

Assessment of pulmonary function abnormalities among chronic smokers and non-smokers.

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Abstract

Background

Smoking remains one of the leading preventable causes of respiratory morbidity and mortality worldwide. Chronic exposure to tobacco smoke results in progressive impairment of pulmonary function, predisposing individuals to chronic obstructive pulmonary disease (COPD), restrictive lung disorders, and other respiratory illnesses.

Aim

To assess and compare pulmonary function abnormalities among chronic smokers and non-smokers attending a tertiary care teaching hospital.

Methods

A prospective observational comparative study was conducted at Madhubani Medical College and Hospital from April 2025 to January 2026. A total of 100 participants were enrolled, including 50 chronic smokers and 50 age-matched non-smokers. Pulmonary function tests (PFTs) were performed using spirometry. Parameters evaluated included forced expiratory volume in one second (FEV1), forced vital capacity (FVC), FEV1/FVC ratio, and peak expiratory flow rate (PEFR). Comparative analysis was performed between the two groups.

Results

The mean FEV1, FVC, and PEFR values were significantly lower among smokers compared with non-smokers ($p < 0.001$). Obstructive ventilatory defects were observed in 36.0% of smokers compared with 6.0% of non-smokers ($p < 0.001$). Pulmonary function impairment increased significantly with smoking duration exceeding 10 years.

Conclusion

Chronic smoking is significantly associated with deterioration of pulmonary function and increased prevalence of obstructive ventilatory abnormalities. Early smoking cessation and regular pulmonary function assessment are essential to prevent progressive respiratory impairment.

Recommendation

Routine pulmonary function assessment should be considered for chronic smokers, particularly those with prolonged smoking exposure, along with smoking cessation counselling and preventive interventions to reduce the risk of progressive respiratory impairment.

Keywords: Smoking, Pulmonary Function Test, Spirometry, Forced Expiratory Volume in One Second, Chronic Obstructive Pulmonary Disease.

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Introduction

Smoking causes millions of lives each year and is one of the biggest global public health issues. Nicotine, carbon monoxide, oxidants, and carcinogens are just a few of the thousands of dangerous substances found in tobacco smoke that negatively impact the respiratory system. Long-term exposure to these drugs results in alveolar architectural damage, mucus hypersecretion, airway inflammation, and a gradual deterioration of lung function(1). Airflow restriction and ventilatory abnormalities are commonly assessed with pulmonary function tests (PFTs), which offer an objective evaluation of respiratory health. The most widely used technique for assessing lung function is spirometry, which is essential for both diagnosing and tracking respiratory conditions. Measures of lung capacity and airway blockage include forced expiratory volume in one second (FEV1), forced vital capacity (FVC), FEV1/FVC ratio, and peak expiratory flow rate (PEFR)(2).

Smoking is strongly linked to decreased pulmonary function, according to a number of epidemiological research. Lung cancer, emphysema, chronic bronchitis, and chronic obstructive pulmonary disease (COPD) are all considerably more common in smokers. The length and severity of smoking exposure are frequently correlated with the reduction in lung function. In many parts of India, smoking is still very common despite growing awareness of the negative effects of tobacco use. Timely interventions, smoking cessation counselling, and the prevention of chronic respiratory diseases may be made easier with early detection of pulmonary impairment in smokers(3).

The effect of tobacco exposure on lung health can be measured by comparing the pulmonary function of smokers and non-smokers. Planning for public health and clinical treatment both benefit from this kind of information. Additionally, even before serious respiratory symptoms appear, spirometry can identify subclinical airflow restriction. The goal of the current study was to compare spirometric parameters with those of non-smokers at Madhubani Medical College and Hospital and evaluate pulmonary function impairments in chronic smokers. The study's objectives were to ascertain the frequency of ventilatory abnormalities and assess the connection between long-term smoking and impaired lung function(4).

Materials and methods

Study Design

This was a clinical, observational, cross-sectional comparative study conducted to assess and compare pulmonary function abnormalities among chronic smokers and non-smokers. The study included two groups: chronic smokers (Group A) and non-smokers (Group B). Pulmonary function was assessed using spirometry, and the measured pulmonary function parameters were compared between the two groups.

Study Setting

The study was conducted in the Department of Pulmonary Medicine at Madhubani Medical College and Hospital, Madhubani, Bihar, India. The hospital is a tertiary care teaching hospital providing outpatient and inpatient medical services, including evaluation and management of patients with respiratory and other medical conditions. The Department of Pulmonary Medicine provides clinical assessment and diagnostic services for patients with respiratory disorders and performs pulmonary function testing, including spirometry. Participants fulfilling the eligibility criteria were assessed and enrolled from the hospital setting during the study period from April 2025 to January 2026.

Study Population

The study population comprised adults aged 25–65 years who were evaluated at the study centre. Participants were categorized into two groups according to their smoking status:

Group A: Chronic smokers (n=50)

Group B: Non-smokers (n=50)

Inclusion Criteria

Participants were eligible for inclusion if they met the following criteria:

Age between 25 and 65 years

For the smoker group, histories of smoking equivalent to ≥ 10 pack-years.

For the non-smoker group, no history of smoking

Participants willing to undergo pulmonary function testing and participate in the study

Exclusion Criteria

Participants were excluded if they had:

Known COPD or asthma under treatment

Pulmonary tuberculosis

Occupational lung disease

Page | 3 Acute respiratory infection

Any other condition likely to significantly affect pulmonary function or interfere with spirometric assessment

Study Size

A total of 100 participants were included in the study, comprising 50 chronic smokers and 50 non-smokers. The sample size was determined based on the feasibility of recruitment during the study period and the availability of eligible participants at the study centre. An equal number of participants were included in each group to facilitate comparative analysis between smokers and non-smokers.

Study Parameters and Data Collection

Demographic characteristics, including age and sex, were recorded for all participants. For smokers, information regarding smoking history and duration of smoking was obtained. Pulmonary function was assessed using spirometry under standardized testing conditions.

The following pulmonary function parameters were recorded:

Forced expiratory volume in one second (FEV1)

Forced vital capacity (FVC)

FEV1/FVC ratio

Peak expiratory flow rate (PEFR)

The spirometric findings were used to identify patterns of ventilatory abnormality, including obstructive, restrictive, and mixed defects. Pulmonary function parameters were subsequently compared between smokers and non-smokers, and the relationship between smoking duration and pulmonary function abnormalities was assessed.

Measures to Minimize Bias

Potential sources of bias were addressed by applying predefined inclusion and exclusion criteria uniformly to all participants. The same eligibility criteria and pulmonary function assessment procedures were applied

to both study groups. Participants with established respiratory conditions or acute respiratory infections that could independently alter pulmonary function were excluded. The use of standardized spirometric parameters for assessment helped ensure consistency in outcome measurement. The comparison group consisted of non-smokers from the same study setting and within a similar age range to reduce differences in baseline characteristics between the groups.

Statistical Analysis

Data were analyzed using SPSS version 26. Continuous variables were expressed as mean $\pm$ standard deviation, and categorical variables were expressed as frequencies and percentages. The independent t-test was used to compare continuous variables between smokers and non-smokers, while the chi-square test was used for categorical variables. The association between smoking duration and pulmonary function abnormalities was assessed using appropriate categorical analysis. A p-value of <0.05 was considered statistically significant.

Ethical Considerations and Informed Consent

The study was conducted in accordance with the ethical principles governing research involving human participants. Ethical approval was obtained from the Institutional Ethics Committee of Madhubani Medical College and Hospital before commencement of the study. Written informed consent was obtained from all participants before their enrollment and pulmonary function assessment. Participants were informed about the purpose and procedures of the study, and participation was voluntary. Confidentiality of participant information was maintained throughout the study.

Results

A total of 100 participants were included in the study, comprising 50 smokers and 50 non-smokers. Both groups were comparable with respect to age and gender distribution.

Smokers demonstrated significantly lower FEV1, FVC, FEV1/FVC ratio, and PEFR compared with non-smokers. Obstructive ventilatory defects were observed in 36% of smokers compared with only 6% of non-smokers.

A significant relationship was observed between smoking duration and pulmonary function abnormalities. Participants with smoking histories exceeding 20 years

showed the highest prevalence of abnormal spirometric findings.

A total of 100 participants were included in the final analysis, comprising 50 smokers and 50 non-smokers. The two groups were comparable with respect to age and sex distribution. The mean age was 46.2 ± 10.8 years among smokers and 44.9 ± 11.2 years among non-smokers ($p=0.542$). Among smokers, 44 (88.0%) were male and 6 (12.0%) were female, whereas among non-

smokers, 42 (84.0%) were male and 8 (16.0%) were female ($p=0.564$).

Table 1 presents the demographic characteristics of the study participants. There were no statistically significant differences between smokers and non-smokers in terms of age or sex distribution, indicating that the groups were comparable with respect to these baseline characteristics.

Table 1. Demographic Characteristics

Variable	Smokers (n=50)	Non-Smokers (n=50)	p-value
Mean Age (years)	46.2 ± 10.8	44.9 ± 11.2	0.542
Male	44 (88.0%)	42 (84.0%)	0.564
Female	6 (12.0%)	8 (16.0%)	

Smokers demonstrated significantly lower pulmonary function parameters than non-smokers. The mean FEV1 (% predicted) was 72.4 ± 12.1 among smokers compared with 89.3 ± 8.4 among non-smokers ($p<0.001$). Similarly, the mean FVC (% predicted) was 78.6 ± 10.7 among smokers and 92.5 ± 7.8 among non-smokers ($p<0.001$). The mean FEV1/FVC ratio was $69.8 \pm 8.5\%$ among smokers compared with $81.4 \pm 5.7\%$ among non-

Table 2 summarizes the comparison of pulmonary function parameters between the two groups. All assessed pulmonary function parameters were significantly lower among smokers than among non-smokers ($p<0.001$ for all comparisons).

Both groups were comparable regarding age and gender distribution.

smokers ($p<0.001$). The mean PEFR was also significantly lower among smokers (348 ± 68 L/min) than among non-smokers (442 ± 54 L/min; $p<0.001$).

Table 2. Comparison of Pulmonary Function Parameters

Parameter	Smokers	Non-Smokers	p-value
FEV1 (% predicted)	72.4 ± 12.1	89.3 ± 8.4	$<0.001^*$
FVC (% predicted)	78.6 ± 10.7	92.5 ± 7.8	$<0.001^*$
FEV1/FVC (%)	69.8 ± 8.5	81.4 ± 5.7	$<0.001^*$
PEFR (L/min)	348 ± 68	442 ± 54	$<0.001^*$

Among smokers, 25 participants had normal pulmonary function, 18 had an obstructive ventilatory defect, 5 had a restrictive defect, and 2 had a mixed defect. Among non-smokers, 44 participants had normal pulmonary function, 3 had an obstructive defect, 2 had a restrictive defect, and 1 had a mixed defect. The distribution of

ventilatory patterns differed significantly between the two groups ($p<0.001$).

Table 3 shows the distribution of ventilatory defects among smokers and non-smokers. Obstructive ventilatory defects were substantially more frequent among smokers than non-smokers.

Table 3. Pattern of Ventilatory Defects

Pattern	Smokers	Non-Smokers	p-value
Normal	25	44	
Obstructive	18	3	
Restrictive	5	2	

Mixed	2	1	<0.001*
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A significant association was observed between smoking duration and pulmonary function abnormality. Among participants with a smoking duration of ≤ 10 years, 8 had abnormal pulmonary function and 12 had normal pulmonary function. Among those with 11–20 years of smoking, 12 had abnormal pulmonary function and 6 had normal pulmonary function. Among participants with >20 years of smoking, 17 had abnormal pulmonary function and only 1 had normal pulmonary function. The association between smoking duration and pulmonary

function abnormality was statistically significant ($p=0.002$).

Table 4 presents the relationship between smoking duration and pulmonary function abnormality. The proportion of participants with abnormal pulmonary function increased with increasing duration of smoking.

Obstructive ventilatory defects were significantly more common among smokers.

Table 4. Smoking Duration and Pulmonary Function Abnormality

Smoking Duration	Abnormal PFT	Normal PFT	p-value
≤ 10 years	8	12	
11–20 years	12	6	
>20 years	17	1	0.002*

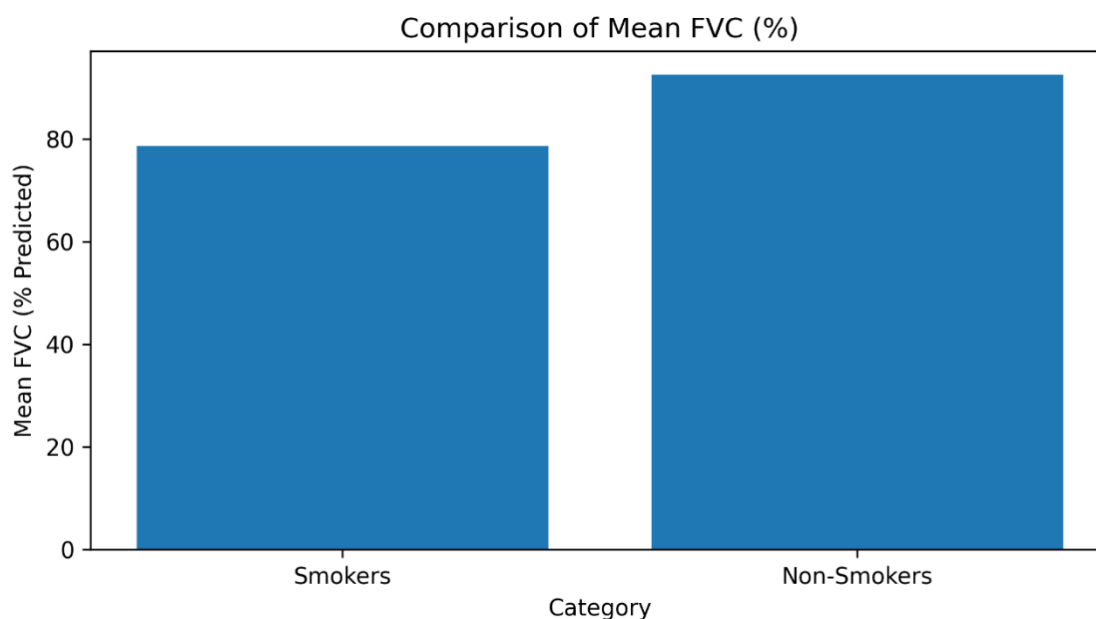


Figure 1: Comparison of mean FVC (%)

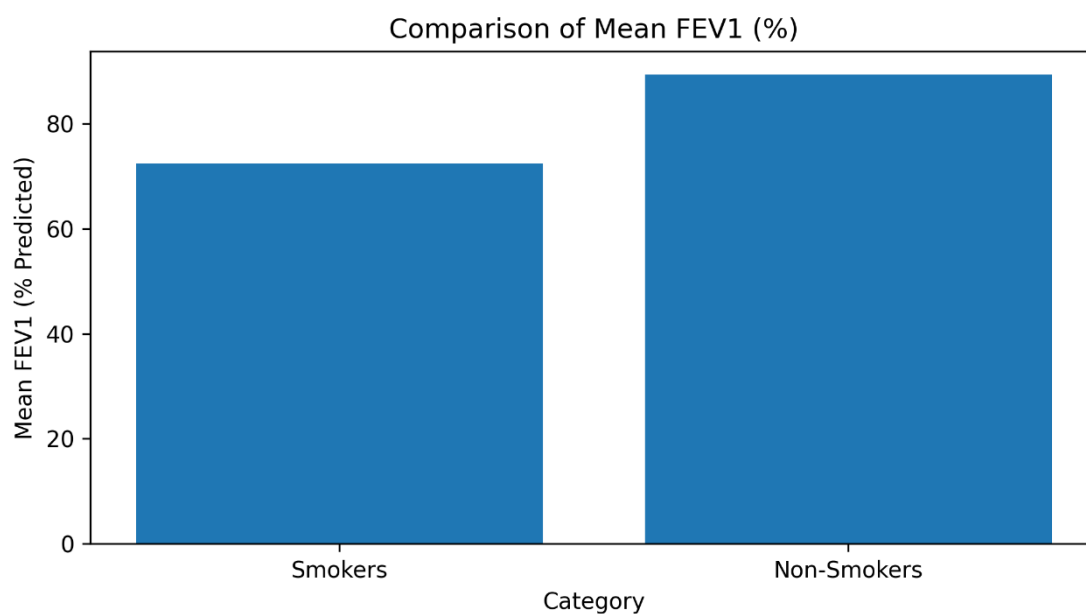


Figure 2: Compariosn of mean FEV1 (%)

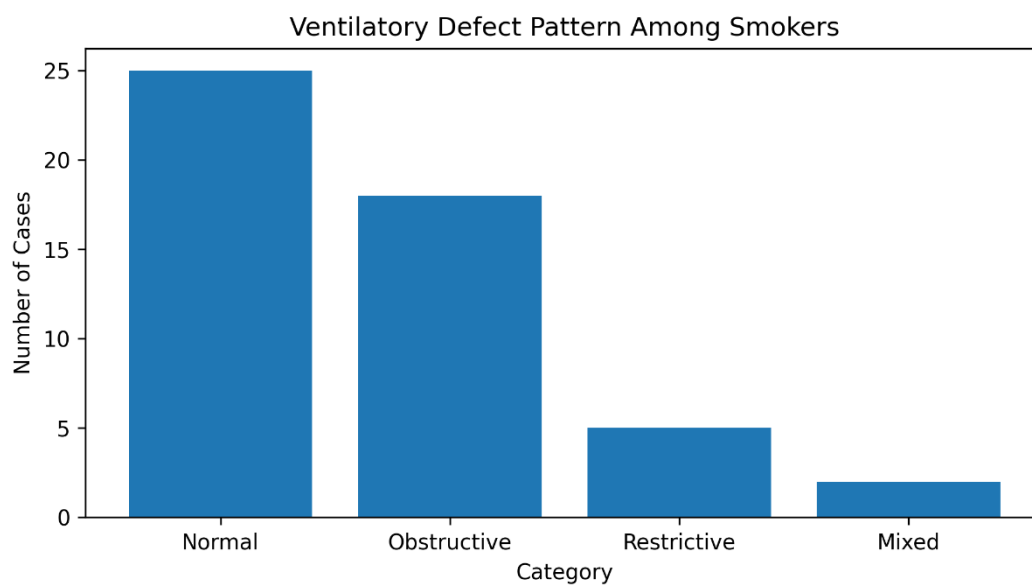
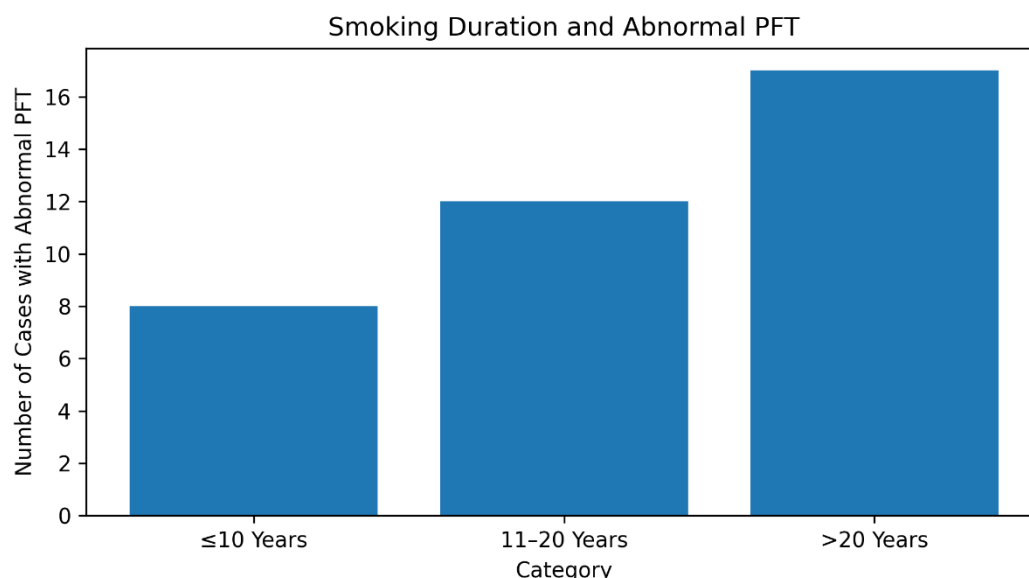


Figure 3: Ventilatory defect pattern amog smokers

Page | 7 Figure 4:



Smoking duration and abnormal PFT

Discussion

The current prospective comparative investigation assessed impairments in pulmonary function in both non-smokers and chronic smokers. The results illustrate the progressive nature of smoking-induced pulmonary deterioration and unequivocally show the detrimental effects of long-term smoking on respiratory function(5). In addition to offering concrete proof of airway blockage and decreased ventilatory capacity, pulmonary function tests are sensitive markers of respiratory health. When compared to non-smokers in the current study, smokers showed significantly reduced FEV1, FVC, FEV1/FVC ratio, and PEFR. These results are in line with earlier research showing that smokers' lung function declines more quickly(6).

Smokers' lower FEV1 is a reflection of airflow restriction brought on by mucus hypersecretion, minor airway constriction, and persistent airway inflammation. Oxidative stress and inflammatory reactions brought on by cigarette smoke gradually harm alveolar walls and bronchial tissues. The decrease in PEFR and FVC is caused by similar mechanisms. The substantially increased incidence of obstructive ventilatory problems in smokers was a particularly notable finding. The two main components of COPD, emphysema and chronic bronchitis, both exhibit obstructive patterns. The recognised link between tobacco exposure and long-term airflow restriction is supported by the prevalence of obstructive anomalies in smokers(7).

Additionally, the study showed a high correlation between the length of smoking and impaired lung function. The largest frequency of aberrant spirometric results was found in participants with smoking histories longer than 20 years. The cumulative negative consequences of exposure to tobacco smoke are highlighted by this dose-response relationship, which has been repeatedly documented in epidemiological research. Even while a small percentage of non-smokers also showed poor pulmonary function, these results could be related to occupational pollutants, passive smoking, environmental exposures, or undiagnosed respiratory diseases. However, compared to smokers, the prevalence of anomalies was significantly reduced(8).

These discoveries have important clinical ramifications. Despite quantifiable declines in pulmonary function, many smokers may not exhibit any symptoms. Regular spirometric screening for long-term smokers can help detect airway restriction early and offer chances for smoking cessation treatments before irreversible harm is done(9). The prospective design and age-matched comparison group are two of the study's strengths. It is important to recognise some limitations, though. Smoking exposure was measured using duration rather than precise pack-year calculations, and the sample size was fairly small. Exposures at work and in the environment were not thoroughly assessed(10).

Notwithstanding these drawbacks, the study offers important proof of the harmful effects of smoking on

respiratory health. The results highlight the significance of early pulmonary function evaluation, tobacco cessation counselling, and smoking prevention programmes. For persistent smokers, especially those with extended smoking histories, routine spirometry should be taken into consideration. Early identification of pulmonary dysfunction may allow for prompt treatment and lessen the burden of chronic respiratory illnesses in the future(11).

Conclusion

The current study shows that long-term smoking is linked to a considerable decline in lung function. When compared to non-smokers, smokers showed significantly reduced spirometric indices, such as FEV1, FVC, FEV1/FVC ratio, and PEFR. The detrimental effects of long-term tobacco exposure on airway function are shown in the much higher prevalence of obstructive ventilatory abnormalities in smokers. Longer smoking histories were linked to more functional deterioration, according to the study, which also found a robust correlation between smoking duration and pulmonary impairment.

These results highlight the possibility of smoking-related lung damage occurring prior to the onset of obvious respiratory symptoms. Therefore, routine pulmonary function testing can be a valuable tool for smokers' early diagnosis and risk assessment. The best way to lessen the burden of chronic lung disorders and prevent progressive respiratory dysfunction is still to quit smoking. Public health campaigns to raise awareness and restrict tobacco use should be reinforced.

The study emphasises the usefulness of spirometry as an easy, non-invasive, and affordable way to assess respiratory health. Frequent screening of long-term smokers may enhance long-term results and enable prompt intervention. To further understand the development of pulmonary dysfunction linked to tobacco use, more multicentric research with bigger populations and thorough evaluation of smoking exposure are advised.

Generalizability

The findings of this study may be applicable to adult smokers and non-smokers attending hospital-based medical services, particularly in tertiary care settings with access to pulmonary function testing. The observed association between chronic smoking and impaired pulmonary function may be relevant to populations with similar demographic and clinical characteristics. However, generalizability to the wider community should be interpreted with caution because the study was conducted at a single tertiary care centre and included a

relatively small sample. Differences in smoking patterns, environmental and occupational exposures, socioeconomic characteristics, and access to healthcare may influence pulmonary function in other populations. Therefore, larger multicentre studies involving more diverse populations are required to determine whether these findings can be generalized to other settings.

Limitations

This study has several limitations. First, it was conducted at a single tertiary care centre with a relatively small sample size, which may limit the generalizability of the findings to other populations and healthcare settings. Second, smoking exposure was assessed primarily in terms of smoking duration, and detailed cumulative exposure based on pack-years was not comprehensively evaluated in the available dataset. Third, occupational and environmental exposures, including passive smoking and other potential respiratory pollutants, were not assessed in detail and may have influenced pulmonary function. Fourth, the cross-sectional nature of the assessment limits the ability to establish a temporal or causal relationship between smoking exposure and pulmonary function impairment. Finally, the study focused on selected spirometric parameters and did not comprehensively evaluate other factors that may influence pulmonary function.

Recommendation

Based on the findings of this study, pulmonary function assessment using spirometry should be considered as part of the clinical evaluation of individuals with prolonged smoking exposure, particularly those at increased risk of respiratory impairment. Smoking cessation counselling and preventive interventions should be emphasized to reduce continued exposure to tobacco smoke. Further multicentre studies involving larger and more diverse populations, with detailed assessment of cumulative smoking exposure and environmental and occupational risk factors, are recommended to further evaluate the long-term effects of smoking on pulmonary function.

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List of Abbreviations

- COPD — Chronic obstructive pulmonary disease

- FEV1 — Forced expiratory volume in one second

- FVC — Forced vital capacity

- PFT— Pulmonary function test

- PEFR— Peak expiratory flow rate

- SPSS — Statistical Package for the Social Sciences

- SD— Standard deviation

Source of Funding

This study received no specific financial support or external funding. The study was conducted using the institutional resources available to the investigators.

Conflict of Interest

The authors declare that they have no conflicts of interest related to this study.

Author Contributions

Mukesh Kumar: Conceptualization, study design, participant recruitment, data collection, data interpretation, and drafting of the manuscript.

Ashutosh Kumar: Study supervision, methodological guidance, data interpretation, critical review, and revision of the manuscript.

Ajay Kumar Lal Das: Overall supervision, critical review of the manuscript, and final approval of the version to be published.

All authors reviewed and approved the final manuscript and agreed to be accountable for all aspects of the work.

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Data Availability

The data supporting the findings of this study are available from the corresponding author upon reasonable request. The data are not publicly available because they contain information that could potentially compromise participant privacy and confidentiality.

References

1. Herath P, Savithri Wasundara Wimalasekera T, Amarasekara D, , Manoj Sanjeeva Fernando ST. Comparison of respiratory symptoms and pulmonary functions of adult male cigarette smokers and non-smokers in Sri Lanka ; A comparative analytical study. PLOSONE [Internet]. 2025;20(2):1-14. <https://doi.org/10.1371/journal.pone.0315095>
2. Kajal NC, Bhushan B, Tiwari LN, Nishanth PS, Mishra A. Evaluation of pulmonary function tests among smokers and non-smokers. Sch J Appl Med Sci. 2017;5(1B):116-20.
3. Bano R, Am M, Nb K, Ahmad N, Nighute S. STUDY OF PULMONARY FUNCTION TESTS AMONG SMOKERS AND NON-SMOKERS IN A RURAL AREA. Pravara Med Rev. 2009;4(1):11-6.
4. Arasan S, P SJP, Wathore N, Ganesan S. Comparative assessment of pulmonary function in non-smokers , tobacco smokers , and exclusive e-cigarette users among young adults : A cross-sectional spirometric analysis. IP Indian J of Immunology Respir Med. 2026;11(2):154-62. <https://doi.org/10.18231/j.ijirm.16136.1775713255>
5. Boskabady MH, Mahmoodinia M, Boskabady M, Heydari GR. Pulmonary function tests and respiratory symptoms among smokers in the city of mashhad (north east of Iran). Rev Port Pneumol. 2011;17(5):199-204. <https://doi.org/10.1016/j.rppneu.2011.05.001>

6. Chimkode SM, Patil L. A cross-sectional study of assessment of lung function tests by spirometry in smoker and non- smoker males. *MedPulse Int J Physiol.* 2021;17(1):1-4.
<https://doi.org/10.26611/1031711>
7. Tabbah K, Abufanas AS, Kanawati AJ, Haitham S, Elawaddlly S, Hamza DN, et al. Spirometric Lung Function Among Smokers and Non-Smokers : A Cross-Sectional Study in University Students. *Int J Environ Res Public Heal.* 2026;23(709):1-23.
<https://doi.org/10.3390/ijerph23060709>
8. Kumar R, Kumari R, Kumar B. A Study of Lung Function Differences Between Smokers and Non-Smokers. *Int J Curr Pharm Rev Res.* 2026;18(2):223-5.
9. Chenicherry M, Datta A, Saha A, Divakaran B. A comparative analysis function variables in athletes of pulmonary smokers. *Int J Acad Med Pharm.* 2025;7(2):111-6.
10. Dutt S, Gogia T, Gupta M. A comparative study on pulmonary function tests in smokers & nonsmokers. *Indian J Clin Anat Physiol.* 2021;8(1):53-6.
<https://doi.org/10.18231/j.ijcap.2021.012>
11. Mistry A, Tyagi R, Kagathara J, Vaidya L, Dholakiya U, Shah C. Comparative Study of Pulmonary Function Tests in Smokers and Non-Smokers. *GCSMC J Med Sci.* 2014;3(1):22-7.

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