

# The Relationship between COPD Assessment Test (CAT) Scores and Severity of Airflow Obstruction in Stable COPD Patients

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Received: 24 December 2011

Accepted: 27 February 2012

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**Background:** COPD is a major cause of morbidity in smokers. The COPD assessment test (CAT) is a validated test for evaluation of COPD impact on health status. CAT is not a diagnostic test and pulmonary function test (PFT) still remains the most important diagnostic test. However, its predictive value for evaluation of disease impact is weak. The purpose of this study was to determine the relationship between CAT score and PFT in COPD patients.

**Materials and Methods:** We evaluated 105 patients with stable COPD. Demographic data were obtained at baseline. Severity of airflow obstruction was assessed by standard spirometry and classified by the Global initiative for Obstructive Lung Disease (GOLD) criteria. Then, the impact of COPD on health status was assessed using CAT. The CAT scores were categorized into four groups. We statistically compared the relationship between CAT score, COPD stages, CAT groups and PFT.

**Results:** The mean age of patients and mean period of smoking (p/y) were  $59.60 \pm 11.93$ SD and  $35.43 \pm 15.33$  SD yrs, respectively. The mean  $FEV_{1\%predicted}$  was  $71.01 \pm 26.70$ SD. The mean CAT score was  $19.61 \pm 8.07$  SD. The correlation between the severity of smoking and GOLD classification was significant ( $p=0.006$ ). There was a significant association between the  $FEV_{1\%predicted}$  and total CAT score ( $r = -0.55$ ,  $p < 0.001$ ).

The correlation between mean  $FEV_{1\%predicted}$  and mean score of CAT groups 1, 2, 3, and 4 was statistically significant ( $p < 0.001$ ).

**Conclusion:** The relationship between CAT score and  $FEV_{1\%predicted}$  suggests that CAT is linked to severity of airflow limitation and GOLD classification in stable COPD patients. Health status as measured by CAT worsens with severity of airflow limitation.

**Key words:** COPD, COPD Assessment Test (CAT), Health status, Pulmonary function test

## INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is a progressive condition leading to morbidity and mortality and is characterized by cough, dyspnea and sputum production. COPD is a condition with persistent airflow limitation and systemic inflammation affecting

the lungs and other organs and impairing quality of life by several mechanisms (1-3).

Although the severity of airflow obstruction is evaluated by forced expiratory volume in one second ( $FEV_1$ ), this test does not show the multidimensional effect of systemic inflammation on health status (4, 5).

On the other hand, COPD is a complex disease with multiple consequences including breathlessness, exercise limitation, muscle wasting, weight loss, increased hypercoagulability, depression, coronary artery disease and other systemic inflammatory effects (6,7).

Recently a new simple system evaluating health status was approved to evaluate the impact of COPD on health status (8). The COPD Assessment Test (CAT) is a new scoring system for COPD patients, which provides a simple method for assessing the impact of COPD on the patient's health. The validation studies have shown that it has similar properties as St. George's Respiratory Questionnaire (SGRQ) (9-11).

The CAT and  $FEV_1$  are complementary measurements for assessment and management of COPD (9,10). The CAT is a standard and validated test containing eight items for the evaluation of the impact of COPD on health status (8,9). It is a tool for the measurement of disease impact on health status, but  $FEV_1$  is essential to establish a diagnosis and to confirm the severity of airway obstruction in symptomatic COPD patients (5).

The CAT and  $FEV_1$  are both reliable methods for assessing the treatment response and progression of disease severity in COPD patients (10).

In some studies  $FEV_1$  was poorly correlated with quality of life, yet several researchers have reported a weak correlation between health status score and  $FEV_1$  (10).

The aim of this study was to evaluate the correlation between airflow obstruction by  $FEV_1$  and Global initiative for Obstructive Lung Disease (GOLD) classification and health status of COPD patients by CAT score and CAT groups.

## MATERIALS AND METHODS

Between March 2010 and April 2011 a total of 105 COPD patients of various severity were enrolled in this cross-sectional study in Imam Khomeini Hospital of Ardabil University of Medical Sciences. All patients

received the optimal treatment according to the GOLD classification.

The diagnosis of COPD was established based on a medical history of smoking, current symptoms of cough, dyspnea or sputum production and available standard pulmonary function test which was performed by a spirometer (Chest Inc., 801, Tokyo, Japan) according to the ATS standards (American Thoracic Society). In case of disparity between the clinical criteria and the ATS standards, a preference was given to clinical criteria. The severity of COPD was assessed according to GOLD classifications as follows:

Stage 0 (at risk), stage 1 (mild), stage 2 (moderate), stage 3 (severe) and stage 4 (very severe).

All patients were clinically stable during the past four weeks. The exclusion criterion was presence of an illness other than COPD such as bronchial asthma, tuberculosis, bronchiectasis, ischemic heart disease or malignancy.

This study was approved by the Institutional Ethics Committee and all patients provided written informed consent.

## CAT score

After history taking and physical examination, all patients completed the Persian version of CAT respiratory questionnaire.

The total CAT score was calculated for each individual by summing the points for each variable.

CAT has a scoring range of zero to 40. The CAT score was classified into four groups of low(1), medium(2), high(3) and very high(4) based on the impact level of disease on health status as shown in Table 1.

Table 1. Impact level of COPD on health status.

CAT score	Impact level
< 10	Low
10 – 20	Medium
21 - 30	High
> 30	Very high

## Analysis

Data were described as means  $\pm$  standard deviation. Differences between means were tested with student's t-test and reported with 95% confidence interval (95% CI).

The correlation between the CAT score and GOLD classification was tested by one way ANOVA. In order to evaluate the correlation between parametric variables, the Pearson's correlation coefficient was utilized. Data analysis was performed using SPSS version 16 software.  $P < 0.05$  was considered statistically significant.

## RESULTS

A total of 105 male patients were included in this study. General characteristics of these patients are shown in Table 2.

Table 2. General characteristics of patients.

General Characteristics	Data
Male (No.)	105
Age, years	59.60 $\pm$ 11.93
FEV <sub>1</sub> %predicted	71.01 $\pm$ 26.70
FVC%predicted	91.39 $\pm$ 27.45
FEV <sub>1</sub> / FVC	61.10 $\pm$ 13.05
Total CAT score	19.61 $\pm$ 8.07
Smoking, P/Y	35.43 $\pm$ 15.33

Values are presented as means  $\pm$  standard deviation

The mean CAT score was 19.61 $\pm$ 8.07 SD with a minimum score of 2 and a maximum score of 34. The correlation between the number of patients in stage 0 to stage IV of COPD severity by GOLD classification and their mean CAT score in each stage was statically significant ( $P < 0.001$ ) as shown in Table 3.

Table 3. Correlation between the number of patients in stage 0 to stage IV of COPD severity by GOLD classification and their mean CAT score

	GOLD 0	GOLD I	GOLD II	GOLD III	GOLD IV
Number of patients	17	22	39	22	5
CAT score	13.12	14.55	21.08	25.09	28.40
P value	$P < 0.001$				

The mean age of patients and the mean period of smoking pack/year(P/Y) were 59.60 $\pm$ 11.93 and 35.43 $\pm$ 15.3, respectively. The mean FEV<sub>1</sub>%predicted was 71.01 $\pm$ 26.70 and the mean FVC%predicted was 91.39 $\pm$ 27.45, respectively. The mean FEV<sub>1</sub>/FVC was 61.10 $\pm$ 13.05.

The correlation between FEV<sub>1</sub> value and total CAT score was significant ( $r = -0.55$ ,  $P < 0.001$ ). The correlation between total score of CAT and FVC%predicted was significant as well ( $r = -0.49$ ,  $P < 0.001$ ).

The amount of smoking by P/Y increased significantly with higher GOLD classification stages ( $P = 0.006$ ) and the differences between the stage II, and stage III and IV ( $P = 0.003$  and  $P = 0.05$  respectively) were statistically significant but no differences were noticed between stage I and II by GOLD classification ( $P = 0.65$ ).

The correlation between the CAT score and amount of smoking by P/Y appeared to be significant ( $P < 0.001$ ,  $r = 0.35$ ). The correlation between FEV<sub>1</sub>%predicted and amount of smoking by P/Y was found to be statistically significant as well ( $P = 0.007$ ).

The comparison of mean FEV<sub>1</sub>%predicted with mean score of CAT groups 1(low impact level) to 4 (very high impact level) were 90.15 $\pm$ 21.11 , 81.52 $\pm$ 24.05 , 61.15 $\pm$ 24.50 and 46.91 $\pm$ 16.38 respectively ( $P < 0.001$ ).

The mean FEV<sub>1</sub>/FVC in the CAT groups 1, 2, 3, and 4 was 64.46 $\pm$ 11.37 , 65.25 $\pm$ 12.74 , 59.05 $\pm$ 13.03 and 49.73 $\pm$ 7.82, respectively ( $P < 0.001$ ).

## DISCUSSION

COPD is a systemic disease with airflow obstruction, systemic inflammation, multi -organ damage and impairment (1). This study demonstrated that CAT questionnaire which is a patient-completed instrument for estimating the impact of COPD on health status has a better correlation with severity of airflow obstruction by FEV<sub>1</sub> in stable COPD patients.

COPD is a complex multidimensional disease that affects the lungs as well as other organs through

chronic systemic inflammation and increased inflammatory markers that do not correctly address the severity of airflow limitation.

In this study no differences were found between CAT score of male and female patients. This fact may be due to the nature of COPD that is not influenced by gender and the major risk factor of disease is smoking. This is in line with some previous researches (10,12,13).

We found that  $FEV_{1\%predicted}$  and  $FEV_1/FVC$  were reduced in COPD patients and the correlation of smoking with airflow limitation is in concordance with previous researches.

Airflow obstruction as measured by  $FEV_1$  in symptomatic patients is a diagnostic tool but it is not suitable for monitoring disease progression. However, the  $FEV_1$  does not adequately reflect all the systemic manifestations of COPD patients. It is an important assay for staging of COPD (4,5).

CAT is not a diagnostic tool but it can identify the health impairment of COPD patients and is better correlated with disease progression.

The multiple consequences of COPD have no relationship with airflow limitation and  $FEV_1$  cannot reflect the total impairment caused by the disease. Some patients experience improvement in health status without change in their  $FEV_1$  after optimal treatment for COPD (5).

Several studies have shown weak correlation between  $FEV_1$  and health status questionnaire. Other researchers showed that the health status was only weakly correlated with the decline in  $FEV_1$ .

Our findings confirm that airflow limitation increased with disease severity is better accompanied by increasing CAT scores.

We observed that health status decline evaluated by CAT is correlated with the decline of airflow obstruction and patients with more severe COPD (as defined by  $FEV_1$ ) had higher CAT scores (10).

One of the most important findings of the current study is the inverse correlation between  $FEV_1$  and CAT groups. These results suggest that a lower  $FEV_1$  indicates high CAT score and health impairment due to COPD (Figure 1).

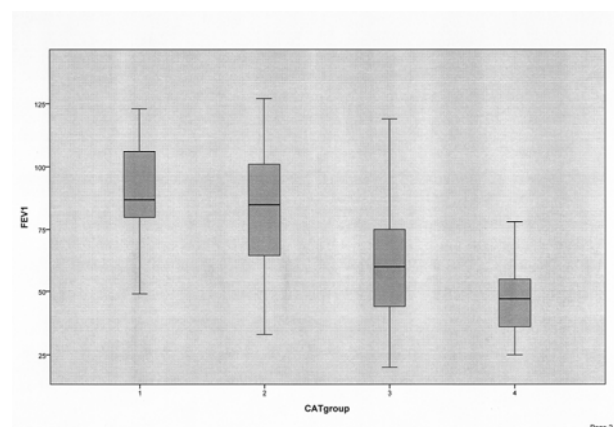


Figure 1. Correlation between  $FEV_1$  and CAT groups.

Results for CAT score and GOLD classification revealed a strong positive correlation between the tests (Figure 2).

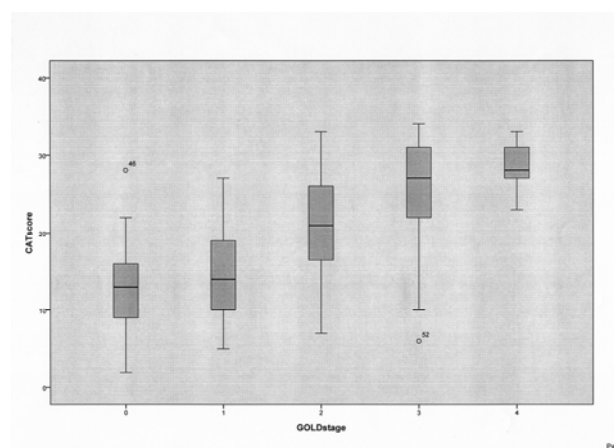


Figure 2. Correlation between CAT score and Gold classification.

The present study suggests that COPD severity assessed by the CAT score can be directly related to airflow limitation. On the other hand, the CAT questionnaire can be employed as a predictor of severity of airway obstruction in COPD patients.

It was also observed that the period of smoking(P/Y) is inversely correlated with FEV<sub>1</sub> as the most important risk factor for COPD.

Our study had some limitations. The first limitation was the lack of serum level of inflammatory markers and other physiologic parameters such as Modified Medical Research Council (MMRC) and 6-minute walking distance(6MWT) to evaluate the correlation of these parameters with CAT score and airflow obstruction. Secondly, our sample size was relatively small.

In conclusion, this study supported the hypothesis that there is a correlation between airflow limitation and health status questionnaires like CAT. FEV<sub>1</sub> is essential for diagnosis of the respiratory impairment resulting from COPD but, the CAT is not a diagnostic tool in COPD patients. However, in previously diagnosed COPD patients the CAT is a better assay for evaluating the severity of disease, management of patient response to treatment and prognosis. Finally, it is likely that airflow limitation and systemic alteration in COPD both happen in one inflammatory environment.

**Conflict of Interest:** the authors report no conflict of interests in this work.

## Acknowledgment

This study was supported financially by the Ardabil University of Medical Sciences , Ardabil, Iran

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