

Psychometric Analysis of Clinical Chronic Obstructive Pulmonary Disease Questionnaire and Chronic Obstructive Pulmonary Disease Assessment Test and Its Correlation with St. George Respiratory Questionnaire in Chronic Obstructive Pulmonary Disease Patients

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ABSTRACT

Introduction: Chronic obstructive pulmonary disease (COPD) is a disease of respiratory airflow obstruction. There are >80 tools to measure various aspects of COPD patients' well-being. This study aimed to evaluate the reliability and consistency of CAT and clinical COPD questionnaire (CCQ) and their correlation with St. George respiratory questionnaire (SGRQ). **Methods:** A prospective observational comparative study was conducted for 6 months in the pulmonology department of a tertiary care hospital. The following questionnaires were employed to evaluate the state of health of COPD patients: modified Medical Research Council (mMRC), COPD assessment test (CAT), CCQ, and SGRQ. Consistency and inter-rater reliability of CAT and CCQ scales was performed by taking into account the scores of four assessors. **Results:** Of the 52 patients included, 96% were male, and 4% were female. Cronbach's alpha was 0.620 (CAT score) and 0.861 (CCQ score). The percentage of patients with an mMRC scale of grade 0, 1, 2, 3, and 4 was 4%, 23%, 38%, 8%, and 27%, respectively. SGRQ showed a moderate correlation with CCQ (0.621) and CAT (0.652) scores. **Conclusion:** The psychometric properties of CAT and CCQ were consistent and satisfactory. Reliability and internal consistency of CAT and CCQ were good and can be employed easily for examining the health state of COPD patients.

Keywords: Chronic obstructive pulmonary disease, clinical chronic obstructive pulmonary disease questionnaire, chronic obstructive pulmonary disease assessment test, Health status, St. George respiratory questionnaire

INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is a common and most prevalent heterogeneous respiratory disease characterized by irreversible airway limitation. It is the most critical reason for morbidity and mortality that is considered the third-leading cause of death worldwide.^[1] COPD is defined in terms of chronic bronchitis and emphysema.^[2] The Global Initiative for Chronic Obstructive Lung Disease (GOLD) guideline describes COPD as a disorder distinguished by a respiratory obstruction that is not completely reversible. It is generally both increasing and characterized by bizarre

inflammatory reactions of the lungs to foreign particles and gases.^[3] A more significant percentage of COPD patients belongs to the middle-aged or geriatric population. COPD

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firmly impairs the quality of life (QOL) and patients' state of health.^[4] General symptoms developed by COPD patients include dyspnea, cough, and phlegm generation. The infrequent and annoying symptoms are wheezing, chest rigidity, and respiratory congestion. However, it varies depending on the severity of the disease.^[5]

COPD management needs a proper examination of lung function and course of symptoms to treat the condition. Along with this, it requires an individualized approach for proper management.^[6] COPD diagnosis often relies on patient history, smoking habits, symptoms, and spirometry. Evidence suggests that COPD patients with the same intensity of respiratory obstruction described similar QOL scores.^[7] Hence, personalized COPD management is necessary to achieve a successful clinical outcome. Concerning the GOLD guideline, patient-reported symptom evaluation questionnaires were incorporated in the algorithm of COPD for patient grading and management. Despite the availability of many questionnaires for measuring health-related QOL (HRQoL) in COPD patients, the St. George respiratory questionnaire (SGRQ) remains the extensively employed tool in routine hospital practice owing to its sensitivity toward changes in patient parameters.^[8,9] However due to its laborious calculations, clinical COPD questionnaire (CCQ) and COPD assessment test (CAT) are sometimes preferred over SGRQ.^[3]

The CAT was developed in 2009 based on COPD statistics accumulated from six countries.^[10] The CCQ was formulated in 2003 on meetings and group dialogs with COPD patients in two countries.^[11] CCQ and CAT can be completed in approximately 2 min and do not require trained staff for their administration.^[12] SGRQ is the most employed questionnaire in clinical trials for the past 20 years. However, it has limited value in everyday clinical practice owing to its length, time needed to be completed, difficulty to administer, and complex score calculation process.^[13]

Although these health evaluation questionnaires display the similar basic content, there exists variability in the quantity and quality of the questions conveyed. Thus, this study aimed at assessing the interrater reliability and consistency of CAT and CCQ scores. We also evaluated the correlation of CAT and CCQ with SGRQ in COPD patients.

METHODS

Study design

A hospital-based prospective observational comparative study was conducted in the Department of Pulmonology of a tertiary care hospital in Hyderabad over 6 months. This study took place from November 2020 to April 2021. Participants enrolled included inpatients and outpatients with established COPD diagnosis. People with the following criteria were allowed to participate in this study: (a) 45 years of age and older; (b) Smoker and nonsmokers; (c) All stages COPD patients. Patients with the following criteria were excluded: (a) Patients with collateral asthma; (b) Any respiratory disease other than

patients with COPD; (c) patients with unstable cardiovascular and cognitive impairments. This study was approved by the Institutional Review Board (IRB) of Deccan College of Medical Sciences with IRB project No. 2021/32/001.

Data collection

Demographic details and medical history of patients were collected from patients' medical records. Data collected were age, gender, smoking status, education details, oxygen saturation level, past medical and medication history, and incidence of pneumonia. The modified Medical Research Council (mMRC) Dyspnea Scale was utilized for assessing the severity of dyspnea in COPD patients. The mMRC is a one-dimensional tool that measures dyspnea at five levels.^[14] Administration of CCQ, CAT, and SGRQ questionnaires was done by raters who were insightful of the questionnaires and in the presence of experienced pulmonologists. All the patients received instructions and explanations regarding the questionnaires before recording the questionnaires' responses.

Questionnaires

The following questionnaires were employed to evaluate the health state of COPD patients: CAT, CCQ, and SGRQ. The CAT estimates the influence of COPD on a person's life. It contains eight items and raises questions regarding disease manifestations, vitality, sleep, and daily activities.^[10] The CCQ measures the patients' disease state and HRQoL. It consists of 10 items, split into three fields: symptoms, functional, and mental state.^[11] Scores of the following components; symptoms, activity, and impact were calculated using the SGRQ-C questionnaire.^[15]

Statistical analysis

The data analysis was performed using the Statistical Package for Social Science (SPSS) Version 18. (IBM, Chicago, IL, USA). Data were expressed as numbers and percentages unless otherwise stated. CCQ and CAT internal consistency was assessed by estimating Cronbach's alpha coefficient. Test-retest reliability was evaluated by estimating the intraclass correlation coefficient (ICC). Convergent validity was evaluated by Spearman's rank correlations.

RESULTS

Baseline characteristics

Of the 52 patients included in the study, 96% were male, and 4% were female. About 38% of patients were in the age group of 61–70 years and 31% of patients in the 51–60 years age group. Table 1 represents study population baseline characteristics.

Internal consistency and reliability of chronic obstructive pulmonary disease assessment test and clinical chronic obstructive pulmonary disease questionnaire questionnaires

The reliability and consistency of CAT and CCQ questionnaires are shown in Tables 2-4.

Table 1: Baseline characteristics of the patients

Characteristic	n (%)
Total number of patients	52
Male	50 (96)
Female	2 (4)
Inpatients	32 (62)
Outpatients	20 (38)
Age (years)	
41-50	6 (11.5)
51-60	16 (30.7)
61-70	20 (38)
71 and above	10 (19)
Smoking status	
Smokers	26 (50)
Nonsmokers	8 (15)
Ex-smokers	18 (35)
Education status	
Educated	12 (23)
Noneducated	40 (76.9)
SpO ₂ (%)	
91-100	40 (77)
81-90	6 (11.5)
80 and below	6 (11.5)
Exacerbation history (number of exacerbations)	
0	10 (19)
1	23 (44)
2	10 (19)
3	9 (18)
mMRC dyspnea score	
0 grade	2 (4)
1 grade	12 (23)
2 grade	20 (38)
3 grade	4 (8)
4 grade	14 (27)
COPD medications	
Corticosteroids	27
PDE4 inhibitors	6
Inhaled beta-2 agonist	8
Inhaled anticholinergics	13
Antibiotics	20
Oxygen therapy	2

mMRC: Modified Medical Research Council, COPD: Chronic obstructive pulmonary disease

Cronbach’s alpha was 0.620 (CAT score) and was 0.861(CCQ score), indicating acceptable internal consistency of both the questionnaires. ICC of both CAT and CCQ was 0.999 demonstrating appreciative reliability of CAT and CCQ questionnaires [Table 4].

The score distribution of all three questionnaires is shown in Table 5.

Figures 1-3 represent the impact of smoking status and exacerbation on CCQ, CAT, and SGRQ scores, respectively.

Convergent validity

CAT, CCQ, and SGRQ demonstrated robust correlations. Correlations are shown in Table 6.

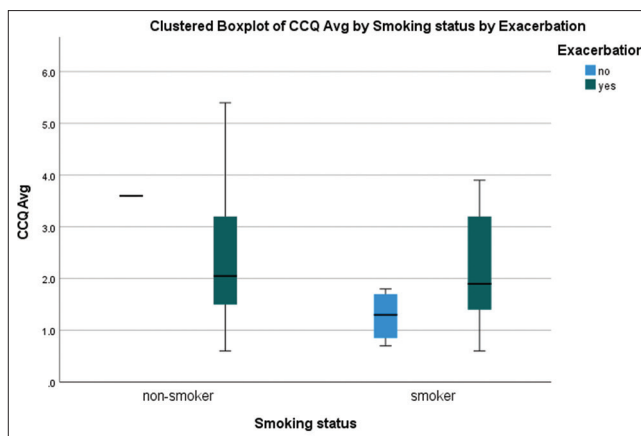


Figure 1: Boxplot of clinical chronic obstructive pulmonary disease questionnaire

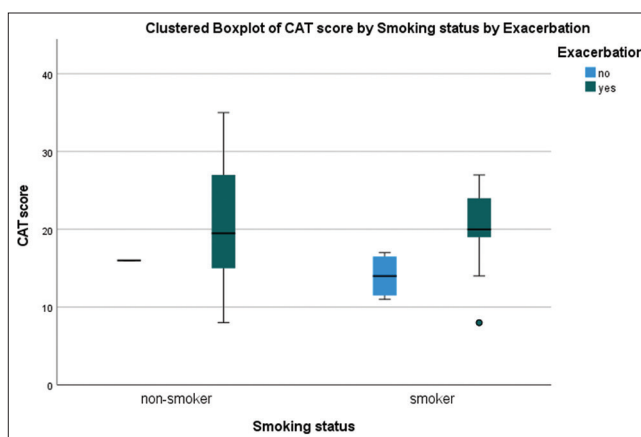


Figure 2: Boxplot of chronic obstructive pulmonary disease assessment test

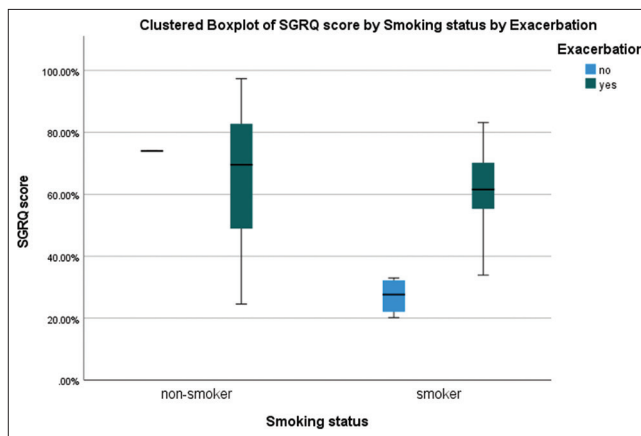


Figure 3: Boxplot of St. George respiratory questionnaire

DISCUSSION

The supreme goal of COPD management is to minimize the patients’ social and personal affliction of disease through improving their symptoms, QoL, and functional status. This can be attained by measuring the health status of patients through questionnaires that summarize the effects of the disease in one

Table 2: Chronic Obstructive Pulmonary Disease Assessment Test Scale consistency statistics

CAT Scale consistency statistics					
Question	Scale mean if item deleted	Scale variance if item deleted	Corrected item-total correlation	Squared multiple correlation	Cronbach's alpha if item deleted
Q1	17.27	43.730	0.107	0.469	0.642
Q2	17.04	37.449	0.349	0.414	0.578
Q3	17.85	37.780	0.417	0.448	0.560
Q4	15.65	39.682	0.497	0.462	0.556
Q5	16.38	34.124	0.497	0.750	0.528
Q6	17.27	38.554	0.287	0.638	0.598
Q7	17.35	45.250	0.003	0.422	0.676
Q8	16.62	36.398	0.505	0.504	0.535

CAT: Chronic obstructive pulmonary disease assessment test

Table 3: Clinical Chronic Obstructive Pulmonary Disease Questionnaire Scale consistency statistics

CCQ Scale consistency statistics					
Question	Scale mean if item deleted	Scale variance if item deleted	Corrected item-total correlation	Squared multiple correlation	Cronbach's alpha if item deleted
Q1	19.73	118.240	0.691	0.694	0.837
Q2	18.69	119.825	0.773	0.712	0.832
Q3	20.65	118.505	0.646	0.951	0.841
Q4	20.77	118.612	0.649	0.952	0.841
Q5	19.96	147.018	0.027	0.591	0.887
Q6	19.77	133.906	0.315	0.505	0.869
Q7	18.92	123.053	0.686	0.761	0.840
Q8	19.31	127.119	0.589	0.853	0.847
Q9	20.00	114.039	0.703	0.680	0.836
Q10	20.19	121.492	0.685	0.676	0.839

CCQ: Clinical chronic obstructive pulmonary disease questionnaire

Table 4: Chronic obstructive pulmonary disease assessment test and clinical chronic obstructive pulmonary disease questionnaire reliability statistics

Mean	Variance	SD	Number of items	Cronbach's alpha	Intra-class correlation coefficient (95% CI)
CAT Scale reliability Statistics					
19.35	48.466	6.962	8	0.620	0.997 (0.995-0.998) ^a
CCQ Scale reliability statistics					
22.00	150.980	12.287	10	0.861	0.999 (0.999-0.999) ^a

^aP< 0.000. CAT: Chronic obstructive pulmonary disease assessment test, CCQ: Clinical chronic obstructive pulmonary disease questionnaire, SD: Standard deviation, CI: Confidence interval

overall score.^[16] CAT, CCQ, and SGRQ were the most common and standard questionnaires employed in this study to evaluate the disease state of COPD patients. The compliance of the chest wall decreased progressively with increasing age resulting in increased residual volume and decreased vital capacity. According to the National Heart, Lung, and Blood Institute, COPD often occurs in people more than 40 years of age who smoke or smoked earlier in life. In this study, most patients belong to 51–70 years of age, which is consistent with the report of MacNee.^[17,18]

Ninety-six percent of patients in this study were male. COPD is recognized as a disease of older men, yet the prevalence of COPD is increasing in women, but the evidence is scanty.^[19]

Smoking is the single important predisposing factor for the development of COPD despite individual vulnerability to the impact of cigarette smoke. There is evidence suggesting that smoking cessation reduces the rate of progression of COPD.^[20] Among the study population, 50% of smokers and 35% of ex-smokers exist in this study. The mMRC scale is generally recommended for COPD patients to assess their dyspnea, disability, and functions as an indicator of exacerbation.^[21] In our study, patient distribution with an mMRC scale of grade 0, 1, 2, 3, and 4 were 4%, 23%, 38%, 8%, and 27%, respectively.

The CCQ and CAT were formulated to evaluate the health status of COPD patients. Both the questionnaires are simple, short, and

Table 5: Score distributions of clinical chronic obstructive pulmonary disease questionnaire, St. George respiratory questionnaire, and chronic obstructive pulmonary disease assessment test scores in chronic obstructive pulmonary disease patients

Scale	Mean score	Median score	Floor ¹ effects, % n (worst health outcome)	“Ceiling” scores, % n (best health outcome)
CCQ				
Symptom	2.46	2.25	4 (5.5)	6 (0)
Functional state	2.39	2.25	4 (6)	8 (0)
Mental state	1.29	0	8 (6)	62 (0)
Total	2.2	1.85	4 (5.4)	8 (0.6)
SGRQ				
Symptom	53	48	4 (100)	4 (19.8)
Activity	71	80	12 (100)	12 (30.2)
Impact	53	53	4 (100)	4 (6)
Total	59	62	4 (97.4)	4 (20.20)
CAT				
Total	19.35	18	4 (35)	8 (8)

The CCQ assigns “0” best health outcome and “6” worst health outcome. The CAT assigns “0” best health outcome and “40” worst health outcome. The SGRQ rates “0” as the best health outcome and “100” as the worst health outcome. SRGQ: St. George respiratory questionnaire, CAT: Chronic obstructive pulmonary disease assessment test, CCQ: Clinical chronic obstructive pulmonary disease questionnaire

Table 6: Correlations among health status questionnaires (chronic obstructive pulmonary disease assessment test, clinical chronic obstructive pulmonary disease questionnaire, St. George respiratory questionnaire) and modified Medical Research Council dyspnea score

	CCQ total	CCQ symptoms	CCQ mental state	CCQ functional state	CAT	SGRQ total	SGRQ symptom	SGRQ activity	SGRQ impact	mMRC dyspnoea score
CCQ total	1.000	0.789**	0.670**	0.862**	0.651**	0.621**	0.516**	0.566**	0.543**	0.469**
CCQ symptoms	0.789**	1.000	0.300*	0.592**	0.712**	0.411**	0.681**	0.238 [#]	0.347*	0.319*
CCQ mental state	0.670**	0.300*	1.000	0.454**	0.288*	0.501**	0.244 [#]	0.449**	0.453**	0.405**
CCQ functional state	0.862**	0.592**	0.454**	1.000	0.653**	0.677**	0.447**	0.708**	0.584**	0.493**
CAT	0.651**	0.712**	0.288*	0.653**	1.000	0.652**	0.747**	0.476**	0.541**	0.400**
SGRQ total	0.621**	0.411**	0.501**	0.677**	0.652**	1.000	0.722**	0.755**	0.954**	0.488**
SGRQ symptom	0.516**	0.681**	0.244 [#]	0.447**	0.747**	0.722**	1.000	0.486**	0.655**	0.501**
SGRQ activity	0.566**	0.238 [#]	0.449**	0.708**	0.476**	0.755**	0.486**	1.000	0.600**	0.577**
SGRQ impact	0.543**	0.347*	0.453**	0.584**	0.541**	0.954**	0.655**	0.600**	1.000	0.407**

[#]Not significant value, * $P < 0.05$, ** $P < 0.01$. SRGQ: St. George respiratory questionnaire, CAT: Chronic obstructive pulmonary disease assessment test, CCQ: Clinical chronic obstructive pulmonary disease questionnaire, mMRC: Modified medical research council

easy to understand compared to the SGRQ. Although, SGRQ is a widely used questionnaire in various research settings. Certain studies reveal that SGRQ provides information mainly on patients’ symptoms and impairment rather than comprehensive information of health status.^[22] This study revealed that both CAT and CCQ evinced similar score distribution and internal consistency was excellent and nearly identical. Both the questionnaires were reliable and simple to administer; hence, these can be used to evaluate the health status of COPD patients in everyday clinical practice. The Cronbach’s alpha for CAT and CCQ were 0.620 and 0.861, respectively, indicating good internal consistency of both the questionnaires. However, the acceptability of CCQ was more as it better reflected their health status than the CAT. The intra-class correlation coefficient of both CAT and CCQ were 0.995 and 0.999, which shows both the questionnaires were reliable. Similar results have been replicated by another study.^[22]

In our study, all three questionnaires (CAT, CCQ, and SGRQ) were displayed as total mean scores and as domain mean scores. The higher values indicate the lower health status. The total mean score of CAT, CCQ, and SGRQ noticed in this study was 19.35, 2.2, and 59. A correlation is indicative of convergent validity. SGRQ and CCQ total scores showed moderate correlation (0.621), whereas SGRQ and CAT total scores also showed moderate correlation (0.652) that is slightly higher than CCQ. It is lesser than the report of Jones *et al.* that owing to variations in the study population in terms of disease severity and gender.^[10] The total score of CAT and CCQ also have a moderate correlation. The total score of mMRC showed a weak correlation with the CAT, CCQ, and SGRQ total scores which were 0.4, 0.469, and 0.488, respectively. Nevertheless, further studies in different clinical settings are required to confirm our study findings.

CONCLUSION

CAT and CCQ are simple, valid, and reliable tools to collect data and can be used in situations when time is limited to examine the disease state of COPD patients. The psychometric properties of CAT and CCQ were consistent and satisfactory. The validity and reliability of CAT and CCQ were almost identical.

Limitations in this study

Our study has some limitations. The study duration was short, and the sample size was small. Furthermore, this study was carried out at a single center. Hence, future multi-centric studies with larger sample sizes are necessary to evaluate the similarity of questionnaires.

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Conflicts of interest

There are no conflicts of interest.

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