Factors determining self–efficacy in chronic obstructive pulmonary disease

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ABSTRACT

Objective: We investigated the factors determining self-efficacy in patients with chronic obstructive pulmonary disease (COPD).

Methods: Thirty male patients with COPD and 30 healthy controls participated in the study. Pulmonary function tests, 6-minute walk test (6MWT), modified Borg scale, modified Medical Research Council (MRC) dyspnea scale, Hospital Anxiety and Depression Scale (HADS), Activities of Daily Living Questionnaire (ADL-Q), and COPD Self-Efficacy Scale (CSES) were used for the evaluation. The study was performed between September 2003 and May 2004 at the Department of Chest Medicine, School of Physical Therapy and Rehabilitation, Hacettepe University, Ankara, Turkey.

Results: The COPD patients expressed higher depression and dyspnea level and impaired activities of daily living than healthy controls ($p<0.05$). Duration of disease and the ADL-Q score was significantly correlated with all subscales of CSES ($p<0.05$). Borg score and anxiety score were significantly related with negative affect, weather/environment, and behavioral risk factors subscales of CSES ($p<0.05$). Lung function was significantly related with physical exertion and behavioral risk factors, and 6MWT distance was significantly correlated with weather/environment and behavioral risk factors subscales ($p<0.05$). The MRC score was correlated with weather/environment score ($p<0.05$). The ADL-Q score and disease duration accounted for 76% of the variance in self-efficacy ($p<0.05$).

Conclusion: Level of impaired activities of daily living due to respiratory limitation and the number of years since diagnosis are independent variables that predict self-efficacy, or level of confidence in engaging specific behaviors that lead to specific desired outcomes in COPD.

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Chronic illness has an important impact of patients' daily life. Chronic obstructive pulmonary disease (COPD) is a major cause of morbidity, and causes deterioration in health status especially in older adults. Progression in the COPD results in worsening of the disabling symptoms including breathlessness and fatigue.[1] These symptoms often interfere with day-to-day activities of patients.[2] Self-efficacy is an indice of adjustment to chronic conditions.[3,4] Behavioral performance and patients' belief in their ability to perform a particular activity in various situations are linked by self-efficacy. It refers to personal judgements concerning one's ability to successfully perform certain behaviors or engage in a particular activity or achieve a specific desired goal.[5,6] Self-efficacy determines which activities or situations a person will perform or avoid.[6]

Patients with COPD usually have low level of self-efficacy regarding to their ability to avoid breathing difficulty while performing certain activities.[7] Lack of confidence or low level of self-efficacy may result in avoiding many activities of daily living although patients may have the

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physical capability to engage in the activities.[5] It has been shown that self-efficacy is an important variable in performance related disability in patients with COPD besides maximal exercise capacity and the degree of airflow obstruction.[3] Patients with low self-efficacy in symptom management was found to be reported higher levels of anxiety and more impaired quality of life.[4] Although it is proposed that self-efficacy is influenced by somatic indicators including physiological, physical and affective states,[6] studies related to self-efficacy in COPD focus on the relationship between self-efficacy and self-management or specific behavior modification.[6,8] Identifying the factors determining the self-efficacy level in COPD patients would enable to design and organize specific interventions to increase patient's self-efficacy in specific situations, and increase their activity participation and independence in daily life.[5] Therefore, in this study, we aimed to investigate physiological, psychological, and physical factors that determine self-efficacy in patients with clinically stable COPD.

Methods. Thirty male patients (aged 39-75 years) with clinically stable COPD, recruited from the outpatient clinic of a university hospital, participated in this study. Inclusion criteria were (1) diagnosed as suffering from emphysema and/or chronic bronchitis by a chest physician, (2) registering a maximum improvement of 12% of predicted value of forced expiratory volume in one second (FEV_1), (3) receiving a stable drug regimen in a period of 4 weeks before the study, (4) free from any other significant pulmonary disease, and (5) free from any chronic disabling nonpulmonary disease that would confound results. The mean number of years since diagnosis of COPD (disease duration) was 10.5 ± 8.2 (range 1-36) years. Twenty-two patients (73.3%) were married, and 26 (86.6%) were living with others, and 7 (23.3%) were working. Thirty male sedentary healthy hospital employees were served as controls. All measurements were included in the routine clinical evaluation of patients, and an informed consent was obtained from all subjects prior to the enrollment.

Age, height, and weight of the subjects were recorded. The body mass index was calculated as weight/height squared (expressed in kg/m^2). Smoking history was assessed using calculated pack-years ([number of cigarettes per day/20] x length of smoking in years).[9] Duration of education, marital status, living arrangements, and employment status were recorded.

The pulmonary function test was performed using a spirometer (Vitalograph Compact, Vitalograph Limited, Buckingham, England). The forced vital capacity (FVC), FEV_1, and peak expiratory flow rate (PEF) were recorded. The highest value from at least 3 technically acceptable maneuvers was expressed as the percentage of predicted values.[10]

Functional exercise capacity was measured using a 6-minute walk test (6MWT).[11] The subjects were instructed to walk as far as possible in 6 minutes in an enclosed hospital corridor 55-m long, and standardized phrases of encouragement given in every one-minute. The distance covered in 6 minutes was recorded as nearest meter at the end of the test. The percentage of predicted 6MWT distance was calculated by a reference equation using age, height, and weight.[12] A distance <82% of predicted value considered as abnormal.[13] Breathlessness at the end of the test was determined using a 10-point modified Borg scale, with 10 as the maximum score.[14]

Functional dyspnea rating was evaluated using the modified Medical Research Council (MRC) dyspnea scale including 5 grades of physical activities that precipitate breathlessness.[15] The ratings of the MRC scale ranged from zero (non-exertional dyspnea at all) to 4 (breathlessness on dressing or undressing). The higher score indicates the worse severity of dyspnea. Each patient was instructed to read the descriptive statements and then selected the number which best fitted his shortness of breath.

The limitation in the day-to-day activities was determined using the Activities of Daily Living Questionnaire (ADL-Q).[16] This questionnaire measures the inability to perform activities of daily living as a result of respiratory dysfunction. It consists of short, one-phrase description of 15 activities for which the participant is asked to choose one of 5 possible responses. Activities in the ADL-Q that were not performed by a given subject for reasons unrelated to breathing were described as "not applicable" and were not retained in the calculation of that participant's overall ADL-Q score.

Hospital Anxiety and Depression Scale (HADS) were used to measure anxiety and depression level.[17] This self-reported questionnaire consists of 14 questions in which the overall severity of anxiety and depression is rated on a 4-point scale (0 to 4). Seven questions are related to anxiety and 7 to depression. Higher scores indicate more emotional stress. Scores <7 indicate no depression/anxiety, 8-10 possible depression/anxiety, and >10 indicate certain depression/anxiety.[18]

The COPD Self-Efficacy Scale (CSES) was used to evaluate confidence level in ability to manage breathing difficulty while engaging in certain activities.[5] The scale rates the strength of expectations of managing or avoiding breathing difficulty. It consists of 34 items and 5 subscales including negative affect, intense emotional arousal, physical exertion, weather/environment, and behavioral risk factors. Each item is rated on a

5-point scale (1-5). To obtain total and subscale scores, items were added up and then divided by the number of items that were included. Higher scores indicated higher self-efficacy in this scale.[2]

Statistical Package for Social Sciences version 11.0 was used for statistical analysis.[19] Data were presented as frequencies, percentages, mean, and related standard deviations (mean ± SD). Between-group comparison was performed using Student's t-test or Mann-Whitney U test, as appropriate. The relationship among variables was examined using Pearson's correlation coefficient analysis. A stepwise multiple linear regression analysis was performed to identify independent contributors to self-efficacy. Statistical significance was defined as a value of $p<0.05$.

Results. The COPD patients and healthy controls were similar with regard to age, height, weight, and body mass index ($p>0.05$, **Table 1**). The mean FVC, FEV_1, and PEF was significantly lower in COPD patients than in healthy controls ($p<0.05$, **Table 1**). The mean distance covered during 6MWT was significantly shorter and the percentage of predicted distance was significantly lower in COPD patients than in healthy controls ($p<0.05$, **Table 1**). Ten COPD patients (33.3%) performed <82% of their predicted distance. Patients expressed significantly higher ratings of functional and exertional dyspnea ($p<0.05$, **Table 1**).

Patients with COPD had a significantly higher depression level than healthy controls ($p<0.05$, **Table 1**). Fourteen patients (46.7%) had a score of 8-10, indicating possible depression, and 2 patients (6.7%) had a score of >10, indicating certain depression, on HADS. A significant difference was not found in anxiety score between the 2 groups ($p>0.05$, **Table 1**). Eleven patients (36.7%) had a score of 8-10, indicating possible anxiety, and 6 patients (20%) had a score of >10, indicating certain anxiety.

The activities of daily living were significantly impaired in COPD patients as compared to healthy controls ($p<0.05$, **Table 1**). The daily activities associated with respiratory limitation were running a short distance in 22 patients (73.3%), doing heavy work in 17 patients (56.7%), carrying a load such as groceries in 14 patients (46.7%), active game with children in 13 patients (43.3%), playing a fast game and walking on level with others in 12 patients (40%), being angry or upset in 11 patients (36.7%), sports such as golfing, swimming in 10 patients (33.3%), working around home in 9 patients (30%), shopping, banking, and using public transportation in 5 patients (16.7%), quiet activity such as playing cards in 4 patients (13.3%), and eating out or with company in one patient (3.3%). In COPD patients, the mean intense emotional arousal score of CSES was 3.49 ± 0.92 (range 1.38-5.00), and it was inversely related with disease duration and ADL-Q score ($p<0.05$, **Table 2**). The mean negative affect score was 3.29 ± 1.04 (range 1.58-5.00), and it was significantly and inversely correlated with disease duration, Borg score, anxiety score, and ADL-Q score ($p<0.05$, **Table 2**). The mean behavioral risk factors score was 3.18 ± 1.02 (range 1.33-5.00), which is positively related with FEV_1 and 6MWT distance, and inversely related with disease duration, Borg score, anxiety score, and ADL-Q score ($p<0.05$, **Table 2**). The mean weather/environment score was 2.84 ± 1.11 (range 1.50-5.00), and it was positively related with 6MWT distance, and inversely correlated with age, disease duration, Borg score, MRC score, anxiety score, and ADL-Q score ($p<0.05$, **Table 2**). The mean physical exertion score was 2.83 ± 1.17 (range 1.00 to 5.00), and it was positively correlated with FEV_1 and PEF ($p<0.05$, **Table 2**). It was inversely associated with disease duration, depression score, and ADL-Q ($p<0.05$, **Table 2**).

The mean total CSES score was 3.18 ± 0.93 (range, 1.41-4.97), and it was inversely related with ADL-Q score (r= -0.77, $p<0.01$), disease duration

Table 1 - Characteristics of patients with chronic obstructive pulmonary disease and healthy controls.

Characteristic	COPD	Healthy	*p* value
Age (years)	61.9 ± 9.9	57.9 ± 9.3	0.11
Height (cm)	169.1 ± 7.6	171.0 ± 7.9	0.37
Weight (kg)	68.9 ± 15.2	73.1 ± 13.5	0.27
BMI (kg/m²)	23.9 ± 4.2	24.9 ± 3.9	0.35
Smoking (pack-years)	43.4 ± 19.9	20.4 ± 21.3	<0.0001
Education (years)	8.4 ± 4.1	12.3 ± 4.4	0.001
FEV_1 (% predicted)	36.8 ± 12.3	100.7 ± 17.9	<0.0001
FVC (% predicted)	66.0 ± 14.0	107.1 ± 17.5	<0.0001
PEF (% predicted)	44.6 ± 12.6	108.6 ± 24.1	<0.0001
MRC score	1.57 ± 0.84	0.03 ± 0.19	<0.0001
6MWT distance (m)	449.4 ± 68.5	556.0 ± 82.4	<0.0001
6MWT distance (%)	84.3 ± 15.9	98.7 ± 14.5	0.001
Borg score	2.5 ± 2.7	0.4 ± 0.9	<0.0001
HADS-depression	6.8 ± 2.8	4.5 ± 2.7	0.003
HADS-anxiety	7.1 ± 4.4	6.0 ± 3.2	0.43
ADL-Q	0.32 ± 0.22	0.04 ± 0.10	<0.0001

COPD - chronic obstructive pulmonary disease,
FEV_1 - forced expiratory volume in one second,
FVC - forced vital capacity, PEF - peak expiratory flow rate,
6MWT - 6-minute walk test, BMI - body mass index
MRC - Modified Medical Research Council Dyspnea Scale,
HADS - Hospital Anxiety and Depression Scale,
ADL-Q - Activities of Daily Living Questionnaire.

Table 2 - Factors associated with self-efficacy in chronic obstructive pulmonary disease.

Variables	Intense emotional arousal	Negative affect	Behavioral risk factors	Weather/ environment	Physical exertion
Age (years)	-0.35	-0.37	-0.38	-0.48†	-0.41
Disease duration (years)	-0.54†	-0.65*	-0.63*	-0.54†	-0.49†
FEV_1 (% predicted)	0.37	0.20	0.46†	0.43	0.53†
PEF (% predicted)	0.39	0.21	0.42	0.44	0.51†
6MWT distance (m)	0.43	0.28	0.49†	0.50†	0.30
Borg score	-0.20	-0.52†	-0.58*	-0.50†	-0.38
MRC score	-0.19	-0.20	-0.11	-0.47†	-0.12
HADS-anxiety	-0.38	-0.64*	-0.61*	-0.55†	-0.42
HADS- depression	-0.36	-0.29	-0.32	-0.32	-0.49†
ADL-Q	-0.74*	-0.64*	-0.59*	-0.77*	-0.71*

*p<0.01, †p<0.05, FEV_1 - forced expiratory volume in one second, PEF - peak expiratory flow rate, 6MWT - 6-minute walk test, MRC - Modified Medical Research Council Dyspnea Scale, HADS - Hospital Anxiety and Depression Scale, ADL-Q - Activities of Daily Living Questionnaire.

Table 3 - Multiple stepwise regression analysis with the COPD Self-Efficacy Scale score as the dependent variable to determine the significance of the model proposed.

Predictor variables	Univariate *r*	Cumulative r^2	Partial r^2	*p* value
ADL-Q	0.77	0.60	0.57	<0.0001
Disease duration (years)	0.87	0.76	0.16	0.004

ADL-Q - Activities of Daily Living Questionnaire, COPD - chronic obstructive pulmonary disease

(r= -0.65, p<0.01), anxiety score (r= -0.59, p<0.01), and Borg score (r= -0.48, p<0.05). The stepwise multiple regression analysis revealed that ADL-Q score and number of years since diagnosis of COPD were significant and independent predictors of the CSES. These 2 variables accounted for 75.8% of the variance in the CSES (**Table 3**). The CSES score was predicted by the following equation: CSES=0.464 + (0.623 x ADL-Q score) - (0.429 x disease duration); r= 0.871, r^2= 0.758, $F_{(2,19)}$ = 26.598, p<0.0001.

Discussion. This study showed that COPD patients had an impaired lung function, functional exercise capacity and the activities of daily living as compared to healthy counterparts. Exertional and functional dyspnea ratings and depression level of the patients were higher than controls. Most importantly, we found that self-efficacy in clinically stable patients with moderate to severe COPD is determined by the number of years since diagnosis of COPD and performance in activities of daily living.

Self-efficacy is the expectation of a patient's own ability to perform a task, to organize and execute action required to manage prospective situtations.[2,5,6] Therefore, self-efficacy beliefs influence our behavior and activity choices, duration that we persist in confronting obstacles or failures, and our feelings.[5,6] In this study, we measured self-efficacy using the CSES. It consists of 5 different subscales, and assesses the confidence of COPD patients in their ability to avoid or manage breathing difficulty in certain situations. Negative affect subscale measures the level of confidence associated with feelings such as detachment, helplessness, incompetence, and anxiousness.[5] We showed that patients who had a longer disease duration, higher levels of anxiety and exertional breathlessness, and more impaired activities of daily living due to respiratory limitation, experienced lower self-efficacy in activities or situations associated

with a negative affect. The intense emotional arousal subscale of CSES represents strong emotional arousal such as anger, excitement, stress, and intense fear.[5] In our COPD patients, both longer disease duration and more limitation in activities of daily living were associated with low self-efficacy in situations related with intense emotional arousal. Patients with COPD frequently suffer from depression and anxiety.[20] Psychological states such as anxiety, stress arousal, and mood states have shown to be an effect on task performance and subsequently influence efficacy beliefs.[21] In our study, anxiety level measured using HADS was inversely related to negative affect, weather/environment, and behavioral risk factors subscales, and depression level was inversely correlated with physical exertion subscale of CSES. In addition, in accordance with the findings of McCathie et al,[4] anxiety score on HADS was significantly related to the total CSES score. As psychological factors effect self-efficacy in symptom management in certain behaviors, these factors should be measured in clinical setting to direct treatment and rehabilitation programs to raise the level of confidence in certain activities and behaviors of COPD patients.

Breathing difficulty associated with physical exertion such as climbing stairs, exercise, and lifting heavy objects is measured using physical exertion subscale of CSES. Also, included in this factor is an item related to fatigue.[5] Patients with lower FEV_1, longer disease duration, more limited activities of daily performance, and higher levels of depression expressed less confidence in management of their breathlessness during situations or activities requiring physical exertion. Previous research has demonstrated that self-efficacy is an important variable in physical performance measured by maximal oxygen consumption.[3] Similar to the findings of Rejeski et al,[3] 6MWT performance was not a variable that explain the confidence of physical performance. This finding may be a result of a reduced expectation of physical capacity as the disease progresses in patients with COPD. It also could be due to lack of any item in the scale specifically stating walking, a common and familiar activity in daily life, and items in this scale solely concerned with activities performed usually within the home. Self-paced 6MWT provides an evaluation of disability caused by respiratory impairment,[11] and imposes a sustainable work to exercising body.[22] The distance walked during the test reflects the functional limitation[11] in the community rather than simply measuring physical exertion level or performance on a sudden activity requirement.

Weather/environment items on CSES are associated with weather and temperature changes and with environmental pollution. There is also an item related to upper and lower airway infections.[5] Our findings indicated that older patients with a longer disease duration and with lower functional exercise capacity, and patients having higher functional and exertional dyspnea ratings and more impaired activities of daily living, and patients reporting higher levels of anxiety had a low self-efficacy in situations or activities related to weather and temperature changes and with environmental pollution. This study was performed in a metropolitan area where air pollution is an important problem during early autumn and winter. Furthermore, climate in this region is very cold during winter, and sudden changes of temperature are common especially in season changes. Therefore, weather or temperature changes had an important aspect in our patients' daily life. Activities including weather and environmental issues in our moderate to severe COPD patients were considered as factors that lead the patients to the lowest level of self-efficacy.

Behavioral risk factors are associated with behaviors that lead to breathing difficulty, such as improper diet and breathing techniques.[5] In our patients, longer disease duration, greater impairment in airflow, lower functional capacity, higher dyspnea ratings on exertion, more impaired activities of daily living performance, and higher levels of anxiety were associated with lower levels of self-efficacy in symptom management in situations including behavioral risk factors. Nutritional counseling and education in appropriate breathing techniques may help to raise self-efficacy or level of confidence in symptom management in certain behaviors but this needs further investigation.

Impaired performance in activities of daily living had a significant impact on self-efficacy in moderate to severe COPD patients, and it accounted for 57% in the variance in the CSES score. Because the COPD is a chronic progressive disabling disease, patients usually give up entirely and limit involvement in activities that precipitates the common symptoms of disease including dyspnea and fatigue.[2] The patients concentrate their efforts on actively meeting the physical challenges of their illness and develop a certain behavior according to their levels of confidence, or self-efficacy, to start or complete a specific task.[2] Self-efficacy beliefs are task-specific and depend on the difficulty and the complexity of the skills needed to perform.[23] In this study, we showed that duration of disease explained the 16% of the variance in self-efficacy in moderate to severe clinically stable COPD patients. A longer disease duration was associated with a low self-efficacy score in negative affect, intense emotional arousal, physical exertion, weather/environment and behavioral risk factors. The duration of disease was over 5 years in 21 patients (70%) and over 10 years in 11 patients

(36.6%). The disease duration is a consequence in COPD.[24,25] Therefore, patients with COPD should have an appropriate treatment and should participate pulmonary rehabilitation including exercise training, education in activities of daily living performance and energy conservation techniques as soon as they had a diagnosis of COPD before the chronic disabling disease starting to design their beliefs related to symptom management and coping.

In conclusion, self-efficacy beliefs are a reliable predictor of behavior modification through its strong relationship to physical, physiological and psychological factors. It should be assessed in patients with COPD to predict performance of self-management behaviors and work on patient's motivation and confidence in their capabilities. It is especially important while designing pulmonary rehabilitation programs according to the individual needs of the patients to improve participation, enhancement in daily life, and to ensure long-lasting effects of rehabilitation and maintenance treatment.

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