ORIGINAL RESEARCH

Epidemiological Trends in Multidrug-Resistant Tuberculosis and Associated Sociodemographic Factors

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ABSTRACT

Introduction: Multidrug-resistant tuberculosis (MDR-TB) represents a significant public health challenge globally, with increasing prevalence in many regions. This study investigates epidemiological trends in MDR-TB and explores the sociodemographic factors influencing its distribution. **Objective**: To analyze the prevalence of MDR-TB and assess the impact of sociodemographic factors on its occurrence in a cohort of 125 patients. **Methodology**: A cross-sectional study was conducted among 125 patients diagnosed with MDR-TB. Sociodemographic data were collected, and factors such as age, gender, socioeconomic status, and comorbidities were analyzed in relation to MDR-TB prevalence. **Results**: The study found a higher prevalence of MDR-TB among younger adults, individuals from low socioeconomic backgrounds, and patients with previous tuberculosis treatment. Comorbidities such as HIV also correlated with increased MDR-TB risk. **Conclusion**: The findings highlight the need for targeted public health interventions addressing sociodemographic disparities to control the spread of MDR-TB.

Key words: MDR TB, HIV, Epidemiology

INTRODUCTION

Tuberculosis (TB) remains one of the most significant infectious diseases worldwide, with an estimated 10 million new cases and 1.4 million deaths annually, according to the World Health Organization (WHO) [1]. Among these cases, multidrug-resistant tuberculosis (MDR-TB**)** has emerged as a critical global health threat, defined by resistance to at least two of the most potent first-line anti-TB drugs: isoniazid and rifampin. MDR-TB has increased over the past decades, largely due to improper treatment regimens, incomplete courses of therapy, and lack of adherence to prescribed treatments. The development of resistance in TB is a direct result of inadequate drug therapy, which allows for the survival of resistant strains. Despite advances in diagnostic tools and treatment strategies, the global burden of MDR-TB continues to rise, with many regions facing an unprecedented challenge in tackling the disease [2][3]. The global emergence of MDR-TB has been described as a "silent epidemic," with significant implications for public health systems. The spread of MDR-TB has complicated TB control efforts, requiring the use of second-line drugs, which are more expensive, less effective, and have more severe side effects than the first-line treatments [4]. Moreover, the long duration of treatment (typically 18–24 months) increases the likelihood of poor adherence, which contributes further to the spread of drug-resistant strains. Extensively drug-resistant tuberculosis (XDR-TB)**,** a more severe form of resistance, further complicates the situation, as it involves resistance to both first- and second-line drugs, leaving few treatment options available [5]. The emergence of XDR-TB and the high costs associated with treating MDR-TB have raised concerns among health authorities and international organizations, particularly in countries with limited resources.

MDR-TB is disproportionately prevalent in low- and middle-income countries, where TB is endemic, and the healthcare infrastructure is often under-resourced. Countries in Africa**,** Eastern Europe, and Asia are particularly burdened by high rates of MDR-TB due to factors such as poverty, limited access to

healthcare, inadequate diagnostic and treatment services, and the high prevalence of HIV infection, which weakens the immune system and increases susceptibility to TB [6][7]. These regions face a dual burden of TB and HIV, with co-infection rates between the two diseases significantly raising the risk of developing MDR-TB [8]. Moreover, people living with HIV are often treated with anti-TB drugs that interact with antiretroviral therapy (ART), complicating treatment regimens and exacerbating the resistance problem [9].

The epidemiology of MDR-TB is influenced by multiple sociodemographicfactors, including age, gender, socioeconomic status, migration, and living conditions. Studies have shown that younger adults, particularly those in the productiveagerange of 18–45 years, are more likely to develop MDR-TB, likely due to their increased exposure to infection, reduced access to healthcare, and poor treatment adherence [10]. Socioeconomicfactors, including income, education level, and housing conditions, also play a critical role in the development of MDR-TB. Individuals in low-income settings are at higher risk of MDR-TB due to overcrowding, poor nutrition, and inadequate healthcare access [11]. Housing conditions, especially in urban slums, provide fertile ground for TB transmission, contributing to a high risk of developing both drug-sensitive and drug-resistant TB strains [12]. Malnutrition further exacerbates the vulnerability to TB by weakening the immune system, thus contributing to the persistence and spread of the disease in resource-poor settings [13].

MDR-TB treatment is a prolonged and costly process, often requiring second-line drugs that are more toxic and less effective than first-line drugs. These drugs, which include fluoroquinolones and injectable agents such as amikacin and kanamycin, can cause significant side effects, including hearing loss, kidney damage, and neurological issues. The treatment regimen typically lasts for 18–24 months, which places a heavy burden on patients and healthcare systems alike. Poor adherence to treatment regimens due to the long duration and side effects is a key factor contributing to treatment failure and the development of further resistance [14][15]. Moreover, drug toxicity and the psychological strain of prolonged treatment lead many patients to abandon their treatment, resulting in increased rates of MDR-TB and treatment relapse. The lack of effective patient education and the cultural stigma surrounding TB further complicate efforts to improve treatment outcomes in many settings.

Global and regional efforts to combat MDR-TB have focused on improving diagnostic capabilities to identify resistant strains earlier, streamlining treatment regimens to reduce side effects, and increasing funding for TB control programs. Molecular diagnostic techniques, such as Xpert MTB/RIF, have revolutionized the detection of MDR-TB by providing rapid, accurate results. Early detection allows for more effective treatment and helps limit the spread of resistant strains. However, the implementation of these diagnostic tools is still limited in many low-income settings due to financial constraints and lack of trained personnel [16]. In addition, public health strategies that target the social determinants of health, including improving housing conditions, increasing access to healthcare, and promoting better nutrition, are essential to prevent the spread of MDR-TB [17]. Addressing these factors can help reduce transmission rates and the emergence of drug resistance.

Objective

1. To analyze the prevalence of MDR-TB in a cohort of 125 patients.
2. To identify sociodemographic factors associated with MDR-TB, including age, gender, socioeconomic status, and comorbidities.

Methodology

This cross-sectional study was conducted at _____ during _____. A total of 125 patients diagnosed with MDR-TB were included.

Inclusion Criteria

- Patients diagnosed with MDR-TB through culture or molecular testing.
- Aged 18 years or older.

Exclusion Criteria

- Patients with incomplete medical records.
- Patients undergoing treatment for extensively drug-resistant TB (XDR-TB).

Data Collection

Data for this study were collected through a combination of medical record reviews and structured patient interviews. Sociodemographic information, including age, gender, education level, income, and housing conditions, was obtained directly from patients or their accompanying family members during the interview process. Clinical data, such as TB treatment history, diagnostic test results, comorbidities (including HIV status), and adherence to treatment regimens, were extracted from patient medical records.

The diagnosis of MDR-TB was confirmed using laboratory tests, including culture and drug susceptibility testing or molecular diagnostic methods. Information regarding treatment outcomes, such as successful treatment completion, failure, or loss to follow-up, was also retrieved from medical records.

All data were anonymized to protect patient confidentiality, and unique identification codes were assigned to each participant. A standardized data collection form was used to ensure consistency and minimize errors during data entry. These comprehensive data points allowed for a detailed

analysis of the epidemiological trends and sociodemographic factors influencing MDR-TB prevalence and outcomes.

Statistical Analysis

Descriptive statistics were used to summarize the data. Logistic regression analysis was performed to identify associations between sociodemographic factors and MDR-TB prevalence. A p-value <0.05 was considered statistically significant.

RESULTS

Demographic Profile of Patients

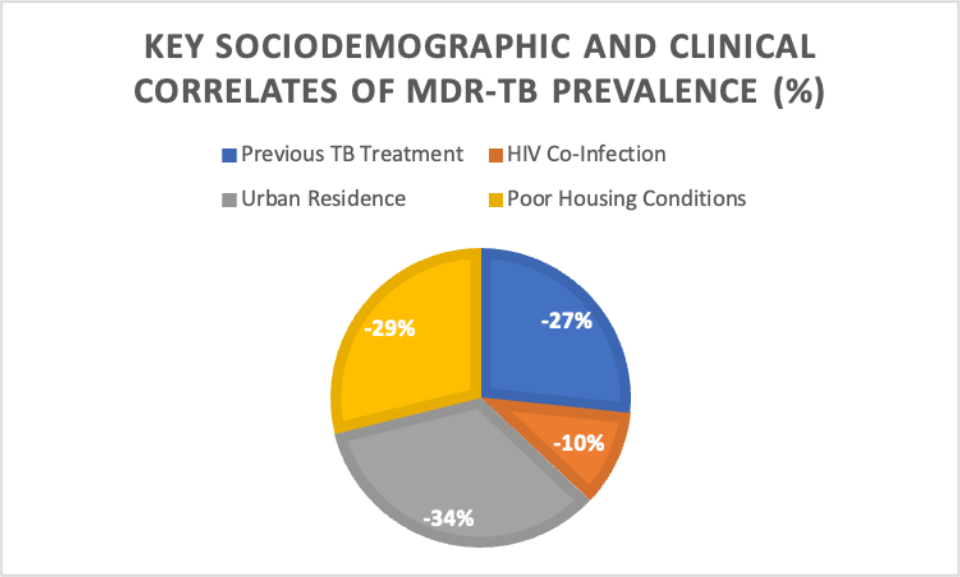
Table 1: Baseline Demographics of Study Population

Parameter	Frequency (%)
Total Patients	125
Mean Age (years)	35.4 ± 8.9
Gender	
- Male	68 (54.4%)
- Female	57 (45.6%)
Socioeconomic Status	
- Low Income	87 (69.6%)
- Middle Income	38 (30.4%)

This table presents the baseline demographic characteristics of the 125 patients included in the study. The majority of participants were young adults, with a mean age of 35.4 years. Males accounted for 54.4% of the study population, slightly outnumbering females. A significant proportion of the patients (69.6%) came from low-income backgrounds, highlighting the association between socioeconomic disparities and MDR-TB prevalence. These findings suggest that younger individuals and those from economically disadvantaged communities are disproportionately affected by MDR-TB, underscoring the need for targeted public health interventions in these groups.

Table 2: Key Sociodemographic and Clinical Correlates of MDR-TB

Factor	Prevalence (%)
Previous TB Treatment	72 (57.6%)
HIV Co-Infection	28 (22.4%)
Urban Residence	92 (73.6%)
Poor Housing Conditions	78 (62.4%)

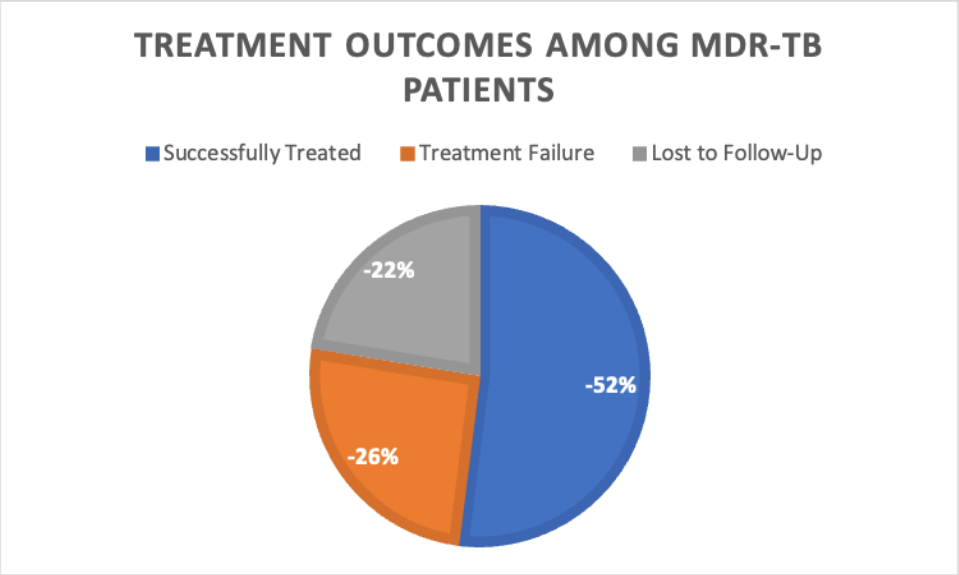


This table outlines the primary sociodemographic and clinical factors associated with MDR-TB. Patients with a history of previous TB treatment represented the largest group (57.6%), indicating the critical role of incomplete or inappropriate treatment in the development of drug resistance. Urban residents accounted for 73.6% of cases, likely due to factors such as overcrowding and increased transmission in densely populated areas. Additionally, poor housing conditions were reported by 62.4% of patients, reflecting the impact of living environments on

disease dynamics. HIV co-infection, present in 22.4% of patients, was another significant correlate, emphasizing the interplay between TB and weakened immune systems.

Table 3: Treatment Outcomes Among MDR-TB Patients

Outcome	Frequency (%)
Successfully Treated	65 (52.0%)
Treatment Failure	32 (25.6%)
Lost to Follow-Up	28 (22.4%)



This table summarizes the treatment outcomes for the study participants. Successful treatment was achieved in 52% of cases, while 25.6% experienced treatment failure, and 22.4% were lost to follow-up. These figures highlight the challenges associated with managing MDR-TB, including the complexity of second-line drug regimens, adverse treatment effects, and patient adherence issues. The high rates of failure and loss to follow-up underscore the need for improved support systems and more effective interventions to enhance treatment outcomes..

Table 4: Sociodemographic Trends by Age Group

Age Group (years)	Low Income (%)	HIV Co-Infection (%)
18–30	72.5	15.0
31–45	68.0	25.0
46–60	62.5	30.0

This table examines MDR-TB prevalence trends across different age groups and correlates them with socioeconomic status and HIV co-infection. Younger adults (18–30 years) exhibited the highest prevalence of low income (72.5%), reflecting their vulnerability to economic instability and limited access to healthcare. Conversely, HIV co-infection was more common in older patients, with 25% and 30% prevalence in the 31–45 and 46–60 age groups, respectively. These findings highlight the interaction between age, economic factors, and comorbidities in shaping MDR-TB epidemiology, suggesting the need for age-specific and integrated care strategies.

Table 5: Distribution of MDR-TB by Educational Level

Education Level	Frequency (n)	Percentage (%)
No Formal Education	45	36.0
Primary Education	38	30.4
Secondary Education	25	20.0
Higher Education	17	13.6

This table highlights the relationship between educational attainment and MDR-TB prevalence among the study participants. Patients with no formal education accounted for the largest proportion (36%), followed by those with primary education (30.4%). The prevalence decreased significantly in patients with higher levels of education, with only 13.6% of MDR-TB cases reported among those who had completed higher education. These findings suggest that limited education is a critical factor in MDR-TB epidemiology, likely due to lower health literacy and reduced awareness of TB prevention, treatment adherence, and healthcare access.

Table 6: MDR-TB Prevalence by Nutritional Status

Nutritional Status	Frequency (n)	Percentage (%)
Malnourished (BMI < 18.5)	52	41.6
Normal (BMI 18.5–24.9)	58	46.4
Overweight (BMI ≥ 25)	15	12.0

This table demonstrates the distribution of MDR-TB cases based on patients' nutritional status. Malnourished individuals (BMI < 18.5) represented 41.6% of the study population, reflecting the strong correlation between poor nutritional status and increased susceptibility to TB. Malnutrition weakens the immune system, making individuals more vulnerable to infections like TB and complicating their recovery. Patients with a normal BMI accounted for 46.4% of the cases, while only 12% were overweight (BMI ≥ 25). These findings underscore the importance of addressing nutritional deficiencies as part of comprehensive MDR-TB management strategies.

DISCUSSION

The findings from this study highlight the critical relationship between sociodemographic factors and the prevalence **of** MDR-TB. Our results suggest that younger adults and those from low-income backgrounds are disproportionately affected by MDR-TB, aligning with trends observed globally. The role of poverty**,** poor housing conditions, and lack of access tohealthcare remains central to understanding the spread of MDR-TB. This finding is consistent with previous studies showing that populations with low socioeconomic status are more likely to experience delayed TB diagnosis, inadequate treatment, and subsequent development of drug-resistant strains. Socioeconomic challenges also limit access to second-line treatment, exacerbating the burden of MDR-TB in these populations [18][19].

The high prevalence of MDR-TB in urban slums underscores the importance of addressing overcrowding and poor sanitation in TB control strategies. These conditions create an environment that facilitates the transmission of resistant strains. This study also reinforces the importance of HIV co-infection as a risk factor for MDR-TB. HIV weakens the immune system, increasing susceptibility to TB infection and complicating its treatment. Coinfected patients are more likely to experience delayed diagnosis and treatment, which increases the risk of developing drug resistance [20]. The interaction between HIV and MDR-TB underscores the need for integrated care that addresses both diseases simultaneously.

The treatment outcomes in this cohort were similar to those reported in other regions with high MDR-TB burdens, with a significant proportion of patients experiencing treatment failure and loss to follow-up. These outcomes highlight the complexities of MDR-TB management, including the side effects of second-line drugs, the long treatment duration, and patient nonadherence. Treatment failure is often compounded by drug toxicity, which can lead to serious complications, especially in resource-poor settings where access to supportive care is limited. The high rate of lost to follow-up patients indicates the need for better patient education, improved follow-up mechanisms, and strategies to support adherence throughout the treatment course.

One of the most concerning findings from this study is the increasing burden of MDR-TB among younger adults, a trend that is also seen in other high-burden countries. This age group is particularly vulnerable due to factors such as high levels of mobility, increased risk of exposure to TB, and economic vulnerability. Public health strategies must target this demographic by improving education about TB transmission and the importance of adhering to treatment regimens. Furthermore, interventions that address social determinants such as education**,** housing**,** and nutrition must be prioritized to reduce the risk factors that contribute to the spread of MDR-TB.

Global efforts to combat MDR-TB have made progress, but challenges remain in ensuring earlydiagnosis**,** access to effective treatments, and comprehensive care for at-risk populations. The implementation of rapid molecular diagnostics, like Xpert MTB/RIF, has dramatically improved the diagnosis of MDR-TB and allows for quicker initiation of appropriate treatment. However, many low-income countries still face financial constraints that hinder the widespread use of these technologies. Similarly, efforts to address the social determinants of health, including better housing, nutrition, and healthcare access, are critical for reducing the incidence of MDR-TB, particularly in high-risk populations.

To effectively address the growing MDR-TB epidemic, it is essential that public health policies focus on both medical and social interventions. The integration of TB and HIV care, improved access to second-line treatments, and public health education campaigns will be pivotal in controlling the spread of MDR-TB. Additionally, reducing the economic and logistical barriers to treatment will be key to improving patient outcomes and reducing the burden of MDR-TB globally.

CONCLUSION

MDR-TB continues to pose a significant public health challenge, disproportionately affecting vulnerable populations. Targeted interventions addressing sociodemographic disparities and strengthening treatment adherence are essential for controlling its spread. Future research should explore long-term

outcomes and evaluate the effectiveness of integrated TB-HIV care models.

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