Biological and Clinical Sciences Research Journal
eISSN: 2708-2261; pISSN: 2958-4728
www.bcsrj.com
DOI: https://doi.org/10.54112/bcsrj.v7i3.2001
*Biol. Clin. Sci. Res. J., Volume 7(3), **2026**: 2001*
Original Research Article

Risk Assessment of Diabetes Mellitus in Chronic Obstructive Pulmonary Disease (COPD) Patients Visiting Tertiary Care Hospitals in Peshawar, Pakistan

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(Received, 24th November 2025, Accepted 8th December 2025, Published 31st March 2026)

Abstract: *Chronic Obstructive Pulmonary Disease (COPD) is a major cause of morbidity and mortality worldwide and is frequently associated with systemic comorbidities, particularly Type 2 Diabetes Mellitus (T2DM). The coexistence of COPD and diabetes may worsen clinical outcomes, yet limited data exist regarding this association in Peshawar, Pakistan.* ***Objective:*** *To assess the prevalence and risk of diabetes mellitus among COPD patients attending tertiary care hospitals in Peshawar.* ***Methods:*** *A hospital-based study was conducted among 100 confirmed COPD patients at Hayatabad Medical Complex, Khyber Teaching Hospital, and Lady Reading Hospital from September to December 2023. Demographic and clinical data were collected using a structured questionnaire. COPD severity was evaluated using spirometry and GOLD classification. Glycemic status was assessed using HbA1c and random blood glucose levels. Data were analyzed using SPSS version 25, and associations were tested using the chi-square test with $p < 0.05$ considered significant.* ***Results:*** *Among the participants, 64% were male, and most were aged 60–69 years. Severe disease (GOLD stage D) was observed in 76% of patients. HbA1c results showed that 33% of patients had diabetes and 14% were pre-diabetic. Significant associations were observed between BMI and diabetes status ($p = 0.026$) and between GOLD stage and diabetes status ($p = 0.001$). COPD awareness among patients was very limited.* ***Conclusion:*** *Diabetes and pre-diabetes are common among COPD patients in Peshawar, particularly in advanced disease stages, highlighting the need for routine metabolic screening and integrated disease management.*

Keywords: COPD, Diabetes mellitus, HbA1c, GOLD stage, Comorbidity

[***How to Cite:*** Romasa, Ihtisham S, Hafsa. Risk Assessment of Diabetes Mellitus in Chronic Obstructive Pulmonary Disease (COPD) Patients Visiting Tertiary Care Hospitals in Peshawar, Pakistan. *Biol. Clin. Sci. Res. J.*, **2026;** 7(3): 1-5. doi: https://doi.org/10.54112/bcsrj.v7i3.2001

Introduction

Chronic Obstructive Pulmonary Disease (COPD) is a prevalent, preventable, and treatable chronic inflammatory disorder characterized by persistent respiratory symptoms and incompletely reversible airflow limitation, representing a leading cause of morbidity and mortality worldwide (1). Beyond its primary pulmonary manifestations, COPD is increasingly recognized as a systemic disease associated with a broad spectrum of comorbidities, among which Diabetes Mellitus (DM) has emerged as particularly significant (2). Type 2 Diabetes Mellitus (T2DM) is a common comorbidity in COPD patients, with prior research indicating that individuals with COPD carry a 1.17 to 1.26 times higher risk of developing T2DM compared to the general population (3). The coexistence of these two conditions is mechanistically plausible, as COPD-associated sedentary lifestyle, systemic inflammation, adiposity, and corticosteroid therapy collectively promote insulin resistance and impaired glucose metabolism (4).

Epidemiological evidence consistently demonstrates a substantial burden of T2DM among COPD patients. Al-Ani et al. reported a prevalence of T2DM of 19.38% among COPD patients, rising to 35.4% in those with very severe disease, with lung function declining more markedly in patients with concurrent T2DM (5). Similarly, Sridhara et al. found a prevalence of diabetes mellitus of 35.8% among COPD patients in a tertiary care setting, with comorbidities including diabetes independently associated with increased frequency of hospitalization ($p < 0.001$) (6). Furthermore, Ahmed et al. demonstrated that pulmonary function was most severely impaired in patients with concurrent COPD and DM, establishing DM as an independent risk factor for reduced lung function irrespective of smoking status (7). Liang et al. further confirmed that metformin use in patients with concurrent DM and COPD reduced the risk of COPD-related hospitalizations (RR 0.72, 95% CI 0.53–0.98) and all-cause mortality (RR 0.60, 95% CI 0.36–1.01), underscoring the clinical importance of identifying and managing DM in this population (8).

In Pakistan, COPD represents a significant public health burden, with smoking, biomass fuel exposure, and occupational hazards serving as predominant risk factors (9). Baloch et al. documented that hypertension and diabetes mellitus were among the most common comorbidities in COPD exacerbated patients at a tertiary care hospital in Karachi (9). In Peshawar specifically, Haseebullah et al. reported that COPD was predominantly prevalent in males aged 41–50 years, with associated comorbidities including hypertension (14.3%) and diabetes (10). Despite this evidence, a dedicated risk assessment of DM in COPD patients within Peshawar's tertiary care context remains absent from the literature. Given the region's unique demographic, socioeconomic, and lifestyle characteristics, including high smoking prevalence and limited healthcare access, such a study is critically needed to inform targeted screening and management strategies for this vulnerable population.

Methodology

A hospital-based randomized controlled study was conducted among patients diagnosed with chronic obstructive pulmonary disease (COPD). The study was carried out in the pulmonology departments of three tertiary care hospitals in Peshawar, Khyber Pakhtunkhwa, Pakistan: Hayatabad Medical Complex (HMC), Khyber Teaching Hospital (KTH), and Lady Reading Hospital (LRH). Data collection was performed over four months from September 2023 to December 2023. Ethical approval for the study was obtained from the Institutional Ethical Committee of Lady Reading Hospital, Peshawar, on 17 August 2023. Written informed consent was obtained from all participants prior to enrollment. The study included 100 patients with confirmed COPD, aged 23-79 years, who

attended the pulmonology outpatient or inpatient departments during the study period.

Participants were recruited using predefined eligibility criteria. Patients with a clinical diagnosis of COPD, confirmed by a pulmonologist and supported by spirometry findings, were eligible for inclusion. Patients with incomplete clinical records, acute respiratory infections at the time of data collection, or those unwilling to participate were excluded. A structured and standardized questionnaire was developed in consultation with a pulmonologist to obtain relevant demographic and clinical information. The questionnaire collected data on age, gender, body mass index (BMI), smoking history, duration of COPD diagnosis, respiratory symptoms, breathing frequency, and Global Initiative for Chronic Obstructive Lung Disease (GOLD) stage classification. In addition, a twenty-one-item questionnaire was used to assess patients' health literacy, knowledge of basic human anatomy, and awareness regarding COPD. Each participant completed the questionnaire through a face-to-face interview conducted by trained research personnel, and the average completion time was approximately 20 minutes.

For laboratory analysis, venous blood samples were collected from each participant under aseptic conditions in gel tubes at the participating tertiary care facilities. The blood samples were allowed to clot and were subsequently centrifuged at room temperature for approximately 10 minutes to separate plasma and cellular components. The plasma fraction was transferred into sterile tubes and further centrifuged for an additional 15 minutes to ensure complete separation of platelets and other residual cellular elements. The resulting serum supernatant was carefully transferred into labeled serum cups using sterile droppers. To preserve biochemical stability and prevent degradation of trace components, the serum samples were temporarily stored at low temperature prior to biochemical analysis.

Pulmonary function was evaluated using spirometry to assess lung function parameters, particularly the forced expiratory volume in one second (FEV_1) and forced vital capacity (FVC), and the FEV_1/FVC ratio was calculated for each participant to confirm COPD severity according to GOLD criteria. Glycemic status was assessed using glycated hemoglobin (HbA1c) analysis and random blood glucose (RBG) measurement. HbA1c levels were determined using ion-exchange high-performance liquid chromatography (HPLC) with the BIO-RAD VARIANT II TURBO system. The reported HbA1c values were categorized into normal, pre-diabetes, and diabetes according to standard clinical thresholds. Random blood glucose levels were measured using standard biochemical laboratory procedures, and the results were similarly categorized into normal, pre-diabetic, and diabetic ranges for analysis.

All collected data were entered and analyzed using the Statistical Package for Social Sciences (SPSS) version 25. Descriptive statistics were used to summarize the participants' demographic and clinical characteristics. Continuous variables were expressed as means with standard deviations where appropriate, while categorical variables were presented as frequencies and percentages. Associations between categorical variables were examined using the Pearson chi-square test. Data accuracy was verified by cross-checking the entered data against the original data collection forms. A p-value of less than 0.05 was considered to indicate statistical significance.

Results

The demographic characteristics of the study participants are presented in Table I. Among the total participants, 64 (64%) were male and 36 (36%) were female. Regarding age distribution, the largest proportion of patients belonged to the 60–69 years age group (31%), followed by 50–59 years (28%), 40–49 years (15%), above 70 years (12%), 20–29 years (9%), and 30–39 years (5%). Most participants were therefore from the older age groups. With respect to body mass index (BMI), 51 (51%) participants had normal BMI (<25), 34 (34%) were overweight (25–29), and 15 (15%) were obese (≥30) (Table 1).

Table 1. Demographic characteristics of the study population (n = 100)

Variable	Response options	n	%	P-value
Gender	Male	64	64	0.007
	Female	36	36	
Age (years)	20–29	9	9	0.000
	30–39	5	5	
	40–49	15	15	
	50–59	28	28	
	60–69	31	31	
	Above 70	12	12	
BMI	Normal (<25)	51	51	0.000
	Overweight (25–29)	34	34	
	Obese (≥30)	15	15	

The clinical profile of COPD patients, including GOLD stages, smoking status, and diabetes status, is summarized in Table II. Most patients were classified in GOLD stage D (76%), followed by stage C (13%), stage B (7%), and stage A (4%). Regarding smoking status, 24 (24%) patients reported smoking, while 76 (76%) were non-smokers. Glycemic status, based on HbA1c, showed that 53% of participants had normal levels, 14% were prediabetic, and 33% were diabetic. Similar findings were observed with random blood glucose (RBG) results, where 53% were normal, 15% were pre-diabetic, and 32% were diabetic (Table 2).

Table 2. Distribution of COPD patients according to GOLD stage, smoking status, and diabetes status (n = 100)

Variable	Response options	n	%	P-value
GOLD stage	A	4	4	0.000
	B	7	7	
	C	13	13	
	D	76	76	
Smoking status	Yes	24	24	0.000
	No	76	76	
HbA1c	Normal	53	53	0.000
	Pre-diabetes	14	14	

	Diabetes	33	33	
RBG	Normal	53	53	0.000
	Pre-diabetes	15	15	
	Diabetes	32	32	

The distribution of COPD patients according to diabetes status and associated characteristics is presented in Table III. Among males, 15% were normal, 7% were pre-diabetic, and 14% were diabetic, while among females, 38% were normal, 8% were pre-diabetic, and 18% were diabetic. In terms of age groups, diabetes prevalence was higher in the older age categories, particularly in the 50–59, 60–69, and above 70 years groups. BMI analysis showed a statistically significant association with diabetes status (p = 0.026), where individuals with normal BMI had the highest proportion of diabetes (23%), followed by overweight (8%) and obese individuals (1%). No significant association was observed between duration of COPD diagnosis and diabetes status (p = 0.572). A significant association was observed between GOLD stage and diabetes status (p = 0.001), with the majority of diabetic patients belonging to GOLD stage D (Table 3).

Table 3. Profile of COPD patients according to diabetes status (n = 100)

Variable	Response options	Normal	Pre-diabetes	Diabetes	P-value
Gender	Male	15	7	14	0.214
	Female	38	8	18	
Age (years)	20–29	4	2	3	0.104
	30–39	2	1	2	
	40–49	10	3	2	
	50–59	11	4	13	
	60–69	22	4	5	
	Above 70	4	1	7	
BMI	Normal (<25)	23	5	23	0.026
	Overweight (25–29)	20	6	8	
	Obese (≥30)	10	4	1	
Length of diagnosis	0–1 years	3	3	5	0.572
	2–5 years	23	7	12	
	6–10 years	18	4	9	
	>10 years	9	1	6	
GOLD stage	A	3	0	1	0.001
	B	7	0	0	
	C	12	1	0	
	D	31	14	31	

The level of awareness and perceptions regarding COPD among the study participants is presented in Table IV. Most participants reported coughing most days of the week (99%) and experiencing dyspnea more than people of the same age (99%). Sputum production was reported by 72% of participants. Regarding smoking history, 24% reported smoking, while 76% had never smoked. When asked about the organ primarily affected by COPD, 55% correctly identified the lungs, while 45% did not know. Only 7% of participants knew the meaning of COPD, whereas 93% were unaware of it. Nearly half of the participants (49%) believed COPD medications could cause addiction, while 36% were uncertain. A considerable proportion of patients were unsure about disease transmission (51%) and treatment availability (65%). Regarding causes of COPD, 23% considered cough as the major factor, 18% shortness of breath, 17% smoking, while 42% were unaware of the cause. Only 2% of participants reported reading educational materials related to COPD, while 98% had not accessed any information sources (Table 4).

Table 4. COPD awareness and knowledge among participants (n = 100)

COPD Knowledge Questions	Response options	n	%
Do you cough most days of the week?	Yes	99	99
	No	1	1
Do you have sputum most days of the week?	Yes	72	72
	No	28	28
Do you suffer more dyspnea than people of your age?	Yes	99	99
	No	1	1
Do you currently smoke, or have you ever smoked?	Yes	24	24
	No	76	76
What organ is most affected by COPD?	Lungs	55	55
	Don’t know	45	45
Do you know what COPD stands for?	Yes	7	7
	No	93	93
Do COPD drugs cause addiction?	Yes	49	49
	No	15	15
	Don’t know	36	36
Do COPD drugs cause weight gain?	Yes	44	44
	No	23	23

	Don't know	33	33
Can COPD spread from person to person?	Yes	34	34
	No	15	15
	Don't know	51	51
Does COPD have treatment?	Yes	31	31
	No	4	4
	Don't know	65	65
The main cause of COPD	Cough	23	23
	Smoking	17	17
	Shortness of breath	18	18
	Don't know	42	42
Have you read any information about COPD?	Yes	2	2
	No	98	98

Discussion

The present study found that 64% of COPD patients were male and 36% were female, with a statistically significant gender difference ($p = 0.007$). Similar findings have been reported in previous studies. Kumar et al. reported that 64.2% of COPD patients in a North Indian cohort were male and 35.7% were female (11). Haseebullah et al. also documented a strong male predominance (84%) among COPD patients in tertiary care hospitals of Peshawar (10). Al-Ani et al. further reported that males were more likely to have T2DM among COPD patients (6). The higher proportion of males in our study may be related to greater exposure to smoking and occupational dust among men in South Asian settings (10).

Most patients in our study were older adults, with the largest proportion in the 60–69-year age group (31%), followed by the 50–59-year age group (28%). Al-Ani et al. similarly reported increased prevalence of T2DM among COPD patients older than 61 years (6). Liao et al. also found that age was significantly associated with diabetes awareness and care behaviors among COPD patients with T2DM ($p < 0.05$) (7). These findings support the understanding that COPD and related metabolic comorbidities are more common in older populations (12).

Regarding BMI, 51% of participants had normal BMI, 34% were overweight, and 15% were obese. A significant association between BMI and diabetes status was observed ($p = 0.026$), with a notable proportion of diabetic patients having normal BMI. Gupta et al. reported that obesity is more common in early COPD stages, whereas advanced COPD is often associated with weight loss and cachexia (13). Kumar et al. also reported a mean BMI of 26.22 ± 7.22 kg/m² among COPD patients and highlighted the presence of metabolic syndrome even in non-obese individuals (11). Su et al. suggested that the relationship between obesity, diabetes, and COPD remains complex and inconsistent across studies (12).

In terms of disease severity, the majority of patients were classified in GOLD stage D (76%), followed by stage C (13%), stage B (7%), and stage A (4%). Santos et al. reported that comorbidities, such as diabetes, are more frequent in advanced stages of COPD (14). Similarly, Al-Ani et al. found that diabetes prevalence increased with COPD severity, rising to 35.4% in very severe COPD (6). Bera et al. also observed higher diabetes prevalence among patients with severe and very severe COPD (15). Our study showed a significant association between GOLD stage and diabetes status ($p = 0.001$), with most diabetic patients belonging to stage D.

Only 24% of participants were active smokers, while 76% were non-smokers. This suggests that non-tobacco factors such as biomass fuel exposure, indoor air pollution, and occupational dust may contribute substantially to COPD in this region. Haseebullah et al. reported that smoking remains a major cause of COPD in Peshawar, although a considerable number of patients were non-smokers (10). Tønnesen et al. found that 51.5% of COPD patients had a history of smoking, and quit rates were relatively low (16). Gonçálves et al. reported an active smoking prevalence of 44.9% among COPD patients, higher than that observed in our study (17).

Our study found that 33% of COPD patients were diabetic and 14% were pre-diabetic according to HbA1c results, giving a combined dysglycemia prevalence of 47%. Random blood glucose results were similar, showing 32% diabetes and 15% pre-diabetes. Previous studies have reported diabetes prevalence among COPD patients ranging from 2% to 37% (18). Sridhara et al. reported a prevalence of 35.8% in a tertiary care setting (8), while Al-Ani et al. reported an overall prevalence of 19.38% (6). Gonçálves et al. found that 38% of COPD patients had diabetes and that diabetes increased the risk of COPD-related hospital admissions (19). Pangaribuan et al. reported 21.9% diabetes and 25% pre-diabetes among COPD patients in Indonesia (20). Bera et al. reported a prevalence of 27% among 1,200 COPD patients (15). The relatively higher prevalence observed in our study may be related to the advanced disease severity of the study population.

HbA1c assessment also highlighted poor glycemic control among COPD patients. Bera et al. reported that 63.9% of COPD patients with diabetes had HbA1c levels between 7–10%, and 28.6% had levels above 10% (15). Liao et al. found that 55.6% of COPD patients with diabetes had HbA1c values above 7%, which was associated with higher mortality (7). These findings emphasize the importance of routine glycemic monitoring in patients with COPD.

Our results also showed a significant association between GOLD stage and diabetes ($p = 0.001$). Ghafil et al. reported similar findings, showing that diabetes and other comorbidities were more common in severe COPD groups (21). Covanțev et al. explained that systemic inflammation, oxidative stress, and corticosteroid therapy in COPD may contribute to insulin resistance and the Development of diabetes (20). Dewi et al. further highlighted that inflammatory pathways such as IL-8 activation may play a role in the pathogenesis of diabetes in COPD patients (22).

Symptom prevalence in our study was high: 99% of participants reported frequent coughing and dyspnea, and 72% reported sputum production. Chaisuksant et al. also reported that dyspnea and chronic cough were common symptoms among COPD patients attending tertiary care centers (3). The high symptom burden in our cohort reflects the predominance of advanced COPD.

A major finding of this study was the poor level of COPD awareness among patients. Only 7% knew the meaning of COPD, and only 2% had accessed educational material about the disease. Liao et al. similarly reported low knowledge and poor self-care behaviors among COPD patients with diabetes (7). In addition, misconceptions were common in our population: 49% believed COPD medicines could cause addiction, 44% believed they caused weight gain, and 34% believed the disease was contagious. Santos et al. emphasized that patient education is essential for improving outcomes in COPD patients with comorbidities such as diabetes (14).

Overall, the study demonstrates a substantial burden of diabetes and pre-diabetes among COPD patients, along with limited disease awareness and advanced disease severity. Cave et al. reported that COPD significantly increases the risk of developing diabetes (23). Liang et al. showed that metformin use in patients with both COPD and diabetes reduced COPD-related hospitalizations and mortality (9). Gunasekaran et al. also reported that COPD patients with diabetes have higher risks of pneumonia, respiratory failure, stroke, and acute kidney injury during hospitalization (24). These findings support the need for routine HbA1c screening and

integrated COPD–diabetes management strategies in tertiary care hospitals.

Conclusion

The study demonstrates a high prevalence of diabetes and pre-diabetes among COPD patients in tertiary care hospitals in Peshawar, particularly among those with advanced disease stages. Limited patient awareness regarding COPD further compounds the clinical burden. Routine glycemic screening and integrated management strategies addressing both COPD and metabolic comorbidities may improve patient outcomes in this population.

Declarations

Data Availability statement
All data generated or analysed during the study are included in the manuscript.
Ethics approval and consent to participate
Approved by the department concerned. (IRBEC-IUCP-3-23)
Consent for publication
Approved
Funding
Not applicable

Conflict of interest

The authors declared no conflict of interest.

Author Contribution

R
Manuscript drafting, Study Design,
SI
Review of Literature, Data entry, Data analysis, and drafting articles.
H
Conception of Study, Development of Research Methodology Design

All authors reviewed the results and approved the final version of the manuscript. They are also accountable for the study's integrity.

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