Original Article

Clinico-Radiological Profile of Non-Smoker Chronic Obstructive Pulmonary Disease Patients at A Tertiary Care Hospital

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A B S T R A C T

Background: Chronic obstructive pulmonary disease (COPD) in non-smokers is increasingly recognised, particularly in developing countries, but remains under-characterised. Understanding clinico-radiological differences between smoker and non-smoker COPD is essential for optimal management.

Objectives: To compare the clinical, radiological, spirometric, and laboratory profiles of smoker and non-smoker COPD patients attending a tertiary care hospital.

Methods: This cross-sectional observational study was conducted in the Department of Respiratory Medicine, PGIMER & Capital Hospital, Bhubaneswar, from May 2023 to December 2024. A total of 271 COPD patients were enrolled, including 196 smokers and 75 non-smokers. Data on demographics, risk factor exposure, clinical features, dyspnoea severity (mMRC), exacerbations, hospitalisations, spirometry, laboratory parameters, radiological findings (chest X-ray and HRCT), and ECG were analysed. Statistical comparisons were performed using Student's t-test and Chi-square test.

Results: Non-smoker COPD patients were predominantly female, younger, and from lower socioeconomic strata, with significant exposure to biomass fuel, prior pulmonary tuberculosis, and asthma ($p < 0.05$). They had higher dyspnoea grades, more frequent exacerbations, and increased hospitalisations. Smoker COPD patients had significantly lower BMI, more severe airflow limitation, and emphysema-predominant changes on chest X-ray and HRCT ($p < 0.001$). Bronchiectasis and basal crackles were more common in non-smokers, while hyperinflation-related physical signs predominated in smokers.

Conclusion: Non-smoker COPD represents a distinct phenotype with different risk factors, clinical presentation, and radiological patterns compared to smoker COPD. Recognition of these differences is crucial for early diagnosis, targeted prevention, and individualised management strategies.

Keywords: COPD, Non-smoker COPD, Biomass fuel, Emphysema, HRCT, Dyspnoea.

INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is a common, preventable, and treatable respiratory disorder characterized by persistent respiratory symptoms and airflow limitation that is not fully reversible and is usually progressive. It is associated with an enhanced chronic inflammatory response of the airways and lungs to noxious particles or gases [1]. COPD is a major public health problem and is currently the third leading cause of death worldwide, contributing substantially to morbidity, mortality, and healthcare burden [2].

Although tobacco smoking is the most important and well-established risk factor for COPD, a significant proportion of COPD patients worldwide are non-smokers, particularly in developing countries [3]. Epidemiological studies suggest that 25–45% of COPD cases occur among never-smokers, highlighting the importance of non-tobacco-related risk factors [4]. In India and other low- and middle-income countries, exposure to biomass fuel smoke, indoor air pollution, occupational dusts and fumes, poorly controlled asthma, recurrent childhood respiratory infections, and prior pulmonary tuberculosis play a crucial role in the development of COPD among non-smokers [5–7].

Non-smoker COPD is increasingly being recognized as a distinct clinical phenotype, differing from smoking-related COPD in terms of demographic profile, clinical presentation, inflammatory patterns, radiological features, and disease progression [8]. Studies have shown that non-smoker COPD patients are more likely to be female, have a history of biomass exposure or post-tuberculosis lung disease, present with more airway-predominant disease, and demonstrate relatively less emphysematous destruction on imaging compared to smoker COPD patients [9–11].

Radiological evaluation, particularly high-resolution computed tomography (HRCT), plays an important role in differentiating phenotypic patterns of COPD by identifying emphysema, bronchial wall thickening, bronchiectasis, and post-infectious sequelae [12]. Similarly, assessment of clinical severity, frequency of exacerbations, spirometric indices, hypoxemia, and cardiovascular involvement provides insight into disease burden and prognosis [13].

Despite the growing recognition of non-smoker COPD, data from eastern India remain limited, especially regarding the combined clinical and radiological profile of these patients in comparison to smoker COPD. Understanding these differences is essential for early diagnosis, targeted management strategies, and prevention of disease progression.

Therefore, the present study was undertaken to evaluate and compare the clinico-radiological profile of non-smoker COPD patients with smoker COPD patients attending a tertiary care hospital in Odisha, India.

MATERIALS AND METHODS
Study Design and Setting
This was a cross-sectional observational study conducted in both the outpatient department (OPD) and indoor settings of the Department of Respiratory Medicine, PGIMER & Capital Hospital, Bhubaneswar, Odisha, from May 2023 to December 2024.

Study Population
Patients attending the OPD or admitted to the Department of Respiratory Medicine with symptoms suggestive of chronic obstructive pulmonary disease (COPD), such as chronic cough with or without sputum production, breathlessness, and spirometry findings showing persistent airflow obstruction (post-bronchodilator FEV_1/FVC <70%) were included in the study. Both smoker and non-smoker COPD patients were enrolled.

Sample Size
The sample size was estimated by comparing two proportions, taking the proportion of breathlessness among smoker COPD and non-smoker COPD patients as 54% and 31%, respectively. The calculated sample size was 72 patients in each group, giving a total of 144 participants. However, during the study period, a total of 271 patients were enrolled, comprising 196 smokers and 75 non-smokers.

Sampling Technique
Consecutive sampling was used to recruit eligible participants during the study period.

Selection Criteria
Inclusion Criteria
- Patients aged ≥40 years with symptoms of chronic cough with or without sputum production, breathlessness, and spirometry evidence of persistent airflow obstruction (post-bronchodilator FEV_1/FVC <70%).
- Diagnosis of COPD based on GOLD guidelines.
- Smoker: Adults who had smoked ≥100 cigarettes in their lifetime and were currently smoking.
- Non-smoker: Adults who had never smoked or had smoked <100 cigarettes in their lifetime.
- Former smoker: Adults who had smoked ≥100 cigarettes in their lifetime but had quit smoking at the time of interview.

Exclusion Criteria
- Age <40 years
- Pregnancy
- People living with HIV/AIDS (PLHA), HBsAg-positive, or HCV-positive individuals

- Interstitial lung disease
- Significant comorbidities such as decompensated left heart failure, recent myocardial infarction, chronic renal disease, or hepatic failure
- Active pulmonary tuberculosis

Study Procedure
Patients presenting with respiratory symptoms and exposure to COPD risk factors were advised to undergo spirometry. Those with post-bronchodilator FEV_1/FVC <70% were diagnosed as having COPD as per GOLD guidelines. Patients with documented evidence of COPD were also included. Written informed consent was obtained from all eligible participants.

Enrolled patients were categorized into **smoker COPD** and **non-smoker COPD** groups based on smoking status. Data were collected using a structured questionnaire through face-to-face interviews. Information regarding exposure to various COPD risk factors—such as smoking, biomass fuel exposure, outdoor air pollution, occupational exposure, history of long-standing asthma, childhood lower respiratory tract infections, and previous tuberculosis—was recorded.
A detailed clinical history was obtained, including symptoms like cough, sputum production, breathlessness, chest tightness, fever, and pedal edema. Physical examination included measurement of height, weight, body mass index (BMI), chest examination, and systemic evaluation. Particular attention was given to signs such as use of accessory muscles, paradoxical chest movements, cyanosis, barrel-shaped chest, obliterated cardiac and liver dullness, raised jugular venous pressure, and pedal edema. Frequency of exacerbations and hospitalizations in the preceding one year was documented. Dyspnoea severity was assessed using the **modified Medical Research Council (mMRC) scale**. The COPD Assessment Test (CAT) was not used.

Investigations
All patients underwent relevant investigations, including:
- **Blood tests**: Complete blood count, blood glucose, absolute eosinophil count, renal and liver function tests, lipid profile, electrolytes, and arterial blood gas (ABG) analysis
- **Sputum examination**: Gram stain, culture and sensitivity, acid-fast bacilli (AFB), cytology, differential count, and CBNAAT
- **Radiological investigations**: Chest radiograph and high-resolution computed tomography (HRCT) thorax
- **Pulmonary function testing**: Spirometry with bronchodilator reversibility
- **Cardiac evaluation**: ECG and ECHO (where indicated)

Exhaled nitric oxide (eNO), diffusion capacity for carbon monoxide (DLCO), and impulse oscillometry were not performed due to non-availability of facilities. Sputum AFB and CBNAAT were done to exclude active tuberculosis, especially in post-TB obstructive airway disease patients.

Spirometry
Spirometry was performed as per American Thoracic Society (ATS) guidelines by a trained technician after proper patient counselling. Measurements included FEV_1, FVC, and FEV_1/FVC ratio. Bronchodilator reversibility testing was conducted 15–30 minutes after administration of 400 μg of salbutamol.

Study Variables
Demographic Variables
Age, sex, occupation, BMI, and socioeconomic status (assessed using the modified Kuppuswamy scale, updated for 2017 inflation).

Clinical Variables
Symptoms and signs, smoking status, pack-years of smoking, laboratory parameters, sputum analysis, and spirometric indices.

Outcome Variables
Severity of dyspnoea (mMRC grade), severity of airflow obstruction (FEV_1 % predicted), severity of hypoxemia (ABG), chest radiographic and HRCT findings, and cardiac abnormalities on ECG/ECHO.

Data Analysis
Data were entered into Microsoft Excel and analysed using IBM SPSS version 29. Normality was assessed using the Kolmogorov–Smirnov test. Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequency and percentage. Independent sample Student's t-test was used for comparison of continuous variables, and Pearson's Chi-square test for categorical variables. A p-value <0.05 was considered statistically significant, and <0.001 as highly significant. Clustered bar charts were used for graphical representation.

Ethical Considerations

The study was conducted after obtaining approval from the Institutional Ethics Committee/Institutional Review Board (IEC/IRB) of PGIMER & Capital Hospital, Bhubaneswar. All participants were informed about the study objectives and procedures, and written informed consent was obtained prior to enrolment.

OBSERVATIONS AND RESULTS

A total of 271 COPD patients were included in the study, of which 196 (72.3%) were smoker COPD patients and 75 (27.7%) were non-smoker COPD patients.

Demographic Profile

**Table 1: Demographic Characteristics of Smoker and Non-Smoker COPD Patients**

Variable	Category	Smoker COPD (n=196)	Non-smoker COPD (n=75)	*p*-value
Age (years)	30–45	3 (1.53%)	1 (1.33%)	
	45–60	45 (22.95%)	41 (54.66%)	
	60–75	122 (62.24%)	32 (42.66%)	
	>75	26 (13.26%)	1 (1.33%)	
	Mean ± SD	**64.95 ± 8.72**	**57.57 ± 7.94**	**<0.001**
Gender	Male	187 (95.4%)	20 (26.7%)	
	Female	9 (4.6%)	55 (73.3%)	**<0.001**
Socioeconomic Status	Upper	11 (5.6%)	0 (0.0%)	
(Kuppuswamy scale)	Upper Middle	26 (13.3%)	8 (10.7%)	
	Lower Middle	62 (31.6%)	16 (21.3%)	
	Upper Lower	74 (37.8%)	26 (34.7%)	
	Lower	23 (11.7%)	25 (33.3%)	**<0.001**

Table 2: EXPOSURE TO RISK FACTORS

Risk Factors	Smoker N (%)	Non-Smoker N (%)	P-Value
Biomass Exposure	31 (15.8%)	50 (66.7%)	<0.001
Past H/O PTB	19 (9.7%)	33 (44.0%)	<0.001
H/O Asthma	15 (7.7%)	16 (21.3%)	0.002
LRTI In Childhood	8 (4.1%)	10 (13.3%)	0.006
Occupational Exposure	19 (9.7%)	8 (10.7%)	0.811
Air Pollution	53 (27.0%)	14 (18.7%)	0.153

Table 3 : COMPARISON OF COMORBIDITIES

COMORBIDITIES	SMOKER N(%)	NON-SMOKER N(%)	P-VALUE
Hypertension (HTN)	25 (12.75%)	7 (9.3%)	
Diabetes Mellitus (DM)	27 (13.8%)	9 (12.0%)	
Cerebro -Vascular Accident (CVA)	3 (1.5%)	0 (0.0%)	
Cardiovascular Diseases (CVS)	28 (14.28%)	15 (20.00%)	
Thyroid disorders	5 (2.55%)	4 (5.33%)	0.551
CA Lungs	2 (1.02%)	0 (0.0%)	
HTN + DM	7 (3.6%)	1 (1.3%)	
No Comorbidities	99 (50.5%)	39 (52.0%)	
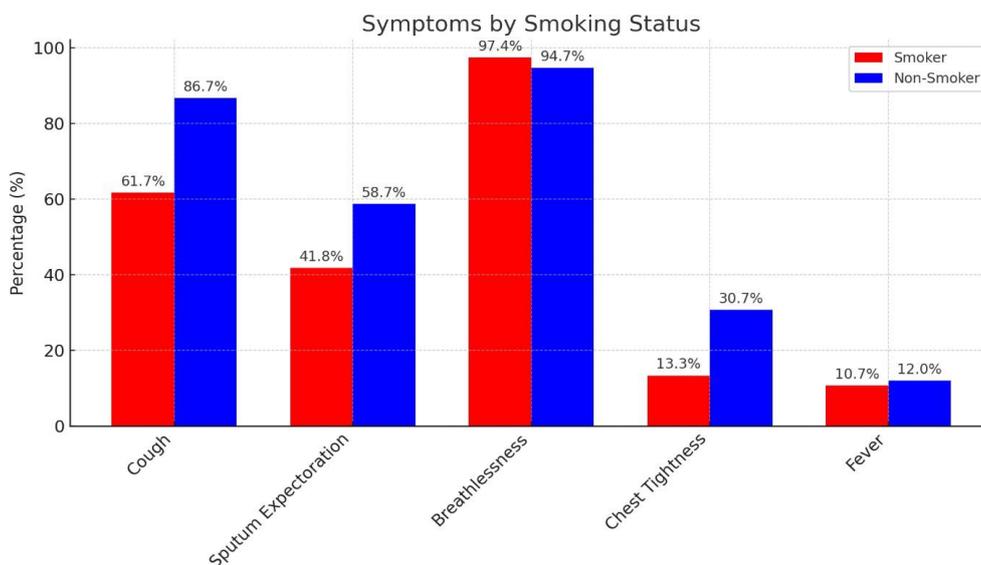
Graph 1: COMPARISON OF SYMPTOMS

Table 4: Comparison of Dyspnoea Severity, Exacerbations, and Hospitalisations in Smoker and Non-Smoker COPD Patients (N = 271)

Parameter	Category	Smoker COPD (n=196)	Non-smoker COPD (n=75)	*p*-value
mMRC Grade of Dyspnoea	0	3 (1.5%)	4 (5.3%)	
	1	12 (6.1%)	0 (0.0%)	
	2	87 (44.4%)	32 (42.7%)	
	3	80 (40.8%)	37 (49.3%)	
	4	14 (7.1%)	2 (2.7%)	**0.034**
Hospitalisations in past 1 year	0	23.5%	2.7%	
	1	40.8%	24.0%	
	2	34.2%	70.7%	
	3	0.5%	2.7%	
	Mean ± SD	**1.14**	**1.73**	**<0.001**
Exacerbations in past 1 year	0	6.6%	1.3%	
	1	49.5%	6.7%	
	2	42.3%	70.7%	
	3	1.0%	21.3%	
	4	0.5%	0.0%	
	Mean ± SD	**1.39**	**2.12**	**<0.001**

Table 5: Comparison of Body Mass Index (BMI) Between Smoker and Non-Smoker COPD Patients

BMI Category (kg/m²)	Smoker COPD (n = 196)	Non-Smoker COPD (n = 75)	*p*-value
< 18.5	77 (39.3%)	21 (28.0%)	
18.5 – 24.9	83 (42.3%)	27 (36.0%)	
25.0 – 29.9	25 (12.8%)	13 (17.3%)	
≥ 30.0	11 (5.6%)	14 (18.7%)	
Mean BMI ± SD	19.55 ± 4.16	22.17 ± 5.38	0.004

Table 6: Comparison of Clinical Examination Findings in Smoker and Non-Smoker COPD Patients (N = 271)

Clinical Finding	Smoker COPD (n = 196)	Non-Smoker COPD (n = 75)	*p*-value
Physical Examination Findings			
Use of accessory muscles	58 (29.6%)	31 (41.3%)	0.064
Paradoxical chest movement	48 (24.5%)	9 (12.0%)	0.025
Cyanosis	21 (10.7%)	16 (21.3%)	0.024
Barrel-shaped chest	103 (52.5%)	12 (16.0%)	<0.001
Obliterated liver dullness	78 (39.8%)	9 (11.7%)	<0.001
Obliterated cardiac dullness	72 (36.7%)	10 (13.3%)	<0.001
Pedal edema	49 (25.0%)	12 (16.0%)	0.112
Raised JVP	17 (8.7%)	7 (9.3%)	0.864

Auscultatory Findings			
Wheeze	108 (55.1%)	36 (48.0%)	0.291
Basal crackles	47 (24.0%)	29 (38.7%)	0.021
Rhonchi	39 (19.9%)	20 (26.7%)	0.213
Decreased breath sounds	92 (46.9%)	18 (24.0%)	<0.001
Prolonged expiration	104 (53.1%)	31 (41.3%)	0.082
Normal auscultation	30 (15.3%)	9 (12.0%)	0.518

Table 7: COMPARISON OF MEAN TLC, HAEMOGLOBIN, AEC

Parameter	Smoker (Mean ± SD)	Non-Smoker (Mean ± SD)	p-value
Hemoglobin (in gm/dl)	11.98 ± 1.60	10.30 ± 1.58	<0.001
TLC (in cells/µL)	7096 ± 1726	6886.93 ± 2351.45	0.485
AEC (in cells/µL)	186.33 ± 118.47	264.05 ± 93.32	<0.001

Table 8: COMPARISON OF SPIROMETRY FINDINGS

Parameter	Smoker COPD (N=196)	Non-smoker COPD (N=75)	p-value
POST FEV1/FVC (%)	50.31 ± 11.38	58.35 ± 10.83	<0.001
POST FVC (L)	1.75 ± 0.83	1.68 ± 0.86	0.532
POST FVC (% Predicted)	62.10 ± 21.78	49.16 ± 22.33	<0.001
POST FEV1 (L)	0.92 ± 0.59	0.91 ± 0.52	0.895
POST FEV1 (% Predicted)	39.10 ± 20.61	35.27 ± 15.69	0.104

Table 9: COMPARISON OF SEVERITY OF AIRFLOW LIMITATION

| GOLD SEVERITY	Smoker COPD N(%)	Non-smoker COPD N(%)	P value
1	12 (6.1%)	1 (1.3%)	
2	39 (19.9%)	13 (17.3%)	
3	60 (30.6%)	30 (40.0%)	0.234
4	85 (43.4%)	31 (41.3%)	
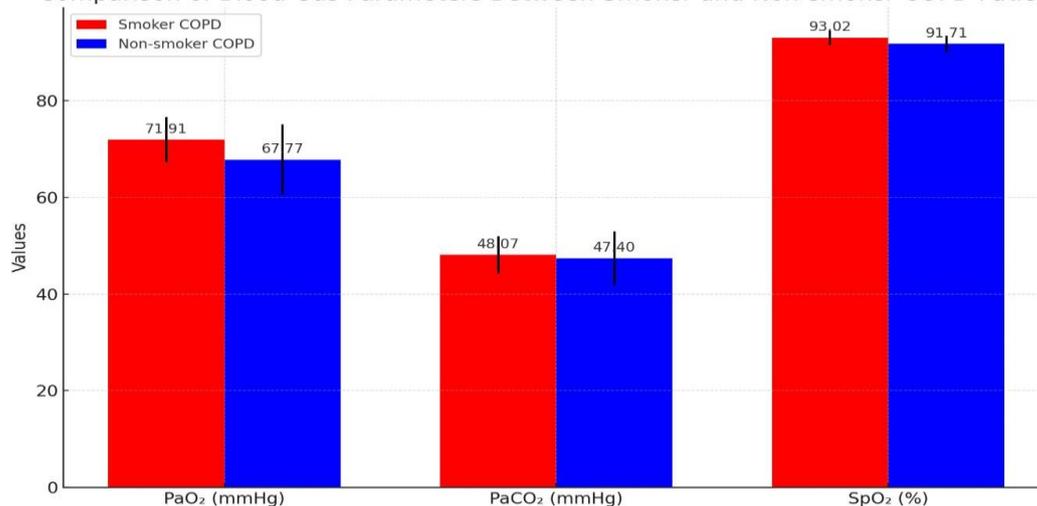
Graph 2: COMPARISON OF HYPOXEMIA AND HYPERCARBIA BETWEEN NON-SMOKER AND SMOKER COPD

Table 10: Comparison of Radiological and ECG Findings in Smoker and Non-Smoker COPD Patients (N = 271)

Investigation	Finding	Smoker COPD (n = 196)	Non-Smoker COPD (n = 75)	p-value
Chest X-ray	Chronic bronchitis (CB)	17 (8.7%)	11 (14.7%)	
	Emphysema (E)	104 (53.1%)	14 (18.7%)	
	Normal	75 (38.3%)	50 (66.7%)	**<0.001**
HRCT Thorax	Emphysema	116 (59.2%)	14 (18.7%)	**<0.001**

	Bronchial wall thickening	31 (15.8%)	13 (17.3%)	0.269
	Bronchiectasis	24 (12.2%)	16 (21.3%)	0.059
ECG	Arrhythmia	6 (3.1%)	2 (2.7%)	
	P-pulmonale	24 (12.2%)	3 (4.0%)	
	P-pulmonale + RAD	7 (3.6%)	4 (5.3%)	
	RVH + RAD	21 (10.7%)	2 (2.7%)	
	Right ventricular strain	34 (17.3%)	11 (14.7%)	
	Normal	104 (53.1%)	53 (70.7%)	**0.075**
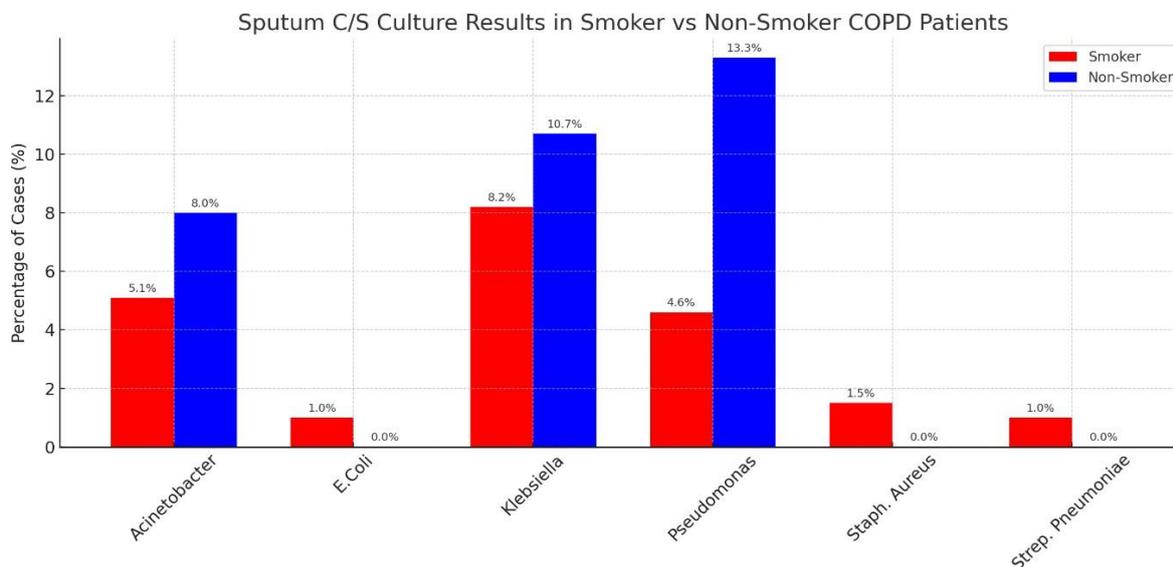
Graph 3: COMPARISON OF SPUTUM CULTURE

DISCUSSION

Chronic obstructive pulmonary disease (COPD) is a heterogeneous disorder influenced by multiple risk factors, of which tobacco smoking remains the most important; however, a substantial proportion of COPD occurs among never-smokers, particularly in developing countries. This study compared the clinical, functional, and radiological profiles of smoker and non-smoker COPD patients to better understand phenotypic differences between these two groups.

In the present study, smoker COPD patients were significantly older than non-smoker COPD patients, with a higher mean age and a greater proportion in the 60–75 year age group. This finding is consistent with earlier studies suggesting a cumulative dose-dependent effect of smoking over time, leading to later clinical presentation of COPD in smokers [1,2]. In contrast, non-smoker COPD patients presented at a relatively younger age, possibly reflecting early exposure to biomass fuel smoke, indoor air pollution, and post-infectious lung damage [3,4].

A striking gender difference was observed between the two groups. Smoker COPD was overwhelmingly male-dominated, whereas non-smoker COPD showed a strong female preponderance. This pattern has been widely reported in Indian and other developing-world studies and is largely attributed to higher smoking prevalence among men and greater exposure of women to biomass fuel combustion during cooking [5,6]. These findings underscore the importance of considering gender-specific risk factors in COPD prevention strategies.

Socio-economic status differed significantly between groups, with non-smoker COPD patients more commonly belonging to lower socio-economic strata. Lower socio-economic status is closely linked to poor housing, use of solid fuels, overcrowding, and limited access to healthcare, all of which are recognized contributors to non-smoking-related COPD [7].

Dyspnoea severity assessed by the modified Medical Research Council (mMRC) scale showed a statistically significant difference between groups. While smoker COPD patients predominantly belonged to mMRC grade 2, non-smoker COPD patients more frequently exhibited grade 3 dyspnoea. This may reflect greater airflow limitation due to airway-predominant disease, recurrent infections, or bronchiectasis commonly seen in non-smoker COPD [8].

Non-smoker COPD patients experienced significantly higher frequencies of exacerbations and hospitalisations over the preceding year. Similar observations have been reported in studies linking non-smoking COPD to post-tuberculosis lung disease and bronchiectasis, both of which predispose to recurrent infections and acute worsening of symptoms [9,10].

Body mass index (BMI) differed significantly between the two groups, with smokers showing a lower mean BMI and a higher prevalence of undernutrition. Smoking-related systemic inflammation, increased metabolic demand, and emphysematous disease contribute to weight loss and muscle wasting in smoker COPD patients [11]. In contrast, non-smokers demonstrated relatively higher BMI, including a greater proportion of overweight and obese individuals.

Physical examination findings such as barrel-shaped chest, obliterated cardiac and liver dullness were significantly more common among smokers, reflecting lung hyperinflation and emphysematous changes. Conversely, cyanosis and basal crackles were more frequently observed in non-smokers, suggesting airway-predominant disease and chronic hypoxia [12].

Radiological evaluation further supported distinct phenotypes. Chest X-ray and HRCT findings revealed emphysema to be significantly more prevalent among smokers, whereas bronchiectasis and bronchial wall thickening were relatively more common in non-smokers. These findings align with previous studies describing emphysema-dominant COPD in smokers and airway-dominant or post-infectious COPD in non-smokers [13,14].

ECG abnormalities suggestive of cor pulmonale and right ventricular hypertrophy were more frequent in smokers, likely secondary to long-standing emphysema and pulmonary hypertension. However, the difference was not statistically significant, possibly due to early-stage disease or adequate medical management in both groups.

Overall, this study highlights that smoker and non-smoker COPD represent distinct clinical and radiological phenotypes. Recognition of these differences is essential for individualized management, prevention strategies, and prognostication.

CONCLUSION
Non-smoker COPD is a distinct clinical entity with unique risk factors and disease characteristics. It predominantly affects females and is strongly associated with biomass fuel exposure, prior pulmonary tuberculosis, and asthma. Despite relatively preserved lung volumes, non-smoker COPD patients experience greater dyspnoea, frequent exacerbations, and higher hospitalisation rates. In contrast, smoker COPD is characterised by lower BMI, more severe airflow limitation, and emphysema-predominant radiological changes. Recognising these differences is essential for early diagnosis, tailored management, and implementation of targeted preventive strategies, particularly in resource-limited settings.

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