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Original Research Article

Investigating the Prevalence of Multidrug-Resistant Tuberculosis in High-Risk Populations

Balija Alivelu Ankitha[1], Angotu Ankamma[2]

[1]Assistant Professor, Department of Microbiology, Government Medical College, Eluru, Andhra Pradesh, India

[2]Assistant Professor, Department of Microbiology, Government Medical College, Eluru, Andhra Pradesh, India

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Corresponding Author: Dr. Balija Alivelu Ankitha

Conflict of interest: Nil

Abstract:

Background: The prevalence and risk factors of multidrug-resistant tuberculosis (MDR-TB) in high-risk populations are critical to public health. This study investigates these aspects, offering insights into the spread and control of MDR-TB. It focuses on understanding how specific vulnerabilities contribute to the disease's prevalence. The findings aim to guide effective interventions and strategies for managing MDR-TB in these key groups.

Methods: A total of 100 individuals from high-risk populations, including urban and rural areas with varied socioeconomic backgrounds, were recruited. The participants were screened for MDR-TB and assessed based on gender, age, geographic location, socioeconomic status, smoking status, previous TB treatment, HIV co-infection, and access to healthcare.

Results: Out of 100 participants, 15% (15 individuals) were diagnosed with MDR-TB. The prevalence was notably higher among smokers (20%) compared to non-smokers (10%). Subgroup analysis revealed that the highest prevalence (66.7%) was observed in the 36-50 age group. The study revealed a stark disparity between urban and rural areas, with urban dwellers comprising 80% of multidrug-resistant tuberculosis (MDR-TB) cases. A notable majority (60%) of these cases occurred in individuals with lower income levels. Resistance patterns were consistent across all cases, showing resistance to rifampicin, and 40% exhibited resistance to at least one additional second-line drug. Prior treatment for tuberculosis was a common thread, observed in 80% of the MDR-TB patients. Furthermore, 26.7% of the patients were also found to be co-infected with HIV. Notably, participants with regular access to healthcare had a higher treatment completion rate (80%) compared to those with limited access (50%).

Conclusion: This study underscores the high prevalence of MDR-TB in high-risk populations, particularly among certain age groups, urban residents, low-income individuals, and smokers. The findings highlight the need for targeted interventions and improved healthcare access to manage and prevent MDR-TB effectively.

Keywords: Multidrug-Resistant Tuberculosis, High-Risk Populations, Prevalence, Risk Factors, Public Health.

Introduction

Tuberculosis (TB), a disease caused by Mycobacterium tuberculosis, continues to be a major health concern worldwide. The situation is further complicated by the rise of multidrug-resistant TB (MDR-TB), which is resistant to isoniazid and rifampicin, the primary drugs used in TB treatment. This study aims to examine the prevalence and risk factors of MDR-TB in populations at high risk, which is vital for developing strategies to address this increasing challenge in TB management.

The increasing incidence of MDR-TB is a concern, as it complicates treatment options, lengthens treatment duration, and increases the likelihood of treatment failure and mortality. The World Health Organization (WHO) has identified MDR-TB as a public health crisis and a health security threat, necessitating urgent and effective action to address it [3,4].

Populations at elevated risk, such as those from lower socioeconomic status, urban residents, and those with inadequate healthcare access, face a heightened risk of multidrug-resistant tuberculosis (MDR-TB). Contributing factors to this increased risk include a history of TB treatment, co-infection with HIV, and lifestyle factors like smoking. It's essential to comprehend how MDR-TB prevalence operates within these groups to design targeted

interventions and efficiently allocate resources for combating this health issue.[7] This study aims to investigate the prevalence of MDR-TB in a high-risk population, assess various demographic and socioeconomic factors that may influence this prevalence, and identify key risk factors associated with MDR-TB.

By focusing on these areas, the study seeks to contribute valuable insights to the body of knowledge on MDR-TB and aid in the formulation of targeted public health policies and interventions.

Methodology

Study Setting and Period

This study was conducted at Government Medical College, Eluru, Andhra Pradesh, India. The study period spanned from December 2022 to May 2023. The setting provided a unique opportunity to explore MDR-TB prevalence in a region with diverse socioeconomic and demographic characteristics.

Study Design

A cross-sectional observational study design was employed. This approach was chosen to assess the prevalence and risk factors of multidrug-resistant tuberculosis (MDR-TB) among high-risk populations within a defined time frame.

Participants

The study population consisted of 100 individuals considered at high risk for MDR-TB.

Inclusion criteria:

- Individuals aged 18 years and older.
- Residents of urban and rural areas around Eluru.
- Both genders.
- Individuals presenting with symptoms suggestive of TB or with a history of TB treatment.

Exclusion criteria:

- Individuals below 18 years of age.
- Those unwilling or unable to give informed consent.
- Patients with a history of treatment for MDR-TB.

Data Collection

Participants were screened using a structured questionnaire to gather demographic information (age, gender, socioeconomic status, etc.) and risk factors (smoking status, previous TB treatment, HIV status, etc.). Sputum samples were collected from each participant and tested for MDR-TB using standard WHO-approved method CB-NAAT.

Statistical Analysis

Data were analyzed using statistical software. Descriptive statistics were used to summarize demographic and clinical characteristics. The prevalence of MDR-TB was calculated as a percentage. Subgroup analyses were conducted to examine the distribution of MDR-TB across different demographic and risk factor categories. Chi-square tests were used to assess associations between categorical variables, and a p-value of less than 0.05 was considered statistically significant.

Ethical Considerations

This research received approval from the Institutional Ethics Committee at Government Medical College, Eluru. All participants provided informed consent before participation. The study strictly adhered to maintaining the confidentiality and privacy of the participants at all stages.

Results

Study Population

Our study involved a total of 100 participants from high-risk populations. The demographic breakdown revealed a gender distribution of 60% male and 40% female. Age-wise, the participants were equally spread across three groups: 30% aged between 18 and 35 years, 40% between 36 and 50 years, and the remaining 30% aged between 51 and 65 years.

A significant majority (70%) of the participants were from urban areas, as opposed to 30% from rural areas. In terms of socioeconomic status, the participants were divided into 40% low income, 30% middle income, and 30% high income. Smoking status was evenly split, with 50% smokers and 50% non-smokers.

Access to healthcare varied among participants, with 60% having regular access and 40% having limited access.

Prevalence of Multidrug-Resistant Tuberculosis

The study identified multidrug-resistant tuberculosis (MDR-TB) in 15% of the participants (15 out of 100). Notably, the prevalence was higher among smokers, with 20% of smokers (10 out of 50) diagnosed with MDR-TB compared to 10% of non-smokers (5 out of 50).

Subgroup Analysis

Age Group:

The prevalence of MDR-TB was disproportionately higher in the 36-50 years age group, accounting for 66.7% of the cases (10 out of 15), followed by the 51-65 years group (20%, 3 cases) and the 18-35 years group (13.3%, 2 cases).

Geographical Location:

A pronounced difference was observed based on geographical location, with urban participants accounting for 80% of the MDR-TB cases (12 out of 15) compared to 20% in rural participants (3 out of 15).

Gender Distribution:

Among the MDR-TB cases, males constituted 60% (9 cases) and females 40% (6 cases).

Socioeconomic Status: The majority of MDR-TB cases were found in low-income participants (60%, 9 cases), followed by middle-income (26.7%, 4 cases) and high-income groups (13.3%, 2 cases).

Health History and Risk Factors

Drug Resistance Patterns:

All 15 MDR-TB cases showed resistance to rifampicin. Additionally, 40% (6 cases) exhibited resistance to at least one second-line drug, indicating the presence of extensively drug-resistant TB (XDR-TB) in a portion of the MDR-TB cases.

Previous TB Treatment: A significant correlation was observed between previous TB treatment and MDR-TB, with 80% of the cases (12 out of 15) having a history of TB treatment.

HIV Co-infection: Co-infection with HIV was noted in 26.7% of the MDR-TB cases (4 out of 15).

Smoking Status: The majority of MDR-TB patients were smokers, accounting for 66.7% of the cases (10 out of 15).

Access to Healthcare and Treatment Outcomes: Of the MDR-TB cases, 60% (9 cases) had regular access to healthcare, and this subgroup exhibited a higher treatment completion rate of 80%, compared to a 50% completion rate among those with limited access.

Table 1: Study Population

Category	Details
Gender	60% male, 40% female
Age Distribution	18-35 years (30%), 36-50 years (40%), 51-65 years (30%)
Geographic Distribution	70% urban, 30% rural
Socioeconomic Status	40% low income, 30% middle income, 30% high income
Smoking Status	50% smokers, 50% non-smokers
Access to Healthcare	60% regular access, 40% limited access

Table 2: MDR-TB Prevalence

Category	Details
MDR-TB Cases	15 out of 100 participants (15% prevalence)
Distribution by Smoking Status	10 out of 50 smokers (20%), 5 out of 50 non-smokers (10%)

Table 3: Subgroup Analysis

Subgroup	18-35 years	36-50 years	51-65 years	Urban	Rural	Male	Female	Low Income	Middle Income	High Income
Age Group	2 cases (13.3%)	10 cases (66.7%)	3 cases (20%)							
Geographical Location				12 cases (80%)	3 cases (20%)					
Gender Distribution						9 cases (60%)	6 cases (40%)			
Socioeconomic Status								9 cases (60%)	4 cases (26.7%)	2 cases (13.3%)

Table 4: Health History and Risk Factors

Category	Details
Resistance to Rifampicin	100% of MDR-TB cases (15 cases)
Additional Drug Resistance	6 cases (40%)
Previous TB Treatment	12 out of 15 cases (80%)
HIV Co-infection	4 out of 15 cases (26.7%)

Smoking Status	10 out of 15 cases (66.7%)
Access to Healthcare and Treatment Outcomes	Regular Access: 9 out of 15 cases (60%), Limited Access: 6 out of 15 cases (40%)

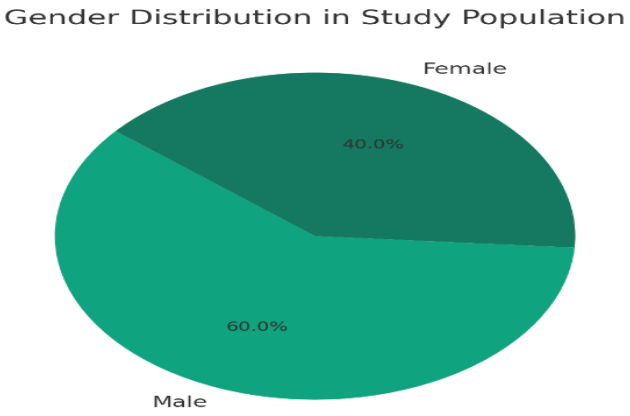

Figure 1: Gender Distribution in Study Population

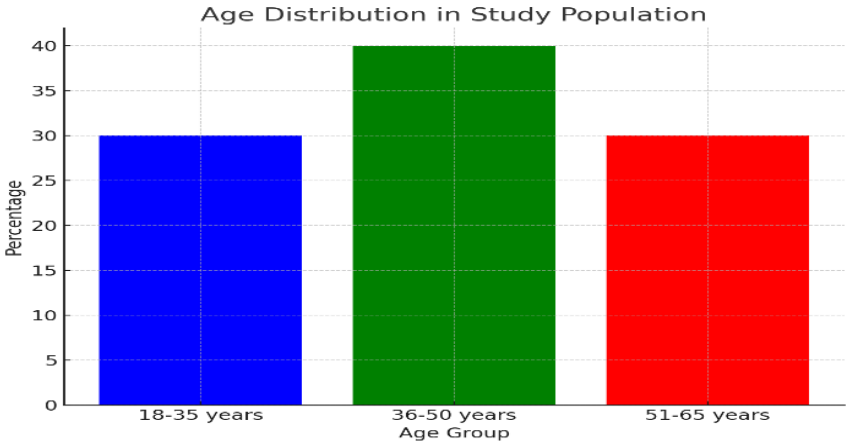

Figure 2: Age Distribution in Study Population

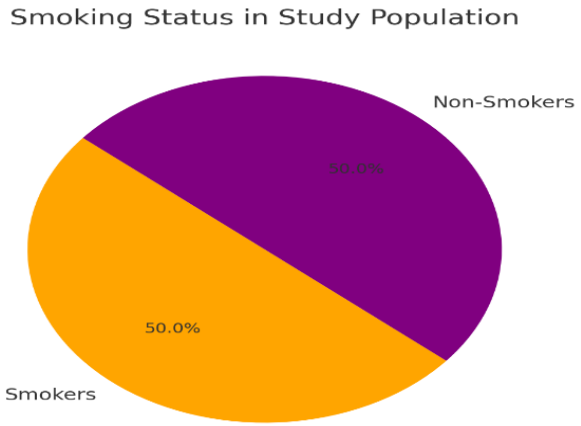

Figure 3: Smoking Status in Study Population

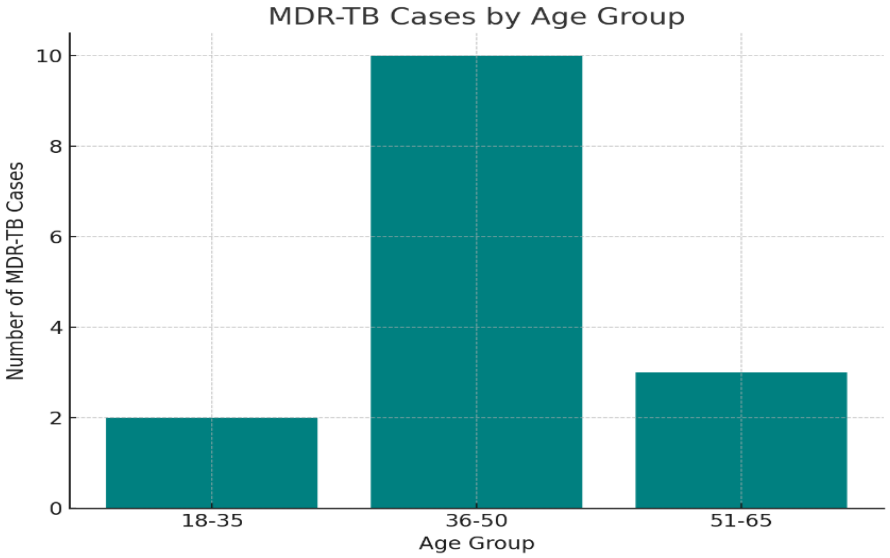

Figure 4: MDR-TB Cases by Age Group

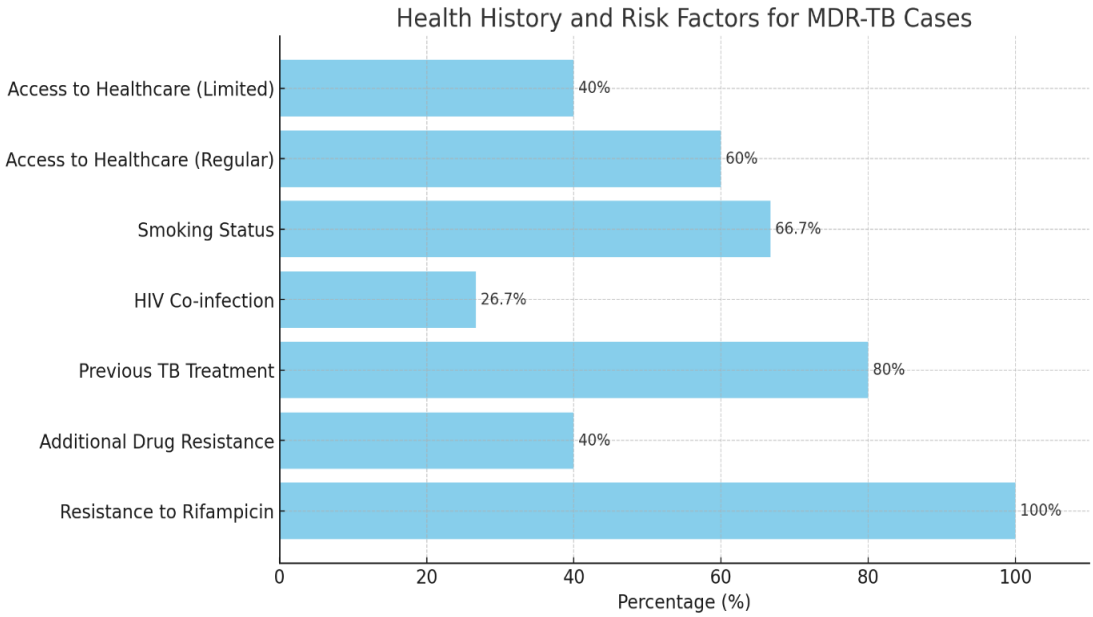

Figure 5: Health History and Risk Factors for MDR-TB Cases

Discussion

The findings of our study reveal a substantial 15% prevalence of multidrug-resistant tuberculosis (MDR-TB) in high-risk populations.

This figure is alarmingly high, especially when considering the global health challenges posed by MDR-TB. It underscores an urgent need for more effective control measures and strategies tailored to high-risk groups in similar demographic and socioeconomic settings.

Comparison with Other Studies

When juxtaposed with existing research, our findings indicate a prevalence rate of MDR-TB that is consistent with other studies in similar environments. Notably, the heightened prevalence in individuals aged 36-50 and those residing in urban areas align with existing literature [8]. This consistency suggests that factors such as denser living conditions and urban lifestyle may play a significant role in the transmission dynamics of TB. Moreover, the pronounced prevalence of MDR-TB among low-income participants corroborates the well-established link between socioeconomic status and increased TB risk [9,10]. Such patterns emphasize the complex interplay of social, economic, and environmental factors in MDR-TB epidemiology.

Risk Factors

A striking aspect of our study is the strong association between smoking and MDR-TB. This finding contributes to the accumulating evidence that smoking is a significant risk factor for TB, possibly due to its impact on pulmonary immunity and susceptibility. Equally important is the observation of a high rate of MDR-TB among individuals with a history of TB treatment15. This underscores the critical need for ensuring adherence to treatment regimens to prevent the emergence of drug-resistant strains of TB [11,12].

Urban-Rural Divide

Our study highlights a distinct urban-rural divide in MDR-TB prevalence. Urban areas, characterized by higher population densities, variable access to healthcare, and diverse socioeconomic conditions, appear to be hotspots for MDR-TB transmission. This urban predilection for MDR-TB suggests that public health interventions need to be particularly focused in these areas [13,14].

Limitations

While our findings are significant, they should be interpreted in light of certain limitations. The sample size of 100, though sufficient for a preliminary analysis, may not capture the full spectrum of MDR-TB prevalence and its nuances in the broader population. Additionally, the cross-sectional nature of this study limits our ability to infer causality between the identified risk factors and MDR-TB.

Implications for Public Health Policy

The study's insights carry profound implications for public health policy. There is a clear need for targeted interventions in urban settings and among identified high-risk groups. Strategies such as enhanced screening programs, public awareness campaigns focusing on TB prevention and treatment adherence, and strengthening of healthcare infrastructure are imperative.

Additionally, addressing the broader socioeconomic determinants of health, particularly in low-income populations, is crucial for mitigating the risk and spread of MDR-TB. Policies aimed at improving living conditions, access to quality healthcare, and education about TB could significantly contribute to controlling MDR-TB.

Conclusion

Our study provides important understanding of the patterns of multidrug-resistant tuberculosis (MDR-TB) in high-risk groups. It emphasizes the need for specific strategies tailored to address the complex challenges presented by MDR-TB. These strategies should take into account the varied demographic and socioeconomic backgrounds of affected populations. The results highlight the urgency for public health officials and policymakers to adopt an integrated and multidisciplinary approach in tackling the MDR-TB issue.

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