

# Assessment of COPD Assessment Test (CAT) Score and Pulmonary Function Tests in Stable and Acute Exacerbation of COPD: An Observational Study

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**Abstract:** ***Background:** Chronic Obstructive Pulmonary Disease (COPD) is a preventable and treatable disease characterized by airflow limitation that is not fully reversible. It is usually progressive and associated with an abnormal inflammatory response of the lungs to noxious particles or gases, along with significant extrapulmonary effects that contribute to disease severity. The COPD Assessment Test (CAT) is a validated, self-completed questionnaire consisting of 8 items scored on a 6-point scale (0–5). It is designed to evaluate the perceived severity of COPD symptoms (e.g., shortness of breath, cough, and phlegm) and should be administered to all COPD patients irrespective of disease severity. **Objectives:** To assess and compare CAT scores, Pulmonary Function Tests (PFTs) in patients with acute exacerbation of COPD (AECOPD) and stable COPD. **Materials and Methods:** A hospital-based descriptive observational study was conducted over 18 months at Navodaya Medical College, Raichur, Karnataka. The study included 50 diagnosed cases of COPD (25 stable, 25 AECOPD). Detailed patient histories, clinical examinations, and laboratory investigations were conducted. CAT scores were evaluated in the patients' vernacular languages. **Results:** The mean CAT score was significantly higher in the AECOPD group compared to the stable COPD group ( $33.76 \pm 0.72$  vs.  $20.92 \pm 2.61$ ;  $p < 0.01$ ). Furthermore, AECOPD patients demonstrated significantly reduced FVC and FEV1 parameters compared to stable patients. **Conclusion:** The CAT score is a concise and valid tool for monitoring COPD health status. The strong clinical correlations observed in this study reinforce the discriminative validity of the CAT and its importance in evaluating the true impact of COPD on patients' daily lives. Its implementation is highly recommended in both hospital and primary care settings.*

**Keywords:** COPD, CAT Score, Pulmonary Function Test, Acute Exacerbation

## 1. Introduction

Chronic Obstructive Pulmonary Disease (COPD) is defined as a preventable and treatable disease characterized by airflow limitation that is not fully reversible. The airflow limitation is usually progressive and associated with an abnormal inflammatory response of the lungs to noxious particles or gases. The disease encompasses emphysema, chronic bronchitis, and small airway disease.

An acute exacerbation of COPD (AECOPD) is defined by the Global Initiative for Chronic Obstructive Lung Disease (GOLD) guidelines as an acute, sustained worsening of the patient's baseline dyspnea, cough, or sputum production that goes beyond normal day-to-day variation and necessitates a change in regular medication. AECOPD is clinically characterized by increased sputum volume, sputum purulence, and dyspnoea.

The natural history of COPD is marked by frequent exacerbations, the majority of which are infectious in etiology. Chronic airway infection may lead to recurrent inflammation and bacterial colonization, which predisposes patients to an accelerated loss of lung function and an increased risk of future exacerbations. While COPD patients frequently develop symptoms such as dyspnoea, exercise intolerance, sleep disturbances, and social restriction, traditional management has relied heavily on spirometry assessments. The COPD Assessment Test (CAT), developed in 2009, offers a simple, validated, and patient-centric tool to measure the comprehensive health status of COPD patients.

## 2. Review of Literature

### 2.1 Epidemiology and Disease Burden

COPD carries a massive global burden. In India, historical data estimated a prevalence of 17 million cases, a figure likely to increase significantly. The World Health Organization estimates that approximately 556,000 deaths in the South-East Asian region are attributable to COPD, with India accounting for a vast majority. COPD accounts for at least 3% of Disability-Adjusted Life Years (DALYs) in India, though this is likely an underestimation.

### 2.2 Pathogenesis and Pathophysiology

The pathogenesis of COPD is driven by chronic inflammation, particularly in the small airways, amplified by exposure to inhaled toxins such as cigarette smoke and biomass fuels. This leads to tissue destruction and disrupted repair mechanisms. Key underlying mechanisms include:

- **Inflammatory Cells:** Increased presence of neutrophils, macrophages, and CD8+ T lymphocytes releasing pro-inflammatory cytokines.
- **Protease-Antiprotease Imbalance:** Increased activity of proteases (e.g., elastase, matrix metalloproteases) and inactivation of antiproteases (e.g., alpha-1 antitrypsin) lead to the destruction of lung parenchyma.
- **Oxidative Stress:** Reactive oxygen and nitrogen species from cigarette smoke and inflammatory cells further stimulate mucus production, inactivate antiproteases, and amplify inflammation.

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These mechanisms result in small airway obstruction, hyperinflation, air trapping, and eventual gas exchange abnormalities (hypoxemia and hypercapnia). Advanced disease may lead to pulmonary hypertension and *cor pulmonale*, alongside systemic effects like skeletal muscle wasting and cardiovascular comorbidities.

### 2.3 Previous Studies on CAT and PFT

Studies by Ghobadi et al. (2012) and Tsigianni et al. (2012) demonstrated a significant correlation between CAT scores and the severity of airflow limitation (FEV1 % predicted) and GOLD classifications. Both concluded that health status, as measured by the CAT, worsens linearly with the severity of airflow limitation, proving the CAT to be a reliable alternative or complement to more complex questionnaires like the St. George's Respiratory Questionnaire (SGRQ).

## 3. Materials and Methods

### 3.1 Study Design and Setting

A hospital-based descriptive observational study was conducted at the Department of Medicine, Navodaya Medical College and Hospital, Raichur, over a period of 18 months (December 2019 to June 2021).

### 3.2 Patient Selection and Data Collection

Following Institutional Ethical Committee approval, 50 patients fulfilling the inclusion criteria were enrolled (25 with stable COPD and 25 with AECOPD). Detailed clinical histories, examinations, and routine investigations (Complete Hemogram, Chest X-Ray PA view, ECG) were conducted.

- **CAT Score:** Administered in the patient's vernacular language. Scores were classified into Slight (0–10), Medium (11–20), High (21–30), and Very High (>30) impact. For indoor patients with AECOPD, the CAT score was noted on admission and on day 3.
- **Pulmonary Function Tests (PFT):** Spirometry (RMS HELIOS spirometer) was performed, evaluating Forced Vital Capacity (FVC), Forced Expiratory Volume in 1 second (FEV1), and the FEV1/FVC ratio. Bronchodilator reversibility was assessed using nebulized salbutamol. Patients were stratified using GOLD criteria (Stages 1 through 4).

### 3.3 Statistical Analysis

Data were analyzed using IBM SPSS. Qualitative data were expressed as proportions, while quantitative data were expressed as Mean  $\pm$  Standard Deviation. Associations between qualitative variables were assessed using the Chi-square or Fisher's exact test. Correlations between quantitative variables were evaluated using Pearson's correlation coefficient. A p-value of  $< 0.05$  was considered statistically significant.

## 4. Results

### 4.1 Clinical Symptoms

Breathlessness was prevalent in both groups (40% in AECOPD vs. 44% in stable COPD). Cough was reported by 60% of AECOPD patients and 56% of stable COPD patients. Increased sputum purulence was noted in 36% of AECOPD cases and 56% of stable cases ( $p > 0.05$ ). However, a significant increase in sputum volume was observed in AECOPD patients compared to the stable cohort ( $p < 0.05$ ).

### 4.2 CAT Score Analysis

The mean CAT score for the stable COPD group was  $20.92 \pm 2.61$ , whereas the AECOPD group recorded a significantly higher mean score of  $33.76 \pm 0.72$  ( $p < 0.01$ ), indicating a substantially higher symptom burden during acute exacerbations.

### 4.3 Spirometric Parameters

PFT analysis revealed significantly compromised lung function in the AECOPD group compared to the stable COPD group:

- **Mean Measured FVC:**  $1.21 \pm 0.17$  L (AECOPD) vs.  $2.41 \pm 0.42$  L (Stable);  $p < 0.01$ .
- **Mean Measured FEV1:**  $0.91 \pm 0.09$  L (AECOPD) vs.  $1.61 \pm 0.29$  L (Stable);  $p < 0.01$ .
- **Mean FEV1/FVC Ratio:**  $0.77 \pm 0.05$  (AECOPD) vs.  $0.67 \pm 0.02$  (Stable);  $p < 0.01$ .

## 5. Discussion

Our study evaluated 50 subjects comprising 25 stable COPD and 25 AECOPD cases. The cohort demonstrated a strong male predominance (84%), aligning with gender distributions reported by Sharma et al. and Kamath et al. Age was a significant differentiating factor; AECOPD patients were significantly older (mean  $65.88 \pm 4.37$  years) compared to the stable group ( $58.32 \pm 11.64$  years;  $p < 0.01$ ). This confirms the demographic trend that advanced age correlates with increased exacerbation frequency.

Clinical severity markers effectively differentiated the two groups. AECOPD patients presented with significantly more advanced airflow limitation, with 40% classified as GOLD Stage III and 60% as Stage II, compared to the stable group which had no Stage III patients ( $p < 0.05$ ). Correspondingly, the symptom burden was markedly higher in the exacerbation group. Our baseline CAT scores for stable patients closely match those reported by Tripathi et al. and Thakuria et al., validating the questionnaire's sensitivity.

Crucially, our study identified strong clinical correlations bridging subjective symptom scores with objective physiological measures. In both groups, CAT scores demonstrated a statistically significant negative correlation with PFT parameters (FEV1 and FVC) and a positive correlation with the BODE index.

While the BODE index is a highly prognostic tool, its calculation requires the 6-minute walk test, which is resource-

intensive and limits its applicability in busy or rural clinics. Our findings suggest that the easily administered CAT questionnaire accurately reflects the severity of airflow limitation and captures multidimensional impairment.

## 6. Conclusion

This descriptive observational study highlights the clinical utility of the CAT score in assessing COPD. AECOPD patients were demographically older, presented with more advanced GOLD staging, and demonstrated significantly reduced PFT parameters compared to stable patients. Crucially, mean CAT scores were significantly elevated during acute exacerbations ( $33.76 \pm 0.72$  vs.  $20.92 \pm 2.61$ ;  $p < 0.01$ ) and correlated strongly with objective measures of lung function and the BODE index. These findings reinforce the discriminative validity of the CAT questionnaire as a concise, reliable, and accessible tool for evaluating airflow limitation and monitoring the multidimensional impact of COPD in routine clinical and primary care settings

## References

- [1] Global strategy for the diagnosis, management, and prevention of chronic obstructive pulmonary disease: Executive summary 2006. Global Initiative for Chronic Obstructive Lung Disease (GOLD). Available from <http://www.goldcopd.org>.
- [2] WHO Global Infobase on 10th March 2012. (Updated as on 20/01/2011). Available online: <https://apps.who.int/infobase/Index.aspx>
- [3] Lopez AD, Shibuya K, Rao C et al. Chronic obstructive pulmonary disease: current burden and future projections. *Eur Respir J*. 2006, 27:397-412
- [4] CAT development steering group: COPD assessment test-healthcare professional user guide. <http://www.catestonline.org>
- [5] Wiklund I, Berry P, Lu KX. The Chinese translation of COPD assessment test (CAT) provides a valid and reliable measurement of COPD health status in Chinese COPD patients. *Am J Respir Crit Care Med*. 2010, 181: A3575-
- [6] Jones PW, Harding G, Berry P et al. Development and first validation of the COPD assessment test. *Eur Respir J*. 2009, 34(3): 648–654
- [7] Jones PW, Harding G, Wiklund I et al. Improving the process and outcome of care in COPD: development of a standardised assessment tool. *Prim Care Respir J*. 2009, 18(3): 208–215
- [8] Sin DD, Anthonisen NR, Soriano JB et al. Mortality in COPD. Role of comorbidities. *Eur Respir J*. 2006, 28:1245–57
- [9] Mitchell RS, Filley GF. Chronic obstructive bronchopulmonary disease. I. Clinical features. *Am Rev Respir Dis*. 1964, 89:360–71
- [10] British Thoracic Society. National clinical guideline on management of chronic obstructive pulmonary disease in adults in primary and secondary care. *Thorax*. 2004, 59 (S 1): i1-i232.
- [11] Celli B, Snider GL, Heffner J et al. Standards for the diagnosis and care of patients with chronic obstructive pulmonary disease. Official statement of the American Thoracic Society. *Am J Respir Crit Care Med*. 1995, 152: S77–S120.
- [12] Han MK, Mullerova H, Curran-Everett D et al. GOLD 2011 disease severity classification in COPD Gene: a prospective cohort study. *The Lancet Respir Med*. 2013, 1:43-50.
- [13] Nishimura K, Oga T, Tsukino M et al. Reanalysis of the Japanese experience using the combined COPD assessment of the 2011 GOLD classification. *Respir Investig*. 2014, 52(2):129-35.
- [14] Leivseth L, Brumpton BM, Nilsen TI et al. GOLD classifications and mortality in chronic obstructive pulmonary disease: the HUNT Study, Norway. *Thorax*. 2013, 68(10):914-21.
- [15] Buist AS, McBurnie MA, Vollmer WM et al. BOLD Collaborative Research Group. International variation in the prevalence of COPD (the BOLD Study). A population-based prevalence study. *Lancet*. 2007, 370:741-50.
- [16] Koul PA. Chronic obstructive pulmonary disease: Indian guidelines and the road ahead. *Lung India*. 2013, 30:175-77.
- [17] Koul PA. Chronic obstructive pulmonary disease: Indian guidelines and the road ahead. *Lung India*. 2013, 30:175-77.
- [18] Menezes AM, Perez-Padilla R, Jardim JR et al. Chronic obstructive pulmonary disease in five Latin American cities (the PLATINO study). A prevalence study. *Lancet*. 2005, 366:1875-81.
- [19] Schirnhofner L, Lamprecht B, Vollmer WM et al. Results from the Burden of Obstructive Lung Disease (BOLD) Study. *Chest*. 2007, 131:29-36.
- [20] Wig KL, Guleria JS, Bhasin RC et al. Certain clinical and epidemiological patterns of chronic obstructive lung disease as seen in Northern India. *Indian J Chest Dis*. 1964, 6:183-94.
- [21] Viswanathan R. Epidemiology of chronic bronchitis: morbidity survey in Patna urban area. *Indian J Med Res*. 1966, 54:105-11.
- [22] Radha TG, Gupta CK, Singh A et al. Chronic bronchitis in an urban locality of New Delhi - an epidemiological survey. *Indian J Med Res*. 1977, 66:273-85.
- [23] Jindal SK. A field study on follow up at 10 years of prevalence of chronic obstructive pulmonary disease & peak expiratory flow rate. *Indian J Med Res*. 1993, 98:20-6.
- [24] Thiruvengadam KV, Raghava TP, Bhardwaj KV et al. Survey of prevalence of chronic bronchitis in Madras city. editors. *Advances in COPD*. Delhi: Asthma and Bronchitis Foundation of India. 1977, p. 59-6.
- [25] Ray D, Abel R, Selvaraj KG. A 5 years prospective epidemiological study of chronic obstructive pulmonary disease in rural South India. *Indian J Med Res*. 1995, 101:238-44.
- [26] Jindal SK, Aggarwal AN, Gupta D et al. Indian study on epidemiology of asthma, respiratory symptoms and chronic bronchitis in adults (INSEARCH). *Int J Tuberc Lung Dis*. 2012, 16:1270-7.
- [27] Bhattacharya SN, Bhatnagar JK, Kumar S et al. Chronic bronchitis in rural population. *Indian J Chest Dis*. 1975, 17:1-7.
- [28] Viswanathan R, Singh K et al. Chronic bronchitis and asthma in urban and rural Delhi. *Ed Advances in*

- Chronic Obstructive Lung Disease. Delhi: Asthma and Bronchitis Foundation of India. 1977, 44-58.
- [29] Charan NB, Viswanathan R, Jaggi OP. Chronic bronchitis in North India, Punjab. Ed Advances in Chronic Obstructive Lung Disease. Delhi: Asthma and Bronchitis Foundation of India. 1977, 92-102.
- [30] Malik SK. Profile of chronic bronchitis in North India: The PGI experience (1972-1985). Lung India. 1986, 4:89-100.
- [31] Global status report on noncommunicable disease 2010. Pg. 1
- [32] Jindal SK, Aggarwal AN, Chaudhry K et al. Tobacco smoking in India: Prevalence, quit rates and respiratory morbidity. Indian J Chest Dis Allied Sci. 2006, 48:37-42
- [33] Behera D, Jindal SK. Respiratory symptoms in Indian women using domestic cooking fuels. Chest. 1991, 100:385-8.
- [34] Salvi S, Barnes PJ. Is exposure to biomass smoke the biggest risk factor for COPD globally? Chest. 2010, 138:3-6.
- [35] Piera B, Sonia et al. Chronic obstructive pulmonary disease (COPD) and occupational exposures. Journal of occupational medicine and toxicology. 2006 1:11
- [36] Pande JN, Bhatta N, Biswas D et al. Outdoor air pollution and emergency room visits at a hospital in Delhi. Indian J Chest Dis Allied Sci. 2002, 44:13-9.
- [37] Willcox PA, Ferguson AD. Chronic obstructive airway disease following treated pulmonary tuberculosis. Respr Med. 1989, 83:195-8
- [38] Limaye S, Salvi S, Jindal SK. Textbook of Pulmonary and Critical Care Medicine. 1<sup>st</sup> ed. Jaypee Publications Pvt. Ltd. 2011. Risk factors for COPD. Pg. 987-92
- [39] Silva GE, Sherrill DL, Guerra S et al. Asthma as a risk factor for COPD in a longitudinal study. Chest. 2004, 126:59-65.
- [40] Saetta M, DiStefano A, Turato G et al. CD8 T-lymphocytes in peripheral airways of smokers with chronic obstructive pulmonary disease. Am J Respir Crit Care Med. 1998, 157:822-826.
- [41] Niewoehner DE, Kleinerman J, Rice DB. Pathologic changes in the peripheral airways of young cigarette smokers. N Engl J Med 1974; 291: 755-758
- [42] Braber S, Thio M, Blokhuis BR et al. An association between neutrophils and immunoglobulin free light chains in the pathogenesis of chronic obstructive pulmonary disease. Am J Respir Crit Care Med. 2012, 185:817-24.
- [43] Thomsen M, Dahl M, Lange P et al. Inflammatory biomarkers and co-morbidities in chronic obstructive pulmonary disease. Am J Respir Crit Care Med. 2012, 186:982-8.
- [44] Massaro GD, Massaro D. Retinoic acid treatment abrogates elastase-induced pulmonary emphysema in rats. Nat Med. 1997, 3:675-7.
- [45] Global initiative for Chronic Obstructive Pulmonary Disease (GOLD). Global strategy for the diagnosis, management, and prevention of chronic obstructive pulmonary disease (updated 2013). www.goldcopd.com
- [46] Bestall JC, Paul EA, Garrod R et al. Usefulness of the Medical Research Council (MRC) dyspnoea scale as a measure of disability in patients with chronic obstructive pulmonary disease. Thorax. 1999, 54:581-86.
- [47] Dodd JW, Hogg L, Nolan J et al. The COPD assessment test (CAT): response to pulmonary rehabilitation. A multicentre, prospective study. Thorax. 2011, 66(5):425-29.
- [48] Ringbaek T et al. A comparison of the assessment of quality of life with CAT, CCQ, and SGRQ in COPD patients participating in pulmonary rehabilitation. COPD. 2012 Feb;9(1):12-5
- [49] Anthonisen NR, Manfreda J, Warren CP et al. Antibiotic therapy in exacerbation of chronic obstructive pulmonary disease. Ann. Intern. Med., 106 (1987), pp. 196-200
- [50] Seemungal TA, Donaldson GC, Bhowmik A et al. Time course and recovery of exacerbations in patients with chronic obstructive pulmonary disease. Am. J. Respir. Crit. Care Med. 2000, 161, pp. 1608
- [51] Mushlin A, Black E, Connolly C et al. The necessary length of hospital stay for chronic pulmonary disease. JAMA, 266 (1991), pp. 80-83
- [52] Bhowmik A, Seemungal T, Sapsford R et al. Relation of sputum inflammatory markers to symptoms and lung function changes in COPD exacerbations. Thorax, 55 (2000), pp. 114-120
- [53] Sethi J, Rochester C. Smoking and chronic obstructive pulmonary disease. Clin. Chest Med., 21 (1) (2000), pp. 67-86
- [54] Abd-Elaziza AA, Alwahsha RA, Abd-Elaal GA et al. Correlation between CAT score, inflammatory markers and pulmonary function tests in patient with acute exacerbation of COPD. Egyptian Journal of Chest Diseases and Tuberculosis. Volume 66, Issue 2, April 2017, Pages 243-246.
- [55] Yoshimoto D, Nakano Y, Onishi K et al. The relationship between the COPD Assessment Test score and airflow limitation in patients aged over 40 years with a smoking history. International Journal of COPD 2014;9 1357-1363.
- [56] Kurashima K, Takaku Y, Ohta et al. COPD assessment test and severity of airflow limitation in patients with asthma, COPD, and asthma-COPD overlap syndrome. International Journal of COPD 2016;11 479-487.
- [57] Sundeep Salvi et al. Prevalence of COPD in a rural population in India. European Respiratory journal. Sept. 2014. vol. 38 no. Suppl 55
- [58] You-Hui T, Yan Zhang Y and Guang-He F. Utility of the CAT in the therapy assessment of COPD exacerbations in China. BMC Pulmonary Medicine 2014 14-42.
- [59] Jones PW, Brusselle G, Dal Negro RW et al. Properties of the COPD assessment test in a cross-sectional European study. Eur Respir J. 2011, 38: 29-35.
- [60] Donaldson GC, Seemungal TA, Bhowmik A et al. Relationship between exacerbation frequency and lung function decline in chronic obstructive pulmonary disease, Thorax 57 (2002) 847-852.
- [61] Chen S, Wang C, Li B et al. Risk factors for FEV1 decline in mild COPD and high-risk populations. International Journal of Chronic Obstructive Pulmonary Disease. 2017, 12:435-442.
- [62] Mackay AJ, Donaldson GC, Patel AR et al. Usefulness of the chronic obstructive pulmonary disease

- assessment test to evaluate severity of COPD exacerbations. *Am J Respir Crit Care Med.* 2012, 185 (11): 1218-1224.
- [63] Miravittles M, Soriano JB, García-Río F et al. Prevalence of COPD in Spain: impact of undiagnosed COPD on quality of life and daily life activities. *Thorax.* 2009; 64: 863–868.
- [64] Domingo-Salvany A, Lamarca R, Ferrer M et al. Health-related quality of life and mortality in male patients with chronic obstructive pulmonary disease. *Am J Respir Crit Care Med.* 2002; 166: 680–685.
- [65] Garcia-Aymerich J, Lange P, Benet M et al. Regular physical activity modifies smoking-related lung function decline and reduces risk of chronic obstructive pulmonary disease:a population-based cohort study. *Am J Respir Crit Care Med.* 2007; 175: 458–463.
- [66] Mannino DM, Doherty DE, Sonia BA. Global Initiative on Obstructive Lung Disease (GOLD) classification of lung disease and mortality: findings from the Atherosclerosis Risk in Communities (ARIC) study. *Respir Med.* 2006, 100:115–22.
- [67] Obesity and Spirometric Ventilatory Status Correlation in Adult Male Population of Amritsar. *National Journal of Physiology, Pharmacy & Pharmacology.* 2012. Vol2. Issue 2 pages 93-98