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Original Research Article

PREVALENCE & PREDICTORS OF MDR TB AMONG PULMONARY TB PATIENTS IN AN ASPIRATIONAL TRIBAL DISTRICT: A CROSS-SECTIONAL STUDY

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ABSTRACT

Background: Multidrug-resistant tuberculosis (MDR-TB) poses a significant challenge to tuberculosis control, particularly in vulnerable and underserved populations. Tribal communities residing in aspirational districts often experience poor healthcare access, malnutrition, and treatment non-adherence, increasing the risk of drug resistance. The objective is to determine the prevalence and predictors of MDR-TB among pulmonary TB patients in an aspirational tribal district.
Materials and Methods: Cross-sectional observational study was conducted among 100 pulmonary TB patients registered under the National TB Elimination Programme in an aspirational tribal district. Socio-demographic, clinical, and treatment-related variables were collected using a structured proforma. Drug susceptibility testing was performed using CBNAAT and Line Probe Assay. Statistical analysis was conducted using SPSS. Associations were assessed using Chi-square test and independent t-test, and odds ratios were calculated with 95% confidence intervals.
Results: The prevalence of MDR-TB was 18% (95% CI: 11.5-26.7%). Tribal status ($p = 0.019$), HIV positivity ($p = 0.012$), and low BMI ($p = 0.015$) were significantly associated with MDR-TB. Treatment-related factors such as previous TB treatment ($p = 0.003$), treatment default ($p = 0.002$), irregular drug intake ($p = 0.001$), and substance abuse ($p = 0.014$) were strong predictors of drug resistance. Age and diabetes mellitus were not significantly associated with MDR-TB.
Conclusion: The study revealed a substantial burden of MDR-TB in an aspirational tribal district, with treatment-related non-adherence emerging as the strongest predictor. Strengthened adherence monitoring, early molecular diagnosis, nutritional support, and targeted interventions in tribal communities are essential to reduce the burden of MDR-TB and achieve TB elimination goals.
Keywords: Multidrug-resistant tuberculosis; Tribal population; Drug resistance predictors.

INTRODUCTION

Tuberculosis (TB) continues to be a major public health challenge worldwide and remains one of the leading causes of morbidity and mortality from infectious diseases. According to the World Health Organization Global Tuberculosis Report, India bears the highest burden of TB globally, accounting for nearly one-fourth of the world's cases. A particularly alarming dimension of the epidemic is the emergence of multidrug-resistant tuberculosis (MDR-TB), defined as resistance to at least isoniazid and rifampicin, the two most potent first-line anti-tubercular drugs. MDR-TB significantly complicates treatment due to prolonged therapy duration, higher toxicity, increased cost, and poorer outcomes compared to drug-sensitive TB.[1]

The burden of MDR-TB is disproportionately higher in vulnerable and underserved populations, including tribal communities residing in geographically isolated and socioeconomically deprived regions. Aspirational districts, identified by the Government of India under the Aspirational Districts Programme, often exhibit poor health indicators, limited diagnostic facilities, inadequate access to healthcare services, malnutrition, and high levels of poverty. These determinants contribute to delayed diagnosis, irregular treatment adherence, and increased risk of drug resistance. Studies have shown that previous history of TB treatment, treatment default, HIV co-infection, diabetes mellitus, malnutrition, and substance abuse are important predictors of MDR-TB.[2,3]

Tribal populations face unique challenges such as cultural barriers, stigma, lack of awareness, difficult terrain, and inadequate healthcare infrastructure. These factors may result in poor compliance to Directly Observed Treatment Short-course (DOTS) strategy implemented under the National TB Elimination Programme (NTEP). Incomplete or irregular therapy promotes selection of resistant strains of Mycobacterium tuberculosis, thereby fueling transmission of MDR-TB in the community.[4]

Aim: To determine the prevalence and predictors of multidrug-resistant tuberculosis (MDR-TB) among pulmonary TB patients in an aspirational tribal district.

Objectives

1. To estimate the prevalence of MDR-TB among diagnosed pulmonary TB patients.
2. To identify socio-demographic and clinical predictors associated with MDR-TB.
3. To assess treatment-related factors contributing to the development of MDR-TB.

MATERIALS AND METHODS

Source of Data: The data were collected from pulmonary TB patients registered under the National TB Elimination Programme (NTEP) at designated microscopy centers and TB units in the aspirational tribal district. Laboratory data were obtained from CBNAAT and Line Probe Assay reports maintained at the district TB center.

Study Design: The study was conducted as a hospital-based cross-sectional observational study.

Study Location: The study was carried out in an aspirational tribal district of India, including district hospital, TB unit, and peripheral health centers providing TB diagnostic and treatment services.

Study Duration: The study was conducted over a period of 12 months.

Sample Size: A total of 100 pulmonary TB patients were included in the study.

Inclusion Criteria

- Diagnosed pulmonary TB patients aged ≥18 years.
- Patients who underwent drug susceptibility testing (CBNAAT/LPA).
- Patients willing to provide informed consent.

Exclusion Criteria

- Extrapulmonary TB cases.
- Patients already on second-line anti-TB treatment.
- Patients with incomplete laboratory or clinical records.

Procedure and Methodology: Eligible pulmonary TB patients registered during the study period were screened based on inclusion and exclusion criteria. After obtaining informed consent, demographic details, clinical history, treatment history, comorbidities (HIV, diabetes), substance use, nutritional status, and treatment adherence details were recorded using a pre-structured proforma.

Sputum samples were collected and subjected to CBNAAT testing for detection of Mycobacterium tuberculosis and rifampicin resistance. Rifampicin-resistant cases were further evaluated using Line Probe Assay (LPA) for confirmation of MDR-TB. Drug susceptibility results were documented.

Patients were categorized into drug-sensitive TB and MDR-TB groups. Potential predictors such as previous treatment history, default, HIV status, diabetes, smoking, alcohol use, and socioeconomic status were analyzed.

Sample Processing: Two sputum samples (spot and early morning) were collected in sterile containers following standard biosafety precautions. Samples were transported to the designated laboratory. CBNAAT was performed as per manufacturer's protocol to detect rifampicin resistance. Rifampicin-resistant samples were subjected to Line Probe Assay for confirmation of isoniazid resistance. Results were recorded in laboratory registers and patient treatment cards.

Statistical Methods: Statistical analysis was performed using SPSS version 25. Descriptive statistics were expressed as mean ± standard deviation for continuous variables and frequencies with percentages for categorical variables. Prevalence of MDR-TB was calculated with 95% confidence interval. Association between predictors and MDR-TB was assessed using Chi-square test for categorical variables and independent t-test for continuous variables. Logistic regression analysis was performed to identify independent predictors of MDR-TB. A p-value <0.05 was considered statistically significant.

Data Collection: Data were collected using a structured and pre-validated data collection proforma. Information included socio-demographic variables (age, sex, tribal status, education, occupation), clinical parameters (symptom duration, BMI), comorbidities (HIV, diabetes), behavioral factors (smoking, alcohol use), and treatment history. Laboratory results were extracted from TB registers and verified with district TB center records. All data were entered into Microsoft Excel and subsequently analyzed in SPSS.

RESULTS

[Table 1] presents the baseline socio-demographic and clinical profile of 100 pulmonary TB patients included in the study. The mean age of the participants was 42.7 ± 13.4 years (95% CI: 40.0-45.4), which was statistically significant (p = 0.031). The majority of patients belonged to the 31-50 years age group (46.0%), followed by those aged >50 years (30.0%) and 18-30 years (24.0%), with the distribution showing statistical significance (p = 0.042). Males constituted 58.0% of the study population, while females accounted for 42.0%; however, this difference was not statistically significant (p = 0.089). A significantly higher proportion of patients were from tribal communities (63.0%) compared to non-tribal (37.0%) (p = 0.021), highlighting the predominance of tribal patients in this aspirational district. HIV positivity was observed in 14.0% of patients and showed a statistically significant distribution (p = 0.018). Diabetes mellitus was present in 17.0% of cases, though this association was not statistically significant (p = 0.064). The mean BMI of patients was 18.9 ± 2.8 kg/m² (95% CI: 18.3-19.5), indicating overall undernutrition among the study population, which was statistically significant (p = 0.047).

Table 1: Baseline Socio-Demographic and Clinical Profile of Pulmonary TB Patients (N = 100)

Variable	Category / Mean ± SD	n (%)	95% CI	Test of Significance	p-value
Age (years)	Mean ± SD	42.7 ± 13.4	40.0 - 45.4	One-sample t-test	0.031*
Age Group	18-30	24 (24.0)	16.2 - 33.4	χ^2 goodness-of-fit	0.042*
	31-50	46 (46.0)	36.0 - 56.3		
	>50	30 (30.0)	21.4 - 40.1		
Sex	Male	58 (58.0)	48.0 - 67.5	Chi-square	0.089
	Female	42 (42.0)	32.5 - 52.0		
Tribal Status	Tribal	63 (63.0)	53.1 - 72.1	Chi-square	0.021*
	Non-tribal	37 (37.0)	27.9 - 46.9		
HIV Positive	Yes	14 (14.0)	8.0 - 22.5	Chi-square	0.018*
	No	86 (86.0)	77.5 - 92.0		
Diabetes Mellitus	Yes	17 (17.0)	10.3 - 25.8	Chi-square	0.064
	No	83 (83.0)	74.2 - 89.7		
BMI (kg/m²)	Mean ± SD	18.9 ± 2.8	18.3 - 19.5	One-sample t-test	0.047*

Table 2: Prevalence of MDR-TB among Pulmonary TB Patients (N = 100)

Variable	Category	n (%)	95% CI	Test of Significance	p-value
Drug Resistance Status	Drug Sensitive TB	82 (82.0)	73.3 - 88.5	χ^2 goodness-of-fit	<0.001*
	MDR-TB	18 (18.0)	11.5 - 26.7		
Rifampicin Resistance (CBNAAT)	Detected	19 (19.0)	12.3 - 27.8	Proportion test	<0.001*
	Not Detected	81 (81.0)	72.2 - 87.7		

Prevalence of MDR-TB = 18% (95% CI: 11.5-26.7%)

[Table 2] illustrates the prevalence of MDR-TB among the 100 pulmonary TB patients. Drug-sensitive TB was observed in 82.0% of patients, whereas 18.0% were diagnosed with MDR-TB, yielding a prevalence of 18% (95% CI: 11.5-26.7%). This distribution was highly statistically significant (p < 0.001). Rifampicin resistance detected by CBNAAT was identified in 19.0% of cases (95% CI: 12.3-27.8%), which was also statistically significant (p < 0.001).

Table 3: Socio-Demographic and Clinical Predictors Associated with MDR-TB (N = 100)

Predictor	MDR-TB (n=18) n (%)	Drug-Sensitive (n=82) n (%)	95% CI (OR)	Test	p-value
Male Sex	13 (72.2)	45 (54.9)	0.89 - 5.71	Chi-square	0.041*
Tribal Status	15 (83.3)	48 (58.5)	1.21 - 8.32	Chi-square	0.019*
HIV Positive	6 (33.3)	8 (9.8)	1.32 - 9.64	Fisher's exact	0.012*
Diabetes	5 (27.8)	12 (14.6)	0.91 - 6.72	Chi-square	0.083
BMI <18.5	12 (66.7)	29 (35.4)	1.27 - 6.51	Chi-square	0.015*
Mean Age (years)	44.9 ± 11.8	42.1 ± 13.7	−3.9 - 9.4	Independent t-test	0.276

[Table 3] analyzes socio-demographic and clinical predictors associated with MDR-TB. Among MDR-TB patients (n = 18), 72.2% were males compared to 54.9% in the drug-sensitive group, showing a statistically significant association (p = 0.041). Tribal status was significantly associated with MDR-TB, as 83.3% of MDR-TB cases were tribal compared to 58.5% in the drug-sensitive group (p = 0.019). HIV positivity was notably higher among MDR-TB patients (33.3%) than drug-sensitive cases (9.8%), with a significant association (p = 0.012), suggesting immunocompromised status as an important predictor. Low BMI (<18.5 kg/m²) was significantly more common in MDR-TB patients (66.7%) compared to drug-sensitive patients (35.4%) (p = 0.015), indicating undernutrition as a potential risk factor. Although diabetes was more frequent among MDR-TB patients (27.8%) than drug-sensitive cases (14.6%), the association was not statistically significant (p = 0.083). Mean age did not significantly differ between groups (p = 0.276).

Table 4: Treatment-Related Factors Associated with MDR-TB (N = 100)

Treatment Variable	MDR-TB (n=18) n (%)	Drug-Sensitive (n=82) n (%)	95% CI (OR)	Test	p-value
Previous TB Treatment	11 (61.1)	19 (23.2)	2.01 - 10.78	Chi-square	0.003*
Treatment Default History	9 (50.0)	13 (15.9)	1.89 - 11.44	Chi-square	0.002*
Irregular Drug Intake	10 (55.6)	16 (19.5)	2.14 - 12.06	Chi-square	0.001*
Delay >30 days in Diagnosis	8 (44.4)	21 (25.6)	0.93 - 7.01	Chi-square	0.061
Substance Abuse	12 (66.7)	28 (34.1)	1.33 - 6.84	Chi-square	0.014*

[Table 4] evaluates treatment-related factors associated with MDR-TB. Previous history of TB treatment was significantly higher among MDR-TB patients (61.1%) compared to drug-sensitive patients (23.2%) (p = 0.003), indicating strong association between prior exposure to anti-TB therapy and development of resistance. Treatment default history was observed in 50.0% of MDR-TB patients versus 15.9% in drug-sensitive cases (p = 0.002), demonstrating that interruption of therapy significantly contributed to drug resistance. Irregular drug intake was also significantly associated with MDR-TB (55.6% vs 19.5%, p = 0.001). Substance abuse was more prevalent among MDR-TB patients (66.7%) compared to drug-sensitive cases (34.1%) and showed statistical significance (p = 0.014). Although diagnostic delay of more than 30 days was higher in MDR-TB patients (44.4%) compared to drug-sensitive patients (25.6%), this association did not reach statistical significance (p = 0.061).

DISCUSSION

Baseline Profile [Table 1]: The mean age of the study population was 42.7 ± 13.4 years, with the majority belonging to the economically productive age group (31-50 years). Similar age distribution has been reported by Park M et al,[5] (2024) who observed that MDR-TB predominantly affects middle-aged adults due to higher exposure risk and treatment interruptions. The male predominance (58%) observed in the present study aligns with findings of Benremila D et al. (2023),[6] who reported higher TB burden among males, possibly due to occupational exposure, smoking, and health-seeking behavior differences. However, in our study, sex was not statistically significant as a baseline factor.

A significant proportion of patients were from tribal communities (63%), reflecting the vulnerability of marginalized populations. Studies from tribal regions of India by Park M et al,[5] (2024) have similarly demonstrated higher TB burden due to poor access to healthcare, malnutrition, and delayed diagnosis. HIV co-infection was present in 14% of cases and showed statistical significance. HIV is a well-established risk factor for TB progression and poor treatment outcomes, as supported by Ravindran TS et al. (2025).[7] Diabetes mellitus was present in 17% of cases, though not statistically significant. While diabetes has been identified as a risk factor for TB in several studies Shariff MK et al. (2022),[8] its association with MDR-TB remains inconsistent.

The mean BMI was 18.9 ± 2.8 kg/m², indicating undernutrition. Malnutrition weakens immune defenses and has been linked to poor treatment outcomes. Hussain T et al,[2] (2020) reported that low BMI significantly increases susceptibility to TB and treatment failure, supporting our findings.

Prevalence of MDR-TB [Table 2]: The prevalence of MDR-TB in this study was 18% (95% CI: 11.5-26.7%), which is considerably higher than the national average for new TB cases reported in India. According to the Foster JB et al,[9] (2023) MDR/RR-TB prevalence among new cases in India is approximately 3-5%, but much higher among previously treated cases. The elevated prevalence in the present study may reflect poor adherence, tribal vulnerability, and prior treatment exposure.

Rifampicin resistance was detected in 19% of patients by CBNAAT, reinforcing the importance of molecular diagnostics in early detection. Shariff MK et al,[8] (2022) similarly emphasized that CBNAAT has significantly improved detection rates of drug-resistant TB in programmatic settings.

Socio-Demographic and Clinical Predictors [Table 3]: Male sex showed a significant association with MDR-TB (p = 0.041), consistent with findings by Hussain T et al. (2020),[2] who identified male gender as an independent predictor due to higher rates of smoking and treatment non-compliance. Tribal status was significantly associated with MDR-TB (p = 0.019), underscoring structural inequities in healthcare access. Adamu AU et al,[3] (2024) also observed higher drug resistance rates in tribal populations.

HIV positivity was significantly higher among MDR-TB patients (33.3%) compared to drug-sensitive cases (p = 0.012). HIV-related immunosuppression may increase bacillary load and complicate treatment adherence. Sailo CV et al,[4] (2022) reported similar associations between HIV and MDR-TB outcomes.

Low BMI (<18.5 kg/m²) was significantly associated with MDR-TB (p = 0.015), supporting the role of malnutrition in treatment failure and resistance development. Diabetes, although more frequent in MDR-TB cases, did not reach statistical significance, similar to findings reported by Park M et al. (2024).[5]

Age was not significantly associated with MDR-TB, suggesting that resistance is more strongly influenced by treatment-related factors than chronological age.

Treatment-Related Predictors [Table 4]: Previous TB treatment emerged as a strong predictor of MDR-TB (p = 0.003). This finding aligns with Bansal SB et al,[10] (2022) who reported prior treatment as the most significant determinant of resistance. Treatment default history (p = 0.002) and irregular drug intake (p = 0.001) were also significantly associated with MDR-TB. Incomplete or interrupted therapy allows selection of resistant bacilli, a mechanism widely documented in MDR-TB pathogenesis.

Substance abuse was significantly associated with MDR-TB (p = 0.014), possibly due to poor adherence and socioeconomic instability. Similar associations were reported by Mali S et al. (2023).[11] Although diagnostic delay (>30 days) was more common among MDR-TB cases, it did not reach statistical significance, though prolonged delay may contribute to transmission and disease severity.

CONCLUSION

The present cross-sectional study demonstrated a high prevalence of multidrug-resistant tuberculosis (MDR-TB) (18%) among pulmonary TB patients in an aspirational tribal district. The findings revealed that socio-demographic factors such as tribal status and HIV positivity, along with clinical indicators like low body mass index, were significantly associated with MDR-TB. More importantly, treatment-related factors including previous history of TB treatment, treatment default, irregular drug intake, and substance abuse emerged as strong predictors of drug resistance. These results underscore the critical role of treatment adherence and early detection strategies in preventing the development and transmission of MDR-TB.

The study highlights the vulnerability of tribal populations due to limited healthcare access, socio-economic constraints, malnutrition, and inadequate awareness, which may contribute to delayed diagnosis and poor treatment compliance. Strengthening programmatic interventions under the National TB Elimination Programme (NTEP), enhancing adherence monitoring, providing nutritional and social support, and ensuring universal drug susceptibility testing are essential to control MDR-TB in aspirational and tribal districts. Targeted public health strategies focusing on high-risk groups are crucial for achieving TB elimination goals.

Limitations of the Study

1. The study was conducted in a single aspirational tribal district, which may limit the generalizability of the findings to other regions.
2. The cross-sectional design prevents establishing a causal relationship between predictors and MDR-TB.
3. The sample size was limited to 100 patients, which may reduce statistical power for certain associations.
4. Information on treatment adherence and substance abuse was partly based on patient self-reporting, which may introduce recall or reporting bias.
5. Some potential confounding variables such as detailed socioeconomic indicators, genetic susceptibility, and environmental exposure were not extensively assessed.

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