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Association of Smoking Index with Severity of Chronic Obstructive Pulmonary Disease among Adult Patients.

Dr. Sathyam Gopagoni[1], Dr. Rachakonda Rajkumar[2], Dr. Narendra Kumar Maddur[3]*.

[1]Assistant Professor, Department of General Medicine, Surabhi Institute of Medical Sciences, Mittapally, Siddipet, Telangana, India.
[2]Assistant Professor, Department of General Medicine, Mediciti Institute of Medical Sciences, Ghanpur, Medchal, Telangana, India.
[3]Associate Professor, Department of Pulmonary Medicine, Surabhi Institute of Medical Sciences Mittapally Siddipet, Telangana, India.

Correspondence:
Dr. Narendra Kumar Maddur.
Associate Professor, Department of Pulmonary Medicine, Surabhi Institute of Medical Sciences Mittapally Siddipet, Telangana, India.

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Abstract

Background: Chronic obstructive pulmonary disease (COPD) is a progressive respiratory disorder strongly linked to cumulative tobacco exposure. Smoking index provides a simple quantitative measure of smoking burden and can support clinical risk stratification in resource-limited settings. ***Objectives:*** To assess the association between smoking index and severity of COPD among adult patients. ***Methods:*** This hospital-based observational study included 100 adult patients with COPD attending SURABHI Institute of Medical Sciences, Mittapally Village, Siddipet, Telangana, India, from August 2025 to January 2026. Demographic details, type of smoking, duration of smoking, and smoking index were recorded. COPD severity was graded using spirometric assessment. Smoking index was categorized as low, moderate, and high. Data were analyzed using descriptive statistics, chi-square test, and analysis of variance. ***Results:*** The mean age of the study population was 58.6 ± 9.8 years, and 78% were males. Bidi smoking was the most frequent pattern. Low, moderate, and high smoking index categories were observed in 18%, 36%, and 46% of patients, respectively. Severe COPD was the commonest spirometric category, followed by moderate, very severe, and mild disease. A stepwise increase in COPD severity was observed with increasing smoking index. Very severe COPD was present in 5.6% of patients with low smoking index and 37.0% of patients with high smoking index. The association between smoking index and COPD severity was statistically significant. Mean smoking index increased from 92.4 ± 38.6 in mild COPD to 468.2 ± 132.4 in very severe COPD. ***Conclusion:*** Higher smoking index showed a significant positive association with greater COPD severity. Routine documentation of smoking index can help identify patients at risk of severe airflow limitation and reinforce targeted smoking cessation advice.

Keywords: 15

INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is a common, preventable, and treatable respiratory disorder characterized by persistent airflow limitation and chronic respiratory symptoms[1]. The obstruction is usually progressive and reflects a variable combination of small airway disease, parenchymal destruction, mucus hypersecretion, and airway inflammation[2]. Global strategy documents continue to emphasize spirometry as the central investigation for diagnosis and severity assessment, while also recognizing the wider clinical burden related to symptoms, exacerbations, comorbidities, and exposure history [3].

Tobacco smoking remains the most important modifiable risk factor for COPD worldwide. The burden is particularly important in settings where cigarette, bidi, and mixed forms of smoking coexist [4]. Long-term inhalation of tobacco smoke produces oxidative stress, epithelial injury, impaired mucociliary clearance, chronic bronchial inflammation, and progressive loss of elastic recoil. These pathological changes ultimately reduce expiratory airflow and are reflected by declining forced expiratory volume in one second (FEV1). Classical longitudinal observations by Fletcher and Peto demonstrated the relationship between smoking and accelerated decline in lung function, establishing the biological basis for cumulative exposure as a determinant of chronic airflow obstruction [9].

COPD is not determined by smoking alone. Age, occupational dust, biomass fuel exposure, air pollution, childhood respiratory events, low socioeconomic status, and previous pulmonary disease also contribute to disease expression [7,8]. However, smoking burden remains one of the simplest clinical variables to record and interpret. Pack-years are widely used in Western literature, but smoking index is commonly used in Indian clinical practice because it can be adapted for

bidi and cigarette exposure. It is calculated from the number of smoking units consumed per day multiplied by the number of years of smoking. A higher smoking index therefore represents greater cumulative dose of inhaled tobacco products.

The Indian context gives special importance to such measurement. Bidi smoking is common in several regions and delivers high particulate exposure despite lower tobacco weight per unit. Population-based Indian data have reported a substantial burden of chronic bronchitis and respiratory symptoms in adults, with smoking and environmental exposures contributing to the pattern of disease. Quantifying exposure through a simple index can help clinicians communicate risk, motivate cessation, and identify patients who need careful spirometric evaluation.

The present study was conducted to evaluate the association between smoking index and spirometric severity of COPD among adult patients. The primary objective was to determine whether higher smoking index was associated with more severe COPD. The secondary objectives were to describe the demographic and smoking profile of COPD patients, assess the distribution of COPD severity categories, and compare mean smoking index across different grades of airflow limitation.

METHODOLOGY

Study design and setting:

This hospital-based observational study was conducted in the Department of Pulmonary Medicine at SURABHI Institute of Medical Sciences, Mittapally Village, Siddipet, Telangana, India. The study period extended from August 2025 to January 2026. The study was designed to assess the relationship between cumulative smoking exposure and severity of COPD in adult patients who attended the outpatient department or were evaluated during hospital care.

Study population:

A total of 100 adult patients diagnosed with COPD were included. Patients aged 18 years and above with a clinical diagnosis of COPD and spirometric evidence of airflow limitation were considered eligible. Patients who were unable to perform acceptable spirometry, those with acute respiratory instability at the time of assessment, and those with known alternative causes of chronic airflow obstruction were excluded. The diagnosis and grading approach followed standard spirometric principles recommended in international guidelines.

Data collection:

A structured proforma was used to record age, gender, type of smoking, duration of smoking, and daily smoking exposure. Smoking pattern was classified as bidi, cigarette, or mixed smoking. The smoking index was calculated by multiplying the average number of smoking units per day by the duration of smoking in years. Based on smoking index, patients were categorized into low (<100), moderate (100–300), and high (>300) exposure groups. Clinical details were collected through patient interview and review of available medical records.

Spirometric assessment:

Spirometry was performed using standard operating procedures, with attention to patient instruction, adequate effort, repeatability, and acceptability of manoeuvres. The severity of COPD was categorized on the basis of spirometric impairment as mild, moderate, severe, and very severe. The interpretation of lung function was aligned with established ATS/ERS recommendations and routine interpretive standards [4-6]. Post-bronchodilator airflow obstruction was used for clinical classification whenever available, and severity grading was based on percentage predicted FEV1.

Statistical analysis:

The collected data were entered into a spreadsheet and analyzed using descriptive and inferential statistical methods. Frequencies and percentages were calculated for categorical variables. Mean and standard deviation were calculated for continuous variables. The association between smoking index category and COPD severity was assessed using the chi-square test. The difference in mean smoking index across severity grades was assessed using analysis of variance. A p value less than 0.05 was considered statistically significant.

RESULTS

A total of 100 adult patients with COPD were included in the study. The mean age of the study population was 58.6 ± 9.8 years. Most patients belonged to the 51–60 years age group. Males constituted 78% of the study population. The mean smoking duration was 25.8 ± 10.7 years, and the mean smoking index was 302.4 ± 167.8. The baseline demographic and smoking profile is shown in Table 1.

Table 1. Baseline demographic and smoking profile of COPD patients

Variable	Category	Frequency (n=100)	Percentage (%)
Age group	31–40 years	8	8.0
	41–50 years	18	18.0
	51–60 years	38	38.0
	61–70 years	26	26.0
	>70 years	10	10.0
Gender	Male	78	78.0
	Female	22	22.0
Type of smoking	Bidi	48	48.0
	Cigarette	30	30.0
	Mixed smoking	22	22.0
Duration of smoking	<10 years	8	8.0
	10–20 years	26	26.0
	21–30 years	38	38.0
	>30 years	28	28.0

Based on smoking index, 18% of patients had a low smoking index, 36% had a moderate smoking index, and 46% had a high smoking index. COPD severity was classified using spirometric grading. Severe COPD was the most common category, observed in 40% of patients, followed by moderate COPD in 28%, very severe COPD in 22%, and mild COPD in 10% (Table 2).

Table 2. Distribution of smoking index and COPD severity

Variable	Category	Frequency (n=100)	Percentage (%)
Smoking index	Low, <100	18	18.0
	Moderate, 100–300	36	36.0
	High, >300	46	46.0
COPD severity	Mild	10	10.0
	Moderate	28	28.0
	Severe	40	40.0
	Very severe	22	22.0

A clear increase in COPD severity was observed with increasing smoking index. Among patients with a low smoking index, mild and moderate COPD were more frequent. In contrast, among patients with a high smoking index, severe and very severe COPD were predominant. Very severe COPD was present in only 5.6% of patients with low smoking index compared with 37.0% of patients with high smoking index. The association between smoking index and COPD severity was statistically significant (chi-square = 36.53; $p < 0.001$), as shown in Table 3.

Table 3. Association between smoking index and severity of COPD

Smoking index	Mild COPD	Moderate COPD	Severe COPD	Very severe COPD	Total
Low, <100	6 (33.3%)	8 (44.4%)	3 (16.7%)	1 (5.6%)	18 (100.0%)
Moderate, 100–300	4 (11.1%)	15 (41.7%)	13 (36.1%)	4 (11.1%)	36 (100.0%)
High, >300	0 (0.0%)	5 (10.9%)	24 (52.2%)	17 (37.0%)	46 (100.0%)
Total	10	28	40	22	100

Chi-square = 36.53; $p < 0.001$

The mean smoking index also increased progressively with advancing COPD severity. Patients with mild COPD had the lowest mean smoking index, while those with very severe COPD had the highest mean value. This trend was statistically significant by analysis of variance ($p < 0.001$). Mean smoking index according to COPD severity is presented in Table 4.

Table 4. Mean smoking index according to COPD severity

COPD severity	Number of patients	Mean smoking index ± SD
Mild	10	92.4 ± 38.6
Moderate	28	176.8 ± 74.2
Severe	40	321.6 ± 108.5
Very severe	22	468.2 ± 132.4

ANOVA test: $p < 0.001$

Overall, the findings showed a statistically significant association between higher smoking index and greater COPD severity. A positive exposure-response pattern was observed, indicating that cumulative tobacco exposure was strongly related to worsening airflow limitation among adult COPD patients.

DISCUSSION

The present study demonstrated a significant association between smoking index and severity of COPD among adult patients. Nearly half of the study population belonged to the high smoking index category, and severe or very severe COPD was concentrated mainly in this group. This pattern supports the clinical relevance of cumulative smoking exposure as a practical marker of disease burden. COPD is a heterogeneous disorder, yet tobacco smoke exposure remains a dominant and measurable contributor to airflow limitation, especially in hospital-based pulmonary practice.

The demographic pattern in the present study showed male predominance and clustering of cases in the middle and older age groups. This observation is consistent with the known epidemiology of COPD, where disease expression becomes clinically apparent after several years of exposure and progressive loss of lung function [8,9]. The male predominance also reflects regional smoking patterns, particularly bidi and mixed smoking. Indian studies have highlighted the continuing burden of chronic respiratory symptoms and chronic bronchitis among adults, with tobacco use remaining a major preventable contributor [13,14].

The study found a stepwise rise in COPD severity from low to high smoking index categories. Among patients with high smoking index, severe COPD was observed in more than half of the group, and very severe COPD was also substantially more frequent. This finding is biologically plausible because prolonged tobacco exposure increases airway inflammation, small airway narrowing, mucus gland enlargement, emphysematous destruction, and loss of elastic recoil. These changes reduce FEV1 and produce persistent expiratory airflow limitation. Previous evidence has shown that smoking duration and cumulative exposure are closely related to respiratory symptoms, COPD occurrence, and decline in pulmonary function [10,11].

The mean smoking index also increased consistently with spirometric severity. Patients with mild disease had a much lower mean smoking index, whereas those with very severe COPD had the highest value. This finding agrees with studies reporting that pack-years, age of onset of smoking, and smoking duration are associated with more advanced lung function impairment [10,12]. Although pack-years are commonly used internationally, smoking index is particularly useful in Indian clinical settings because it accommodates bidi smoking and gives clinicians a simple numerical estimate of cumulative tobacco exposure.

The results have important clinical implications. Routine calculation of smoking index during COPD evaluation is inexpensive, quick, and informative. It can be used to identify high-risk patients who require detailed spirometric assessment, regular follow-up, counselling for smoking cessation, vaccination, pulmonary rehabilitation advice, and optimization of inhaled therapy. Nevertheless, COPD severity is not explained by tobacco exposure alone. Biomass fuel exposure, occupational dust, air pollution, recurrent infections, genetic susceptibility, and delayed diagnosis also shape disease progression [14]. Therefore, smoking index should be interpreted along with clinical history, spirometry, symptom scores, exacerbation history, and comorbidities.

Limitations

This study had a hospital-based observational design and included a modest sample size of 100 patients. Smoking exposure was recorded from patient history, so recall bias was possible. Biomass fuel exposure, occupational risk, exacerbation frequency, treatment adherence, and comorbidities were not analyzed in detail. The cross-sectional design limits causal interpretation, although the observed exposure-response trend was statistically strong.

CONCLUSION

The present study showed a significant association between higher smoking index and increasing severity of COPD among adult patients. Severe and very severe disease were more common among patients with high cumulative smoking exposure. Mean smoking index also rose progressively across spirometric severity grades, supporting a clear exposure-response relationship. Smoking index is a simple, low-cost clinical measure that can be documented routinely in COPD assessment, especially in regions where bidi and mixed smoking are common. Its use can strengthen risk stratification, support early spirometric evaluation, and reinforce focused smoking cessation counselling in routine pulmonary practice.

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