhance patients' self-selected walking speeds and improve their quality of life [43]. Further investigation involving 511 individuals with varying degrees of COPD severity (mild to very severe) compared to 113 healthy controls demonstrated that COPD patients exhibited significantly lower walking speeds during the 6-minute walking test [44]. Notably, individuals with COPD who experienced falls displayed even lower walking speeds. This decrease in quadriceps (QF) strength among COPD patients might be attributed to compounded factors such as muscle weakness, balance impairments, and the development of fear surrounding falling, all of which can lead to physical inactivity and adversely affect walking speed.

In patients with chronic lung conditions, a combination of respiratory symptoms, reduced physical activity, muscle weakness, and impaired coordination can result in balance issues and an increased risk of falls. These falls can lead to serious health complications and impose a substantial financial burden on healthcare systems globally. Therefore, it is essential to conduct thorough evaluations of individuals with chronic respiratory diseases for balance issues, fall risks, muscle strength, and the implementation of adequate pulmonary rehabilitation programs.

The management of COPD should extend beyond improving lung function and preventing exacerbations to include addressing comorbidities, promoting physical activity, and supporting smoking cessation. This holistic approach aims to enhance the quality of life for individuals with COPD. We advocate for comprehensive assessments of balance, walking speed, QF muscle strength, and quality of life, followed by tailored rehabilitation programs.

Our findings will serve as a valuable resource for future research aimed at understanding falls in COPD patients. While most studies have categorized participants into COPD and healthy groups, our research diverges by focusing on the distinctions between falling and non-falling individuals within the COPD population. Our findings indicate that factors such as muscle strength loss, balance issues, low walking speed, and fatigue are significant contributors to fall risk in patients with COPD, ultimately impacting their quality of life.

Quadriceps Femoris Muscle Strength

In both acute and chronic diseases, the degradation of muscle proteins leads to a decrease in muscle mass. In the case of chronic diseases like Chronic Obstructive Pulmonary Disease (COPD), this muscle loss occurs gradually, resulting in atrophy of skeletal muscles. Such atrophy adversely affects respiratory function and exercise tolerance, which in turn deteriorates the quality of life for affected individuals. The gradual loss of muscle mass contributes to a cycle of physical inactivity and further muscle deterioration, exacerbating respiratory symptoms and leading to increased shortness of breath. This decline in physical capabilities can create a sense of dependency and reduce patients' overall engagement in daily activities. As muscle strength diminishes, the risk of falls and associated complications rises, further contributing to morbidity. Moreover, the impact of muscle loss in COPD is not merely physical; it has significant implications for mental health and overall well-being. Patients may experience feelings of frustration, sadness, or anxiety related to their declining health, which can further hinder their motivation to participate in rehabilitation and engage in physical activity [45].

Over time, the cumulative effects of muscle atrophy, reduced exercise tolerance, and diminished respiratory function can lead to a higher risk of mortality among COPD patients. Therefore, it is crucial for healthcare providers to address muscle mass preservation and enhance physical activity through tailored rehabilitation programs, nutritional support, and interventions aimed at improving overall muscle strength and endurance. By focusing on these factors, we can potentially improve the quality of life and longevity for individuals living with COPD and other chronic diseases. [45].

In a thesis study that investigated the severity of the disease and the ability to exercise of QF strength, balance and knee joint proprioseption in individuals with COPD, Saritaj found that 82 individuals with stable COPD between the ages of 40 and 80 and 21 healthy adults included in the study, and compared to healthy individuals, some people with COPD had reduced exercise capacity in parallel with severity. According to the results of the control group, the loss of strength in the muscles that operate the knee joint was statistically significant in the patient groups and compared between the groups and there was a positive meaningful relationship between the exercise capacity of our patients and the muscle strength loss [46].

To measure the role of peripheral muscle strength, in 41 patients with consecutive COPD (FEV1, 43 +/- %19) Weak 6 MWD (372 +/) in a study that re-examined the potential determinants of exercise capacity (6 minutes walking distance [6 MWD] and maximum oxygen consumption [V02max])/- 136 m) and VO2max (1.35 +/- 0.60 L, 71%), decreased respiratory and peripheral muscle strength (QF 74 +/-27) were found. It was concluded that lung function and peripheral muscle strength in COPD are important determinants of exercise capacity [47]. Gosselink et al. included 22 healthy elderly individuals and 40 healthy COPD patients with the aim of determining the degree of respiratory and peripheral muscle weakness in individuals with moderate to severe chronic obstructive pulmonary disease (COPD). Compared with normal patients, respiratory muscle strength (average 64% of control subjects' value [% control] and peripheral muscle strength (average 75% control) were found to decrease [48].

49-year-old women participated in the study by Borges et al. Fall records, fall- related self-sufficiency (FES-I Brazil), functional abilities (Temporary Staircase Ascension and Bounce Test [TUDS] and Temporary Up and Walk Test (TUG]), muscle strength of the lower limbs (bone extenders and ankle planar flexors) were evaluated. Older women with fall records over the past year have found lower strength in the knee extender and plantar flexor muscles. Those with lower self-sufficiency associated with falling have found lower power of the knee extenders [49].

As a result, in the current study, the right and left QF muscle forces of the individuals with COPD were weaker than those of the individuals with COPD who did not fall. Well-known risk factors for falls in individuals with COPD include advanced age, increased comorbidities, dyspnea, physical inactivity, muscle weakness, fear and decreased balance confidence in lower extremity muscle weakness, as well as functional deficiencies, etc, it has been reported that there is a lack of performance and postural control [11]. We think that the presence of lower QF muscle strength in individuals with falling COPD increases the number of falls. We think that studies involving balance assessment and treatment should be performed in COPD individuals as balance loss may occur, which is one of the important determinants of mortality in individuals with COPD, due to decreases in muscle strength, physical activity and exercise capacity in COPD individuals.

Fatigue

Individuals with chronic obstructive pulmonary disease and asthma are often reported up to dyspnea in fatigue. Approximately 43-58% of patients diagnosed with COPD experiencing fatigue. The person minimizes the effort spent during the day to minimize shortness of breath and fatigue. In this case, the day-to-day life activities are limited and often the person becomes dependent on someone else. As fatigue progresses, it is defined as "energy shortage" and the quality of life is negatively affected. Fatigue is a significant symptom that requires evaluation and treatment in individuals with COPD [50].

In his study, Paddison et al. aimed to examine the intensity of fatigue in COPD patients by comparing them with levels, and as a result, a significant relationship was found between fatigue and COPD severity. Also, reports of fatigue suggested that it predicts the risk of future hospitalization [47].

Pana et al. fell rate with personally reported or perceived fatigue in older adults (≥60 years), which has done recurrent falls, in a systemic review that reports the findings of studies investigating the association between fall injuries or the risk of falls, most of the studies concluded that they provide strong evidence of the association between increased fall rate or risk of falls and fatigue in older adults [51].

Renner et al. recently conducted the study between the ages of 64-100 and 5642 men, which aimed to evaluate the relationship between fatigue and the risk of a forward fall (%Men with 26) were found to be older, 24% less active and had worse physical performance [52].

As a result of the current study, fatigue severity of COPD individuals who fell similarly to the literature was found to be higher. Fatigue is an important symptom in individuals with COPD. However, in people with COPD who fall frequently, balance and muscle strength loss, fatigue affects individuals even more negatively. We believe that fatigue severity can negatively affect the treatment process and motivation of these individuals. For this reason, we think that it is important to develop the necessary strategies for the assessment and prevention of fatigue in COPD individuals.

Quality of Life

The factors that may be associated with quality of life impairment are not fully understood. But in most of the studies, it has been shown that dyspnea is the most important factor that has been shown to impair quality of life in COPD. In addition, various factors such as body mass index, age, six-minute walking distance have been associated with poor quality of life in COPD [53].

Improving the quality of life in COPD is more important than prolonging life. Sensitive and realistic determination of quality of life can be achieved by correct perception of conceptual differences [54]. Miravitlles et al. 68,2 and FEV1(%) of the average age of 49,2% of COPD individuals with an average age of 222 aimed to study the factors that determine quality of life. As a result of the study, they found that in individuals with COPD, quality of life showed significant impairment; chronic cough and dyspnea were associated with a higher quality of life. Strategies aimed at changing these factors have concluded that they will significantly improve the well-being of individuals with COPD [55]. Budapest National Koranyi Institute of Chest Diseases 2019-2020'de COPD diagnosing individuals with 321 COPD of frequent flare-ups in a survey-based cross-sectional study combined with clinical data aimed at identifying the most important risk factors affecting quality of life among individuals with COPD, they found that multiple comorbidities and tobacco smoking were associated with poorer quality of life [56].

In a study aimed at assessing the relationship between health-related quality of life (HRQL) and disease severity using lung function measurements, 168 COPD individuals were included and the quality of life in COPD was associated with disease severity and age they have found that it is getting worse [57]. When the literature was examined, the study investigating the quality of life of COPD subjects who fell and did not fall was not found and therefore the results of the studies related to factors affecting quality of life in elderly individuals and COPD subjects who did not fall and fall in this section were reported. In our study, the quality of life in COPD individuals who fell was found to be lower than in the group that did not fall. The presence of COPData symptoms and the addition of falls in addition to this condition, together with the result of complications, make the quality of life worse. Therefore, as a result of rehabilitation programs that reduce symptoms in COPD subjects, we think that dyspnea, exercise capacity, walking distance, oxygen use and hospitalization will decrease and the quality of life will improve significantly.

Limitations of the Study

The COPD individuals included in the study were included from only one institution. Forward studies, instead of falling and non-falling groups, groups can be created according to the frequency of falls or a study can be planned with groups consisting of falling, non-falling and healthy individuals. We also recommend that the population be increased and diversified in future studies.

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CrediT Authorship Contribution Statement

All authors approve the final version of the manuscript, including the authorship list and agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. All authors have read and approved the final version of the manuscript for submission.

YK: Conceptualization, Data curation, Formal Analysis, Writing, original draft

MS: Conceptualization, Data curation, Formal analysis, Writing, original draft

SD: Conceptualization, Data curation

Data Availability

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

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