Original Article

Correlation of chronic obstructive pulmonary disease assessment test and clinical chronic obstructive pulmonary disease questionnaire score with BODE index in patients of stable chronic obstructive pulmonary disease

Shashank Singh, Mradul Kumar Daga, HS Hira, Lalit Kumar, Govind Mawari

Department of Medicine, Maulana Azad Medical College, New Delhi, India

ABSTRACT

Background: Chronic obstructive pulmonary disease (COPD) has a major impact on health status in accordance with disease severity. It is usually assessed by the various quality of life questionnaires. **Objectives:** The aim of this study is to assess the disease severity and health status in stable patients of COPD using COPD assessment test (CAT) and clinical COPD questionnaire (CCQ) scores and to correlate with BODE index and its components. **Methods:** One hundred patients of stable COPD were subjected to CAT, CCQ irrespective of the stage of COPD during their visit. BODE index was also calculated. **Results:** COPD severity status assessed using forced expiratory volume 1% (FeV1%) predicted values correlated significantly with individual scores (CAT and FeV1%; $r = -0.67$; $P < 0.001$ and CCQ and FeV1%; $r = 0.61$; $P < 0.001$). CAT and CCQ score also correlated significantly ($r = 0.84$, $P < 0.001$) and both with the BODE index ($r = 0.80$; CAT and $r = 0.66$; CCQ, $P < 0.01$). Individual components of BODE index significantly correlated with CAT and CCQ scores. **Conclusions:** The CAT and CCQ have similar psychometric as well physical properties to assess the health status of COPD patients and can be used as a reliable scientific research tool and can be used in clinical practise to study the disease state and plan an appropriate treatment plan. The BODE index which is more objective, correlated well.

KEY WORDS: 6-min walk distance, chronic obstructive pulmonary disease assessment test, clinical chronic obstructive pulmonary disease questionnaire, modified medical research council

Address for correspondence: Dr. Mradul Kumar Daga, Department of Medicine, Maulana Azad Medical College, 129, B. L. Taneja Block, New Delhi - 110 002, India. E-mail: drmraduldaga@gmail.com

INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is one of the leading causes of morbidity and mortality worldwide and results in economic and social burden that is substantial. It also affects the quality of life (QoL). It is currently the fourth leading cause of death in the world.[1,2] It has been projected that COPD burden will increase in coming decades because of continued exposure to risk factors and ageing of population.[3,4] According to the projections, COPD will be the seventh leading cause of disability-adjusted life-years lost worldwide in 2030.[5] However, COPD is not just a pulmonary disease; it is also associated with systemic manifestations and co-morbid conditions.[6] Several multidimensional grading systems

Access this article online

Quick Response Code:

Website: www.lungindia.com

DOI: 10.4103/lungindia.lungindia_93_18

How to cite this article: Singh S, Daga MK, Hira HS, Kumar L, Mawari G. Correlation of chronic obstructive pulmonary disease assessment test and clinical chronic obstructive pulmonary disease questionnaire score with BODE index in patients of stable chronic obstructive pulmonary disease. Lung India 2018;35:494-8.

have therefore emerged which should enable better prediction of future morbidity and mortality risk in COPD patients than Forced Expiratory Volume 1 (FEV1) alone. Recently, updated gold guidelines advocated the use of a combined assessment approach for understanding the impact of the disease on an individual based on annual number of exacerbations, gold stage, Medical Research Council stage as well health status assessment using various questionnaires such as COPD assessment test (CAT), the clinical COPD questionnaire (CCQ) and the BODE index, etc.[7-10] We, in this study, have used CAT and CCQ scores and correlated these with BODE index in stable COPD patients for assessment of their clinical status and disease severity.

METHODS

Study design

This was an observational cross-sectional study carried out in the Department of Medicine, Maulana Azad Medical College and Associated Lok Nayak Hospital, New Delhi, India. We considered 100 stable patients of COPD as our sample size considering 95% confidence level i.e., $Z = 1.96$ and calculating confidence interval which came out as 0.04. We considered the total prevalence of COPD in Indian population as 4%[11] for our study. In addition, we also considered seven more individuals to compensate for dropouts during study-related procedures; COPD was diagnosed on the basis of past history, physical examination and spirometric data, according to GOLD guidelines and patients were also categorized for disease severity using spirometric parameters. The study was conducted after being approved by the Ethical Committee of the Institute and obtaining informed consent from the patients.

Patient selection

One hundred stable patients of COPD, stable being those who were not in exacerbation at the time of enrollment i.e., not having any symptomatic day-to-day variation or need for change in medication who came to medicine OPD and aged 40 or above; were included in the study group over a period of 6 months. COPD was diagnosed (duration of preexisting disease was variable) using clinical parameters along with spirometric assessment as per gold guideline. Patients who were having exacerbation (minimal 3 months of exacerbation-free period was considered as an inclusion criteria), anemia or some preexisting nonrespiratory illnesses such as anemia, cardiac illness, chronic kidney disease, and chronic liver disease were excluded, along with previously diagnosed respiratory entities such as pneumonia, diffuse bronchiectasis, and interstitial lung disease.

Chronic obstructive pulmonary disease assessment test and chronic obstructive pulmonary disease questionnaire score

CAT and CCQ score are simple questionnaires, easy and quick to complete, consisting of 8 and 10 questions, respectively. Both the questionnaires were given to the patients in their own language. Patients were explained how to fill the questionnaire and assisted in its completion. Scoring was done at the time of presentation to hospital.

BODE index

The BODE index includes one domain that quantifies the degree of pulmonary impairment (FEV1), one that captures the patient's perception of symptoms (the modified Medical Research Council [MMRC] dyspnea scale), and two independent domains (the distance walked in 6 min and the body mass index [BMI]) expressing the systemic consequences of COPD. The BODE index[9] results in a score of zero to ten. Its use as a clinical tool has gained acceptance.

Statistical analysis

Descriptive analyses were conducted by calculating mean and standard deviation (SD) for continuous variables (i.e., after normality testing confirmed a normal distribution) and frequency and percentages for discrete variables. The correlation between quantitative variables was performed using the Pearson correlation coefficient. $P < 0.05$ was considered statistically significant.

RESULTS

All the patients were assisted by the primary investigator in filling the CAT and CCQ questionnaires and then, subjected to BODE index calculation. The mean age of the study group was 57.72 years (range 40–76 years). The mean age of the males was 57.68 years and the female was 56.8. 90% of the COPD patients in the study were males while 10% were females. The mean BMI of the study group was 21.92 kg/m^2.

There was a history of smoking in 86% of the participants (mean duration of smoking was 14 years). About 62% were bidi smokers and 24% were inhaling cigarette. The rest were exposed to chullah, including some males attributing to their occupationa. Majority of the participants (68%) were in gold Stage 2 or 3 (8%, 36%, 32%, and 24% were in each COPD gold Stage 1–4, respectively). Similarily, 14%, 60%, 25%, and 1% were in respective MMRC Stages 1–4.

The mean CAT score of this study was 19.75 (range 13–31). Nearly 87% participants were having CAT score between 11 and 30, and 6% having scores 1–10 and 7% having more than 31, respectively. The mean CCQ score of this study was 2.932 (range 0.5–4.7). 48% were having scores between 1.6% and 3.0%, 43% were having 3.1–4.5, respectively. So, the majority (91%) having the scores in mid ranges of 1.6–4.5.

We found a statistically significant positive correlation ($r = 0.8479$, $r^2 = 0.7189$) with a $P < 0.001$ between CAT and CCQ scores. There is evident positive

correlation between CAT scores and BODE Index scores ($r = 0.8038$) with a $P < 0.001$). There is also positive correlation between CCQ and BODE scores in this study group; (CCQ vs. BODE, $r = 0.6565$ [$P < 0.001$]) as shown in the following graphs[Figures 1-3].

There is evident negative correlation between CAT scores and the FeV1% predicted among study subjects

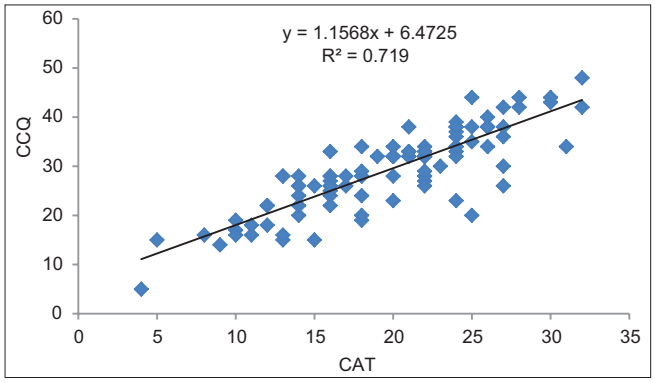

Figure 1: Correlations between chronic obstructive pulmonary disease assessment test (x-axis) and clinical chronic obstructive pulmonary disease questionnaire (y-axis) scores. For plotting of the curve; y axis = |CCQ| ×10. CCQ: Clinical chronic obstructive pulmonary disease questionnaire

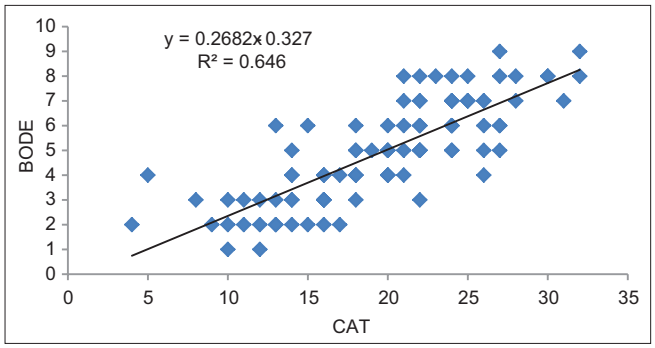

Figure 2: Correlations between chronic obstructive pulmonary disease assessment test (x-axis) and BODE (y-axis) scores

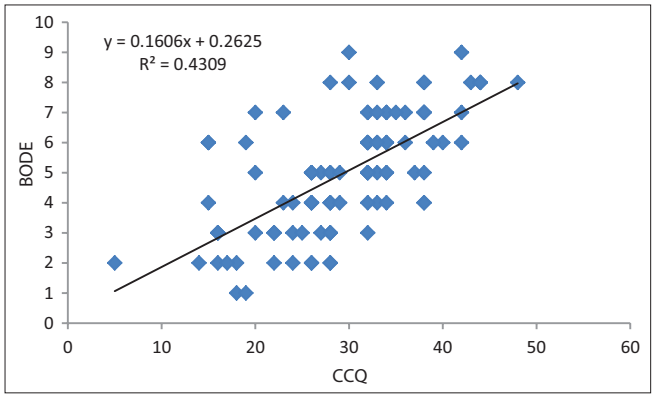

Figure 3: Correlations between clinical chronic obstructive pulmonary disease questionnaire (x-axis) and BODE (y-axis) scores. For plotting of the curve; x axis = |CCQ| ×10. CCQ: Clinical chronic obstructive pulmonary disease questionnaire

($r = -0.6761$, $r^2 = 0.4571$) with a $P < 0.001$. When CCQ score was compared to the FeV1% predicted in the study group, there was an evident negative correlation ($r = -0.6155$, $r^2 = 0.378$), with a significant $P < 0.001$. When the BODE INDEX score of study sample was compared with FeV1% predicted, there was evident negative correlation ($r = -0.8297$, $r^2 = 0.6884$) with a significant $P < 0.001$.

When the BODE index score of study sample was compared with MMRC grade scores, there was evident positive correlation ($r = 0.6645$, $r^2 = 0.4416$) with a significant $P < 0.001$. When the CAT score of study sample was compared with MMRC grade scores, there was evident positive correlation ($r = 0.6713$, $r^2 = 0.4506$) with a significant $P < 0.001$. When the CCQ score of study sample was compared with MMRC scores, there was evident positive correlation ($r = 0.6925$, $r^2 = 0.4796$) with a significant $P < 0.001$. When the CAT score of study sample was compared with 6-min walk distance (6MWD) scores, there was evident negative correlation ($r = -0.5309$, $r^2 = 0.2819$) with a significant $P < 0.001$. When the CCQ score of study sample was compared with 6MWD scores, there was evident negative correlation ($r = -0.3434$, $r^2 = 0.1174$) with a significant $P < 0.001$. When the CAT score of the study sample was compared with BMI scores, there was evident correlation ($r = -0.225$, $r^2 = 0.0506$) with a $P = 0.0244$, which is statistically significant. When the CCQ score of study sample was compared with BMI scores, there was evident correlation ($r = -0.227$, $r^2 = 0.0771$) with a $P = 0.005$ as depicted in the Table 1.

DISCUSSION

In this study, the evident 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 assessing health status in COPD patients. CAT score can also be used in long

Table 1: Correlation between variables used for CAT, CCQ and BODE scores calculation

Parameter 1	Parameter 2	Pearson's correlation coefficient (*r*)	R^2	*P*
CAT	CCQ	0.8479	0.7189	<0.001
CAT	BODE	0.8038	0.6461	<0.001
CCQ	BODE	0.6565	0.431	<0.001
CAT	FeV1% predicted	−0.6761	0.4571	<0.001
CCQ	FeV1% predicted	−0.6155	0.3788	<0.001
BODE	FeV1% predicted	−0.8297	0.6884	<0.001
BODE	MMRC	0.6645	0.4416	<0.001
CAT	MMRC	0.6713	0.4506	<0.001
CAT	6MWD	−0.5309	0.2819	<0.001
CAT	BMI	−0.225	0.0506	0.0244
CCQ	MMRC	0.6925	0.4796	<0.001
CCQ	6MWD	−0.3434	0.1174	0.0004
CCQ	BMI	−0.227	0.0771	0.005

COPD: Chronic obstructive pulmonary disease, CAT: COPD assessment test, CCQ: Clinical COPD questionnaire, MMRC: Modified medical research council, BMI: Body mass index, 6MWD: 6-min walk distance, BODE: Body-mass index, airflow Obstruction, Dyspnea, and Exercise, FeV1: forced expiratory volume-1 s

term clinical and therapeutic monitoring of COPD patients, especially in the clinical settings where spirometry is not readily available. It is patient friendly and easy to calculate and hence can be used repeatedly for health monitoring in technology-deprived point of care health facilities. Similar results were seen by Ghobadi *et al*.,[12] who conducted a study in 105 patients with stable COPD to determine the impact of COPD on health status and to assess the relationship between CAT score and PFT in COPD patients. The mean CAT score was 19.61 ± 8.07 SD. There was a significant association between the FEV1%predicted and total CAT score ($r = -0.55$, $P < 0.001$).

Analyzing the assessment of CCQ score regarding COPD disease severity and QoL, the above significant statistical findings suggested that as the severity of disease in patients increases, thereby, leading to fall in FeV1% predicted, the CCQ scores will continue rising. This also suggests that severity status of COPD patients can also be classified with the assessment of individual CCQ scores. Kon *et al*.[13] conducted a similar study to assess the responsiveness of the CCQ to pulmonary rehabilitation (PR) in 261 COPD patients. They concluded that the CCQ, St. George Respiratory Questionnaire, Chronic Respiratory Questionnaire, and CAT all significantly improved with PR with an effect size of − 0.39, −0.33, 0.62, and − 0.25, respectively and advocated the use of CCQ as a practical alternative to more time-consuming measures of health-related QoL.

When the BODE index score of study sample was compared with FeV1% predicted, there was evident negative correlation with a significant $P < 0.001$. Hence, we can also assess the disease severity of COPD by assessing BODE index score value of an individual. Celli *et al*.[9] also concluded that the BODE index, a simple multidimensional grading system including objective (FEV1) as well functional assessment (MMRC, 6MWD) is a better tool than using FEV1 alone, at predicting the risk of death from any cause and from respiratory causes among patients with COPD. Patients with higher BODE scores were at higher risk for death; the hazard ratio for death from any cause per one-point increase in the BODE score was 1.34 (95% confidence interval, 1.26–1.42; $P < 0.001$).

When compared individually, using the statistical analytical tests; we found a strong positive correlation among all specific scores in the study group: CAT versus BODE, $r = 0.8038$; CCQ versus BODE, $r = 0.6565$; ($P < 0.001$ for all correlations). This was consistent with the prospective cross-sectional study conducted by Liu *et al*.[14] to know about the relationship between CCQ score and BODE index. They found that the total CCQ score correlated well with BODE score ($P < 0.001$) and GOLD staging ($P < 0.001$). In an another retrospective study including 50 patients conducted by Ladeira *et al*.,[15] CAT score and its impact on a patient's daily life (assessed with mMRC, 6MWT) were correlated with BODE index score: $r = 0.475$, $P < 0.01$, and $r = 0.377$, $P = 0.004$, and BODE index class: $r = 0.357$, $P = 0.011$, and $r = 0.326$, $P = 0.021$.

Moreover, when we compared CAT and CCQ scores individually with various other parameters of BODE index beside FeV1% pred., there was also significant correlation observed. Huang *et al*.[16] conducted a study involving 757 participants showed moderate correlations between CAT and mMRC. Marallu *et al*.[10] conducted a study on 105 patients and found a significant correlation between CAT score and MMRC scale ($P < 0.001$, $r = 0.55$). There was also negative significant correlation between the CAT score and 6MWD ($P < 0.001$, $r = -0.49$).

A limitation of the new GOLD combined COPD assessment classification system is that it produces very different categories, depending on the instrument used (e.g., CAT and mMRC). This is partly due to the mMRC and CAT measuring different constructs; whereas the mMRC focuses on breathlessness according to ability to perform physical activities, the CAT is a multidimensional instrument. However, the components of CAT, being a more descriptive, multidimensional score, do encompass subjective assessment of breathlessness, while the mMRC grading is less subjective. Henceforth, one can infer that CAT and mMRC scores are not ideal for head-to-head comparision; however, in the present study both showed statistically significant correlation. We can use both scores in a collaborative manner for disease assessment, as both are related to common underlying pathophysiology and its functional consequences.

Limitations

We cannot apply results of this study on a larger population having variable ethinicity and duration of preexisting COPD. Most patients were from poor socioeconomic group, so prior to enrollment in the study; they were not on any standard treatment of COPD. This study hadn't included follow-up visits, which could have strengthened the reliability of these scores.

CONCLUSIONS

FeV1% predicted, and thereby interpreted GOLD classification is being used to categorize COPD patients on the basis of disease severity. Various clinical as well patient-oriented health questionnaires are being devised to assess the severity of disease in all the stages namely, stable, exacerbation and during PR. Two well known, patient-friendly questionnaires; CAT and CCQ are very sensitive in predicting the disease severity stage in COPD patients. A multi-dimensional BODE index also can be used to categorize COPD in sensitive manner.

Our study showed that statistically significant correlation among CAT, CCQ, and BODE INDEX scores in assessing the disease stage in stable patients of COPD; very well in consistence with various previous studies.[14,15] These

scores also correlate well statistically with FeV1% predicted; the basic parameter for an individual in the study sample for assessing the particular severity stage of COPD (using GOLD parameters). Large-scale longitudinal prospective studies are required to further elaborate the results.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

REFERENCES

1. World Health Organization. The World Health Report 2000: Health Systems: Improving Performance. Geneva 27, Switzerland: World Health Organization; 2000. p. 166.
2. Global Initiative for Chronic Obstructive Lung Disease. Global Strategy for the Diagnosis, Management, and Prevention of Chronic Obstructive Pulmonary Disease (revised 2011). Germany & University of Gießen and Marburg: Global Initiative for Chronic Obstructive Lung Disease, Inc.; 2011.
3. Lopez AD, Shibuya K, Rao C, Mathers CD, Hansell AL, Held LS, *et al*. Chronic obstructive pulmonary disease: Current burden and future projections. Eur Respir J 2006;27:397-412.
4. Maciewicz RA, Warburton D, Rennard SI. Can increased understanding of the role of lung development and aging drive new advances in chronic obstructive pulmonary disease? Proc Am Thorac Soc 2009;6:614-7.
5. Mathers CD, Loncar D. Projections of global mortality and burden of disease from 2002 to 2030. PLoS Med 2006;3:e442.
6. Fabbri LM, Luppi F, Beghé B, Rabe KF. Complex chronic comorbidities of COPD. Eur Respir J 2008;31:204-12.
7. van der Molen T, Willemse BW, Schokker S, ten Hacken NH, Postma DS, Juniper EF, *et al*. Development, validity and responsiveness of the clinical COPD questionnaire. Health Qual Life Outcomes 2003;1:13.
8. Tsiligianni IG, van der Molen T, Moraitaki D, Lopez I, Kocks JW, Karagiannis K, *et al*. Assessing health status in COPD. A head-to-head comparison between the COPD assessment test (CAT) and the clinical COPD questionnaire (CCQ). BMC Pulm Med 2012;12:20.
9. Celli BR, Cote CG, Marin JM, Casanova C, Montes de Oca M, Mendez RA, *et al*. The body-mass index, airflow obstruction, dyspnea, and exercise capacity index in chronic obstructive pulmonary disease. N Engl J Med 2004;350:1005-12.
10. Marallu HG, Lari SM, Fouladi N, Beukaghazade K. Subjective (CAT, MMRC) versus objective (PFT, 6MWD, SPO2) assessment in stable COPD patients. Eur Respir J 2012;40 Suppl 56:P730.
11. Barne M, Salvi S. Health and economic burden of chronic obstructive pulmonary disease. In: SK Jindal, editor. Textbook of Pulmonary and Critical Care Medicine. Vol. 1. New Delhi: Jaypee; 2011. p. 975-86.
12. Ghobadi H, Ahari SS, Kameli A, Lari SM. TANAFFOS Journal of respiratory diseases. Thoracic surgery. Intensive Care Tuberc 2012;11:22-6.
13. Kon SS, Dilaver D, Mittal M, Nolan CM, Clark AL, Canavan JL, *et al*. The clinical COPD questionnaire: Response to pulmonary rehabilitation and minimal clinically important difference. Thorax 2014;69:793-8.
14. Liu SF, Tseng CW, Tu ML, Wang CC, Tseng CC, Chin CH, *et al*. The clinical COPD questionnaire correlated with BODE index-A cross-sectional study. ScientificWorldJournal 2012;2012:361535.
15. Ladeira I, Gomes T, Castro A, Ribeiro C, Guimarães M, Taveira N, *et al*. The overall impact of COPD (CAT) and BODE index on COPD male patients: Correlation? Rev Port Pneumol (2006) 2015;21:11-5.
16. Huang WC, Wu MF, Chen HC, Hsu JY; TOLD Group. Features of COPD patients by comparing CAT with mMRC: A retrospective, cross-sectional study. NPJ Prim Care Respir Med 2015;25:15063.