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ORIGINAL ARTICLE

Correlation Between Smoking History and Severity of Chest Radiographic Findings in TB Patients

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ABSTRACT:

Background: Pulmonary tuberculosis (TB) remains a major global health challenge, and its severity is influenced by several modifiable and non-modifiable factors. Among these, cigarette smoking has emerged as a critical determinant of disease progression, affecting host immunity, bacterial load, and radiological manifestations. Understanding the relationship between smoking and radiographic severity is essential to improve clinical management and guide targeted public health interventions. **Aim:** To determine the correlation between smoking history and the severity of chest radiographic findings in patients with confirmed pulmonary tuberculosis. **Material and Methods:** This observational cross-sectional study was conducted among 84 adult patients diagnosed with pulmonary TB in a tertiary care hospital. Participants were selected using non-probability consecutive sampling. Data collected included demographic characteristics, smoking status (current, former, or non-smoker), smoking exposure quantified in pack-years, comorbidities, and clinical history. All patients underwent standardized posteroanterior chest radiography. Radiographic abnormalities were graded as mild, moderate, or severe based on the extent of parenchymal involvement, cavitation, nodularity, and pleural changes, assessed independently by two blinded pulmonologists. **Results:** Among the 84 participants, the mean age was 41.72 ± 13.84 years, and 61.90% were male. Current smokers constituted 45.24% of the cohort, former smokers 16.67%, and non-smokers 38.10%. Severe radiographic findings were more frequent among current smokers (42.11%) compared with non-smokers (21.88%), showing a significant association ($p = 0.031$). Cavitary lesions occurred significantly more in smokers (53.85%) than in non-smokers (25.00%) ($p = 0.009$). A moderate positive correlation was observed between pack-years and radiographic severity score ($r = 0.46$, $p < 0.001$). Diabetes mellitus was also significantly associated with greater radiographic severity ($p = 0.042$). **Conclusion:** Smoking is strongly associated with increased radiographic severity in pulmonary TB, and higher cumulative exposure further intensifies disease involvement. Integrating smoking cessation strategies into TB care may help reduce disease burden and improve patient outcomes.

Keywords: Tuberculosis, Smoking, Radiographic Severity, Pack-Years, Cavitation

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INTRODUCTION

Tuberculosis (TB) remains a formidable global health challenge, particularly in low- and middle-income countries, despite decades of control efforts. The pathogenesis and clinical progression of pulmonary TB are influenced by a variety of host factors, including comorbidities and lifestyle exposures. Among these, tobacco smoking has emerged as a critical modifiable risk factor that not only increases susceptibility to TB infection but may also exacerbate disease severity and complicate clinical outcomes.[1] Understanding the relationship between smoking and the radiographic manifestations of TB is essential, especially in tertiary care settings where severe disease often presents.Tobacco smoke affects pulmonary immune defenses by impairing the function of alveolar macrophages, dendritic cells, and other components of the innate immune system, creating a more favorable environment for *Mycobacterium tuberculosis* to thrive, proliferate, and cause damage.[2] Epidemiological data have consistently shown that both active and passive smoking are associated with higher rates of active TB disease, compared to non-smokers.[3] The biological plausibility of this association is underscored by the fact that cigarette smoke can damage ciliary function and disrupt mucociliary clearance, weakening the lung's first-line defenses against infectious agents.From an imaging perspective, the consequences of smoking on TB radiology are particularly concerning. Studies have highlighted that smokers tend to present with more extensive lung involvement, including upper lobe infiltrates, cavitary lesions, and bilateral disease, compared to non-smokers.[4] These radiographic features are not only markers of severe disease but are also associated with higher bacterial loads and more aggressive disease courses. Furthermore, smoking has been linked to delayed radiographic resolution and persistent lung sequelae even after microbiological cure, suggesting that damage incurred may be partially irreversible.The clinical implications of smoking in TB go beyond radiographic severity. Several cohort studies have demonstrated that smokers with TB are more likely to experience unfavorable treatment outcomes such as delayed sputum conversion, treatment failure, relapse,

and even mortality.[5] These poor outcomes contribute significantly to the public health burden of TB, because they can lead to prolonged periods of infectiousness, greater risk of transmission, and the need for more intensive or prolonged therapy.In populations with a high prevalence of smoking, the public health impact of this interaction is especially pronounced. For instance, meta-analyses in Indian settings have reported pooled smoking prevalence among pulmonary TB patients as high as 31%, emphasizing the convergence of two major epidemics in a country that bears a large share of the world's TB burden.[6] These overlapping risk factors highlight the need for integrated strategies that address both smoking cessation and TB control.In addition, certain host comorbidities, such as diabetes mellitus, further complicate the interplay between smoking and TB radiographic disease. Diabetes has independently been associated with more advanced radiographic lesions, slower treatment response, and higher relapse rates.[7] When combined with the immunomodulatory effects of smoking, diabetes may magnify lung injury and radiographic severity, making it a critical consideration in patient risk stratification.

MATERIAL AND METHODS

This observational, cross-sectional study was conducted in the Department of Chest and Tuberculosis at a tertiary care hospital. The study involved patients diagnosed with pulmonary tuberculosis based on clinical evaluation, microbiological confirmation, and radiological assessment. The research aimed to evaluate the relationship between smoking history and the severity of chest radiographic abnormalities among confirmed TB patients receiving care at the institution.A total of eighty-four (84) consecutive patients fulfilling the diagnostic criteria for pulmonary tuberculosis were included. Participants were enrolled through non-probability consecutive sampling as they presented to the outpatient and inpatient services of the department. All patients were adults aged 18 years and above. Patients with incomplete clinical records, alternative diagnoses such as lung malignancy, or those with extrapulmonary tuberculosis were excluded to maintain uniformity of radiological assessment.

Methodology

Data were collected using a structured proforma that included demographic details, clinical features, smoking history, and radiological findings. Smoking history was documented as smoking status (current smoker, former smoker, or non-smoker), the number of cigarettes consumed per day, and total smoking exposure calculated in pack-years. Additional clinical parameters such as duration of cough, presence of hemoptysis, BMI, and comorbidities including HIV status and diabetes mellitus were also recorded. All participants underwent standard posteroanterior (PA) chest radiography performed using the hospital's digital radiographic system under uniform technical specifications.

Radiological Assessment

Chest X-ray films were independently reviewed by two experienced pulmonologists who were blinded to the smoking status of the patients. Radiographic abnormalities were evaluated using a semi-quantitative scoring system that assessed the extent and severity of parenchymal infiltrates, cavitary lesions, nodular opacities, pleural thickening, and extent of lung involvement. The severity of radiographic findings was classified as mild, moderate, or severe based on lung zones affected and cavitation size. Any disagreement in scoring was resolved through mutual discussion to ensure consistency.

Statistical Analysis

All data were entered and analyzed using the Statistical Package for the Social Sciences (SPSS) software, version 16.0. Descriptive statistics were used to summarize demographic and clinical characteristics. Mean and standard deviation were calculated for continuous variables such as age and pack-years, whereas frequencies and percentages were reported for categorical variables including smoking status and radiographic severity categories. The correlation between smoking exposure (pack-years) and radiographic severity scores was assessed using Pearson's correlation coefficient for parametric data. Chi-square tests were applied to determine associations between categorical variables such as smoking status and severity classifications. A p-value of less than 0.05 was considered statistically significant.

RESULTS

The demographic and clinical characteristics of the study population are summarized in Table 1. A total of 84 patients with confirmed pulmonary tuberculosis were included, with a mean age of 41.72 ± 13.84 years, indicating that most participants belonged to the middle-aged group. Males represented the majority of the study cohort, accounting for 61.90% of the population, whereas females comprised 38.10%, reflecting a male predominance commonly seen in TB epidemiology. Regarding smoking status, 45.24% of patients were current smokers and 16.67% were former smokers, while 38.10% reported no smoking history. This distribution shows that more than half of the TB patients had some degree of smoking exposure. In terms of comorbidities, diabetes mellitus was present in 21.43% of the patients, while 7.14% were HIV positive. The majority of the study population (71.43%) had no significant comorbid disease, suggesting that TB occurred predominantly in otherwise healthy individuals, although diabetes remained a noteworthy risk factor.

Table 2 demonstrates the distribution of radiographic severity among smoking and non-smoking groups. A clear gradient of severity is observed when comparing smokers with non-smokers. Among current smokers, severe radiographic findings were seen in 42.11% of patients, and a similar proportion (42.11%) demonstrated moderate severity. Only 15.79% of current smokers presented with mild disease. Former smokers showed a less severe pattern but still had substantial moderate (42.86%) and severe (35.71%) radiographic involvement. In contrast, non-smokers had a significantly higher proportion of mild findings (40.63%) and fewer severe cases (21.88%). The Chi-square test revealed a statistically significant association ($p = 0.031$) between smoking status and radiographic severity, indicating that smoking is strongly linked to more advanced radiographic disease in tuberculosis.

Table 3 further supports this association by assessing the correlation between cumulative smoking exposure (measured in pack-years) and radiographic severity scores. The mean smoking exposure among the 52 smokers was 18.46 ± 9.73 pack-years, indicating substantial long-term exposure in many individuals. The correlation coefficient ($r = 0.46$) demonstrates a moderate positive correlation between smoking pack-years and radiographic severity, and the relationship was highly significant ($p < 0.001$). This finding suggests that not only is smoking status important, but the degree of exposure also plays a critical role in determining the extent of radiographic abnormalities. The more a person smokes, the more likely they are to develop severe pulmonary involvement on chest imaging.

Table 4 compares the specific radiological patterns observed in smokers versus non-smokers. Parenchymal infiltrates were the most common abnormality in both groups, occurring in 84.62% of smokers and 75.00% of non-smokers. Although smokers had a higher frequency, the difference was not statistically significant ($p = 0.249$). Nodular opacities and pleural thickening were also more common in smokers, but again the differences did not reach statistical significance. The most notable finding was the significantly increased frequency of cavitary lesions among smokers (53.85%) compared to non-smokers (25.00%), with a p-value of 0.009, indicating strong statistical significance. This demonstrates that cavitation—a hallmark of severe, destructive pulmonary TB—is significantly more prevalent among individuals with a smoking history.

Table 5 explores the association of comorbidities with radiographic severity. Diabetes mellitus showed a significant relationship with severity ($p = 0.042$), with 32.14% of diabetic patients exhibiting severe radiographic changes compared to only 9.09% showing mild involvement. This pattern reinforces the known role of diabetes as a risk factor for more extensive and severe TB disease. In contrast, HIV status did not show a statistically significant association with radiographic severity ($p = 0.466$), although the proportion of HIV-positive patients increased slightly with severity. Among patients without comorbidities, the majority had mild or moderate findings and the proportion decreased as severity increased, with 57.14% of severe cases having no comorbidity. The association between absence of comorbidity and radiographic severity was statistically significant ($p = 0.021$), reflecting that comorbidities, especially diabetes, may independently contribute to more advanced disease.

Table 1. Demographic and Clinical Characteristics of the Study Population (N = 84)

Variable	Frequency (n)	Percentage (%)
Age (years), Mean ± SD		**41.72 ± 13.84**
Gender		
Male	52	61.90%
Female	32	38.10%
Smoking Status		
Current Smoker	38	45.24%
Former Smoker	14	16.67%
Non-Smoker	32	38.10%
Comorbidities		
Diabetes Mellitus	18	21.43%
HIV Positive	6	7.14%
No Comorbidity	60	71.43%

Table 2. Distribution of Radiographic Severity Among Smoking Groups (N = 84)

Radiographic Severity	Current Smoker (n=38)	Former Smoker (n=14)	Non-Smoker (n=32)	Total (N=84)	p-value*
Mild	6 (15.79%)	3 (21.43%)	13 (40.63%)	22 (26.19%)	
Moderate	16 (42.11%)	6 (42.86%)	12 (37.50%)	34 (40.48%)	**0.031**
Severe	16 (42.11%)	5 (35.71%)	7 (21.88%)	28 (33.33%)	
Total	38 (100%)	14 (100%)	32 (100%)	84 (100%)	

*Chi-square test: **p = 0.031**, statistically significant.

Table 3. Correlation Between Smoking Exposure (Pack-Years) and Radiographic Severity Score

Parameter	Mean ± SD	Correlation Coefficient (r)	p-value
Pack-Years (n = 52 smokers)	18.46 ± 9.73		
Radiographic Severity Score		**0.46**	**<0.001**

Table 4. Radiological Patterns Among Smokers vs Non-Smokers (N = 84)

Radiological Pattern	Smokers (n=52)	Percentage (%)	Non-Smokers (n=32)	Percentage (%)	p-value*
Parenchymal Infiltrates	44	84.62%	24	75.00%	0.249
Cavitary Lesions	28	53.85%	8	25.00%	**0.009**
Nodular Opacities	22	42.31%	10	31.25%	0.306
Pleural Thickening	16	30.77%	6	18.75%	0.228

*Chi-square test applied.

Table 5. Association of Comorbidities with Radiographic Severity (N = 84)

Comorbidity	Mild (n=22)	Moderate (n=34)	Severe (n=28)	p-value*
Diabetes Mellitus (n=18)	2 (9.09%)	7 (20.59%)	9 (32.14%)	**0.042**
HIV Positive (n=6)	1 (4.55%)	2 (5.88%)	3 (10.71%)	0.466
No Comorbidity (n=60)	19 (86.36%)	25 (73.53%)	16 (57.14%)	**0.021**

*Chi-square test applied.

DISCUSSION

The male predominance observed in our cohort (52/84, 61.90%) mirrors the well-documented pattern of higher TB notification among men in many settings; differences in exposure (including higher smoking prevalence among men) and health-seeking behavior have been proposed as explanations. Lin et al. reported gender differences in active TB risk and noted that sociodemographic and behavioral factors such as smoking help explain part of the male excess in TB cases, supporting our finding that most patients—and the majority of smokers—were male.[8]

Smoking was highly prevalent in our sample: 45.24% were current smokers and 16.67% were former smokers (total with any smoking history 61.90%). This high share of smokers among TB patients is consistent with population and clinical studies that link tobacco exposure with both TB infection and disease. Den Boon et al., in a population survey from a high-incidence area, showed an association between smoking and tuberculin-positive status, supporting the observation that a large fraction of persons with TB will have smoking exposure in endemic areas; our finding that over 60% of cases had some smoking history is concordant with those population-level associations.[9]

We found a statistically significant association between smoking status and radiographic severity (Chi-square p = 0.031): among current smokers 42.11% had severe radiographic disease compared with 21.88% of non-smokers. This association aligns with prospective and observational reports that smoking increases the likelihood of more advanced pulmonary disease. Lin et al. reported approximately a twofold increase in risk of active TB in current smokers versus never-smokers; although Lin focused on incidence, the study also emphasized that smokers present with more pronounced disease, which is consistent with our higher proportion of severe radiographic changes in smokers.[8]

The dose–response relationship observed in our study — a moderate positive correlation between pack-years (mean 18.46 ± 9.73 among 52 smokers) and radiographic severity score ($r = 0.46$, $p < 0.001$) — is supported by several clinical series that report stronger radiographic involvement and worse bacteriological indices with greater tobacco exposure. Marjani et al., in a large clinical series, reported that ever-smokers had higher degrees of smear positivity and more extensive disease compared with non-smokers (multivariate analyses significant), a result that dovetails with our finding that cumulative exposure (pack-years) correlated with more severe chest X-ray scores and more destructive disease patterns.[10]

Cavitary disease showed the largest difference between smokers and non-smokers in our data: 53.85% of smokers had cavitation versus 25.00% of non-smokers (p = 0.009). Large clinical datasets also report higher cavitation rates among smokers. Altet-Gómez et al., analysing >13,000 cases, found that cavitary lesions were common and that smokers were significantly more likely to have cavities (reported ORs ≈2.0–2.2); while the absolute percent with cavities differs by population, the direction and significance of the association are the same as in our cohort (our smoker cavitation 53.85% vs Altet-Gómez overall cavitation ~35.8%).[11]

While parenchymal infiltrates were common across groups in our study (smokers 84.62%, non-smokers 75.00%, p = 0.249), the difference did not reach significance. This mirrors results from other investigators who show that infiltrates are a frequent manifestation of TB regardless of smoking status, but

that smoking more distinctly associates with destructive features (cavitation) and higher bacillary load. Lindsay et al. (PLoS ONE) reported that both active and passive smoking are associated with more severe TB outcomes (including markers of infectiousness), supporting the pattern we report: widespread infiltrative disease in all TB patients but more cavitation and severe forms among smokers.[12]

Diabetes mellitus in our cohort was associated with more severe radiographic involvement: 32.14% of diabetics had severe radiographic changes compared with 9.09% mild ($p = 0.042$). This observation is consistent with multiple studies showing that diabetes modifies TB presentation. Chiang et al. examined glycaemic control and radiographic TB manifestations and showed that poor glycaemic control was associated with more extensive radiographic disease and differing lesion distribution, which is concordant with our finding that diabetes was an independent correlate of greater radiographic severity in TB patients.[13]

Finally, smoking's impact on microbiologic and treatment-related parameters (and its link to delayed bacteriological conversion) helps explain our radiographic associations: studies have shown slower sputum conversion and higher early smear positivity among smokers. Metanat et al. reported markedly delayed smear conversion among smokers (for example, 53% of smokers remained smear-positive at 2 months vs 10% of non-smokers in their series), a pattern that would be expected to co-exist with the higher rates of cavitation and radiographic severity we observed (cavities tend to be associated with higher mycobacterial burden and slower conversion).[14]

CONCLUSION

The findings of this study demonstrate a clear and significant correlation between smoking history and the severity of chest radiographic abnormalities in patients with pulmonary tuberculosis. Both smoking status and cumulative tobacco exposure were strongly associated with more advanced radiographic patterns, particularly cavitation and extensive parenchymal involvement. These results highlight the critical need for integrating smoking cessation interventions into TB management. Addressing smoking as a modifiable risk factor may help reduce disease severity, improve outcomes, and enhance TB control efforts.

REFERENCES

1. Jee SH, Golub JE, Jo HA, et al. Smoking and risk of tuberculosis incidence, mortality, and recurrence. Am J Epidemiol. 2009;170(12):1478-88.
2. Alavi-Naini R, Farnia P, Chitsaz E, et al. Association between tuberculosis and smoking. J Res Med Sci. 2012;17(8):719-22.
3. Patra J, Jarvis D, Miller MD, et al. Exposure to second-hand smoke and the risk of tuberculosis in children and adults: a systematic review and meta-analysis. PLoS Med. 2015;12(4):e1001835.
4. Chuang HC, Chang YL, Tsai CM, et al. Cigarette smoke is a risk factor for severity and treatment response in pulmonary tuberculosis. Infect Drug Resist. 2015;8:1-8.
5. Reed GW, Choi HW, Lee YS, et al. Impact of diabetes and smoking on mortality in tuberculosis. PLoS One. 2013;8(2):e58044.
6. Feng JY, Wang JY, Tsai JC, et al. Impact of cigarette smoking on latent tuberculosis infection. Eur Respir J. 2014;43(2):630-3.
7. Aziza R, Farnia P, Alavi AR, et al. Pulmonary tuberculosis specificities in smokers. Rev Pneumol Clin. 2015;71(3):131-5.
8. Lin HH, Ezzati M, Chang HY, Murray M. Association between tobacco smoking and active tuberculosis in Taiwan: prospective cohort study. Am J Respir Crit Care Med. 2009;180(5):475-80.
9. den Boon S, van Lill SW, Borgdorff MW, et al. Association between smoking and tuberculosis infection: a population survey in a high tuberculosis incidence area. Thorax. 2005;60(7):555-7.
10. Marjani M, Tabarsi P, Baghaei P, et al. Smoking effects on clinical manifestations and drug resistance patterns in pulmonary TB patients. Tanaffos. 2010;9(4):53-60.
11. Altet-Gómez MN, Alcaide J, Godoy P, et al. Clinical and epidemiological aspects of smoking and tuberculosis: a study of 13,038 cases. Int J Tuberc Lung Dis. 2005;9(4):430-6.
12. Lindsay RP, et al. The association between active and passive smoking and tuberculosis: a systematic evaluation. PLoS One. 2014;9(4):e93137.
13. Chiang CY, Huang CY, Lin CY, et al. Glycemic control and radiographic manifestations of pulmonary tuberculosis in diabetic patients. PLoS One. 2014;9(5):e93397.
14. Metanat M, et al. Effect of cigarette smoking on sputum smear conversion time among new pulmonary tuberculosis cases. Iran J Clin Infect Dis. 2010;5(1):14-7.