Factors Influencing Activities of Daily Living in Subjects With COPD

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BACKGROUND: Activities of daily living (ADL) are important for an independent life. As COPD progresses, the ability to complete ADL is usually reduced. Knowing the possible factors that influence the ability to perform ADL may allow better targeting of appropriate rehabilitation programs to increase the independence levels and/or to prevent further decreases in patients with COPD. Therefore, the aim of this study was to investigate ADL performance as measured by the London Chest Activity of Daily Living scale, which is a commonly used measure in patients with COPD. METHODS: This cross-sectional study included 44 clinically stable subjects who were not taking antibiotics and had not made any changes in their medications for at least three weeks with a COPD diagnosis based on Global Initiative for Chronic Obstructive Lung Disease. Demographic characteristics, pulmonary function, ADL measured by the London Chest Activity of Daily Living scale, functional exercise capacity via the 6-min walk distance, disease-related symptoms measured by the COPD Assessment Test, and peripheral and respiratory muscle strength were evaluated. A multiple linear regression (stepwise) analysis was used to determine the variables that have the greatest influence on ADL (ie, the London Chest Activity of Daily Living scale score). RESULTS: The London Chest Activity of Daily Living scale score had moderate correlations with the COPD Assessment Test score ($r = 0.31$, $P = .041$), maximum expiratory pressure value ($r = -0.37$, $P = .01$), 6-min walk distance ($r = -0.48$, $P = .001$), knee extensor muscle strength ($r = -0.47$, $P = .001$), handgrip strength ($r = -0.44$, $P = .003$). The 6-min walk distance, COPD Assessment Test score and maximal expiratory pressure values were significant and independent determinants of the London Chest Activity of Daily Living scale, with 40.1% of the variance in subjects with COPD. CONCLUSIONS: Functional exercise capacity, disease-related symptoms, and expiratory muscle strength have the greatest influence on ADL in the subjects with COPD. The level of independence to perform ADL can be increased by improving functional exercise capacity, reducing symptoms, and increasing expiratory muscle strength in subjects with COPD. *Key words: COPD; activities of daily living; ADL; functional exercise capacity; disease-related symptoms; muscle strength.* [Respir Care 2019;64(2):189–195. © 2019 Daedalus Enterprises]

Introduction

COPD, which is a treatable and preventable disease, is one of the most important causes of mortality and morbidity.[1] Although COPD mainly influences the pulmonary system, it may cause several systemic manifestations.[2] Functional impairment and limitations in activities of daily living (ADL) are frequent in patients with COPD. Functional status can be defined as the ability to fulfill ADL.[3] Functional impairment was found as a predictor of exac-

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erbations and mortality.[4,5] ADL, such as eating, walking, dressing, and bathing, are important for an independent life.[6] As COPD progresses, the ability to complete ADL is usually reduced.[7] Physiologic limitations, especially ventilatory insufficiency, have an important role in ADL impairment in patients with COPD.[8] There is research that dynamic hyperinflation occurs after completing general ADL in subjects with moderate-to-severe COPD.[9] Symptoms, especially dyspnea, cause reductions in ADL, and this situation leads to dependence and disability.[10,11]

Knowing the possible factors that influence the performance of ADL will assist with targeting appropriate rehabilitation programs to increase independence levels and/or prevent further declines in patients with COPD. A number of studies have sought to determine the correlation of variables that may influence the performance of ADL in subjects with COPD,[7,12,13] yet, which variables have the greatest influence on ADL is still unclear. Questionnaires and scales are the most commonly used methods for evaluating ADL limitations.[14] The London Chest Activity of Daily Living scale is a valid and reliable tool currently used in the evaluation of ADL in patients with COPD.[15] Therefore, the aim of this study was to investigate the factors that influence ADL measured by the London Chest Activity of Daily Living scale in subjects with COPD.

QUICK LOOK

Current knowledge

Activities of daily living (ADL), such as eating, walking, dressing, and bathing, are important for leading an independent life. As COPD progresses, it usually decreases patients' ability to perform ADL.

What this paper contributes to our knowledge

We showed that functional exercise capacity, COPD-related symptoms, and expiratory muscle strength had the greatest influence on ADL in subjects with COPD. The level of independence needed to perform ADL can be increased by improving functional exercise capacity, reducing symptoms, and increasing expiratory muscle strength in subjects with COPD.

Methods

Study Design and Subjects

The study design was cross-sectional. Forty-four clinically stable subjects who were not taking antibiotics and had not made any changes in their medications for at least three weeks with a diagnosis of COPD according to the Global Initiative for Chronic Obstructive Lung Disease (GOLD) (GOLD I [$n = 3$], GOLD II [$n = 21$], GOLD III [$n = 15$], and GOLD IV [$n = 5$]) participated in the study.[1] Patients who were clinically unstable or who had cardiovascular, musculoskeletal, or neurologic disease that might influence assessments were excluded from the study. All the participants provided written consent to participate in the study, which was approved by the ethics committee of Dokuz Eylül University.

Measurements

The evaluations were carried out in 2 d. In particular, muscle strength tests and exercise capacity tests were conducted on separate days.

Pulmonary Function

Spirometry (Sensor Medics Vmax 22, SensorMedics, Anaheim, California) was used to assess pulmonary function according to published guidelines by American Thoracic Society/European Respiratory Society.[16]

Symptom Assessment

The COPD Assessment Test was used to assess symptoms in subjects with COPD. The COPD Assessment Test is a reliable and valid method to assess the impact of COPD on a patient's health status.[1] The COPD Assessment Test has 8 items related to COPD symptoms. The score ranges from 0 to 40, and high scores indicate increased symptoms.[1]

Respiratory Muscle Strength

Maximal inspiratory pressure (P_{Imax}) and maximal expiratory pressure (P_{Emax}) were performed to assess respiratory muscle strength (Sensormedics Vmax 22). The subjects performed 3–5 acceptable and reproducible maximal maneuvers (ie, differences of $\leq$10% between values). The recorded value was the highest value unless this was obtained from the last effort.[17] The percentage of normal values by age and sex were used to interpret measurements.[18]

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Functional Exercise Capacity

The 6-min walk test (6MWT) was performed to assess functional exercise capacity according to American Thoracic Society guidelines.[19] Assessments of blood pressure (Erka Manual Sphygmomanometer, Bad Toelz, Germany), heart rate (Beurer pulse oximeter, Ulm, Germany), oxygen saturation (Beurer pulse oximeter, Ulm, Germany), and dyspnea and fatigue (modified Borg scale) were recorded before and after the 6MWT.

Peripheral Muscle Strength

Handgrip and knee extensor strength were assessed by using a handgrip dynamometer (Jamar dynamometer, Patterson Medical, Warrenville, Illinois) and a hand-held dynamometer (JTECH, Medical Commander Powertrack II, Salt Lake City, Utah), respectively.[20,21] The hand-held dynamometry has good reliability (intraclass correlation coefficient, 0.84–0.87) and is suitable for measuring mean changes in muscle force generation for groups of people with COPD.[22,23] Measurements were repeated 3 times in the dominant limbs, and average values were recorded.

ADL

The London Chest Activity of Daily Living scale is a valid, reliable, simple, and short disease-specific scale used to assess breathlessness during ADL in patients with COPD.[15] The London Chest Activity of Daily Living scale is a commonly used measure, with many language validation studies.[12,22-25] It has 15 items related to 4 domains, including self-care, domestic, physical, and leisure. Each item score ranges from 0 to 5 (the total score ranges from 0 to 75), and higher scores show increased limitation during ADL.[15]

Statistical Analysis

The IBM SPSS Statistics for Windows software v. 20.0 (IBM, Armonk, New York) was used to analyze the data. Skewness and Kurtosis tests were used to check normality.[26] Parametric analysis was used because of the normally distributed data. Values are expressed as mean ± SD for continuous variables, and number was reported for categorical variables. The Pearson product-moment correlation coefficients were used to examine the correlations between the London Chest Activity of Daily Living scale and other variables. Correlation coefficients of > 0.5 were considered as a strong correlation, 0.3–0.5 as a moderate correlation, and 0.2–0.3 as a weak correlation.[27] The level of significance was set at $P < .05$. Stepwise multiple linear regression analysis was used to determine the variables that had the greatest influence on the London Chest Activity of Daily Living scale score. Significantly correlated variables (COPD Assessment Test, P_{Emax}, 6MWT, handgrip strength, and knee extensor muscle strength) with the London Chest Activity of Daily Living scale scores were included in the regression model. In addition, the regression equation formula of the study was calculated.

To date, to our knowledge, the possible factors that influence the London Chest Activity of Daily Living scale have not been investigated. Nevertheless, a previous study showed that age is a significant determinant of ADL performance in elderly people ($R^2 = 0.176$, $P < .05$).[28] Based on the findings of that study, the minimum required sample size for a multiple linear regression analysis was calculated as 40 participants for the probability level of .05; for the 8 determinants (age, FEV_1 % predicted, COPD Assessment Test score, P_{Imax}, P_{Emax}, 6MWT distance [6MWD], knee extensor muscle, and handgrip strength) in the model, the anticipated effect size as 0.213; and a statistical power level of 80% when using G*Power Software (version 3.1.9.2).[29]

Results

Forty-four subjects completed the assessments. The characteristics of the subjects are presented in the Table 1. The London Chest Activity of Daily Living scale score had moderate correlation with COPD Assessment Test score ($r = 0.31$, $P = .041$), P_{Emax} ($r = -0.37$, $P = .01$), 6MWD ($r = -0.48$, $P = .001$), knee extensor muscle strength ($r = -0.47$, $P = .001$), and handgrip strength ($r = -0.44$, $P = .003$) (Table 2). The COPD Assessment Test score, P_{Emax}, 6MWD, knee extensor muscle strength, and handgrip strength were included as independent variables in the regression model to determine the possible determinants of London Chest Activity of Daily Living scale score.

Stepwise multiple linear regression analysis demonstrated that the 6MWD, COPD Assessment Test score, and P_{Emax} were significant and independent determinants of the London Chest Activity of Daily Living scale score in subjects with COPD, with 40.1% of the variance (Table 3 and Fig. 1). The regression equation formula of the dependent variable (London Chest Activity of Daily Living scale score) was calculated by using explanatory variables (6MWD, COPD Assessment Test score, and P_{Emax}) and coefficients (Table 3). The regression equation formula was London Chest Activity of Daily Living scale score $= 36.52 + (-0.04 \times 6MWD) + (0.72 \times$ COPD Assessment Test score$) + (-0.12 \times P_{Emax})$.

Discussion

The main finding of the study demonstrated that 6MWD, COPD Assessment Test score, and P_{Emax} had the greatest influence on ADL performance in subjects with COPD,

Table 1. Subjects' Characteristics

Characteristics	Result
Age, mean ± SD y	66.4 ± 9.2
BMI, mean ± SD kg/m^2	26.4 ± 3.4
GOLD stage, *n*	
I	3
II	21
III	15
IV	5
FEV_1, mean ± SD % predicted	53.4 ± 17.9
FVC, mean ± SD % predicted	71.1 ± 18.5
FEV_1/FVC, mean ± SD	57.7 ± 8.7
PEF, mean ± SD % predicted	55.4 ± 17.1
$FEF_{25–75}$, mean ± SD % predicted	24.0 ± 11.7
CAT score, mean ± SD	10.7 ± 3.2
6MWD mean ± SD, m	411.1 ± 64.6
P_{Imax}, mean ± SD cm H_2O	61.8 ± 26.3
% P_{Imax}, mean ± SD	63.7 ± 25.4
P_{Emax}, mean ± SD cm H_2O	74.8 ± 6.2
P_{Emax}, mean ± SD %	40.5 ± 9.4
Knee extensor muscle strength, mean ± SD kg	30.5 ± 5.6
Handgrip strength, mean ± SD kg	32.4 ± 7.2
LCADL score, mean ± SD	19.1 ± 6.1

BMI = body mass index
GOLD = Global Initiative for Chronic Obstructive Lung Disease
PEF = peak expiratory flow
$FEF_{25–75}$ = forced expiratory flow at 25–75%
CAT = COPD Assessment Test
6MWD = 6-min walk test distance
P_{Imax} = maximal inspiratory pressure
P_{Emax} = maximal expiratory pressure
LCADL = London Chest Activity of Daily Living scale

Table 2. Correlation Between LCADL Score and Other Parameters

Parameter	r*	*P*
Age, y	0.004	.98
FEV_1, % predicted	−0.28	.07
CAT score (0–40)	0.31	.041
P_{Imax}, cm H_2O	−0.19	.23
P_{Imax}, %	−0.04	.82
P_{Emax}, cm H_2O	−0.37	.01
P_{Emax}, %	−0.06	.72
6MWD, m	−0.48	.001
Knee extensor muscle strength, kg	−0.47	.001
Handgrip strength, kg	−0.44	.003

* Pearson product moment correlation coefficient.
LCADL = London Chest Activity of Daily Living scale
CAT = COPD Assessment Test
P_{Imax} = maximal inspiratory pressure
P_{Emax} = maximal expiratory pressure
6MWD = 6-min walk test distance

with these variables explaining 40.1% of the variance in the London Chest Activity of Daily Living scale. In addition, the study demonstrated that the London Chest Activity of Daily Living scale was correlated with peripheral muscle strength.

Table 3. Stepwise Multiple Linear Regression Model of Activities of Daily Living

Variable	B	SE	β	*P*
Constant	36.52	5.39	NA	<.001
6MWD, m	−0.04	0.01	−0.41	.002
CAT score	0.72	0.22	0.39	.002
P_{Emax}, cm H_2O	−0.12	0.045	−0.33	.01

r = 0.67; R^2 = 0.44; adjusted R^2 = 0.401 ($P < .001$).
B = unstandardized regression coefficient
NA = not applicable
SE = standard error
6MWD = 6-min walk test distance
CAT = COPD Assessment Test
P_{Emax} = maximal expiratory pressure

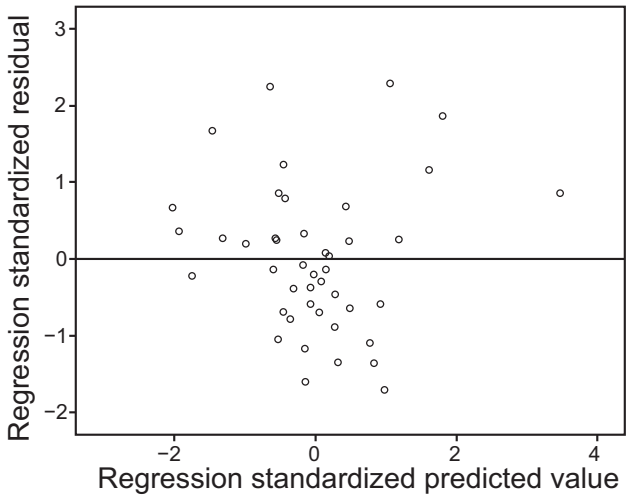

Fig. 1. Scatter plot graphic of the regression model to determine daily living activities.

The 6MWT is inexpensive, reliable, and commonly used to assess functional capacity in patients with COPD.[30] The 6MWD is used as a marker of many parameters in these patients. Previous studies showed that the 6MWT is a predictor of nocturnal oxygen desaturation,[31] physical activity,[32] and mortality[33] in subjects with COPD. In addition, our study showed that 6MWD is a factor that influences ADL. This finding indicated that subjects with COPD with good functional exercise capacity would experience fewer limitations in fulfilling their ADL.

Dyspnea, cough, and sputum production are characteristic features of COPD.[1] As COPD progresses, ventilatory limitations occur. Lahaije et al[8] showed that ventilatory limitations have an important role in the decline of ADL performance. Symptoms, especially dyspnea, limit exercise capacity as well as ADL ability.[34] The COPD Assessment Test is a suggested and comprehensive assessment

for symptoms in subjects with COPD.[1] Our study showed that the COPD Assessment Test score was a factor that influences the performance of ADL. Programs for symptom management in patients with COPD may increase participation in daily life and independence.

Systemic changes, for example, expiratory muscle weakness with alterations in muscle structure, are found in patients with COPD.[35] Early signs of fatigue and decreased endurance typically occur in expiratory muscles of patients with COPD.[36] Singer et al[37] showed that reduced muscle strength is associated with decreased functional capacity, and muscle weakness is an important factor for disability in subjects with COPD. In addition, dyspnea, one of the most important consequences of imbalance between respiratory muscle strength and load,[38] is an important factor for limitations in ADL.[10] Khalil et al[39] showed that the P_{Emax} is correlated with dyspnea and functional exercise capacity. Expiratory muscle strength was found as a factor that influences ADL in subjects with COPD. Participation in ADL can be increased by improving expiratory muscle strength.

Exercise intolerance and dyspnea limit ADL in patients COPD.[10] Previous studies showed that respiratory muscle weakness caused exercise intolerance and dyspnea.[37,40] In addition, it was shown that dyspnea is reduced and exercise capacity is increased after inspiratory muscle training.[41] Surprisingly, no significant association between inspiratory muscle strength and ADL was found in our study. We assumed that these findings were due to the high inspiratory muscle strength averages found in our subjects, with a mean P_{Imax} of >60 cm H_2O as the cutoff value for respiratory muscle weakness.[42] There may be a relationship between ADL and P_{Imax}, depending on dyspnea and exercise intolerance that will develop in patients with inspiratory muscle weakness.

Peripheral muscle dysfunction is one of the well-known consequences of COPD.[43] Previous studies demonstrated that peripheral muscle weakness is related to a shorter life expectancy,[44] poor health-related quality of life,[45] and exercise intolerance[46] in patients with COPD. Our study showed that peripheral muscle strength was associated with ADL. As peripheral muscle strength increases, daily life activities may improve.

To determine the phase of airway obstruction and disease severity, FEV_1 is used in patients with COPD.[1] Simon et al[7] showed a positive correlation between the FEV_1% and ADL. Nevertheless, our study demonstrated that there was no correlation between FEV_1% and ADL. This finding may be due to the low number of GOLD I group and GOLD IV group subjects with COPD. Studies that involve subjects with different degrees of airway obstruction may be helpful.

Liu et al[47] showed that COPD is associated with mortality and disability in the elderly. Participation in ADL decreases in elderly subjects with COPD in this study.[47] However, there was no association between age and ADL in our study. We believed that these results were found because the average age of the participants was >65 y (mean age, 66.4 y). More studies involving individuals with COPD in different age groups would be helpful.

There were some limitations of this study. First, although we had more than the minimum required sample size, the number of participants in the GOLD I and IV groups was low. In this respect, the study findings cannot be generalized to patients with COPD and different disease severity. Second, ADL were not compared with an age- and sex-matched healthy control group in the study. Including a healthy comparison group may provide a better perspective on whether the defined factors that influence ADL are only related to patients with COPD.

Conclusions

Functional capacity, COPD-related symptoms, and expiratory muscle strength have the greatest influence on ADL in subjects with COPD. The level of independence in ADL of subjects with COPD can be increased by improving functional exercise capacity and expiratory muscle strength, and reducing COPD-related symptoms. Further studies should investigate the effects of rehabilitation programs by targeting these factors on ADL in subjects with COPD.

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