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Original Article

Quality of Life and Symptom Burden Among Patients with Chronic Obstructive Pulmonary Disease in Pakistan

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ABSTRACT

Background: Chronic obstructive pulmonary disease (COPD) is associated with airflow limitation, substantial symptom burden, functional restriction, psychological morbidity, and impaired health-related quality of life (HRQoL). Patient-reported measures may capture disease burden not fully reflected by spirometric severity. Objective: To assess HRQoL and symptom burden among patients with COPD in Pakistan and examine their relationships with airflow limitation, respiratory symptoms, and psychological characteristics. Methods: This cross-sectional study included 93 patients with COPD attending Johar Institute of Professional Studies from March to September 2025. Clinical variables included demographics, smoking and biomass exposure, COPD duration, FEV_1 percentage predicted, and GOLD stage. Symptom burden was assessed using the COPD Assessment Test (CAT) and modified Medical Research Council (mMRC) scale, while HRQoL was evaluated using the St George's Respiratory Questionnaire (SGRQ) and estimated EQ-5D index. Depression and anxiety were classified using PHQ-9- and GAD-7-based criteria. Data were analysed using SPSS version 26.0. Results: Mean age was 60.43±8.69 years; 69.9% were male. GOLD 2 disease was present in 68.8%, while 21.5% had GOLD 3–4 disease. Mean CAT and SGRQ scores were 25.19±9.97 and 59.41±15.34, respectively; 79.6% had CAT >10 and 80.6% had mMRC ≥2. CAT correlated strongly with SGRQ (ρ=0.869) and inversely with EQ-5D (ρ=–0.846), while FEV_1 showed weaker correlations. CAT, FEV_1, and probable depression remained independently associated with HRQoL. Conclusion: Pakistani patients with COPD experienced marked symptom burden and HRQoL impairment, supporting multidimensional assessment beyond spirometry alone. Keywords: COPD; quality of life; CAT; SGRQ; dyspnea; EQ-5D; Pakistan.

INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is a heterogeneous chronic respiratory disorder characterized by persistent respiratory symptoms and airflow limitation resulting from abnormalities of the airways and/or alveoli. It represents a major and increasing global health burden because of its high prevalence, progressive functional consequences, recurrent healthcare utilization, premature mortality, and substantial socioeconomic impact. Global estimates indicate that COPD affects hundreds of millions of individuals, with the burden concentrated increasingly in low- and middle-income countries where tobacco exposure, household air pollution, occupational hazards, delayed diagnosis, and restricted access to pulmonary healthcare frequently coexist. Although spirometry remains fundamental for confirming persistent airflow obstruction and characterizing physiological impairment,

contemporary COPD assessment emphasizes that the clinical impact of the disease cannot be adequately represented by pulmonary function alone (1,2).

Tobacco smoking remains one of the most established risk factors for COPD, but an important proportion of patients develop chronic airflow limitation despite never smoking. Exposure to smoke generated by biomass fuels, ambient and household air pollution, occupational dusts and fumes, previous respiratory infections, and other environmental factors are particularly relevant in low-resource settings. This wider exposure profile is clinically important in Pakistan, where tobacco exposure occurs alongside household and environmental respiratory hazards. Recent population-based evidence from Karachi has demonstrated appreciable burdens of chronic cough, chronic phlegm, wheezing, and shortness of breath among adults, with increasing age and smoking-related exposures associated with respiratory symptoms (3). Such findings reinforce the importance of considering both conventional smoking history and non-tobacco exposures when characterizing COPD in the Pakistani population.

The clinical burden of COPD extends considerably beyond the degree of measured airflow obstruction. Persistent dyspnea, cough, sputum production, fatigue, restriction of physical activity, loss of independence, impaired sleep, and reduced participation in occupational and social activities collectively influence patients' perceptions of health. Consequently, health-related quality of life (HRQoL) has become a central outcome in the assessment of COPD. A Pakistani cross-sectional study conducted in Karachi previously demonstrated impaired respiratory quality of life and reported associations between HRQoL, disease severity, age, smoking, and spirometric measures (4). Comparable evidence from South Asian populations has similarly shown that poorer pulmonary function, increasing symptom severity, greater dyspnea, longer duration of disease, and smoking burden are related to worse HRQoL (5). These observations indicate that physiologic, symptomatic, functional, and psychosocial dimensions need to be examined together when estimating the real-world burden of COPD.

Patient-reported measures provide an important means of quantifying this burden. The COPD Assessment Test (CAT) is an eight-item instrument designed to provide a concise standardized assessment of the impact of COPD on health status, with a total score ranging from 0 to 40 and higher scores indicating greater disease impact. Its original development demonstrated good internal consistency, reproducibility, and strong correlation with established respiratory health-status measures (6). Subsequent systematic evaluation has supported its reliability, validity, and responsiveness across COPD populations and demonstrated relationships between CAT scores, Global Initiative for Chronic Obstructive Lung Disease (GOLD) severity, exacerbation status, dyspnea, and other health-status indicators (7). The modified Medical Research Council (mMRC) dyspnea scale provides a complementary assessment by grading activity limitation attributable to breathlessness and therefore captures an aspect of COPD burden that is readily interpretable in routine clinical practice.

Disease-specific quality-of-life instruments permit more detailed assessment of respiratory health impairment. The St George's Respiratory Questionnaire (SGRQ) was developed to quantify impaired health status in chronic airflow limitation and has demonstrated relationships with respiratory symptoms, exercise limitation, psychological health, and other indicators of disease activity (8). Its total score ranges from 0 to 100, with higher scores representing worse respiratory health status. In contrast, the EQ-5D provides a generic health-utility framework that permits assessment of overall health status across disease populations. Evidence in COPD has demonstrated that the EQ-5D utility index can distinguish between clinically different COPD severity groups and provides information that complements disease-specific measures (9). Simultaneous assessment of SGRQ and an EQ-5D index can therefore characterize both respiratory-specific impairment and broader health utility.

Psychological morbidity further contributes to the multidimensional burden of COPD. Anxiety and depressive symptoms may coexist with breathlessness, activity limitation, social withdrawal, impaired sleep, and fear of exacerbations, thereby amplifying the perceived consequences of respiratory disease. Studies using COPD-specific health-status instruments have identified associations of anxiety and depression with impaired HRQoL (10), while COPD-specific validation research has demonstrated that anxiety-screening scores are related to symptom burden and quality of life (11). Assessment of probable depression and anxiety is therefore relevant when examining variation in patient-reported quality-of-life outcomes, particularly when physiological impairment alone does not fully explain the patient's experience of illness.

An additional issue is the relationship between spirometric severity and patient-perceived burden. Patients with similar FEV_1 values can report markedly different levels of dyspnea, activity restriction, cough, psychological

distress, and quality-of-life impairment. Conversely, patients with relatively preserved spirometric values may experience considerable symptom burden. This divergence provides the rationale for integrating physiological classification with patient-reported outcomes rather than relying exclusively on GOLD airflow limitation stage. CAT, mMRC, SGRQ, and generic health-utility measures assess overlapping but non-identical dimensions of disease and can therefore provide a more comprehensive representation of COPD burden than any single measure in isolation (7-9).

Despite the clinical importance of these dimensions, integrated data examining airflow limitation, CAT-defined symptom impact, mMRC dyspnea, cough, phlegm, respiratory-specific quality of life, generic health utility, and psychological comorbidity remain relatively limited in Pakistani COPD populations. Existing local evidence has principally described respiratory risk factors, symptoms, or individual quality-of-life measures rather than examining these domains together (3,4). Characterizing the relationships among symptom burden, pulmonary function, GOLD stage, psychological screening status, and HRQoL may help identify which dimensions of disease most closely reflect the patient's experienced health burden.

The present study therefore aimed to assess quality of life and symptom burden among patients with COPD in Pakistan and to examine their relationships with airflow limitation severity and selected clinical and psychological characteristics. The principal outcomes were CAT score, mMRC dyspnea grade, SGRQ total score, and estimated EQ-5D index. Secondary analyses examined their relationships with age, duration of COPD, FEV_1 percentage predicted, GOLD airflow limitation stage, cough, phlegm, probable depression, and probable anxiety.

MATERIALS AND METHODS

A cross-sectional observational study was conducted at the Johar Institute of Professional Studies from March 2025 to September 2025. The study evaluated patients with COPD at a single time point to characterize symptom burden, respiratory-specific health-related quality of life, generic health utility, and their relationships with demographic and clinical characteristics. Reporting and organization of the study were informed by recommendations for observational and cross-sectional research described in the Strengthening the Reporting of Observational Studies in Epidemiology framework (12). The final analytical sample consisted of 93 patients with COPD.

Data collected for each participant included patient identification code, age in years, sex, smoking history, biomass exposure, duration of COPD in years, FEV_1 expressed as percentage of the predicted value, GOLD airflow limitation stage, CAT total score, mMRC dyspnea grade, presence of frequent cough, presence of phlegm during most of the day, SGRQ total score, a dichotomous indicator of compromised HRQoL, probable depression, probable anxiety, and an estimated EQ-5D index. Patient identifiers were represented by study-specific codes for analysis.

Age and COPD duration were treated as continuous variables. Sex was analyzed as male or female. Smoking history was categorized as never smoking or ever/current smoking, while biomass exposure was recorded as present or absent. Frequent cough and phlegm present for most of the day were treated as binary respiratory symptom indicators. These exposure and symptom variables were evaluated descriptively and, where appropriate, in relation to the quality-of-life outcomes.

Pulmonary function was represented by FEV_1 percentage predicted. Airflow limitation was categorized using GOLD spirometric stages: GOLD 1, GOLD 2, GOLD 3, and GOLD 4, representing progressively greater impairment in expiratory airflow (2). GOLD stage was treated as an ordinal clinical severity variable in comparative analyses. Both the continuous FEV_1 percentage predicted and categorical GOLD stage were retained in the analysis because they provide related but clinically distinct representations of physiological disease severity.

COPD symptom impact was evaluated using the COPD Assessment Test. The CAT consists of eight patient-reported items and produces a total score from 0 to 40, with increasing scores representing greater impact of COPD on health status (6,7). In the present analysis, CAT was examined both as a continuous total score and using the prespecified binary dataset classification of CAT >10 as high symptom impact. Dyspnea-related functional limitation was assessed using the mMRC scale on its 0-4 ordinal range, with progressively higher grades indicating increasing activity limitation due to breathlessness. For descriptive clinical interpretation, mMRC grades were also grouped as 0-1 and ≥2.

Respiratory-specific HRQoL was assessed using the SGRQ total score. The SGRQ was developed specifically for chronic airflow limitation and provides a health-status score ranging from 0 to 100, with higher values indicating greater impairment (8). The continuous SGRQ total score was used as a principal quality-of-life outcome. A dichotomous variable representing compromised HRQoL was additionally evaluated. Generic health status was represented by the estimated EQ-5D index contained in the study dataset. Higher EQ-5D index values were interpreted as representing better generic health status, while lower values represented poorer health utility. The EQ-5D has demonstrated validity for differentiating health status across COPD severity levels (9).

Psychological burden was represented by binary classifications of probable depression and probable anxiety. Probable depression was derived from the Patient Health Questionnaire-9 framework, a validated nine-item measure used for screening and quantification of depressive symptom severity (13). Probable anxiety was represented using the Generalized Anxiety Disorder-7 framework, a validated seven-item screening measure for anxiety symptoms (14). These variables were analyzed as screening classifications rather than definitive psychiatric diagnoses. Their associations with SGRQ and estimated EQ-5D outcomes were evaluated to determine whether psychological symptom burden corresponded with poorer perceived health status.

Data were analysed using IBM SPSS Statistics version 26.0. Continuous variables were summarized using mean and standard deviation and, where informative for distribution or ordinal comparison, median and interquartile range. Categorical variables were reported as frequencies and percentages. CAT, mMRC, SGRQ, and EQ-5D outcomes were summarized for the complete sample. Differences in CAT, mMRC, SGRQ, and EQ-5D across GOLD airflow limitation stages were assessed using the Kruskal-Wallis test because GOLD stage is ordinal and the comparison involved more than two independent groups. Associations between categorical GOLD stage and compromised HRQoL were examined using cross-tabulation and the chi-square test.

Relationships between continuous or ordinal clinical variables and quality-of-life outcomes were evaluated using Spearman rank correlation coefficients. Correlations were calculated between CAT score, mMRC grade, FEV_1 percentage predicted, COPD duration, and age and each of the principal quality-of-life outcomes, SGRQ and estimated EQ-5D. A positive correlation with SGRQ represented greater impairment because higher SGRQ values indicate worse respiratory health, whereas a negative correlation with EQ-5D represented poorer generic health status because higher EQ-5D values indicate better health utility.

Two-group comparisons were additionally undertaken to characterize quality-of-life differences according to clinically relevant symptom and psychological classifications. SGRQ and estimated EQ-5D were compared between patients with high versus lower CAT impact, mMRC ≥2 versus 0-1, probable depression versus no probable depression, probable anxiety versus no probable anxiety, frequent cough versus no frequent cough, and phlegm versus no phlegm. Mann-Whitney U testing was used for non-parametric two-group comparisons where applicable.

Exploratory multivariable linear regression analyses were performed separately for SGRQ total score and estimated EQ-5D index to evaluate whether symptom burden remained associated with quality of life after simultaneous consideration of clinical and psychological characteristics. The models included CAT score, mMRC grade, FEV_1 percentage predicted, COPD duration, age, probable depression, and probable anxiety as explanatory variables. Regression coefficients, 95% confidence intervals, p-values, and overall model fit were reported. All statistical tests were two-sided, and a p-value <0.05 was considered statistically significant.

RESULTS

A total of 93 patients with COPD were included in the analysis. Their mean age was 60.43 ± 8.69 years, with a median age of 61 years (IQR 52-67). Sixty-five participants (69.9%) were male and 28 (30.1%) were female. Ever/current smoking was reported by 55 participants (59.1%), whereas 38 (40.9%) were never smokers. Twenty-four participants (25.8%) had a history of biomass exposure. The mean duration of COPD was 5.00 ± 3.54 years, and mean FEV_1 was 60.31 ± 15.19% of predicted. GOLD 2 airflow limitation predominated, accounting for 64 patients (68.8%), followed by GOLD 3 in 18 (19.4%), GOLD 1 in nine (9.7%), and GOLD 4 in two (2.2%). Frequent cough was present in 58 participants (62.4%), and 56 (60.2%) reported phlegm during most of the day. Probable depression was identified in 53 participants (57.0%), while 19 (20.4%) had probable anxiety (Table 1).

Overall symptom burden was considerable. The mean CAT score was 25.19 ± 9.97, and the median was 28 (IQR 22-32). Seventy-four participants (79.6%) had CAT scores >10 and were classified as having high symptom impact. The mean mMRC grade was 2.54 ± 1.32. Fourteen patients (15.1%) had mMRC grade 0, four (4.3%) grade 1, 16 (17.2%) grade 2, 36 (38.7%) grade 3, and 23 (24.7%) grade 4. Consequently, 75 of 93 patients (80.6%) had mMRC grade ≥2.

Table 1. Demographic and Clinical Characteristics of Patients With COPD (N=93)

Characteristic	Value
Age, years, mean ± SD	60.43 ± 8.69
Age, years, median (IQR)	61 (52-67)
Male, n (%)	65 (69.9)
Female, n (%)	28 (30.1)
Ever/current smoking, n (%)	55 (59.1)
Never smoking, n (%)	38 (40.9)
Biomass exposure, n (%)	24 (25.8)
COPD duration, years, mean ± SD	5.00 ± 3.54
COPD duration, years, median (IQR)	4 (2-7)
FEV_1, % predicted, mean ± SD	60.31 ± 15.19
GOLD 1, n (%)	9 (9.7)
GOLD 2, n (%)	64 (68.8)
GOLD 3, n (%)	18 (19.4)
GOLD 4, n (%)	2 (2.2)
Frequent cough, n (%)	58 (62.4)
Phlegm most of the day, n (%)	56 (60.2)
Probable depression, n (%)	53 (57.0)
Probable anxiety, n (%)	19 (20.4)

Abbreviations: COPD, chronic obstructive pulmonary disease; FEV_1, forced expiratory volume in one second; GOLD, Global Initiative for Chronic Obstructive Lung Disease; IQR, interquartile range; SD, standard deviation.

Respiratory quality of life was also substantially impaired. The mean SGRQ total score was 59.41 ± 15.34, with a median of 64.3 (IQR 52.1-70.1) and an observed range from 24.7 to 88.5. Forty-eight participants (51.6%) were classified as having compromised HRQoL. The mean estimated EQ-5D index was 0.500 ± 0.145, with a median of 0.465 (IQR 0.410-0.545) and a range of 0.288-0.818 (Table 2).

Table 2. Symptom Burden and Health-Related Quality of Life Outcomes

Outcome	Value
CAT score, mean ± SD	25.19 ± 9.97
CAT score, median (IQR)	28 (22-32)
CAT >10, n (%)	74 (79.6)
CAT ≤10, n (%)	19 (20.4)
mMRC grade, mean ± SD	2.54 ± 1.32
mMRC grade 0, n (%)	14 (15.1)
mMRC grade 1, n (%)	4 (4.3)
mMRC grade 2, n (%)	16 (17.2)
mMRC grade 3, n (%)	36 (38.7)
mMRC grade 4, n (%)	23 (24.7)
mMRC ≥2, n (%)	75 (80.6)
SGRQ total, mean ± SD	59.41 ± 15.34
SGRQ total, median (IQR)	64.3 (52.1-70.1)
SGRQ total, range	24.7-88.5
Compromised HRQoL, n (%)	48 (51.6)
Estimated EQ-5D index, mean ± SD	0.500 ± 0.145
Estimated EQ-5D index, median (IQR)	0.465 (0.410-0.545)
Estimated EQ-5D index, range	0.288-0.818

Abbreviations: CAT, COPD Assessment Test; EQ-5D, EuroQol five-dimension health index; HRQoL, health-related quality of life; IQR, interquartile range; mMRC, modified Medical Research Council; SD, standard deviation; SGRQ, St George's Respiratory Questionnaire.

A clear gradient in symptom burden and quality of life was observed across GOLD airflow limitation stages. Median CAT score increased from 6.0 in GOLD 1 to 28.0 in GOLD 2 and 30.5 in GOLD 3, while the two GOLD 4 patients had a median CAT score of 28.5. CAT scores differed significantly across GOLD stages (Kruskal-Wallis H=18.50, p<0.001).

Median mMRC grade similarly increased from 0 in GOLD 1 to 3 in GOLD 2 and GOLD 3 and 4 in GOLD 4 (H=22.04, p<0.001).

Respiratory-specific quality of life deteriorated with increasing airflow limitation. Median SGRQ increased from 28.3 in GOLD 1 to 62.9 in GOLD 2 and 68.7 in GOLD 3, with a median of 69.2 among the two GOLD 4 participants (H=29.73, p<0.001). The estimated EQ-5D index showed the reverse pattern, decreasing from 0.751 in GOLD 1 to 0.480 in GOLD 2 and 0.412 in GOLD 3 (H=25.13, p<0.001). None of the GOLD 1 patients were classified as having compromised HRQoL compared with 29 of 64 GOLD 2 patients (45.3%), 17 of 18 GOLD 3 patients (94.4%), and both GOLD 4 patients (Table 3). The GOLD 4 estimates were based on only two participants and therefore contributed limited precision to stage-specific descriptive comparisons.

Table 3. Symptom Burden and Quality of Life According to GOLD Airflow Limitation Stage

Outcome	GOLD 1 (n=9)	GOLD 2 (n=64)	GOLD 3 (n=18)	GOLD 4 (n=2)	p-value
CAT, median (IQR)	6.0 (6.0-7.0)	28.0 (22.8-32.3)	30.5 (28.0-32.0)	28.5 (27.8-29.3)	<0.001
mMRC, median (IQR)	0 (0-1)	3 (2-3)	3 (3-4)	4 (4-4)	<0.001
SGRQ, median (IQR)	28.3 (27.3-31.2)	62.9 (52.2-69.7)	68.7 (65.8-75.0)	69.2 (68.8-69.5)	<0.001
Estimated EQ-5D, median (IQR)	0.751 (0.707-0.770)	0.480 (0.415-0.538)	0.412 (0.345-0.430)	0.436 (0.432-0.439)	<0.001
Compromised HRQoL, n (%)	0 (0.0)	29 (45.3)	17 (94.4)	2 (100.0)	<0.001

Continuous and ordinal outcomes compared using Kruskal-Wallis tests. Categorical HRQoL status was assessed by cross-tabulation. Interpret the GOLD 4 estimates with caution because n=2. Abbreviations: CAT, COPD Assessment Test; EQ-5D, EuroQol five-dimension health index; GOLD, Global Initiative for Chronic Obstructive Lung Disease; HRQoL, health-related quality of life; IQR, interquartile range; mMRC, modified Medical Research Council; SGRQ, St George's Respiratory Questionnaire.

The magnitude of quality-of-life impairment was particularly pronounced among participants with high CAT symptom impact. Patients with CAT >10 had a mean SGRQ score of approximately 66.0 ± 8.5, compared with 33.8 ± 6.2 in those with CAT ≤10 (p<0.001). Their corresponding mean estimated EQ-5D indices were 0.437 ± 0.079 and 0.746 ± 0.047, respectively (p<0.001). Similarly, patients with mMRC ≥2 demonstrated markedly worse SGRQ and EQ-5D outcomes than those with mMRC grades 0-1.

Probable depression was associated with poorer quality-of-life measures. Participants classified with probable depression had a median SGRQ score of 65.8 (IQR 60.0-73.0) compared with 58.2 (IQR 41.7-66.6) among those without probable depression (p=0.001). Their median estimated EQ-5D index was 0.422 (IQR 0.357-0.483) compared with 0.527 (IQR 0.460-0.753) in those without probable depression (p<0.001). Probable anxiety showed a less pronounced relationship with SGRQ (p=0.060) but was associated with lower EQ-5D values (p=0.041).

Respiratory symptoms were also associated with poorer health status. Participants with frequent cough had a median SGRQ of 66.4 (IQR 59.7-73.3) compared with 54.8 (IQR 36.5-65.4) in those without frequent cough (p<0.001), while their corresponding median EQ-5D values were 0.431 (IQR 0.390-0.500) and 0.534 (IQR 0.435-0.715) (p=0.003). Participants reporting phlegm during most of the day had higher SGRQ scores than those without this symptom (p=0.004); the corresponding difference in estimated EQ-5D did not reach the conventional level of statistical significance (p=0.061) (Table 4).

Table 4. Quality-of-Life Outcomes According to Respiratory and Psychological Characteristics

Characteristic	SGRQ summary	p-value	Estimated EQ-5D summary	p-value
CAT >10	66.0 ± 8.5	<0.001	0.437 ± 0.079	<0.001
CAT ≤10	33.8 ± 6.2		0.746 ± 0.047	
mMRC ≥2	65.6 ± 9.0	<0.001	0.441 ± 0.088	<0.001
mMRC 0-1	33.5 ± 6.3		0.744 ± 0.048	
Probable depression	65.8 (60.0-73.0)	0.001	0.422 (0.357-0.483)	<0.001
No probable depression	58.2 (41.7-66.6)		0.527 (0.460-0.753)	
Probable anxiety	66.7 (61.7-71.7)	0.060	0.418 (0.390-0.464)	0.041
No probable anxiety	61.7 (49.1-69.9)		0.483 (0.415-0.586)	
Frequent cough	66.4 (59.7-73.3)	<0.001	0.431 (0.390-0.500)	0.003
No frequent cough	54.8 (36.5-65.4)		0.534 (0.435-0.715)	
Phlegm most of day	65.7 (59.9-70.3)	0.004	0.443 (0.415-0.513)	0.061
No phlegm	52.8 (34.3-69.2)		0.505 (0.398-0.741)	

Values are mean ± SD or median (IQR), according to the underlying comparison. Abbreviations: CAT, COPD Assessment Test; EQ-5D, EuroQol five-dimension health index; IQR, interquartile range; mMRC, modified Medical Research Council; SD, standard deviation; SGRQ, St George's Respiratory Questionnaire.

Correlation analysis demonstrated that patient-reported symptom burden had the strongest relationship with quality-of-life outcomes. CAT score showed a very strong positive correlation with SGRQ (Spearman ρ=0.869, p<0.001), indicating progressively poorer respiratory health with increasing CAT burden. CAT also demonstrated a very strong inverse correlation with the estimated EQ-5D index (ρ=-0.846, p<0.001). mMRC dyspnea grade was strongly correlated with SGRQ (ρ=0.786, p<0.001) and inversely correlated with EQ-5D (ρ=-0.714, p<0.001).

Physiological airflow impairment was also related to quality of life but demonstrated weaker correlations than CAT or mMRC. FEV_1 percentage predicted correlated inversely with SGRQ (ρ=-0.509, p<0.001) and positively with estimated EQ-5D (ρ=0.444, p<0.001). Longer COPD duration was associated with higher SGRQ (ρ=0.289, p=0.005) and lower EQ-5D (ρ=-0.280, p=0.007). Increasing age was similarly associated with poorer respiratory and generic health status, with correlations of ρ=0.386 for SGRQ and ρ=-0.435 for EQ-5D (both p<0.001) (Table 5).

Table 5. Spearman Correlations of Clinical Characteristics With Quality-of-Life Outcomes

Variable	SGRQ, ρ	p-value	Estimated EQ-5D, ρ	p-value
CAT score	0.869	<0.001	-0.846	<0.001
mMRC grade	0.786	<0.001	-0.714	<0.001
FEV_1 % predicted	-0.509	<0.001	0.444	<0.001
COPD duration, years	0.289	0.005	-0.280	0.007
Age, years	0.386	<0.001	-0.435	<0.001

ρ denotes Spearman rank correlation coefficient. Abbreviations: CAT, COPD Assessment Test; COPD, chronic obstructive pulmonary disease; EQ-5D, EuroQol five-dimension health index; FEV_1, forced expiratory volume in one second; mMRC, modified Medical Research Council; SGRQ, St George's Respiratory Questionnaire.

In exploratory multivariable analysis, CAT remained the strongest symptom-related correlate of both quality-of-life outcomes after simultaneous adjustment for mMRC grade, FEV_1 percentage predicted, COPD duration, age, probable depression, and probable anxiety. For SGRQ, each one-point increase in CAT was associated with an estimated 1.048-point higher SGRQ score (95% CI 0.759-1.337; p<0.001). Lower FEV_1 percentage predicted was independently associated with higher SGRQ (B=-0.165, 95% CI -0.249 to -0.080; p<0.001), while probable depression was associated with an additional 2.396-point increase in SGRQ (95% CI 0.136-4.656; p=0.038). The SGRQ model explained a large proportion of observed variability (R^2=0.897; adjusted R^2=0.889; overall p<0.001).

For the estimated EQ-5D index, CAT demonstrated an independent inverse association (B=-0.0120 per CAT point, 95% CI -0.014 to -0.010; p<0.001). Higher FEV_1 was independently associated with better EQ-5D status (B=0.0011, 95% CI approximately 0.0004-0.0018; p=0.004), whereas probable depression was associated with a 0.059 lower EQ-5D index (95% CI -0.078 to -0.040; p<0.001). Age, COPD duration, mMRC grade, and probable anxiety did not retain statistically significant independent associations after simultaneous adjustment. The EQ-5D model yielded R^2=0.920 and adjusted R^2=0.913 (overall p<0.001) (Table 6).

Table 6. Exploratory Multivariable Linear Regression of Factors Associated With SGRQ and Estimated EQ-5D

Predictor	SGRQ B (95% CI)	p-value	Estimated EQ-5D B (95% CI)	p-value
CAT score, per point	1.048 (0.759 to 1.337)	<0.001	-0.0120 (-0.014 to -0.010)	<0.001
mMRC grade, per grade	1.814 (-0.207 to 3.834)	0.078	0.0018 (-0.015 to 0.019)	0.830
FEV_1, % predicted	-0.165 (-0.249 to -0.080)	<0.001	0.0011 (0.0004 to 0.0018)	0.004
COPD duration, years	0.104 (-0.227 to 0.436)	0.533	-0.0001 (-0.003 to 0.003)	0.957
Age, years	-0.009 (-0.151 to 0.133)	0.900	-0.0004 (-0.002 to 0.001)	0.540
Probable depression	2.396 (0.136 to 4.656)	0.038	-0.059 (-0.078 to -0.040)	<0.001
Probable anxiety	0.621 (-2.107 to 3.349)	0.652	-0.006 (-0.029 to 0.017)	0.609

SGRQ model: R^2=0.897; adjusted R^2=0.889; overall p<0.001. Estimated EQ-5D model: R^2=0.920; adjusted R^2=0.913; overall p<0.001. B represents the unstandardized regression coefficient. Binary psychological variables were entered as absence versus presence. Abbreviations: CAT, COPD Assessment Test; CI, confidence interval; COPD, chronic obstructive pulmonary disease; EQ-5D, EuroQol five-dimension health index; FEV_1, forced expiratory volume in one second; mMRC, modified Medical Research Council; SGRQ, St George's Respiratory Questionnaire.

Collectively, the analyses demonstrated substantial symptom and quality-of-life burden in the study population. Approximately four-fifths of participants had CAT >10 and mMRC ≥2, and more than half were classified as having compromised HRQoL. Increasing GOLD airflow limitation severity was accompanied by worsening CAT, mMRC, SGRQ, and EQ-5D profiles. However, CAT and mMRC demonstrated stronger bivariate relationships with quality-of-life measures than FEV_1 percentage predicted. CAT remained strongly associated with SGRQ and estimated EQ-5D after adjustment for demographic, physiological, and psychological characteristics, while probable depression contributed additional independent information to both quality-of-life outcomes.

DISCUSSION

The present study demonstrates a substantial multidimensional burden of COPD among the studied Pakistani patients. Nearly four-fifths of participants had CAT scores >10, more than four-fifths had mMRC grades ≥2, the mean SGRQ score approached 60, and slightly more than half were classified as having compromised HRQoL. These findings indicate that clinically important COPD burden in this population extended well beyond physiological airflow limitation. Contemporary COPD assessment similarly recognizes that symptoms, functional limitation, exacerbation risk, comorbidities, and patient-perceived health status provide complementary information to spirometry and should be considered together when evaluating disease impact (2,7).

The magnitude of HRQoL impairment observed in this study is broadly consistent with previous Pakistani evidence. Zafar reported impaired HRQoL among COPD patients in Karachi and identified relationships between quality-of-life measures and age, smoking, disease severity, and spirometric parameters (4). More recent Pakistani research has similarly demonstrated that compromised HRQoL remains common among patients with COPD. In a 2023 cross-sectional study from Rawalpindi, Sabir et al. found compromised quality of life in approximately half of patients, with advancing age and longer disease duration associated with poorer health status (15). A 2025 study from Haripur also documented substantial HRQoL impairment among Pakistani patients with COPD, reinforcing the persistence of this problem across different local clinical settings (16). Together with the present findings, these observations suggest that quality-of-life impairment represents a major component of COPD morbidity in Pakistan and deserves routine clinical assessment rather than being inferred solely from spirometric staging.

One of the most important findings was the strong relationship between CAT score and both disease-specific and generic measures of health status. CAT correlated strongly with SGRQ (ρ=0.869) and inversely with the estimated EQ-5D index (ρ=-0.846). These relationships were stronger than those observed between FEV_1 and either quality-of-life measure. This pattern is biologically and clinically plausible because CAT incorporates several dimensions directly experienced by the patient, including cough, sputum, chest symptoms, breathlessness, activity limitation, sleep, confidence, and energy, whereas FEV_1 primarily quantifies one physiological dimension of COPD. The original CAT validation demonstrated a strong relationship with respiratory health status measured using the SGRQ, and subsequent systematic evaluation confirmed that CAT provides a reliable and responsive representation of COPD-related health impairment (6,7). More recent cross-sectional validation in patients with COPD in rural Uganda found a strong CAT-SGRQ correlation of approximately 0.79, closely supporting the magnitude and direction observed in the present study (17).

Dyspnea also emerged as an important marker of patient-perceived disease burden. More than 80% of participants had mMRC grade ≥2, and mMRC showed strong associations with both SGRQ and EQ-5D. Patients with greater dyspnea had substantially poorer quality-of-life profiles. These findings support the concept that limitation produced by breathlessness represents one of the most consequential manifestations of COPD. CAT and mMRC should nevertheless not be regarded as interchangeable instruments. Recent evidence has demonstrated clinically relevant discordance between the two scales because CAT captures a broader spectrum of symptoms and health effects, whereas mMRC is focused principally on activity-related dyspnea (18). The strong but non-identical relationships observed in the present analysis therefore support using both tools when feasible, particularly when attempting to understand why patients with similar airflow limitation report different degrees of disability.

Quality-of-life impairment also showed a clear gradient according to GOLD airflow limitation stage. Median SGRQ increased substantially from GOLD 1 to GOLD 2 and GOLD 3, while estimated EQ-5D declined in parallel. The proportion classified with compromised HRQoL increased from 0% in GOLD 1 to 45.3% in GOLD 2 and 94.4% in GOLD 3. These findings confirm that greater physiological disease severity remains relevant to perceived health status. However, the weaker correlations of FEV_1 with SGRQ and EQ-5D compared with CAT and mMRC demonstrate that

spirometry cannot fully account for the patient's health experience. Studies evaluating EQ-5D and disease-specific measures in COPD have similarly shown worsening health utility with increasing clinical severity while emphasizing that generic and respiratory-specific instruments capture complementary dimensions (9). A 2024 systematic review and meta-analysis of EQ-5D utility values in COPD further demonstrated substantial heterogeneity according to disease stage, geographical region, and measurement approach, supporting context-specific interpretation of utility estimates rather than reliance on a single generalized value (19).

Respiratory symptoms contributed additional information to quality-of-life impairment. Frequent cough was associated with significantly poorer SGRQ and EQ-5D values, while phlegm was associated with significantly worse SGRQ scores. Cough and sputum may disrupt daily activities, sleep, communication, social participation, and perceptions of disease control even when their relationship with spirometric impairment is modest. Recent symptom-burden research has emphasized that individuals with COPD frequently experience multiple simultaneous physical and psychological symptoms rather than isolated dyspnea alone (20). This multidimensional symptom load provides further justification for symptom-focused clinical assessment rather than exclusive reliance on lung-function parameters.

Psychological morbidity was also prominent. Probable depression was present in 57.0% of participants and probable anxiety in 20.4%. Participants screening positive for probable depression had significantly poorer SGRQ and EQ-5D outcomes, and depression retained an independent association with both quality-of-life measures in exploratory multivariable models. This finding is consistent with evidence showing close relationships among psychological symptoms, COPD symptom severity, and impaired HRQoL. Çinar Özdemir and Özonay reported significant relationships among anxiety, depression, CAT scores, and SGRQ outcomes in patients with stable COPD (21). Roberts et al. similarly found that anxiety and depression were independently associated with greater overall symptom burden in patients with moderate-to-severe COPD (20). More recent work has also demonstrated a high prevalence of psychiatric comorbidity among COPD populations, with depression and anxiety contributing to poorer patient-reported health status (22). These findings support integrating psychological screening into comprehensive COPD assessment, particularly among individuals reporting disproportionate symptom or quality-of-life impairment.

The exploratory multivariable analyses reinforce the clinical importance of symptom-centred assessment. CAT remained independently associated with both SGRQ and estimated EQ-5D after adjustment for age, COPD duration, FEV_1, mMRC, probable depression, and probable anxiety. FEV_1 retained an independent association with both outcomes, confirming that physiological impairment remains relevant, but its effect was accompanied by strong patient-reported symptom associations. Probable depression additionally remained associated with poorer SGRQ and EQ-5D values. Recent international evidence is compatible with this multidimensional pattern. Jarab et al. found that COPD HRQoL was associated with disease severity, age, comorbidity, socioeconomic characteristics, and treatment-related factors (23), while a 2025 clinical-practice study from Nigeria identified high CAT and mMRC scores as independent determinants of poorer SGRQ-defined HRQoL (24). The consistency of these findings across markedly different settings suggests that symptom intensity and functional breathlessness may provide clinically useful information beyond spirometric classification.

The mean estimated EQ-5D index of 0.500 in the present study indicates substantial impairment in generic health status. This value is lower than the pooled mean utility reported in a recent systematic review of COPD studies, although direct numerical comparison must be cautious because EQ-5D values vary by instrument version, valuation set, population, disease severity, comorbidity profile, and geographical context (19). The strong inverse association between CAT and estimated EQ-5D in the current analysis suggests that increasing respiratory symptom burden is accompanied by broader losses in perceived health. Simultaneous use of disease-specific and generic instruments may therefore be valuable when both clinical severity and wider health utility are of interest.

The study has several strengths. It evaluated COPD burden using multiple complementary domains, including spirometry, GOLD airflow limitation stage, CAT, mMRC, respiratory symptoms, SGRQ, estimated EQ-5D, and psychological screening variables. Availability of participant-level data permitted direct examination of correlations and subgroup patterns rather than reliance solely on aggregate comparisons. The simultaneous evaluation of respiratory-specific and generic health outcomes also provided a broader representation of disease burden. Nevertheless, the findings should be interpreted within the limitations of a cross-sectional design.

Temporal direction cannot be established, and associations between symptoms, psychological morbidity, pulmonary function, and HRQoL should not be interpreted as causal. The single-institution setting and sample size of 93 participants may limit generalizability to the wider Pakistani COPD population, and the very small GOLD 4 subgroup limits interpretation of estimates for the most severe airflow limitation category. Psychological variables represent probable depression and probable anxiety based on screening classifications rather than diagnostic psychiatric interviews. In addition, the exploratory regression models included correlated measures of symptom burden, particularly CAT and mMRC, which may reduce the apparent independent contribution of overlapping constructs.

These findings have practical implications for COPD assessment in Pakistan. Spirometry remains essential for documenting and grading airflow limitation, but the present results indicate that physiological severity alone is unlikely to identify the full burden experienced by patients. Routine incorporation of brief measures such as CAT and mMRC, combined where appropriate with disease-specific HRQoL assessment and screening for depression or anxiety, could provide a more patient-centred characterization of COPD. Such an approach is particularly relevant in settings where healthcare resources are constrained and rapid identification of patients with substantial functional or psychological burden may facilitate prioritization for more comprehensive evaluation, pulmonary rehabilitation, symptom management, exposure reduction, and psychosocial support (2,20,24).

CONCLUSION

Patients with COPD in this Pakistani cross-sectional sample experienced substantial symptom burden, dyspnea, and impairment in both respiratory-specific and generic quality of life. Higher CAT and mMRC scores, greater airflow limitation, respiratory symptoms, and probable depression were associated with poorer HRQoL, while CAT demonstrated the strongest relationship with both SGRQ and estimated EQ-5D outcomes. These findings indicate that spirometric severity alone does not fully represent the burden experienced by patients with COPD. Integrating patient-reported symptom measures, functional dyspnea assessment, pulmonary function, quality-of-life evaluation, and psychological screening may provide a more comprehensive clinical characterization of COPD in Pakistani healthcare settings.

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