

# Correlation of forced expiratory volume in one second and COPD Assessment Test Scores in chronic obstructive pulmonary disease patients

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## ABSTRACT

**Objective:** to investigate the correlation between forced expiratory volume in one second predicted (FEV1%predicted) and The COPD Assessment Test (CAT) in subjects with Chronic Obstructive Pulmonary Disease (COPD). **Design:** Sixty men (40-60 years old) with Chronic Obstructive Pulmonary Disease (COPD) were enrolled for this study. Seriousness of airflow obstruction was determined by standard spirometry. Then, the influence of COPD on health status was evaluated using CAT. We statistically compared the correlation between CAT score and FEV1%predicted. FEV1%predicted was measured by utilizing the spirometry, and CAT was performed. **Results:** There was a statistically significant negative relationship between CAT score results and FEV1%predicted ( $r = -0.39$ ,  $p = 0.002$ ). **Conclusions:** The relationship between CAT score and FEV1%predicted recommends that CAT is connected to severity of airflow limitation in stable COPD patients. The CAT can be utilized as a reliable scientific research instrument and can be utilized in clinical practice to study the disease state.

**Keywords:** forced expiratory volume in one second, COPD Assessment Test, chronic obstructive pulmonary disease.

## Introduction

Chronic Obstructive Pulmonary Disease (COPD) is a preventable and curable lung illness. Patients with COPD have difficulties for breath, which can result in shortness of breath and/or feeling exhausted. In the early stages of the disease, subjects with COPD may feel short of breath when they exercise. As the illness progresses, it can be difficult to breathe out (exhale) or even breathe in (inhale) [1]. COPD is a major cause of morbidity and mortality, with the expectation that its predominance will be increased in the coming years [2].

COPD patients frequently develop manifestations such as

dyspnea, cough, chest tightness, exercise intolerance, sleep and mental disorders and social activity restriction, but COPD management and treatment have been largely based on spirometric evaluation [3]. Between 1990 and 2010 the number of deaths from COPD has decreased somewhat from 3.1 million to 2.9 million [4].

Although the severity of airflow obstruction is evaluated by forced expiratory volume in one second (FEV1), this test does not reveal the multidimensional effect of systemic inflammation on health status [5, 6].

The COPD assessment test (CAT) [7] was developed as a short, simple instrument for evaluating the symptom burden of COPD in routine practice to help health status assessment and facilitate communication between patient and healthcare professionals. It comprises of eight items, each presented as a semantic 6-point differential scale, providing a score out of 40 showing the effect of the disease. It is finished by the patient and the result is quickly available without the need for any calculation, apart from summing the scores on individual items. Scores of 0-10, 11-20, 21-30 and 31-40 represent mild, moderate, severe or very severe clinical influence [8].

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The CAT and FEV1 are integral measurements for assessment and management of COPD [9]. The CAT is an instrument for the measurement of disease impact on health status, but FEV1 is basic to establish a diagnosis and to affirm the severity of airway obstruction in symptomatic COPD patients [6]. The CAT and FEV1 are both reliable methods for assessing the treatment reaction and progression of disease severity in COPD patients [9].

The aim of this study was to assess the correlation between FEV1%predicted and the CAT in Chronic Obstructive Pulmonary Disease (COPD) patients.

## Materials and Methods:

### Subjects and study design:

Sixty patients with spirometric evidence of chronic airflow limitation with COPD were included for this research. They were selected from chest diseases department, faculty of medicine, Cairo university, where the study was conducted. They were diagnosed by chest specialist. The practical work was done from March 2017 to November 2018. The aim and nature of the study were described for patients before conduction of the study. An informed written assent was attained from candidates. This study was approved by the institutional review board of the Faculty of Physical Therapy, Cairo University.

Patients were enrolled according to the following criteria: chronic obstructive lung disease history for at least 5 years, medically stable, overweight and class I obesity, their age (40 – 60 years old), both sexes

The patients fulfilled the criteria for COPD: the presence of a post bronchodilator FEV1 > 80% predicated with an FEV1/FVC < 0.70 [10].

All patients were clinically stable during the past four weeks. The exclusion criterion was having a disease other than COPD including bronchial asthma, tuberculosis, bronchiectasis, ischemic heart disease or malignancy.

## Methods:

### a) For evaluation

1. Measurement of forced expiratory volume in one second predicted (FEV1%predicted): Lung function was measured with a spirometer (536053-001 Ultima PFX system Medical Graphics Corporation, St Paul, Minnesota, USA 536053-001) in the sitting position in relaxed and natural environments.
2. The COPD Assessment Test (CAT): it is an eight-item questionnaire, administered by the patient [7]. By using the Arabic translated CAT in which patients were asked about both respiratory symptoms and complaints showing disease impact such as sleep disturbances, reduced energy levels and limitations of daily activities. The response format for each question ranges from zero meaning no effect on patient's living

to five meaning that the patient's life is greatly affected. CAT has a scoring scope of zero to 40. The CAT score was classified into four groups of low <10 [11], medium 10-20 [12], high 21-30 [13] and very high >30 [5] based on the impact level of disease on health status.

## Statistical Analysis:

Descriptive analyses were performed by determining mean and standard deviation (SD) for continuous variables (i.e., after normality testing verified a normal distribution) and frequency and percentages for discrete variables. The relationship between quantitative variables was assessed by the Pearson Product Moment Correlation Coefficient.  $P < 0.05$  was considered statistically significant.

## Results:

Overall, 60 male patients were included in this study. General characteristics of these patients are shown in Table 1 and 2.

**Table 1. Descriptive statistics for the age, weight, height and BMI of the study group.**

	$\bar{X} \pm SD$	Minimum	Maximum
Age (years)	51.6 ± 6.71	40	65
Weight (kg)	79.8 ± 7.44	60	96
Height (cm)	169.45 ± 7.83	154	186
BMI (kg/m <sup>2</sup> )	27.74 ± 2.03	22	33.5

**Table 2. Descriptive statistics of the Predicted FEV1 and CAT of the study group.**

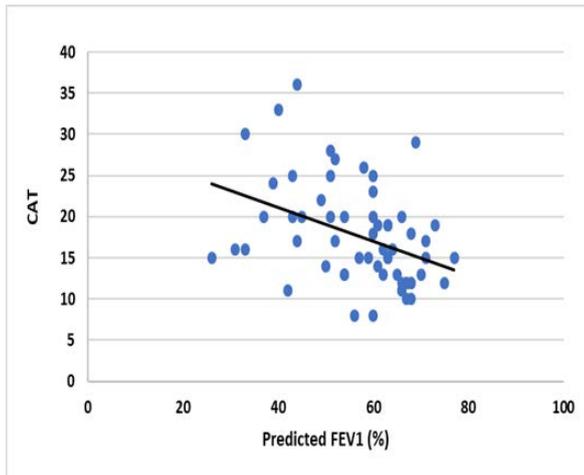
	$\bar{X} \pm SD$	Minimum	Maximum
Predicted FEV1 (%)	56.96 ± 11.91	26	77
CAT	17.65 ± 6.15	8	36

The mean age of patients and the mean FEV1%predicted were  $51.6 \pm 6.71$  and  $56.96 \pm 11.91$ , respectively. The mean was  $71.01 \pm 26.70$  and the mean CAT was  $17.65 \pm 6.15$ . The correlations between predicted FEV1 and CAT were moderately negative significant correlations ( $r = -0.39$ ,  $p = 0.002$ ) as shown in Table 3 and Fig. 1.

**Table 3. Correlation between FEV1 and CAT:**

	r value	p value	
Predicted FEV1 (%)	CAT	-0.39	0.002*

r value, Pearson correlation coefficient; p value, Probability value; Significant



**Figure 1:** The correlations between predicted FEV1 and CAT

## Discussion:

The aim of this research was to study the correlation between forced expiratory volume in FEV1%predicted and CAT in COPD patients. Results of this study showed that there were moderate negative significant correlations between predicted FEV1 and CAT. COPD is a developing cause of morbidity and mortality worldwide, and will be the third driving reason of death by 2020 [14]. COPD is a systemic disease with airflow obstruction, systemic inflammation, multi-organ harm and impairment [11].

This study showed that CAT questionnaire which is a patient-completed tool for evaluating the impact of COPD on health status has a higher correlation with severity of airflow obstruction by FEV1 in stable COPD patients.

Airflow obstruction as determined by FEV1 in symptomatic patients is a diagnostic tool, but it is not proper for monitoring disease progression. However, the FEV1 does not properly show all the systemic manifestations of COPD patients. It is an essential test for staging of COPD [5, 6]. CAT is not a diagnostic tool but it can detect the health impairment of COPD patients and is better correlated with disease progression. The numerous outcomes of COPD have no relationship with airflow limitation and FEV1 cannot reflect the total impairment caused by the disease. A few patients experience enhancement in health status without change in their FEV1 after optimal treatment for COPD [6]. Our results confirm that airflow limitation enhanced with disease severity is better accompanied by increasing CAT scores. Jones et al. (2011) mentioned that health status decrease evaluated by CAT is associated with the reduction of airflow obstruction and patients with more severe COPD (as defined by FEV1) had higher CAT scores [9].

One of the most significant results of this research is the reversed correlation between FEV1 and CAT groups. These results suggest that a lower FEV1 reveals high CAT score and health impairment because of COPD.

In the present study, the obvious negative correlation between CAT scores and the FeV1%predicted among study subjects

proved CAT questionnaire as a sensitive, simple, and reliable tool for early recognition and evaluating health status in COPD patients. CAT score can likewise be used in long term clinical and therapeutic monitoring of COPD patients, especially in the clinical settings where spirometry is not readily available.

In agreement with the results of the current study, Singh et al. (2018) showed that there is an obvious negative correlation between CAT scores and the FeV1% predicted among study subjects [15].

Comparable findings were observed by Ghobadi et al. (2012) who performed a research in 105 subjects with stable COPD to show the impact of COPD on health status, and to evaluate the correlation between CAT score and PFT in COPD patients [16]. The mean CAT score was  $19.61 \pm 8.07$  SD. There was a significant correlation between the FEV1%predicted and total CAT score ( $r = -0.55$ ,  $P < 0.001$ ).

In concordance with the findings of the present investigation, Abd-Elaziz et al. (2017) reported that there was a statistically significant negative correlation between CAT score results and FEV1 [17]. These findings agreed with Jones et al. (2011) who stated that improvement in the CAT score recorded at exacerbation were significantly correlated with reduction in FEV1 at exacerbation ( $r = 0.20$ ,  $p = 0.032$ ) [7].

Our results also were in concordance with Donaldson et al. (2002) who hypothesized that patients with frequent exacerbations had a significantly faster decline in FEV1 and peak expiratory flow (PEF) than infrequent exacerbations [18]. In few studies FEV1 was poorly associated with quality of life, yet several studies have shown a weak correlation between health status score and FEV1 [9].

## Conclusions:

There is a correlation between airflow limitation and health status questionnaires like CAT. FEV1 is vital 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 assessing the severity of illness.

## Conflict of interest:

The authors declared that present study was performed in absence of any conflict of interest.

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