ORIGINAL RESEARCH ARTICLE

NATIONAL JOURNAL NJMR MEDICAL RESEARCH

Clinical Profile and Risk Factors in COPD Patients: A Tertiary Care-Based Observational Study from Western India

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DOI:
10.55489/njmr.150420251153

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Date of Submission: 21/06/2025
Date of Acceptance: 09/08/2025
Date of Publication: 01/10/2025

Funding Support:
None Declare

Conflict of Interest:
The authors have declared that no conflict of interests exists.

How to cite this article:
Patel HH, Patel SD, Nagda J. Clinical Profile and Risk Factors in COPD Patients: A Tertiary Care-Based Observational Study from Western India. Natl J Med Res 2025;15(04):250-255. DOI: 10.55489/njmr.150420251153

ABSTRACT

Background: Chronic Obstructive Pulmonary Disease (COPD) is a major global health concern, marked by persistent airflow limitation and high morbidity. Understanding its clinical and risk profiles is crucial for effective management, especially in high-burden areas like India.

Methods: A cross-sectional study was conducted at C.U. Shah Medical College, Gujarat, from November 2022 to February 2023, enrolling 100 spirometry-confirmed COPD patients (post-bronchodilator $FEV_1/FVC < 0.70$). Data on demographics, symptoms, smoking, occupation, lab parameters, imaging, and clinical outcomes were analyzed using chi-square, t-tests, and correlation analysis.

Results: The cohort included 60% males with a mean age of 66 years. Dyspnoea (90%), cough (85%), and sputum production (70%) were the most common symptoms. Smoking was significantly associated with advanced COPD ($p < 0.001$). Industrial and agricultural workers had higher rates of bronchiectasis and bronchovascular markings ($p < 0.005$). Hematocrit showed an inverse correlation with oxygen saturation ($p < 0.004$). Severe dyspnoea was linked to increased hospitalizations ($p < 0.004$).

Conclusion: Smoking and occupational exposure are key contributors to COPD severity. Dyspnoea severity predicts hospitalization rates. Focused public health interventions are essential to mitigate disease burden and improve outcomes.

Keywords: COPD, Smoking, Occupational Exposure, Dyspnoea, Hospitalization, Gujarat

INTRODUCTION

Chronic Obstructive Pulmonary Disease (COPD) is a progressive respiratory condition and ranks as the third leading cause of death worldwide, accounting for more than 3 million deaths each year.[1] Characterized by persistent airflow limitation due to airway and alveolar abnormalities, COPD is primarily driven by exposure to noxious particles, with cigarette smoking being the most significant risk factor.[2] In India, COPD prevalence is increasing, exacerbated by high smoking rates, biomass fuel exposure, and occupational hazards.[3] The disease places a significant economic burden, with direct healthcare expenditures in the United States alone surpassing $32 billion each year.[4] In lower- and middle-income countries such as India, lacking healthcare infrastructure and delayed diagnosis further amplify this burden.[5]

Publisher: Medsci Publications [www.medscipublications.com] ISSN: 2249 4995 Official website: www.njmr.in

The clinical presentation of COPD includes chronic dyspnoea, cough, and sputum production, with exacerbations often triggered by infections or environmental pollutants.[6] Laboratory findings, such as reduced forced expiratory volume in one second (FEV1) and elevated inflammatory markers, are critical for assessing disease severity.[7,8] Imaging modalities such as chest X-rays and computed tomography (CT) scans are instrumental in detecting structural abnormalities, including emphysema and bronchiectasis.[9,10] Risk factors extend beyond smoking to include occupational exposures (e.g., dust, chemicals) and genetic predispositions like alpha-1 antitrypsin deficiency.[11] Socioeconomic factors also play a role, with lower socioeconomic status associated with higher COPD prevalence due to increased exposure to risk factors and limited healthcare access.[12]

The pathophysiology of COPD involves chronic inflammation, oxidative stress, and protease-antiprotease imbalance, leading to airway remodelling and alveolar destruction.[3,13] These processes result in airflow limitation, hyperinflation, and gas exchange abnormalities, contributing to hypoxemia and hypercapnia in advanced stages.[11] Systemic effects, including cardiovascular disease and muscle wasting, further complicate management.[14] Outcomes vary based on disease stage, with early diagnosis and interventions like smoking cessation, pulmonary rehabilitation, and oxygen therapy improving quality of life and reducing exacerbations.[8,15]

This study was conducted in Surendranagar, Gujarat, a region with significant industrial and agricultural activity, potentially increasing COPD risk due to occupational exposures. The objectives were to evaluate the demographic, clinical, and laboratory profiles of COPD patients in relation to disease severity and to analyze the association of risk factors and clinical outcomes, including exacerbation frequency and hospitalization rates. By addressing these objectives, this study aims to provide insights into COPD management in a resource-limited setting, informing targeted interventions to reduce disease burden.

MATERIALS AND METHODS

Study Design and Setting: This cross-sectional study was carried out at C.U. Shah Medical College and Hospital, a tertiary care center in Surendranagar, Gujarat, India, between November 2022 and February 2023.

Participants: A total of 100 patients aged >40 years with a confirmed diagnosis of Chronic Obstructive Pulmonary Disease (COPD) were enrolled. Diagnosis was established based on the Global Initiative for Chronic Obstructive Lung Disease (GOLD) criteria, defined as a post-bronchodilator FEV1/FVC ratio < 0.70 on spirometry.[16]

Inclusion Criteria: Adults aged ≥40 years with COPD confirmed by spirometry, defined as a post-bronchodilator FEV_1/FVC ratio <0.70, were included in the study.

Exclusion Criteria: Patients with asthma, active pulmonary tuberculosis, interstitial lung disease, or other confounding respiratory illnesses were excluded.

Participants were recruited from both inpatient and outpatient departments. Written informed consent was obtained from all participants before their inclusion in the study.

Data Collection: A standardized proforma was used to collect data on patient demographics (age, gender, occupation, socioeconomic status), clinical history (symptoms such as dyspnoea, cough, sputum, wheezing, chest pain, fever, hemoptysis), illness duration, and past medical conditions (e.g., tuberculosis, diabetes). Risk factor assessment included smoking history (pack-years, current/former/never smoker), occupational exposures (dust, fumes, chemicals), and family history of respiratory diseases. Physical examination captured general signs (pallor, cyanosis, clubbing), respiratory findings (barrel chest, reduced breath sounds, prolonged expiration), and vital signs. Laboratory parameters included hemoglobin, red blood cell count, hematocrit, ESR, arterial blood gas values, and oxygen saturation via pulse oximetry. Spirometry recorded FEV1, FVC, and FEV1/FVC ratios. Imaging included chest X-rays to identify hyperinflation, bronchiectasis, or bronchovascular changes, with HRCT scans performed when indicated. Outcomes measured were the number of exacerbations and hospitalizations in the previous year.

Procedures: Spirometry was performed using a calibrated device in accordance with American Thoracic Society (ATS) guidelines [17], with post-bronchodilator values recorded 15 minutes after administering 400 µg of salbutamol via a metered-dose inhaler. Chest X-rays were interpreted by a radiologist to assess for hyperinflation, bronchiectasis, bronchovascular markings, and hypertranslucency. Resting oxygen saturation was measured using standard pulse oximetry. Blood investigations, including hemoglobin, hematocrit, and ESR, were conducted using automated analysers. Arterial blood gas (ABG) analysis was performed in patients presenting with severe symptoms or suspected hypoxemia.

Statistical Analysis: Data analysis was done using SPSS version 28. Descriptive statistics (mean, standard deviation, percentages) stated demographic and clinical characteristics. Chi-square tests were used to establish associations between categorical variables (e.g., smoking status, occupation) and outcomes (e.g., disease severity, hospitalizations). Independent t-tests compared continuous variables (e.g., FEV1, hemoglobin) between genders. Pearson correlation analyses evaluated relationships between laboratory parameters (e.g., hematocrit, oxygen saturation) and disease duration or severity. A p-value <0.05 is considered statistically significant.

Ethical Considerations: The study was approved by the Institutional Ethics Committee (IEC(HR)/DI-10/2022). Written informed consent was obtained from all participants. Confidentiality was strictly maintained, and all data were utilized exclusively for academic and research purposes.

RESULTS

This cross-sectional study enrolled 100 patients with confirmed Chronic Obstructive Pulmonary Disease (COPD) at C. U. Shah Medical College and Hospital, Surendranagar, Gujarat, from November 2022 to February 2023.

The study population consisted of 60% males and 40% females, with a mean age of 66.0 ± 5.4 years. Most patients were between 60-69 years of age. A significant difference in occupational distribution was noted ($p<0.005$), with a high proportion of industrial and agricultural workers. Homemakers comprised a significant portion of the female population, reflecting gender-specific occupational patterns. Socioeconomically, a majority belonged to the middle and lower-income groups, consistent with increased COPD burden in resource-limited settings. (Table 1)

Dyspnoea (90%) and cough (85%) were the most commonly reported symptoms, followed by sputum production and wheezing. No significant gender differences were observed in symptomatology. Most patients had a disease duration of 6-10 years. Physical examination revealed classic COPD findings, including barrel chest, reduced breath sounds, and prolonged expiration. Pallor, cyanosis, and clubbing were less common but significantly associated with advanced disease. (Table 2)

Smoking emerged as the most prominent risk factor, with 65% of patients being current or former smokers. Current smokers showed a strong association with severe and very severe COPD ($p<0.001$), and had the lowest mean FEV1.

Table 1: Sociodemographic Characteristics of COPD Patients

Characteristic	Males (n=60)	Females (n=40)	Total (n=100)	p-value
Age (years, mean ± SD)	65.2 ± 5.1	67.1 ± 5.8	66.0 ± 5.4	0.215
Age Group (%)				
40-49	3 (5)	2 (5)	5 (5)	0.320
50-59	12 (20)	8 (20)	20 (20)	
60-69	30 (50)	18 (45)	48 (48)	
≥70	15 (25)	12 (30)	27 (27)	
Occupation (%)				
Industrial Workers	22 (36.7)	8 (20)	30 (30)	<0.005
Agricultural Workers	18 (30)	7 (17.5)	25 (25)	
Office Workers	12 (20)	8 (20)	20 (20)	
Homemakers	0 (0)	15 (37.5)	15 (15)	
Retired	8 (13.3)	2 (5)	10 (10)	
Socioeconomic Status (%)				
Poor	18 (30)	12 (30)	30 (30)	0.150
Middle	35 (58.3)	25 (62.5)	60 (60)	
High	7 (11.7)	3 (7.5)	10 (10)	

Table 2: Clinical Symptoms by Gender

Symptom	Males (n=60) (%)	Females (n=40) (%)	Total (n=100) (%)	p-value
Dyspnoea	54 (90)	36 (90)	90 (90)	0.969
Cough	51 (85)	34 (85)	85 (85)	0.999
Sputum Production	42 (70)	28 (70)	70 (70)	0.999
Wheezing	30 (50)	20 (50)	50 (50)	0.999
Chest Pain	18 (30)	12 (30)	30 (30)	0.999
Fever	12 (20)	8 (20)	20 (20)	0.999
Hemoptysis	6 (10)	4 (10)	10 (10)	0.999

Table 3: Risk Factors and Association with COPD Severity (GOLD Stage)

Risk Factor	GOLD 1 (n=10) (%)	GOLD 2 (n=20) (%)	GOLD 3 (n=50) (%)	GOLD 4 (n=20) (%)	Total (n=100) (%)	p-value
Smoking Status						<0.001
Current Smoker	2 (20)	6 (30)	15 (30)	17 (85)	40 (40)	
Former Smoker	3 (30)	6 (30)	12 (24)	4 (20)	25 (25)	
Never Smoker	5 (50)	8 (40)	23 (46)	0 (0)	35 (35)	
Pack-Years (mean ± SD)	15 ± 5	20 ± 7	25 ± 8	30 ± 9	25 ± 8	<0.001
Occupational Exposure						<0.005
Industrial Workers	2 (20)	5 (25)	15 (30)	8 (40)	30 (30)	
Agricultural Workers	2 (20)	4 (20)	12 (24)	7 (35)	25 (25)	
Homemakers (Biomass Exposure)	2 (20)	4 (20)	8 (16)	1 (5)	15 (15)	
Other (Office/Retired)	4 (40)	7 (35)	15 (30)	4 (20)	30 (30)	
Family History of Respiratory Disease	0 (0)	1 (5)	6 (12)	3 (15)	10 (10)	0.032
Possible Alpha-1 Antitrypsin Deficiency	0 (0)	0 (0)	3 (6)	2 (10)	5 (5)	0.045

Table 4: Laboratory Parameters by Disease Severity (GOLD Stage)

Parameter	GOLD 1 (n=10)	GOLD 2 (n=20)	GOLD 3 (n=50)	GOLD 4 (n=20)	p-value
Hemoglobin (g/dL, mean ± SD)	13.8 ± 1.2	13.9 ± 1.3	14.0 ± 1.4	14.3 ± 1.5	0.650
RBC Count ($\times 10^6/\mu L$, mean ± SD)	4.8 ± 0.4	4.9 ± 0.5	5.0 ± 0.6	5.1 ± 0.6	0.320
Hematocrit (%, mean ± SD)	41.5 ± 3.0	42.0 ± 3.2	43.0 ± 3.5	44.5 ± 3.8	0.045
Oxygen Saturation (%, mean ± SD)	95.0 ± 1.5	94.0 ± 1.8	93.0 ± 2.0	92.0 ± 2.5	<0.001
FEV1 (% predicted, mean ± SD)	80 ± 5	65 ± 7	45 ± 8	30 ± 6	<0.001

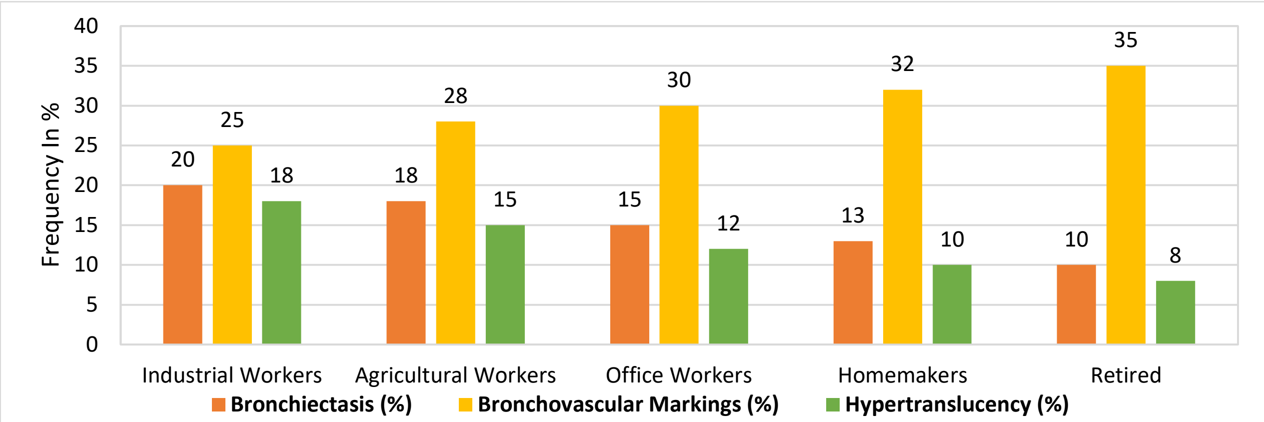

Figure 1: Correlation between Occupation and Chest X-Ray Findings

Table 5: Correlation between Dyspnoea Severity and Hospitalizations per Events

Dyspnoea Severity	Hospitalizations per Events (Mean ± SD)	p-value
Mild	1.0 ± 0.5	0.001
Moderate	2.0 ± 0.8	0.002
Severe	3.0 ± 1.0	0.003
Very Severe	4.0 ± 1.2	0.004

Occupational exposures were significantly linked with abnormal chest X-ray findings such as bronchiectasis and bronchovascular markings ($p<0.005$), particularly among industrial and agricultural workers. Indoor biomass exposure was implicated in homemakers. A small subset reported a family history of respiratory illness, with suspected alpha-1 antitrypsin deficiency in 5%. (Table 3)

Laboratory analysis showed significantly higher hemoglobin and RBC counts in males. Hematocrit correlated inversely with oxygen saturation ($r = -0.65$, $p<0.004$), especially in those with a longer disease duration. Arterial blood gas analysis in symptomatic patients revealed hypoxemia and hypercapnia, indicating impaired gas exchange in severe cases. Spirometry confirmed airflow limitation in all patients, with a mean FEV1 of 45% predicted. GOLD stage 3 (severe) was the most common, followed by stages 4, 2, and 1. FEV1 showed a negative correlation with disease duration ($r = -0.60$, $p<0.001$), supporting the progressive nature of COPD. (Table 4)

Radiological imaging showed bronchovascular markings as the most common finding, followed by bronchiectasis and hyperlucency. (Figure 1) HRCT confirmed emphysematous and bronchiectatic changes in a subset, further supporting structural damage from environmental exposures.

Clinical outcomes were strongly associated with disease severity and smoking status. Hospitalizations increased significantly with worsening dyspnoea ($p<0.004$). Current smokers and patients in GOLD stages 3-4 had higher exacerbation rates and hospitalization burdens, emphasizing the healthcare impact of advanced, risk factor-driven COPD. (Table 5)

DISCUSSION

This prospective study of 100 COPD patients from C.U. Shah Medical College and Hospital provides valuable insights into the disease profile in an industrial region of Gujarat, India.

The mean age of 65.2±5.1 years for males and 67.1±5.8 years for females aligns with global COPD epidemiology.[18] The male predominance (60%) reflects the traditional smoking patterns in India, where cultural norms historically limited tobacco use among women.[19] However, the substantial female representation (40%) suggests an evolving disease burden, likely attributed to biomass fuel exposure in rural settings a finding consistent with previous Indian studies.[20]

The high proportion of industrial (30%) and agricultural workers (25%) is particularly significant given Surendranagar's industrial landscape. This occupational distribution aligns with established evidence linking dust, fumes, and chemical exposures to COPD development.[21] The predominance of middle (60%) and poor (30%) socioeconomic status patients reflects the well-documented association between lower socioeconomic status and COPD prevalence, driven by limited health

care access and higher environmental exposures.[22]

The high prevalence of classic symptoms dyspnoea (90%), cough (85%), and sputum production (70%) is consistent with GOLD guidelines.[23] Notably, the absence of gender differences in symptom prevalence contrasts with studies like COPDGene, which reported more severe dyspnoea in females.[24] This discrepancy may reflect uniform exposure to environmental triggers in this industrial region, where both genders face similar air pollution levels.

Smoking emerged as the dominant risk factor (65% current or former smokers), with current smokers showing the highest rates of severe disease (GOLD 3-4: 50%). The mean pack-years of 25±8 indicates substantial cumulative exposure, consistent with studies demonstrating accelerated lung function decline with higher smoking intensity.[25] The persistence of severe disease in former smokers underscores the irreversible nature of smoking-induced lung damage.

Occupational exposures showed clear radiographic correlations, with industrial and agricultural workers exhibiting higher rates of bronchiectasis and bronchovascular markings. The elevated prevalence of bronchovascular markings among homemakers (32%) suggests significant indoor air pollution from biomass fuel combustion, a major COPD risk factor in India.[26]

The gender differences in hemoglobin levels (14.2±1.5 g/dL in males vs. 13.5±1.3 g/dL in females) and the inverse correlation between hematocrit and oxygen saturation (r=-0.65) reflect compensatory responses to chronic hypoxia.[27] These findings support the concept of secondary erythrocytosis in advanced COPD.

Spirometry results showing lower FEV1 in males (45% predicted) compared to females (50% predicted) likely reflects higher smoking intensity among males. The negative correlation between disease duration and FEV1 (r = -0.60) confirms the progressive nature of airflow limitation in COPD.[28]

The strong correlation between dyspnoea severity and hospitalization rates represents a crucial finding for healthcare planning. Patients with severe dyspnoea had 3-4 hospitalizations per year compared to 1-2 for mild cases, reflecting the substantial clinical and economic burden of advanced disease.[29] Current smokers demonstrated the highest exacerbation rates (2.5 ± 0.8/ year), supporting evidence that ongoing smoking accelerates disease progression.[30]

These findings have important implications for COPD management in similar industrial regions. The high burden among occupational groups necessitates targeted workplace interventions, including improved ventilation and protective equipment. The significant representation of biomass fuel exposure among homemakers highlights the need for clean cooking initiatives, which have proven effective in reducing COPD risk in other low-income settings.[31]

The predominance of lower socioeconomic status patients calls for cost-effective strategies, including subsidized diagnostics and medications. The correlation between symptom severity and healthcare utilization underscores the importance of early intervention to prevent progression to severe stages.

LIMITATIONS

The single center design and short duration limit generalizability and long-term outcome assessment. The tertiary care setting may have introduced selection bias toward more severe cases. Additionally, reliance on chest X-rays rather than CT scans may have underestimated structural abnormalities. This study provides valuable insights into COPD patterns in an industrial region of India, highlighting the complex interplay of occupational, environmental, and socioeconomic factors in disease development and progression.

CONCLUSION

This prospective study of 100 COPD patients in Gujarat, India, successfully characterized the clinico-laboratory profile in an industrial setting. The findings reveal smoking (65%) and occupational exposures as primary risk factors, with current smokers showing the most severe disease. High dyspnoea prevalence (90%) strongly correlated with hospitalization rates, indicating substantial healthcare burden. Industrial and agricultural workers demonstrated significant radiographic abnormalities, while biomass fuel exposure affected homemakers. The study emphasizes the need for comprehensive COPD management including smoking cessation, occupational health interventions, and symptom-focused care. These findings inform targeted public health strategies for similar industrial regions to reduce disease burden and improve patient outcomes.

Acknowledgments: Gratitude is extended to the faculty members, residents, and staff of C. U. Shah Medical College for their invaluable support throughout the course of this study. Sincere appreciation is also owed to the patients whose participation and consent were essential to making this research possible.

Author's Contribution: HHP and **SDP** contributed to the study conception, study design, data collection, data analysis and interpretation, and manuscript preparation. **JN** contributed to the study design, data analysis and interpretation, and manuscript preparation.

Availability of Data: The datasets generated and/or analyzed during the current study are not publicly available due to institutional policies on patient confidentiality but are available from the corresponding author on reasonable request.

Declaration of Non-use of generative AI Tools: The authors affirm that no generative artificial intelligence (AI) or automated language tools were used in the design, data collection, analysis, or interpretation of this study. The manuscript was prepared entirely by the authors, and all responsibility for the content rests with them.

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