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Application of COPD Assessment Test (CAT) to Assess Health Status of COPD Patients– Findings from a Cross-Sectional Study

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Abstract

Objective: Chronic Obstructive Pulmonary Disease Assessment Test (CAT) is a very simple and reliable symptom-based tool to assess the health status of Chronic Obstructive Pulmonary Disease (COPD) patients. The current study was conducted to assess the utility of CAT in COPD patients during their routine checkups and its association with clinical parameters.

Material and Methods: This cross-sectional observational study was conducted in COPD patients visiting a private chest outpatient clinic. Where the patient-specific data related to spirometry and symptomatic assessment (using CAT and modified medical research council (mMRC) scale) was collected. For the statistical analysis, a student's t-test or ANOVA and Mann-Whitney U test or Kruskal Wallis test were used.

Results: A total of 66 patients were included in the study having a mean age of 60.64 ±13.44 years. The mean score CAT in study participants was 28.89 ± 7.66 whereas the mean mMRC score was 3.14 ± 0.68. Most patients were categorized into stage III (54.5%) and Stage IV (30.3%) according to the Global Initiative of Chronic Lung Disease (GOLD) guidelines. of The CAT score was significantly associated with the mMRC score ($p<0.001$) and GOLD severity stages ($p<0.001$).

Conclusion: The CAT score can be more suitable in the routine assessment of the health status of patients with COPD in developing countries like Pakistan, where spirometry facilities are not available or affordable by the majority of patients.

Keywords: Chronic Obstructive Pulmonary Disease, Symptomatic assessment, COPD assessment test, Outpatients

Introduction

Chronic obstructive pulmonary disease (COPD) is responsible for a significant economic burden to the patients and society (ur Rehman, Ahmad Hassali et al. 2020, ur Rehman, Hassali et al. 2020, Ur Rehman, Hassali et al. 2021). It is the third leading cause of death worldwide after cardiovascular and cerebrovascular diseases (Singh, Agusti et al. 2019). COPD is one of the major public health challenges, causing chronic morbidity and mortality all over the world. According to the "World Burden of Disease Report", over 174.5 million people are affected by COPD in the world (Vos, Abajobir et al. 2017). With the persistent increase of COPD risk factors and the aging of the population, the global burden of COPD is projected to increase in the future (ur Rehman, Hassali et al. 2020, ur Rehman, Ahmad Hassali et al. 2020).

COPD is usually due to alveolar abnormalities caused by frequent exposure to gases and toxic particles that lead to persistent limitation in airflow and respiratory symptoms (Vestbo 2014). Chronic cough and dyspnea are the major symptoms of COPD, while the airway obstruction caused by COPD is

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approximately irreversible (Viegi, Pistelli et al. 2007, Vestbo 2014).COPD exacerbation is acute worsening of respiratory symptoms of COPD patients which could be sudden or gradual in pattern (ur Rehman, Hassali et al. 2019, Gershon, Warner et al. 2011). Patients usually develop COPD and exacerbations due to continuous exposure to major risk factors like tobacco smoke, and air pollution, and biomass fuel (ur Rehman, Hassali et al. 2019, Aaron, Donaldson et al. 2012).

The Lung function test (spirometry) is usually performed to diagnose but does not explain the heterogeneous features of COPD (Rehman, Hassali et al. 2020, Papaioannou, Loukides et al. 2009, Agusti, Calverley et al. 2010). Therefore, the Global Initiative of Chronic obstructive Lung Disease (GOLD) proposed guidelines to identify and classify the severity of the disease based on a combined system of spirometry, exacerbation risk, and symptoms assessment (Singh, Agusti et al. 2019, Mirza, Clay et al. 2018). These guidelines adopted a modified Medical Research Council (mMRC) questionnaire and COPD assessment test (CAT) as the best fitting tool for the symptomatic assessment of the patients with COPD (Singh, Agusti et al. 2019, Mittal and Chhabra 2017).

The key risk factors for the development and worsening of COPD (air pollution and cigarette smoking) are increasing in Pakistan with every passing day and it is becoming a challenge for the health agencies to cope with the burden of this disease (Saqib, Rafique et al. 2018). Since it is known that the CAT is the most reliable and simple tool to assess the severity of COPD in comparison to its counterparts in routine clinical practices. Therefore, the current study was conducted to assess the symptom-based severity of COPD patients by using the CAT. Additionally, the relationship of CAT with the GOLD severity grading system was also assessed.

Methodology:

Study design and population

This cross-sectional observational study was conducted in COPD patients visiting a private chest outpatient clinic from October 2019 to December 2019. During this period a total of 326 patients were approached by trained interviewers to participate in the study from which only 153 patients agreed to participate in the study. While patients with age greater than 30 years and previously diagnosed COPD were only included in the study. The patients who were unable to perform spirometry or to answer CAT were excluded from the study. The flow chart of the study participants can be seen in Figure 1.

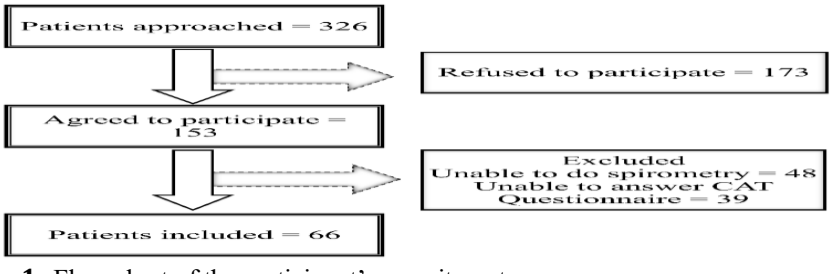

Figure 1: Flow chart of the participant's recruitment

Data Collection

The trained interviewers assessed all participants through face-to-face interviews and collected data related to the participant's age, gender, body mass index (BMI), marital status, smoking history, influenza vaccination, and lung function test after spirometry. American thoracic society guidelines were followed as a reference for spirometry (Society 1991). While the mMRC and CAT were used to assess the symptomatic health status of COPD patients. The mMRC scale was used to quantify the dyspnea with scores ranging from 0-4. CAT was used to assess the health status of the patient, which includes questions about cough, chest tightness, limited at home, phlegm, shortness of breath, confidence leaving home, energy, and sleep to be rated on a scale from 0-5. A higher CAT score indicated the severity of symptoms. The CAT score is used to categorize COPD patients into low (CAT score 0-10), medium (CAT score 11-20), high (CAT score 21-30), and very high (CAT score 31-40) severity groups (Jones, Harding et al. 2009).

Statistical analysis

All continuous variables were presented as the mean ± standard deviation (SD) while categorical variables were summarized as frequency and percentage. To compare categorical variables Chi-square or fisher test was used as per need. While to compare continuous variables student's t-test or ANOVA was used for parametric and Mann-Whitney U test or Kruskal Wallis test was used for non-parametric variables. All tests were two-tailed and a p-value of <0.05 was considered statistically significant. All the statistical analyses were performed by using Statistical Package for Social Sciences 22.0 0 (IBM Corporation, Armonk, NY, USA).

Results

Table1: Characteristics of Chronic Obstructive Pulmonary Disease Patients

Characteristics	**N (%) or Mean (±SD)**
Age	60.64 (±13.44)
≤50 years	13 (19.7%)
>50 years	53 (80.3%)
Gender	
Male	63 (95.5%)
Female	03 (04.5%)
Body Mass Index	24.87 (±6.84)
≤ 25 kg/m^2	41 (62.1%)
>25 kg/m^2	25 (37.9%)
Comorbidity	
Yes	47 (71.2%)
No	19 (28.8%)
Influenza Vaccination	
Yes	22 (33.3%)
No	44 (66.7%)
Smoking History (Packs/year)	19.15 (± 5.39)
≤ 20 packs/year	18 (27.3%)
>20 packs/year	48 (72.7%)

Data were collected from 66 patients with previously diagnosed COPD, while the majority of patients (i.e., female) refused to participate in the study. The mean age of patients was 60.64 ±13.44 years with the majority of patients being male (95.5%). The majority of patients (71.2%) had comorbidity with COPD and were smokers with a mean smoking history of 19.15 ±5.39 packs/years. Most of the patients (66.7%) were not vaccinated against influenza. The characteristics of the patients are shown in Table 1.

The spirometry analysis of patients showed that mean FEV1, FVC, and FEV1/FVC were 1.06 ± 0.60 L, 1.63 ± 0.98 L, and 0.67 ± 0.11 respectively. The mean score CAT was 28.89 ± 7.66 whereas the mean mMRC score was 3.14 ± 0.68. The participants were categorized into severity grades according to GOLD guidelines into stage 1 (4.5%), stage II (10.6%), stage III (54.5%), and stage IV (30.3%). **Table 2:** The clinical assessment of COPD patients

Variables	**N (%) or Mean (±SD)**
FEV1 (L)	01.06 (± 0.60)
FVC (L)	01.63 (± 0.98)
FEV1/FVC	00.67 (± 0.11)
mMRC Score	03.14 (± 0.68)
2 mMRC score	11 (16.7%)
3 mMRC score	35 (53.0%)
4 mMRC score	20 (30.3%)
CAT Score	28.89 (± 7.66)
01-10 CAT score	01 (01.5%)
11-20 CAT score	09 (13.8%)
21-30 CAT score	27 (41.5%)
31-40 CAT score	28 (43.1%)
GOLD Stages	
GOLD Stage 1	03 (04.5%)
GOLD Stage 2	07 (10.6%)
GOLD Stage 3	36 (54.5%)
GOLD Stage 4	20 (30.3%)

CAT; COPD Assessment Test, mMRC; modified Medical Research Council, GOLD; Global Initiative of Chronic Lung Disease

The mean CAT score of the participants was 28.89 ± 7.66, among which 1.5%, 13.8%, 41.5%, and 43.1% of the participants fell in mild, moderate, severe, and very severe COPD health status. The continuous CAT score was used to explore the association with different patient characteristics that are presented in Table 2. The CAT score was significantly associated with BMI ($p = 0.02$). The patients with BMI $\leq$ 25 kg/m^2 had worse symptoms (CAT score 30.29±7.76) as compared to patients with BMI >25 kg/m^2 (CAT score 26.60 ±7.04). The CAT score was higher in patients with age greater than 50 years (29.45 ±7.25) in comparison to patients with age ≤50 years (26.61±9.09).

The mmRC score was significantly associated with the CAT score ($P < 0.001$). The patients with a higher mMRC score also had higher CAT score [patients with 2 mMRC score = CAT score 17.63±7.00, 3 mMRC = CAT score 28.80±5.03 and 4 mMRC = CAT score 35.25±3.68]. The CAT score was

significantly associated with the GOLD stages (P <0.001), which showed that the patients with higher GOLD stages were having severe symptoms.

Table 3: Association between patient's characteristics and COPD assessment test score

Patients characteristics		CAT Score (± SD)	P-value
Age	≤50 years	26.61 (±9.09)	0.234
	>50 years	29.45 (±7.25)	
Gender	Male	28.71 (±7.75)	0.387
	Female	32.67 (±4.61)	
BMI	≤ 25 kg/m^2	30.29 (±7.76)	**0.021**
	>25 kg/m^2	26.60 (±7.04)	
Comorbidity	Yes	27.85 (±7.86)	0.082
	No	31.47 (±6.61)	
Influenza Vaccination	Yes	28.31 (±7.43)	0.669
	No	29.18 (±7.83)	
Smoking History (Packs/year)	≤ 20 packs/year	26.72 (±8.36)	0.160
	>20 packs/year	29.70 (±7.30)	
mMRC Score	2 mMRC score	17.63 (±7.00)	**<0.001**
	3 mMRC score	28.80 (±5.03)	
	4 mMRC score	35.25 (±3.68)	
GOLD Stages	GOLD Stage 1	09.33 (±4.62)	**< 0.001**
	GOLD Stage 2	20.14 (±4.88)	
	GOLD Stage 3	28.69 (±5.00)	
	GOLD Stage 4	35.25 (±3.68)	

Bold fonts indicate the statistically significant value (P<0.05); CAT; COPD Assessment Test, BMI; Body Mass Index, mMRC; modified Medical research Council, GOLD; Global Initiative of Chronic Lung Disease

Discussion

To the best of our knowledge, this is the first study that has evaluated the correlation between CAT score and a wide variety of COPD parameters such as GOLD stage, body mass index, spirometry, and mMRC dyspnea scale score in the COPD population of Pakistan. Even though the CAT consists of a small number of questions, the CAT correlated with a wide variety of impairments because of COPD. This questionnaire may be useful in settings where physical and laboratory tests are not readily available because of facility or time limitations especially in developing countries like Pakistan where the health system is not well established.

The CAT score was significantly associated with the mMRC dyspnea scale score (P<0.001). The results of our study are consistent with studies similarly done to assess the determinants of CAT score in routine clinical practices for outpatients of COPD; where CAT score was significantly associated with the mMRC dyspnea scale score (p<0.001) (Kelly, Bamsey et al. 2012, Horita, Yomota et al. 2014). The CAT and mMRC dyspnea scale both are included in GOLD guidelines to classify the patients based on the symptoms. But the CAT is a more recommended tool to assess the symptomatic severity of COPD

patients as compared to the mMRC dyspnea scale (Karloh, Mayer et al. 2016). Because CAT provides a more detailed assessment of symptoms as compared to mMRC dyspnea scale.

The GOLD stages of severity showed a statistically significant association with the CAT score ($P<0.001$). These findings of the current study are consistent with different studies assessing the relationship between CAT and airflow obstruction in COPD patients using spirometry ($p<0.001$) (Horita, Yomota et al. 2014, Rehman, Hassali et al. 2020). The CAT score questionnaire is a more reliable and easy-to-use tool for the assessment of the severity of symptoms as compared to other tools for assessing the impact level of symptoms in COPD patients to monitor their health status (Ringbaek, Martinez et al. 2012). The current study and data from the previous studies support the use of CAT score for the routine health status assessment of COPD patients to monitor the efficacy of therapy and prevention of future worsening of health.

The different demographic parameters of patients (age, gender, smoking history, and comorbidities) showed no significant association with the CAT score. A systematic review about the psychometric properties of the CAT questionnaire also revealed similar findings that CAT has a significant relationship with different clinical outcomes, but not with other parameters like age, gender, smoking, and comorbidities (Gupta, Pinto et al. 2014).

All of the study participants were smokers whereas the majority of participants had a smoking history of more than 20 packs per year. Cigarette smoking is one of the leading causes of COPD onset and acute exacerbations, which is needed to be neutralized (ur Rehman, Hassali et al. 2019). Whereas the average national prevalence of smokers in Pakistan was 21.6% (Shah and Siddiqui 2015). Proper management of COPD patients and efforts to prevent the disease through smoking cessation programs could lead to a reduction in the burden of this disease (ur Rehman, Hassali et al. 2019).

There are some limitations in our study. The first limitation was the lack of other physiologic parameters like 6-minute walking distance and serum level of inflammatory markers to find a correlation of these parameters with the CAT score. Secondly, our study was single-centered with a relatively small sample size because the majority of participants refused to participate in the study.

Conclusion

The health status of COPD patients is associated with exacerbation rate and breathlessness, which can easily be assessed by using CAT. The CAT score can be more suitable in the routine assessment of the health status of patients with COPD in developing countries like Pakistan, where spirometry facilities are not available or affordable by the majority of patients.

Availability of supporting data:

Data is available on request from corresponding author.

Competing interests:

The authors declare that they have no conflict of interest.

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