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SOCIO-DEMOGRAPHIC PROFILE AND RISK FACTORS AMONG PATIENTS WITH MULTIDRUG-RESISTANT TUBERCULOSIS IN RAICHUR DISTRICT: A CROSS-SECTIONAL STUDY

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ABSTRACT

Background: Multidrug-resistant tuberculosis is a major challenge to tuberculosis control because it requires prolonged treatment, is associated with frequent adverse drug reactions, and commonly affects socially and economically vulnerable populations. Socio-demographic characteristics, behavioral exposures, previous anti-tuberculosis treatment, comorbidities, and poor treatment adherence may influence the occurrence and outcomes of MDR-TB. The present study was conducted to assess the socio-demographic profile and risk factors among patients with multidrug-resistant tuberculosis in Raichur district. **Aim:** To assess the socio-demographic profile and risk factors among patients with multidrug-resistant tuberculosis in Raichur district. **Materials and Methods:** A community-based cross-sectional study was conducted among 60 patients diagnosed with MDR-TB and registered at the District Tuberculosis Centre, Raichur. Eligible adult patients who provided informed consent were included. Data were collected using a predesigned and pretested questionnaire through interviews and review of programme records. Information regarding socio-demographic characteristics, housing conditions, behavioral risk factors, tuberculosis contact history, awareness, comorbidities, previous treatment, current treatment status, and adverse drug reactions was recorded. Data were summarized using frequencies, percentages, mean, and standard deviation. The chi-square goodness-of-fit test and one-sample analysis were used where applicable, and a p-value of <0.05 was considered statistically significant. **Results:** The mean age of the patients was 38.9±11.8 years, and 85.0% were younger than 50 years. Males constituted 70.0% of the study population, and 75.0% were rural residents. Illiteracy was present in 55.0%, while 56.4% belonged to socioeconomic Class IV. Business owners or farmers constituted 31.7%, unskilled workers 30.0%, and unemployed patients 26.7%. Most patients were married (81.7%) and belonged to nuclear families (68.3%). Inadequate ventilation was reported by 48.3%, and 58.3% had exposure to indoor air pollution. Smoking and alcohol consumption were each reported by 28.3%, while 16.7% chewed tobacco. A family history of contact with tuberculosis was present in 26.7%, and only 50.0% had adequate awareness regarding tuberculosis. Comorbidities were present in 13.3%; among them, diabetes mellitus accounted for 50.0%, HIV infection for 37.5%, and psychiatric illness for 12.5%. All patients had previously received anti-tuberculosis treatment. At the time of assessment, 48.3% were on treatment, 16.7% had treatment interruption, 10.0% were cured, 8.3% had completed treatment, 6.7% had died, and 1.7% had developed XDR-TB. Severe adverse drug reactions were reported in 58.3% of patients. **Conclusion:** MDR-TB in Raichur district predominantly affected young and middle-aged men from rural, less educated, and socioeconomically disadvantaged backgrounds. Previous tuberculosis treatment was universal, while behavioral risks, inadequate awareness, treatment interruption, comorbidities, and adverse drug reactions were common. Patient-centered adherence support, early drug-resistance testing, contact investigation, management of comorbidities, and strengthened socioeconomic and counselling interventions are required to improve MDR-TB control and treatment outcomes.

INTRODUCTION

Tuberculosis (TB) remains one of the most important infectious diseases worldwide and continues to pose a major public health challenge, particularly in low- and middle-income countries. It is caused by *Mycobacterium tuberculosis* and is primarily transmitted through airborne droplets expelled by individuals with pulmonary tuberculosis. Despite the availability of effective diagnostic methods and anti-tubercular therapy, TB remains among the leading causes of morbidity and mortality globally. According to the World Health Organization (WHO), an estimated 10.8 million people developed tuberculosis and approximately 1.25 million deaths occurred due to TB in 2023. India contributes nearly one-fourth of the global TB burden and remains one of the highest TB burden countries despite substantial improvements under the National Tuberculosis Elimination Programme (NTEP).[1]

Multidrug-resistant tuberculosis (MDR-TB), defined as tuberculosis resistant to at least isoniazid and rifampicin, represents one of the greatest obstacles to global TB control. MDR-TB develops due to spontaneous genetic mutations in *Mycobacterium tuberculosis* combined with inadequate or incomplete treatment, poor adherence to therapy, inappropriate drug regimens, interrupted drug supply, delayed diagnosis, and ongoing community transmission of resistant strains. Treatment of MDR-TB requires prolonged multidrug therapy with second-line anti-tubercular drugs that are less effective, more toxic, and considerably more expensive than standard first-line regimens. Patients often experience severe adverse drug reactions, prolonged infectiousness, psychological stress, and reduced quality of life.[2]

Several socio-demographic and behavioral factors have been associated with the occurrence of MDR-TB. Poverty, overcrowding, malnutrition, illiteracy, unemployment, poor housing conditions, tobacco smoking, alcohol consumption, diabetes mellitus, HIV infection, previous TB treatment, treatment interruption, and close contact with infectious TB patients significantly increase the risk of developing drug-resistant tuberculosis. Identification of these determinants is essential for designing targeted public health interventions, improving treatment adherence, and reducing disease transmission.[3]

India has adopted the National Strategic Plan for Tuberculosis Elimination with the ambitious goal of eliminating TB by 2025. The programme emphasizes universal drug susceptibility testing, rapid molecular diagnosis using CBNAAT/Truenat, individualized treatment regimens, nutritional support, digital patient monitoring through Nikshay, and strengthened patient-centered care. Although these initiatives have improved case detection and treatment outcomes, MDR-TB continues to remain a significant challenge, particularly in socioeconomically disadvantaged regions.[4]

Raichur district in Karnataka is recognized as one of the socioeconomically backward districts where poverty, inadequate living conditions, limited access to healthcare services, and high prevalence of tuberculosis contribute to the persistence of MDR-TB. Understanding the socio-demographic characteristics and risk factors among MDR-TB patients in this region is essential for planning effective preventive strategies, strengthening treatment adherence, and improving programmatic outcomes. Therefore, the present cross-sectional study was undertaken to assess the socio-demographic profile and associated risk factors among patients diagnosed with multidrug-resistant tuberculosis in Raichur district.

Aim

To assess the socio-demographic profile and risk factors among patients with multidrug-resistant tuberculosis in Raichur district.

Objectives

1. To study the socio-demographic characteristics of patients diagnosed with multidrug-resistant tuberculosis.
2. To identify behavioral, environmental, and clinical risk factors associated with multidrug-resistant tuberculosis.
3. To determine the distribution of selected comorbidities and previous tuberculosis treatment history among MDR-TB patients.

MATERIALS AND METHODS

Source of Data: The data were collected from the Multidrug-Resistant Tuberculosis (MDR-TB) register maintained at the District Tuberculosis Centre (DTC), Raichur. Eligible patients registered under the National Tuberculosis Elimination Programme (NTEP) were contacted and interviewed using a structured pretested questionnaire.

Study Design: A community-based cross-sectional observational study was conducted.

Study Location: The study was conducted in Raichur District, Karnataka, among patients registered at the District Tuberculosis Centre (DTC), Raichur.

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

Sample Size: A total of 60 patients diagnosed with multidrug-resistant tuberculosis and fulfilling the eligibility criteria were included in the study.

Inclusion Criteria

- Patients aged 18 years and above diagnosed with multidrug-resistant tuberculosis.
- Patients registered under the District Tuberculosis Centre, Raichur.
- Patients who provided written informed consent.
- Patients available for interview during the study period.

Exclusion Criteria

- Patients unwilling to participate.

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- Patients who could not be contacted despite repeated visits.
- Patients who were seriously ill and unable to respond to the questionnaire.
- Patients with incomplete records.

Procedure and Methodology

Prior approval was obtained from the Institutional Ethics Committee and permission was secured from the District Tuberculosis Officer, Raichur. The list of eligible MDR-TB patients was obtained from the District Tuberculosis Centre. Eligible participants were contacted either during follow-up visits or through field visits with assistance from health workers.

The purpose of the study was explained in the local language, and written informed consent was obtained from every participant. Information was collected through face-to-face interviews using a pretested structured questionnaire.

The questionnaire included information regarding:

- Age
- Gender
- Religion
- Residence
- Educational status
- Occupation
- Marital status
- Family type
- Socioeconomic status
- Housing conditions
- Tobacco use
- Smoking
- Alcohol consumption
- Previous history of tuberculosis
- Previous anti-tubercular treatment
- Treatment adherence
- Contact history with TB patients
- Comorbidities (Diabetes mellitus, HIV infection and other chronic illnesses)

Anthropometric measurements including height and weight were measured using standardized procedures whenever feasible. Information regarding laboratory diagnosis, treatment category, drug susceptibility testing, and previous treatment details was extracted from the NTEP treatment records.

Sample Processing

No biological samples were collected specifically for this study. Laboratory findings including CBNAAT, Line Probe Assay (LPA), culture reports, drug susceptibility testing (DST), and treatment records were retrieved from the District Tuberculosis Centre records maintained under the National Tuberculosis Elimination Programme.

Statistical Methods

The collected data were entered into Microsoft Excel and analyzed using SPSS version 25.0.

Descriptive statistics were expressed as frequency, percentage, mean, and standard deviation.

Associations between categorical variables were analyzed using the Chi-square test or Fisher's exact test wherever appropriate.

Continuous variables were compared using the independent Student's *t*-test.

A p-value of <0.05 was considered statistically significant.

Data Collection

Data were collected using a structured and pretested interview schedule after obtaining written informed consent from each participant. Information was obtained through direct interviews and review of MDR-TB treatment records maintained at the District Tuberculosis Centre.

The questionnaire consisted of the following sections:

- Socio-demographic characteristics
- Behavioral risk factors
- Clinical history
- Previous tuberculosis treatment
- Contact history
- Comorbidities
- Housing and environmental factors
- Treatment-related information

All collected information was kept confidential and used exclusively for research purposes.

RESULTS

Table 1: Overall socio-demographic profile among patients with multidrug-resistant tuberculosis (N=60)

Variable	Category	n (%) / Mean±SD	Test of significance	95% CI	p-value
Age (years)	Mean±SD	38.9±11.8	One-sample t=25.56	35.9-41.9	<0.001*
Age group	<30	16 (26.7)	χ^2=23.20	—	<0.001*
	30-40	18 (30.0)			
	40-50	17 (28.3)			
	50-60	6 (10.0)			
	60-70	2 (3.3)			
	≥70	1 (1.7)			
Sex	Male	42 (70.0)	χ^2=9.60	57.4-80.7%	0.002*
	Female	18 (30.0)			
Residence	Rural	45 (75.0)	χ^2=15.00	62.1-85.3%	<0.001*
	Urban	15 (25.0)			

[Table 1] presents the overall socio-demographic profile of the study participants. The mean age of the patients was 38.9±11.8 years (95% CI: 35.9-41.9 years), which was statistically significant on one-

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sample analysis (t=25.56, p<0.001). The majority of patients belonged to the 30-40 years age group (30.0%), followed closely by the 40-50 years age group (28.3%) and those aged <30 years (26.7%), while only 10.0% were aged 50-60 years, 3.3% were aged 60-70 years, and 1.7% were aged ≥70 years. The age distribution was statistically significant (χ^2=23.20, p<0.001). Male patients predominated, accounting for 70.0% of the study population compared to 30.0% females, demonstrating a significant male predominance (χ^2=9.60, 95% CI: 57.4-80.7%, p=0.002). Most participants were residents of rural areas (75.0%), whereas only 25.0% were from urban areas. The predominance of rural residence was also statistically significant (χ^2=15.00, 95% CI: 62.1-85.3%, p<0.001).

Table 2: Socio-demographic characteristics of patients diagnosed with multidrug-resistant tuberculosis (N=60)

Variable	Category	n (%)	Test of significance	95% CI	p-value
Education	Illiterate	33 (55.0)	χ^2=49.80	42.4-67.1%	<0.001*
	Primary	3 (5.0)			
	Middle	6 (10.0)			
	High School	10 (16.7)			
	PUC	5 (8.3)			
	Graduate	3 (5.0)			
Occupation	Business/Farmer	19 (31.7)	χ^2=18.47	20.8-44.5%	0.001*
	Skilled	5 (8.3)			
	Unskilled	18 (30.0)			
	Unemployed	16 (26.7)			
	Student	2 (3.3)			
Marital status	Married	49 (81.7)	χ^2=24.07	69.1-90.9%	<0.001*
	Unmarried	11 (18.3)			
Family type	Nuclear	41 (68.3)	χ^2=38.10	55.0-79.7%	<0.001*
	Joint	18 (30.0)			
	Separated	1 (1.7)			
Socioeconomic class	Class II	5 (9.1)	χ^2=20.69	2.6-15.6%	<0.001*
	Class III	19 (34.5)			
	Class IV	31 (56.4)			
House type	Kacha	12 (20.0)	χ^2=9.10	10.9-31.9%	0.011*
	Pucca	31 (51.7)			
	Semi-pucca	17 (28.3)			

[Table 2] summarizes the detailed socio-demographic characteristics of the study participants. More than half of the patients (55.0%) were illiterate, followed by those educated up to high school (16.7%), middle school (10.0%), PUC (8.3%), and primary and graduate education (5.0% each). The educational distribution was statistically significant (χ^2=49.80, p<0.001). Regarding occupation, 31.7% were engaged in business or farming, 30.0% were unskilled workers, 26.7% were unemployed, 8.3% were skilled workers, and only 3.3% were students, showing a significant occupational distribution (χ^2=18.47, p=0.001). The majority of patients were married (81.7%), while 18.3% were unmarried (χ^2=24.07, p<0.001). Most participants belonged to nuclear families (68.3%), followed by joint families (30.0%) and separated families (1.7%), with a statistically significant distribution (χ^2=38.10, p<0.001). According to the Modified Kuppuswamy socioeconomic classification, over half (56.4%) belonged to Class IV, followed by Class III (34.5%) and Class II (9.1%), indicating that the majority were from lower socioeconomic strata (χ^2=20.69, p<0.001). With respect to housing, 51.7% lived in pucca houses, 28.3% in semi-pucca houses, and 20.0% in kacha houses, and the distribution was statistically significant (χ^2=9.10, p=0.011).

Table 3: Behavioral, environmental and clinical risk factors associated with multidrug-resistant tuberculosis (N=60)

Variable	Category	n (%)	Test of significance	95% CI	p-value
Adequate ventilation	Yes	31 (51.7)	χ^2=0.07	38.5-64.7%	0.796
	No	29 (48.3)			
Indoor air pollution	Yes	35 (58.3)	χ^2=1.67	45.0-70.8%	0.197
	No	25 (41.7)			
Smoking history	Yes	17 (28.3)	χ^2=11.27	17.6-40.8%	0.001*
	No	43 (71.7)			
Alcohol consumption	Yes	17 (28.3)	χ^2=11.27	17.6-40.8%	0.001*
	No	43 (71.7)			
Tobacco chewing	Yes	10 (16.7)	χ^2=26.67	8.3-28.5%	<0.001*
	No	50 (83.3)			
TB contact history	Family	16 (26.7)	χ^2=34.53	16.8-38.8%	<0.001*
	Neighbour	5 (8.3)			
	Co-worker	3 (5.0)			
	Unknown	36 (60.0)			
Awareness regarding TB	Yes	30 (50.0)	χ^2=0.00	37.0-63.0%	1.000
	No	30 (50.0)			

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[Table 3] depicts the behavioral, environmental, and clinical risk factors among MDR-TB patients. Adequate household ventilation was present in 51.7% of patients, while 48.3% reported inadequate ventilation; this difference was not statistically significant (χ^2=0.07, p=0.796). Similarly, 58.3% of participants reported exposure to indoor air pollution compared with 41.7% who did not, although this association was not statistically significant (χ^2=1.67, p=0.197). A history of smoking was observed in 28.3% of patients, whereas 71.7% were non-smokers, and this distribution was statistically significant (χ^2=11.27, p=0.001). Likewise, 28.3% of patients reported alcohol consumption, while 71.7% did not consume alcohol, which was also statistically significant (χ^2=11.27, p=0.001). History of tobacco chewing was present in 16.7% of patients, whereas 83.3% denied tobacco chewing, showing a highly significant distribution (χ^2=26.67, p<0.001). Regarding contact history, 26.7% had a family history of tuberculosis, 8.3% reported contact with neighbours, 5.0% with co-workers, whereas 60.0% were unaware of any contact history; the overall distribution was statistically significant (χ^2=34.53, p<0.001). Awareness regarding tuberculosis was equally distributed, with 50.0% of patients being aware and 50.0% unaware of the disease, and this difference was not statistically significant (χ^2=0.00, p=1.000).

Table 4: Distribution of comorbidities and previous tuberculosis treatment history among MDR-TB patients (N=60)

Variable	Category	n (%)	Test of significance	95% CI	p-value
Presence of comorbidity	Yes	8 (13.3)	χ^2=32.27	5.9-24.6%	<0.001*
	No	52 (86.7)			
Type of comorbidity (n=8)	Diabetes mellitus	4 (50.0)	χ^2=1.75	15.7-84.3%	0.417
	HIV	3 (37.5)			
	Psychiatric illness	1 (12.5)			
Previous TB treatment history	Previously treated	60 (100.0)	—	100%	—
MDR-TB treatment status	On treatment	29 (48.3)	χ^2=38.33	35.3-61.5%	<0.001*
	Treatment interrupted	10 (16.7)			
	Cured	6 (10.0)			
	Treatment completed	5 (8.3)			
	Death	4 (6.7)			
	XDR-TB	1 (1.7)			
Severe adverse drug reaction	Present	35 (58.3)	χ^2=1.67	45.0-70.8%	0.197
	Absent	25 (41.7)			

*** Statistically significant (p < 0.05).**

[Table 4] presents the distribution of comorbidities and previous treatment history among the MDR-TB patients. Overall, 13.3% of participants had at least one comorbidity, while 86.7% had no associated comorbid condition, and this distribution was statistically significant (χ^2=32.27, p<0.001). Among the eight patients with comorbidities, diabetes mellitus was the most common condition, affecting 50.0%, followed by HIV infection (37.5%) and psychiatric illness (12.5%); however, the distribution of specific comorbidities was not statistically significant (χ^2=1.75, p=0.417). All 60 patients (100%) had a history of previous anti-tuberculosis treatment before being diagnosed with MDR-TB. Regarding treatment status at the time of assessment, nearly half (48.3%) were continuing MDR-TB treatment, while 16.7% had interrupted treatment, 10.0% had been cured, 8.3% had completed treatment, 6.7% had died, and 1.7% had progressed to extensively drug-resistant tuberculosis (XDR-TB). This distribution was statistically significant (χ^2=38.33, p<0.001). Severe adverse drug reactions were reported in 58.3% of patients, whereas 41.7% did not experience severe adverse effects; however, this difference was not statistically significant (χ^2=1.67, p=0.197).

DISCUSSION

The present community-based cross-sectional study described the socio-demographic characteristics, behavioral and environmental exposures, comorbidities, and treatment-related profile of 60 patients with multidrug-resistant tuberculosis (MDR-TB) in Raichur district. The findings indicate that MDR-TB predominantly affected economically productive adults, males, rural residents, individuals with limited education, and patients from relatively disadvantaged socioeconomic groups. Behavioral exposures, previous tuberculosis treatment, treatment interruption, contact with patients with TB, and adverse drug reactions were also prominent. These findings are relevant because India remains among the countries carrying a substantial proportion of the global MDR/RR-TB burden, and previously treated patients continue to have a considerably higher prevalence of drug resistance than newly diagnosed patients.[1]

Socio-demographic profile

The mean age of the participants was 38.9±11.8 years, and approximately 85% were younger than 50 years. The largest proportions belonged to the age groups of 30-40 years and 40-50 years. This demonstrates that MDR-TB mainly affected people in the economically productive period of life. Dzeyie et al. (2019),[2] in an Indian study of drug-resistant tuberculosis, similarly reported that most patients

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were young or middle-aged adults. Jain et al. (2018),[3] also observed that MDR-TB disproportionately affected economically productive age groups, leading to loss of employment, prolonged dependency, and increased household expenditure. The concentration of MDR-TB among younger adults may be related to greater occupational and community exposure, mobility, delayed healthcare-seeking, and previous incomplete treatment.

Males constituted 70.0% of the study population, showing a statistically significant predominance over females. Dzeyie et al. (2019),[2] reported a comparable male predominance, with approximately two-thirds of drug-resistant TB patients being men. Suryawanshi et al. (2017),[4] also identified male sex as an important characteristic associated with unfavourable outcomes among patients treated for MDR-TB in India. The higher male proportion may reflect greater exposure to occupational hazards, smoking, alcohol consumption, migration, and crowded workplaces. Social and healthcare-access factors may also lead to underdiagnosis or delayed notification among women.

Three-fourths of the patients were from rural areas. This marked rural predominance may reflect the predominantly rural population of Raichur district, but it also suggests the role of restricted access to diagnostic facilities, distance from treatment centres, poverty, poor transportation, and interruptions in treatment follow-up. Rural patients frequently experience delayed drug-susceptibility testing and may reach specialist services only after repeated or unsuccessful courses of anti-tubercular therapy. Shewade et al. (2018),[5] highlighted that delays in drug-susceptibility testing postpone appropriate MDR-TB treatment and may contribute to continued transmission and clinical deterioration. Recent Indian evidence has also indicated that rural residence and barriers to accessing treatment facilities can contribute to unfavourable outcomes.[6]

Education, occupation and socioeconomic characteristics

More than half of the study participants were illiterate, while only a small proportion had completed pre-university or graduate education. The significant educational distribution indicates that MDR-TB was concentrated among individuals with low educational attainment. Limited education may reduce understanding of the prolonged duration of treatment, importance of regular medication, adverse-effect management, infection-control precautions, and consequences of treatment interruption. Deshmukh et al. (2018),[7] observed that adherence to MDR-TB treatment was influenced by patient understanding, social support, treatment-related difficulties, and the responsiveness of healthcare services. Their findings support the need for individualized counselling using simple language and repeated reinforcement rather than relying exclusively on written instructions.

Business owners and farmers constituted 31.7% of the participants, followed by unskilled workers at 30.0% and unemployed individuals at 26.7%. Therefore, a substantial majority had occupations characterized by unstable income, physical labour, or absence of regular employment. Jain et al. (2018),[3] similarly found that drug-resistant TB patients frequently belonged to socioeconomically vulnerable occupational groups. MDR-TB treatment can further worsen economic insecurity because repeated health-facility visits, prolonged illness, medication toxicity, and social stigma may result in absenteeism and loss of employment. These factors may create a cycle in which disease worsens poverty and poverty reduces the ability to complete treatment.

Most patients were married and belonged to nuclear families. Married individuals may have greater household responsibilities and may continue working despite illness, potentially delaying care. Conversely, family support can improve medication adherence, nutrition, transportation, and psychological well-being. Sawyer et al. (2018),[8] in an ethnographic study conducted in Bengaluru, found that support from family and friends formed an important informal network of care for people with drug-resistant TB. However, nuclear families with limited financial and caregiving resources may experience substantial stress when the principal earning member develops MDR-TB.

Among the 55 patients for whom socioeconomic status was available, 56.4% belonged to Class IV and 34.5% to Class III. Dzeyie et al. (2019),[2] similarly reported that a considerable proportion of Indian drug-resistant TB patients came from poor socioeconomic backgrounds. Poverty can increase exposure through overcrowding, malnutrition, indoor pollution, delayed diagnosis, and restricted access to healthcare. It may also affect treatment adherence through transportation costs and loss of daily wages. Although slightly more than half lived in pucca houses, 48.3% lived in either kacha or semi-pucca houses. Housing quality alone may not accurately reflect overcrowding, ventilation, household density, or indoor exposure; these should be considered jointly when assessing transmission risk.

Behavioral and environmental factors

Adequate ventilation was reported by 51.7% of patients, while 48.3% lived in inadequately ventilated houses. The almost equal distribution was not statistically significant. Nevertheless, inadequate ventilation remains epidemiologically important because airborne transmission is facilitated in enclosed and poorly ventilated spaces. The absence of statistical significance in this study should not be interpreted as evidence that ventilation is unimportant; rather, the single-group design and modest sample size limited the ability to estimate its independent effect.

Indoor air pollution was reported by 58.3% of participants. Although the observed distribution was not statistically significant, the high prevalence is relevant in a rural district where biomass fuel, smoke exposure, and poorly ventilated cooking spaces may be common. Prolonged exposure to household air

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pollution can impair respiratory health and may increase susceptibility to pulmonary infections. However, because there was no comparison group and the source and intensity of exposure were not quantified, the present study could not determine whether indoor pollution independently increased the risk of MDR-TB.

Smoking was reported by 28.3% of patients. Tobacco smoke adversely affects mucociliary clearance, pulmonary immune defence, treatment response, and general respiratory health. The male predominance in the study may partly explain the observed smoking prevalence. Although most patients were non-smokers, the presence of smoking in more than one-fourth of MDR-TB patients is programmatically important, as smoking cessation may improve respiratory health and adherence-related outcomes.

Alcohol consumption was also reported by 28.3% of the participants. Alcohol can contribute to missed doses, inadequate nutrition, liver toxicity, economic hardship, and irregular attendance at treatment centres. Parmar et al. (2018),[9] in an analysis of India's initial MDR-TB cohorts under the national programme, documented substantial levels of unfavourable outcomes and emphasized the importance of addressing patient- and treatment-related barriers. Deshmukh et al. (2018),[7] further showed that adherence was strengthened by social support and patient-centred care. Therefore, screening and counselling for alcohol use should form part of routine MDR-TB management rather than being treated as a separate social issue.

Tobacco chewing was reported by 16.7% of patients. Although smokeless tobacco does not produce direct household air pollution, it reflects nicotine dependence and may coexist with other health-risk behaviours. Tobacco cessation interventions should therefore include both smoking and smokeless tobacco use.

A known family contact with TB was reported by 26.7% of patients, while contact with neighbours and co-workers was reported by 8.3% and 5.0%, respectively. However, 60.0% did not know of any previous contact. Chatla et al. (2018),[10] demonstrated the value of active screening of household contacts of MDR-TB patients in India. Shadrach et al. (2021),[11] reported a substantial burden of active TB and MDR-TB among symptomatic household contacts, reinforcing the need for systematic contact investigation. The present finding that more than one-fourth had a family contact supports early screening of household members, symptom surveillance, molecular testing when indicated, and preventive interventions according to current programme guidance.

Awareness regarding tuberculosis was present in only half of the patients. Equal proportions of aware and unaware participants indicate a substantial knowledge gap despite previous exposure to TB services. Inadequate knowledge may contribute to treatment interruption, delayed reporting of adverse events, unsafe sputum disposal, and continued transmission. Structured counselling should therefore be repeated throughout treatment and should cover the duration of therapy, infection-control practices, adverse effects, follow-up testing, and the risk of further drug resistance.

Comorbidities and previous treatment history

Comorbid conditions were documented in 13.3% of patients. Among those with comorbidities, diabetes mellitus was the most frequent, followed by HIV infection and psychiatric illness. The difference in the distribution of the three conditions was not statistically significant, probably because only eight patients had a recorded comorbidity.

Diabetes accounted for half of all documented comorbidities. Diabetes may increase susceptibility to TB, worsen disease severity, delay sputum conversion, and complicate treatment through drug interactions and metabolic instability. Although only four patients had diabetes in the present study, systematic blood glucose screening remains important because undiagnosed diabetes may be missed in routine records.

HIV infection accounted for 37.5% of recorded comorbidities. HIV-MDR-TB coinfection is associated with high clinical complexity, drug interactions, pill burden, and increased risk of mortality. Isaakidis et al. (2015),[12] reported challenging treatment outcomes and frequent adverse events among patients with HIV and MDR-TB. Suryawanshi et al. (2017),[4] also identified HIV infection as an important risk factor for mortality and loss to follow-up among patients receiving MDR-TB treatment. These findings support universal HIV testing, prompt antiretroviral therapy, prophylaxis for opportunistic infections, and close clinical monitoring.

Psychiatric illness was recorded in one patient, but the true burden may have been underestimated because systematic mental-health screening was not described. Drug-resistant TB is associated with anxiety, depression, stigma, social isolation, and distress caused by prolonged treatment. Sawyer et al. (2018),[8] emphasized that the suffering associated with MDR-TB extends beyond physical symptoms and includes psychological and social dimensions. Mental-health assessment and counselling should therefore be integrated into MDR-TB services.

All 60 patients had been previously treated for tuberculosis. This is one of the most important findings of the study and strongly indicates acquired resistance related to previous treatment, although direct transmission of resistant strains cannot be excluded. WHO data consistently show that MDR/RR-TB is substantially more frequent among previously treated patients than among new patients.[1] Parmar et al. (2018),[9] also reported poor outcomes in India's early MDR-TB cohorts, highlighting the long-term consequences of delayed resistance detection, inadequate regimens, and interruption of treatment. Universal drug-susceptibility testing at the time of diagnosis and

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rapid initiation of an effective regimen are essential to prevent amplification of resistance.

Treatment status and adverse drug reactions

At the time of assessment, 48.3% of patients were still receiving MDR-TB treatment, while 16.7% had interrupted therapy. Only 10.0% were classified as cured and 8.3% had completed treatment; 6.7% had died and one patient had progressed to XDR-TB. Interpretation of these percentages requires caution because nearly half of the patients had not yet reached a final treatment outcome. Therefore, the cure and completion proportions do not represent final cohort treatment-success rates.

The 16.7% treatment-interruption proportion is nevertheless concerning because interruption increases the risks of treatment failure, ongoing transmission, and amplification of drug resistance. Parmar et al. (2018),[9] documented substantial unfavourable outcomes in India's initial MDR-TB cohorts. Deshmukh et al. (2018),[7] found that social support was a key determinant of adherence and recommended patient-centred measures. Digital adherence technologies may also be useful; Thomas et al. (2021),[13] reported that electronic medication reminder monitoring was acceptable to MDR-TB patients, although such technologies must be adapted to literacy, connectivity, and patient preferences.

Severe adverse drug reactions were reported in 58.3% of patients, demonstrating the considerable toxicity associated with the regimens used during the study period. Fatima et al. (2021),[14] reported that nausea, vomiting, arthralgia, peripheral neuropathy, and giddiness were among the common adverse reactions during MDR-TB treatment. Matambo et al. (2020),[15] also documented serious adverse events, particularly hearing impairment and psychiatric effects, among patients receiving longer drug-resistant TB regimens. Chavan et al. (2020),[16] reported frequent gastrointestinal and cardiac safety concerns among patients treated for pre-XDR/XDR-TB. These observations are consistent with the high adverse-reaction burden in the present study.

Adverse effects can result in missed doses, interruption, permanent disability, and reduced quality of life. Active drug-safety monitoring, prompt symptomatic management, audiological and laboratory monitoring, psychological support, and timely modification of the regimen are therefore essential. WHO has progressively recommended shorter, all-oral regimens containing newer drugs to improve effectiveness and reduce the toxicity associated with injectable-containing regimens [1]

CONCLUSION

The present study demonstrated that multidrug-resistant tuberculosis predominantly affected young and middle-aged adults, particularly males, rural residents, individuals with low educational attainment, and patients from lower socioeconomic groups in Raichur district. Most participants were married, belonged to nuclear families, and were engaged in farming, business, unskilled work, or were unemployed. Behavioral and environmental risk factors such as smoking, alcohol consumption, tobacco chewing, indoor air pollution, inadequate ventilation, and contact with patients with tuberculosis were frequently observed. Awareness regarding tuberculosis was inadequate in half of the participants.

All patients had a history of previous anti-tuberculosis treatment, emphasizing the important role of prior treatment exposure and possible treatment-related factors in the development of MDR-TB. Treatment interruption was observed in a notable proportion of patients, while severe adverse drug reactions were common. Diabetes mellitus and HIV infection were the major comorbidities identified. These findings indicate that MDR-TB is closely linked with social disadvantage, behavioral risks, previous treatment, inadequate awareness, and treatment-related challenges. Strengthening early drug-resistance testing, adherence counselling, adverse drug reaction monitoring, contact screening, nutritional and socioeconomic support, and integrated management of diabetes, HIV, tobacco use, alcohol consumption, and mental health may improve treatment outcomes and reduce further transmission of MDR-TB.

Limitations of The Study

1. The study was conducted among only 60 MDR-TB patients from Raichur district; therefore, the findings may not be generalizable to other districts or populations.
2. The cross-sectional design assessed exposures and outcomes at a single point in time and could not establish a temporal or causal relationship between the identified factors and MDR-TB.
3. The absence of a comparison group of patients with drug-sensitive tuberculosis limited the ability to determine whether the observed socio-demographic and behavioral characteristics were independently associated with MDR-TB.
4. Several variables, including smoking, alcohol consumption, tobacco chewing, treatment adherence, contact history, and awareness, were based on self-report and were therefore subject to recall and social desirability bias.
5. Some information was obtained from programme records, which may have contained incomplete or inaccurately documented data.
6. The number of patients with comorbidities was small, limiting meaningful statistical comparison between diabetes mellitus, HIV infection, and psychiatric illness.
7. Treatment outcomes were incomplete for many participants because a substantial proportion were still receiving MDR-TB treatment at the time of assessment.
8. Environmental exposures such as overcrowding, indoor air pollution, and ventilation were not measured using objective or standardized quantitative methods.

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9. Important potential risk factors, including nutritional status, drug susceptibility patterns, duration and type of previous treatment, migration, treatment-provider characteristics, and household income loss, were not evaluated in detail.
10. Multivariable regression analysis could not be performed because of the small sample size and lack of an appropriate control group.

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