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Smoking Status and Clinical Outcomes among Patients with Multidrug-Resistant Tuberculosis: A Retrospective Comparative Study in Lahore

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ABSTRACT

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Background: Multidrug-resistant tuberculosis (MDR-TB) remains a major challenge because treatment is prolonged and clinical outcomes can be unfavorable. Tobacco smoking may adversely affect pulmonary defense, microbiological response, and treatment outcomes. This study examined the clinical profile and outcomes of patients with MDR-TB according to smoking status at a tertiary care hospital in Lahore.

Objective: To compare demographic, clinical, diagnostic, and treatment characteristics of MDR-TB patients who were smokers and non-smokers.

Methodology: A retrospective comparative study was conducted at Lahore General Hospital using records from January 2018 to December 2022. The final analysis included 272 eligible MDR-TB records. Data on demographic characteristics, previous TB treatment, comorbidities, sputum smear results, smoking status, and treatment outcomes were extracted from hospital records. Descriptive statistics and chi-square tests were used, and odds ratios (ORs) with 95% confidence intervals (CIs) were calculated. Statistical significance was set at $p < 0.05$.

Results: Of 272 patients, 136 (50.0%) were smokers and 136 (50.0%) were non-smokers. Most patients were aged 31–45 years (42.6%), male (64.0%), and urban residents (62.5%). Previous TB treatment was documented in 77.2% of patients, while 39.7% had at least one recorded comorbidity. Overall treatment success was 58.8%. Treatment success was lower among smokers than non-smokers (50.0% vs. 67.6%; $\chi^2 = 8.12$, $p = 0.004$; OR for successful outcome = 0.46, 95% CI: 0.27–0.77). Comorbidities were more frequent among smokers (47.1% vs. 32.4%; $\chi^2 = 5.78$, $p = 0.016$), and sputum smear positivity was also higher (88.2% vs. 73.5%; $\chi^2 = 9.09$, $p = 0.003$).

Conclusion: Within this tertiary-care MDR-TB sample, smoking status was significantly associated with treatment outcome, comorbidity burden, and sputum smear positivity. Because of the retrospective design, these findings indicate associations rather than causation. Smoking cessation support and integrated management of comorbidities may be considered as components of comprehensive MDR-TB care.

Introduction

Multidrug-resistant tuberculosis (MDR-TB), defined by resistance to at least isoniazid and rifampicin, remains an important obstacle to tuberculosis control. MDR-TB requires complex treatment regimens and is associated with substantial morbidity, mortality, treatment interruptions, and economic burden. The burden is particularly important in high-TB-incidence settings where delayed diagnosis, previous treatment, and health-system constraints may contribute to drug resistance [1,2].

Pakistan remains a high-burden setting for tuberculosis, and tertiary-care hospitals receive patients with complicated disease, including drug-resistant TB. Previous treatment is an established risk factor for MDR-TB, while socioeconomic conditions, access to care, and treatment adherence can influence clinical outcomes [3,6]. Understanding the characteristics of patients managed at referral hospitals can therefore provide useful local evidence for strengthening TB services.

Tobacco smoking is a modifiable exposure that can affect respiratory and immune function. Smoking impairs mucociliary clearance and pulmonary host defenses and has been associated with delayed microbiological response and unfavorable tuberculosis treatment outcomes [4,7,8]. Evidence also suggests an association between tobacco exposure and drug-resistant tuberculosis, although the pathways linking smoking with resistance and poor outcomes are multifactorial [5].

The present study was designed as a retrospective comparative analysis of patients with confirmed MDR-TB treated at Lahore General Hospital. Rather than estimating population prevalence of MDR-TB, the study focused on differences in clinical profile, diagnostic findings, and treatment outcomes between smokers and non-smokers within the MDR-TB cohort. The findings may help identify clinically important patterns that can be addressed through integrated TB and tobacco-control services.

Methods

Study Design and Setting

A retrospective comparative design was used. The study was conducted at Lahore General Hospital (LGH), a tertiary-care referral hospital in Lahore, Pakistan, with diagnostic facilities including sputum testing and drug susceptibility testing. The records covered a five-year period from January 2018 to December 2022; data collection and analysis were undertaken from March 2023 to June 2023.

Study Population and Eligibility

The study population comprised patients registered in the hospital TB treatment program with MDR-TB during the study period. Patients aged 18 years or older, with MDR-TB confirmed by drug susceptibility testing and complete demographic, clinical, and smoking information, were eligible. Records with substantial missing information, undocumented smoking history, or chronic respiratory diseases other than TB were excluded.

Final sample and sampling: The final analytical dataset comprised 272 eligible MDR-TB records. The study dataset contained equal numbers of smokers and non-smokers (136 in each group), allowing direct comparative analysis.

Data Collection and Variables

Information was extracted from the TB register and individual medical records using a structured data-extraction form. Variables included age, sex, residence, previous TB treatment, comorbidities, smoking status, sputum smear findings, drug susceptibility testing, and treatment outcome. Smoking status was based on the documented history at registration. Current smoking was defined as daily or occasional smoking within the previous six months; former smoking as cessation for more than six months; and non-smoking as never having smoked.

Statistical Analysis

Data were entered and analyzed using SPSS version 25.0. Frequencies and percentages were used to summarize categorical variables. Associations between smoking status and treatment outcome, comorbidity, and sputum smear result were assessed using chi-square tests. Odds ratios with 95% confidence intervals were calculated. A p-value <0.05 was considered statistically significant.

Ethical considerations: Ethical clearance was obtained from the Institutional Review Board of Lahore General Hospital. Patient confidentiality was maintained through anonymized coding, restricted access to electronic records, and secure data storage.

Results

Table 1 summarizes the demographic profile. The largest age group was 31–45 years (42.6%), followed by 18–30 years (31.6%). Males accounted for 64.0% of the cohort and urban residents for 62.5%. The smoking groups were equally represented, with 136 smokers and 136 non-smokers.

Table 1. Demographic Characteristics and Smoking Status of MDR-TB Patients (N = 272)

Variable	Category	Frequency (n)	Percentage (%)
Age (years)	18–30	86	31.6
	31–45	116	42.6
	46–60	52	19.1
	>60	18	6.6
Gender	Male	174	64.0
	Female	98	36.0
Residence	Urban	170	62.5
	Rural	102	37.5
Smoking status	Smoker	136	50.0
	Non-smoker	136	50.0

Clinical history and diagnostic findings: Previous TB treatment was documented in 77.2% of patients. Diabetes mellitus was the most frequently recorded comorbidity (21.3%), while 60.3% had no recorded comorbidity. Sputum smear was positive in 80.9% of patients, and DST confirmed MDR-TB in all 272 records.

Table 2. Clinical History and Diagnostic Findings of MDR-TB Patients (N = 272)

Variable	Category	Frequency (n)	Percentage (%)
Previous TB treatment	Yes	210	77.2
	No	62	22.8
Comorbidities	None	164	60.3
	Diabetes mellitus	58	21.3
	HIV	8	2.9
	Chronic kidney disease	14	5.1
	Other	28	10.4
Sputum smear	Positive	220	80.9
	Negative	52	19.1
DST	Performed	272	100.0
MDR-TB confirmation	INH + RIF resistant	272	100.0

Treatment outcomes: Overall, 58.8% of patients were cured or completed treatment. Treatment failure occurred in 12.5%, death in 14.0%, loss to follow-up in 7.4%, and 7.4% remained on treatment at the time of data collection.

Table 3. Treatment Outcomes of MDR-TB Patients (N = 272)

Treatment outcome	Frequency (n)	Percentage (%)
Cured / Completed	160	58.8
Treatment failed	34	12.5
Died	38	14.0
Lost to follow-up	20	7.4
Still on treatment	20	7.4

Comparison by smoking status: Treatment success was significantly lower among smokers (50.0%) than non-smokers (67.6%; $\chi^2 = 8.12$, $p = 0.004$). The odds ratio for successful treatment was 0.46 (95% CI: 0.27–0.77), equivalent to an approximately 2.17-fold higher odds of an unfavorable outcome among smokers. Comorbidities were present in 47.1% of smokers versus 32.4% of non-smokers ($\chi^2 = 5.78$, $p = 0.016$; OR = 1.85, 95% CI: 1.11–3.08). Sputum smear positivity was 88.2% among smokers compared with 73.5% among non-smokers ($\chi^2 = 9.09$, $p = 0.003$; OR = 2.72, 95% CI: 1.37–5.41).

Table 4. Associations between Smoking Status and Clinical/Treatment Outcomes (N = 272)

Outcome / Variable	Smokers (n=136)	Non-smokers (n=136)	χ^2 (df)	p-value	OR (95% CI)
Cured / Completed	68 (50.0%)	92 (67.6%)	8.12 (1)	0.004	0.46 (0.27–0.77)
Unfavorable outcome*	68 (50.0%)	44 (32.4%)			
Comorbidity present	64 (47.1%)	44 (32.4%)	5.78 (1)	0.016	1.85 (1.11–3.08)
Comorbidity absent	72 (52.9%)	92 (67.6%)			
Sputum smear positive	120 (88.2%)	100 (73.5%)	9.09 (1)	0.003	2.72 (1.37–5.41)
Sputum smear negative	16 (11.8%)	36 (26.5%)			

*Unfavorable outcome = treatment failure, death, or loss to follow-up. OR for treatment outcome is presented for successful treatment; the reciprocal corresponds to the odds of an unfavorable outcome.

Discussion

The present study examined the clinical and treatment profile of patients with confirmed MDR-TB and compared selected outcomes according to smoking status. The cohort consisted predominantly of young and middle-aged adults, males, and urban residents. This pattern is consistent with the broader epidemiology of TB in high-burden settings, where disease affects economically active age groups and social and healthcare-access factors influence case detection [1,12].

Previous TB treatment was documented in 77.2% of the cohort. This finding is clinically important because previous TB treatment is consistently identified as one of the strongest risk factors for drug-resistant TB [6]. The high proportion of previously treated patients in the present tertiary-care cohort may reflect referral patterns and the concentration of complicated or treatment-experienced cases at specialized facilities. Strengthening adherence support, continuity of drug supply, and follow-up of previously treated patients remains relevant to preventing further resistance.

Nearly two-fifths of patients had at least one recorded comorbidity, with diabetes mellitus being the most common. The coexistence of diabetes and TB has been widely documented, and diabetes may adversely affect immune function and treatment response [9,10]. In the present study, comorbidities were significantly more frequent among smokers than non-smokers. This finding suggests that smoking-related clinical burden may coexist with other chronic conditions and should be considered when planning comprehensive MDR-TB management.

More than four-fifths of the cohort had a positive sputum smear at diagnosis, while DST confirmed MDR-TB in all included records. The high proportion of smear-positive cases indicates a substantial microbiological burden at presentation. The significantly higher smear positivity among smokers than non-smokers is compatible with evidence that smoking can impair pulmonary clearance and microbiological response during TB treatment [7,15]. However, the retrospective design does not permit determination of whether smoking directly caused the observed difference.

Overall treatment success was 58.8%, with the remaining patients experiencing treatment failure, death, loss to follow-up, or remaining on treatment. The observed success rate is comparable to treatment outcomes reported in Pakistani MDR-TB cohorts [3,11]. The lower treatment success among smokers was statistically significant. Similar associations between smoking and unfavorable TB treatment outcomes have been reported in cohort studies and meta-analyses [7,8,14]. Biological mechanisms proposed in the literature include impaired pulmonary immune defense, altered macrophage activity, delayed bacterial clearance, and reduced treatment adherence [4,7].

The present study also found higher odds of comorbidity and sputum smear positivity among smokers. These findings are clinically relevant because a more complicated comorbidity profile and persistent microbiological positivity may increase the complexity of MDR-TB care. Evidence specifically addressing smoking and drug-resistant TB supports an association between tobacco use and drug resistance, although drug resistance is multifactorial and cannot be attributed to smoking alone [5]. Therefore, smoking status should be interpreted alongside previous treatment, adherence, comorbidities, and other clinical and social determinants.

Taken together, the findings support the integration of smoking assessment and cessation support into MDR-TB services. Previous intervention research has shown that tobacco cessation can be incorporated into TB care and may improve treatment-related outcomes [16]. Future studies using longitudinal designs and larger multicenter samples are needed to clarify temporal relationships and adjust for potential confounding factors such as socioeconomic status, nutritional status, alcohol use, and treatment adherence.

Conclusion

This retrospective study of 272 patients with confirmed MDR-TB at a tertiary-care hospital in Lahore found that the cohort was predominantly composed of young and middle-aged adults, males, and urban residents, and that previous TB treatment was common. Smoking status was significantly associated with treatment outcome, comorbidity, and sputum smear positivity. Smokers had lower treatment success, more frequent comorbidities, and greater sputum smear positivity than non-smokers. These results describe important associations within the study population but do not establish causality. Comprehensive MDR-TB services should consider smoking cessation and routine management of comorbid conditions as part of patient-centered care.

Recommendations

- Smoking cessation assessment and support should be incorporated into routine MDR-TB management.
- Patients with MDR-TB should receive systematic screening and management of comorbidities, particularly diabetes mellitus.
- Early microbiological diagnosis and drug susceptibility testing should continue to be strengthened, especially for patients at increased risk of drug resistance.
- Patients with previous TB treatment should receive enhanced adherence counseling and follow-up to reduce treatment interruption and further resistance.
- Future multicenter prospective studies should assess smoking intensity, duration of exposure, treatment adherence, socioeconomic factors, nutritional status, and longitudinal treatment outcomes.

Limitations

- The retrospective design relied on existing medical records and may therefore be affected by incomplete documentation or recording errors.
- Smoking status was based on the history documented at registration and may be subject to recall or reporting bias.
- The study was conducted at a single tertiary-care hospital, which limits generalizability to other settings.
- Detailed socioeconomic, nutritional, alcohol-use, smoking-intensity, and treatment-adherence variables were not sufficiently captured for adjustment.
- The cross-sectional nature of the available record-based comparisons prevents causal inference between smoking and the observed outcomes.

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