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Research Article

A Prospective Study on Correlation between Clinical Parameters and Health-Related Quality of Life in Chronic Obstructive Pulmonary Disease Patients at a Tertiary Care Hospital

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Abstract

Background: Chronic Obstructive Pulmonary Disease (COPD) is associated with persistent respiratory symptoms and progressive functional limitation, significantly impairing health-related quality of life (HRQoL). While spirometry remains essential for diagnosis, symptom-based assessment tools such as the COPD Assessment Test (CAT), Modified Medical Research Council (mMRC) dyspnea scale, and Borg Rating of Perceived Exertion scale provide important insight into patient-perceived disease burden. However, the interrelationship between these scales and their combined impact on HRQoL requires further evaluation.

Objectives: To assess the correlation between clinical severity parameters and health-related quality of life among patients with COPD.

Methods: A prospective observational study was conducted among 125 clinically stable COPD patients in a tertiary care hospital. Demographic and clinical data were collected. Symptom severity and HRQoL were assessed using CAT, mMRC, and Borg scales. Pain severity and interference domains were also evaluated. Statistical analysis included descriptive statistics, chi-square tests, and Spearman's rank correlation, with $p < 0.05$ considered statistically significant.

Results: The majority of patients were aged 36–60 years (52.8%), with male predominance (70.4%) and high smoking prevalence (70.4%). Most patients were categorized under medium (44.0%) and high (41.6%) CAT impact levels. Moderate to moderately severe dyspnea (mMRC Grades 2–3) was observed in 56.8% of participants. Borg scale assessment showed 94.4% of patients experienced mild-to-severe exertional symptoms. Severe to very severe pain was reported by 78.4% of patients, significantly interfering with daily activities and sleep. HRQoL analysis revealed that 64.8% had

moderate and 32.8% had poor quality of life. Strong positive correlations were observed between CAT and Borg scores (ϱ = 0.910), mMRC and Borg scores (ϱ = 0.913), and mMRC and CAT scores (ϱ = 0.879), all statistically significant ($p < 0.0001$).

Conclusion: COPD patients demonstrate substantial multidimensional symptom burden and impaired HRQoL. Strong inter-scale correlations validate the complementary use of CAT, mMRC, and Borg tools in comprehensive clinical assessment and patient-centered management.

Keywords: COPD, Health-related quality of life, CAT, mMRC, Borg scale, Dyspnea, Pain

INTRODUCTION

Chronic Obstructive Pulmonary Disease (COPD) is a progressive and preventable respiratory disorder characterized by persistent airflow limitation and an abnormal inflammatory response of the airways and lung parenchyma to noxious particles or gases [1]. It represents a major global public health challenge and is currently the third leading cause of death worldwide, contributing substantially to long-term disability and healthcare utilization [2,3]. The global burden of COPD continues to increase due to aging populations, continued tobacco consumption, biomass fuel exposure, urban air pollution, and occupational hazards [4,5].

In India, COPD prevalence varies widely across regions, with estimates ranging between 4% and 13%, reflecting demographic variation and differing environmental exposures [5]. Males and individuals with a history of smoking or chronic exposure to indoor biomass smoke remain disproportionately affected. Beyond mortality risk, COPD significantly impairs exercise capacity, limits daily activities, and reduces overall health-related quality of life (HRQoL), leading to substantial socioeconomic burden and increased healthcare expenditure [6]. Frequent exacerbations, chronic dyspnea, fatigue, and comorbid conditions further contribute to disease progression and functional decline.

Although spirometry remains the gold standard for diagnosing and staging COPD based on airflow limitation, it does not fully capture the complexity of symptom burden experienced by patients [1,7]. Studies have shown that spirometric parameters such as FEV_1 correlate only modestly with patient-reported symptoms and functional limitations [8,9]. Many patients with similar levels of airflow obstruction report markedly different levels of dyspnea, fatigue, and activity restriction. This discrepancy highlights the importance of incorporating multidimensional, symptom-based assessment tools into routine clinical practice.

The COPD Assessment Test (CAT) was developed as a concise, validated instrument designed to quantify the overall impact of COPD on a patient's health status [10]. It evaluates multiple symptom domains including cough, sputum production, chest tightness, breathlessness, activity limitation, sleep disturbance, and energy levels. The CAT has demonstrated strong reliability, responsiveness, and correlation with more comprehensive instruments such as the St. George's Respiratory Questionnaire [10,11]. Similarly, the Modified Medical Research Council (mMRC) dyspnea scale provides a simple and widely used grading system for breathlessness severity based on functional limitation [12]. The Borg Rating of Perceived Exertion scale further assesses subjective perception of exertion and breathlessness intensity during activity, offering insight into functional compromise beyond resting symptoms [13].

Recent Global Initiative for Chronic Obstructive Lung Disease (GOLD) guidelines emphasize integrated assessment, combining symptom burden and exacerbation risk with spirometric staging to guide individualized treatment strategies [14]. Despite these recommendations, limited prospective data from Indian tertiary care settings have examined the interrelationship among CAT, mMRC, and Borg scales and their collective association with health-related quality of life. Furthermore, pain and functional interference, which are increasingly recognized as contributors to reduced HRQoL in COPD, remain underexplored in many clinical evaluations.

Understanding the correlation between validated clinical severity scales and HRQoL measures is essential for optimizing patient-centered care, identifying individuals at higher risk of functional deterioration, and guiding comprehensive management strategies. Therefore, the present study aimed to evaluate the relationship between CAT, mMRC, and Borg severity scores and their association with health-related quality of life among patients with COPD in a tertiary care hospital setting.

MATERIALS AND METHODS

A prospective observational study was conducted in the Department of Pulmonary Medicine at a tertiary care teaching hospital over a period of six months. A total of 125 patients with clinically diagnosed Chronic Obstructive Pulmonary Disease (COPD) were enrolled in the study. Patients aged 40 years and above with spirometry-confirmed COPD who were clinically stable and willing to provide informed consent were included. Patients presenting with acute exacerbation, severe comorbid conditions interfering with assessment, or inability to complete questionnaires were excluded from the study.

Demographic details including age, gender, and smoking history were recorded using a structured data collection form. Clinical information and spirometric parameters were obtained from patient medical records. Health-related quality of life and symptom severity were assessed using validated instruments. The COPD Assessment Test (CAT), consisting of eight items scored on a scale of 0 to 5, was used to evaluate disease impact, with total scores ranging from 0 to 40, where higher scores indicated greater impairment. Dyspnea severity was assessed using the Modified Medical Research Council (mMRC) dyspnea scale, graded from 0 to 4 based on functional limitation. The Borg Rating of Perceived Exertion scale was used to measure subjective breathlessness and exertional intensity during physical activity.

The primary objective was to evaluate the correlation between CAT, mMRC, and Borg scores. Data were entered and analyzed using statistical software. Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequencies and percentages. Spearman's rank correlation coefficient was used to assess relationships between severity scales, and the Chi-square test was applied to determine associations between categorical variables. A p-value of less than 0.05 was considered statistically significant. Ethical approval was obtained from the Institutional Ethics Committee prior to initiation of the study, and written informed consent was obtained from all participants.

RESULTS

A total of 125 COPD patients were included in the study.

1. Baseline Characteristics

The majority of patients were aged 36–60 years (52.8%), followed by >60 years (45.6%), while only 1.6% were ≤35 years. There was a male predominance (70.4%). A history of smoking was present in 70.4% of patients.

2. CAT Symptom Profile and Impact Levels

Table 1: Distribution of CAT Symptom Responses (N = 125)

Symptom Domain	Most Common Category	%
Cough	Frequent	39.2%
Phlegm	Moderate amount	40.8%
Chest tightness	Moderate	41.6%
Breathlessness climbing stairs	Moderate/Very breathless	75.2% combined
Activity limitation at home	Some/Frequent limitation	65.6% combined
Reduced confidence leaving home	Moderate to low confidence	76.0% combined
Sleep disturbance	Often wake due to COPD	34.4%
Low energy	Low energy	34.4%

CAT Impact Classification

Impact Level	Frequency	%
Low	13	10.4%
Medium	55	44.0%
High	52	41.6%
Very High	5	4.0%

85.6% of patients were in medium-to-high impact categories.Chi-square test confirmed significant clustering ($\chi^2 = 64.54$, $p < 0.001$).

3. mMRC Dyspnea Severity

Table 2: mMRC Grade Distribution

Grade	Severity	%
0	None/Minimal	7.2%
1	Mild	26.4%
2	Moderate	29.6%
3	Moderately Severe	27.2%
4	Severe	9.6%

83.2% were in Grade 1–3 categories.Chi-square significant ($\chi^2 = 28.56$, $p < 0.001$).

4. Borg Scale Findings

Effort Intensity

Most patients reported Moderate (37.6%), Strong (17.6%), or Very Strong (13.6%) exertion.

Borg Severity Interpretation

Severity	%
No/Minimal	2.4%
Mild–Moderate	55.2%
Severe	39.2%
Very Severe	3.2%

94.4% experienced at least mild-to-severe burden.Chi-square significant ($\chi^2 = 162.48$, $p < 0.001$).

5. Pain Assessment

Worst Pain Severity

Level	%
Mild	3.2%
Moderate	18.4%
Severe	32.8%
Very Severe	45.6%

78.4% reported severe to very severe pain.

Average Pain (Past 7 Days)

69% experienced severe or very severe pain.

Current Pain

84% had moderate to severe pain at assessment.

Pain Interference

Domain	Moderate–Severe %
General activity	79.2%
Walking ability	76.8%
Sleep	77.6%

Pain score clustering was significant ($\chi^2 = 132.45$, $p < 0.001$).

6. Health-Related Quality of Life (HRQoL)

Category	Frequency	%
Good	3	2.4%
Moderate	81	64.8%
Poor	41	32.8%
Very Poor	0	0%

97.6% had moderate to poor QoL.Chi-square significant ($\chi^2 = 77.92$, $p < 0.001$).

7. Correlation Analysis

Table 3: Spearman Correlations

Variables	ϱ	p-value
CAT vs Borg	0.910	<0.0001
mMRC vs Borg	0.913	<0.0001
mMRC vs CAT	0.879	<0.0001

All correlations were strong and statistically significant.

8. Cross-Tab Comparisons

Progressive increases in Borg severity were observed with higher mMRC grades. Similarly, higher CAT impact categories were increasingly represented in higher mMRC grades.

No patients reported maximal Borg severity (9–10 range).

A total of 125 patients with clinically diagnosed COPD were included in the study. The majority of participants were aged between 36–60 years (52.8%), followed by those aged above 60 years (45.6%), while only 1.6% were aged 35 years or below. There was a clear male predominance (70.4%), and 70.4% of patients had a history of smoking.

Analysis of CAT symptom domains revealed a high symptom burden across multiple areas. Frequent coughing was reported by 39.2% of patients, while 40.8% reported a moderate amount of phlegm. Chest tightness was moderate to frequent in 74.4% of patients. Breathlessness during stair climbing was moderate to very severe in 75.2% of participants. Activity limitation at home was reported as some

or frequent by 65.6% of patients, and 76% reported reduced confidence in leaving home. Sleep disturbances were common, with 57.6% waking up sometimes or often due to COPD symptoms. Reduced energy levels were also prominent, with 70.4% reporting moderate to low energy.

According to CAT impact classification, 44.0% of patients were in the medium impact category and 41.6% in the high impact category, while 4.0% were categorized as very high impact. Only 10.4% fell into the low impact group. The chi-square test confirmed significant clustering toward medium and high impact levels ($\chi^2 = 64.54$, $p < 0.001$).

Assessment using the mMRC dyspnea scale showed that 29.6% of patients were in Grade 2 and 27.2% in Grade 3, indicating moderate to moderately severe dyspnea. Severe dyspnea (Grade 4) was present in 9.6% of patients, while only 7.2% reported minimal symptoms (Grade 0). The distribution was statistically significant ($\chi^2 = 28.56$, $p < 0.001$).

Borg scale severity analysis demonstrated that 55.2% of patients experienced mild-to-moderate exertional symptoms, 39.2% reported severe symptoms, and 3.2% reported very severe symptoms, with only 2.4% reporting minimal symptoms. The clustering toward moderate and severe levels was statistically significant ($\chi^2 = 162.48$, $p < 0.001$).

Pain assessment revealed a substantial symptom burden. Worst pain severity was reported as severe or very severe in 78.4% of patients. During the past seven days, 68.8% experienced severe to very severe pain, and at the time of assessment, 84% reported moderate to severe pain. Pain significantly interfered with general activity (79.2%), walking ability (76.8%), and sleep (77.6%). The distribution of pain scores was statistically significant ($\chi^2 = 132.45$, $p < 0.001$).

Health-related quality of life analysis showed that 64.8% of patients had moderate QoL and 32.8% had poor QoL, while only 2.4% reported good QoL. No patients fell into the very poor category. The chi-square test confirmed a significant concentration of patients in moderate and poor QoL groups ($\chi^2 = 77.92$, $p < 0.001$).

Correlation analysis demonstrated strong positive relationships between all severity scales. CAT scores showed a strong correlation with Borg scores ($\varrho = 0.910$, $p < 0.0001$). Similarly, mMRC dyspnea grades were strongly correlated with Borg severity ($\varrho = 0.913$, $p < 0.0001$) and CAT impact levels ($\varrho = 0.879$, $p < 0.0001$). These findings indicate that increasing dyspnea severity and perceived exertion are consistently associated with higher disease impact and poorer health-related quality of life.

DISCUSSION

The present study evaluated the relationship between clinical severity parameters and health-related quality of life (HRQoL) among COPD patients using CAT, mMRC, and Borg scales. The findings demonstrate a substantial symptom burden across multiple domains, with the majority of patients experiencing moderate to severe impairment.

A predominance of middle-aged and elderly individuals was observed, consistent with the established epidemiology of COPD, which shows increasing prevalence with advancing age due to cumulative exposure to risk factors and progressive airway damage. The marked male predominance and high smoking prevalence in the study population further reinforce the well-documented association between tobacco exposure and COPD development.

Analysis of CAT domains revealed that cough, phlegm production, chest tightness, breathlessness, reduced energy, sleep disturbances, and activity limitation were highly prevalent. More than 85% of patients fell within medium to high impact categories, indicating that the majority experience clinically meaningful disease burden. These findings align with previous studies demonstrating that symptom-based assessments often capture functional impairment more effectively than spirometric indices alone.

The mMRC dyspnea scale showed that over 80% of patients were classified within Grades 1 to 3, reflecting mild to moderately severe breathlessness. Dyspnea remains one of the most disabling symptoms in COPD and is strongly associated with reduced exercise tolerance and diminished quality of life. The significant clustering in moderate grades suggests that many patients are functionally compromised but may still benefit substantially

from early intervention and pulmonary rehabilitation.

Borg scale findings further highlighted exertional limitation, with nearly 95% of patients reporting at least mild-to-severe perceived exertion. The concentration of responses in moderate and severe categories supports the multidimensional impact of COPD beyond airflow limitation, emphasizing the importance of subjective symptom evaluation.

Pain assessment revealed a notable and often under-recognized burden. A large proportion of patients reported severe or very severe pain, with substantial interference in walking ability, general activity, and sleep. Although pain is not traditionally considered a cardinal COPD symptom, emerging evidence suggests that systemic inflammation, musculoskeletal strain, reduced mobility, and comorbid conditions contribute significantly to pain perception in this population. The clustering of moderate-to-severe pain underscores the need for comprehensive symptom management.

HRQoL classification demonstrated that nearly all patients experienced some degree of impairment, with approximately one-third categorized as having poor quality of life. This finding reinforces the cumulative impact of dyspnea, fatigue, exertional limitation, and pain on daily functioning.

Importantly, strong positive correlations were observed between CAT and Borg scores ($\rho = 0.910$), mMRC and Borg scores ($\rho = 0.913$), and mMRC and CAT scores ($\rho = 0.879$), all statistically significant. These results confirm a consistent and progressive relationship between dyspnea severity, perceived exertion, and overall disease impact. As mMRC grades increased, patients were more likely to fall into higher CAT impact categories and report greater Borg severity. This strong inter-scale alignment validates the complementary use of these instruments in routine clinical assessment.

The findings support current recommendations advocating multidimensional evaluation of COPD rather than reliance solely on spirometric staging. Incorporating CAT, mMRC, and Borg scales together provides a comprehensive understanding of functional impairment and patient-perceived burden.

Strengths

The present study possesses several methodological and clinical strengths. First, it was conducted using a prospective observational design, which allowed for structured and systematic data collection from clinically stable COPD patients. Second, the sample size of 125 patients provides adequate representation of the target population and strengthens the reliability of statistical associations observed.

Third, the study utilized validated and widely accepted assessment tools, including the COPD Assessment Test (CAT), Modified Medical Research Council (mMRC) dyspnea scale, and Borg Rating of Perceived Exertion scale. The use of standardized instruments enhances internal validity and allows comparison with existing literature.

Another important strength is the multidimensional assessment approach. In addition to dyspnea and exertional limitation, the study incorporated pain assessment and interference domains, offering a broader evaluation of symptom burden. This comprehensive approach provides a more holistic understanding of disease impact beyond airflow limitation.

Furthermore, strong and statistically significant correlations were observed among CAT, mMRC, and Borg scales, reinforcing the internal consistency of findings and supporting the complementary clinical utility of these tools in routine practice.

Limitations

Despite its strengths, the study has certain limitations. The single-center design may limit generalizability to other healthcare settings or populations with different demographic and environmental characteristics. Multi-center studies would enhance external validity.

Although the study was prospective, the analysis was cross-sectional in nature, assessing symptom burden at a single time point. Longitudinal follow-up would be valuable to evaluate progression of symptoms, changes in quality of life over time, and response to therapeutic interventions.

Spirometric parameters were not incorporated into correlation modeling, which limits the ability to directly compare physiological severity with symptom-based

scales. Future studies integrating FEV_1 percent predicted and GOLD classification would provide deeper insights.

Additionally, symptom and pain assessments were based on patient-reported measures, which may introduce recall bias or subjective variability. However, validated scales were used to minimize measurement error.

Conclusion

The findings of the present study demonstrate a substantial symptom burden and significant impairment in health-related quality of life among patients with COPD. A majority of participants were classified within moderate to high impact categories on CAT scoring and moderate to moderately severe dyspnea grades on the mMRC scale. Pain and exertional limitation were also highly prevalent and frequently interfered with daily activities, walking ability, and sleep.

Strong positive correlations between CAT, mMRC, and Borg scales indicate that increasing dyspnea severity and perceived exertion are closely associated with higher disease impact and reduced quality of life. These results highlight the multidimensional nature of COPD and underscore the importance of integrating symptom-based assessment tools into routine clinical practice.

Comprehensive evaluation using validated scales enables better identification of patients at risk of functional decline and may facilitate more individualized management strategies. Future multicenter and longitudinal studies incorporating spirometric parameters are recommended to further validate and expand upon these findings.

Conflict of Interest

The authors declare no conflict of interest.

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Ethical Approval

The study was approved by the Institutional Ethics Committee.

Informed Consent

Written informed consent was obtained from all participants.

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