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RESEARCH ARTICLE

Prevalence of Tuberculosis and Associated Risk Factors in Slum Dwellers

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Abstract: ***History***: Tuberculosis (TB) is among the most common infectious diseases in the very world in the form of an illness the burden of which includes interdisciplinarily vulnerable and low-income groups. The slum dwellers are at risk due to the congestion, sanitation, undernourishment and medical services provision. The burden and determinants of TB sensitization in the settings are critical in the control measures. ***Premise***: The aim of the current research was to determine the prevalence of tuberculosis and risk factors of the slum residents in one of the semi-urban neighborhoods. ***Materials and Methods:*** The selected community of 600 individuals in the slums has undertaken cross-sectional study in the slum. The data that was collected through the questionnaire was a pretested questionnaire, the questionnaire included the social demographic variables, housing conditions, lifestyle habits and the medical history. The Sputum samples were used to confirm all the symptomatic patients through the use of ZiehlNeelsen-stained and GeneXpert. The chi square and multivariate logistic regression were the statistical tests that were used to identify the independent predictors. ***Findings***: The overall prevalence rate of tuberculosis was found to be 6.5% (n = 39). The male prevalence of TB was very high (8.1) compared to the female counterparts (4.8). Overcrowding ($p < 0.001$), poor ventilation ($p = 0.002$), low body mass index ($p = 0.01$), smoking ($p = 0.004$) and previous exposure to a TB incidence ($p < 0.001$) were major risk factors of TB. The strongest independent predictors were found to be overcrowding, malnutrition, and contact history using multivariate analysis. ***Conclusion***: The article shows that incidences of tuberculosis amongst slum residents are high and largely influenced by socioeconomic and environmental factors that are preventable. Community-level awareness, better living conditions, early diagnosis and nutritional support are essential in the control of TB in such marginalized communities.

Keywords: Tuberculosis, Prevalence, Risk factors, Slum dwellers, Overcrowding, Malnutrition, Public health, GeneXpert, Community-based study.

INTRODUCTION

Tuberculosis (TB) refers to a chronic infectious illness that is caused by the Mycobacterium tuberculosis which mostly infects the lungs but may also affect various other body systems. Although the world is trying to contain TB, it is a major cause of morbidity and mortality in the world particularly in the low and middle income nations [1]. The World Health Organization (WHO) Global Tuberculosis Report 2024 estimates that 10.6 million people contracted TB in 2023 and 1.3 million deaths were reported in HIV-negative people. India, which has supplied almost 27 percent of worldwide TB cases, is still a burden country despite tremendous gains made on the diagnosis and treatment of TB in the country through the National Tuberculosis Elimination Programme (NTEP).

TB is directly linked with socioeconomic factors, such as poverty, malnutrition, overcrowding, poor sanitation and access to health care. These do not only make it susceptible to infection, but also allow it to spread swiftly in the societies. The congested slums of the urban centers have no proper ventilation, lack of hygiene and lack of proper health facilities, which are the final place where TB is contracted. The other issues that have increased the threat of infection in these areas are low levels of literacy, stigma against the disease, delayed health seeking behavior, and insufficient provision of public health interventions [2].

The slum dwellers are often subjected to a number of risk factors that are intertwined that trigger the contraction of TB in addition to its exacerbation. Malnutrition inhibits the immune system such that one becomes vulnerable to latent TB infection and active disease progression. Squeezing and lack of ventilation has positive impact on the spread of airborne infection and tobacco smoking and alcoholism also result in weakened pulmonary defense. Additionally, close contact with TB victims particularly within a family or community is highly dangerous because an infection may occur [3].

Although much literature has been conducted regarding the prevalence of TB within the urban and rural population, a comparative lack of research has been focused upon slum population particularly in the semi-urban areas where the urbanization and migration rates

are changing the epidemiological landscape. To influence effective programs in the sphere of the health of the population, it is necessary to learn about the prevalence of TB and its risk factors in such vulnerable groups. Evidence-based interventions can place emphasis on the early diagnosis, assist in enhancing treatment adherence, nutrition consumption, and environmental risk factors that, ultimately, may result in the realization of the objective of TB elimination [4].

The given research was, thus, focused on both establishing the prevalence of TB and also establishing the most significant risk factors of TB among the slum occupants. The research will enlighten the policymakers and healthcare professionals to develop certain interventions to prevent, diagnose and treat TB in marginalized populations to assist in reducing the disease transmission and improving the overall healthcare outcomes through the creation of the community-based evidence [5].

MATERIALS AND METHODS

Study Design and Setting

A cross-sectional study involving the community was used to determine the prevalence of tuberculosis (TB) and the risk factors associated with the disease in slum dwellers. The research will be conducted in the period of January-June 2025 in the chosen slum regions of Andhra Pradesh, which will be semi-urban settlements with a dense population, unsanitary environment and inaccessibility to health facilities [6].

Study Population

The target population involved the residents of the slum that were aged between 15 years and over and had lived in the slum at least 1 year. The people who were very sick, who declined to attend or were already on treatment of TB were left out [7].

Sample Size Determination

The sample size was determined by the formula of cross-sectional studies, given that the estimated prevalence of TB was 5 percent in urban slums; then the confidence interval was 95 percent and the margin of error was 2 percent. The sample size of 600 participants was the minimum. The participants were chosen using a multistage random sampling technique, and one household that met all the criteria was picked [8].

Data Collection Tools

The pretested structured questionnaire was used to collect the data through face-to-face interviews. The questionnaire captured [9]:

- Sociodemographic variables: age, gender, education, occupation, income and household size.
- Environmental conditions: the kind of house, the occupancy per room, ventilation and toilets.
- Behavioral components: smoking, alcohol consumption and diet.
- Medical history: former TB infection, being exposed to TB carriers, comorbidity, and symptoms that could have been implying TB (cough lasting over 2 weeks, fever, weight loss, night sweats) [10].

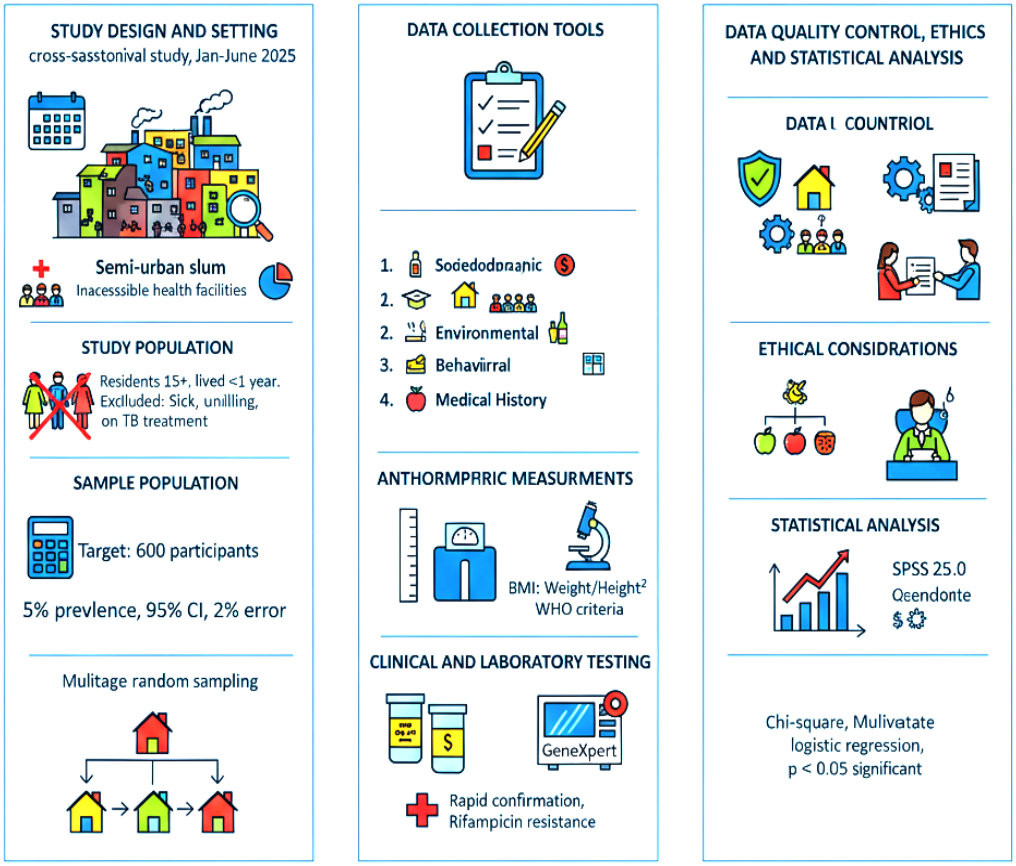
Anthropometric Measurements

- Measured heights and weights were taken on standardized measurements and Body Mass Index (BMI) computed.
- The nutritional status was defined as underweight, normal, overweight or obese based on WHO criteria [11].

Clinical and Laboratory Testing

Those participants who claimed to have a symptom related to TB were further assessed [12]:

- Sputum testing: Two samples of sputum (spot and early morning) were taken.
- Microscopy: Ziehl130 Neelsen staining of acid-fast bacilli (AFB) was done.
- Molecular testing: Rapid confirmation and detection of rifampicin resistance was done in positive samples or symptomatic persons of negative smears through GeneXpert MTB/RIF assay.



For those who were confirmed to have TB, they were referred to the nearest DOTS centers to be treated (Figure 1).

Figure 1: Research Methodology

Data Quality Control

Data collection, interviewing methods, and sample processing were all trained to all the study personnel. Currently, the questionnaire was pretested in a local slum and some modifications were done to enhance clarity and reliability. Standard biosafety and quality assurance procedures were used in laboratory procedures [13].

Ethical Considerations

The Institutional Ethics Committee approved and provided the ethical approval. All participants were informed and gave the written informed consent (or guardians of those aged between 15 and 18 years). Anonymity was ensured and the participants diagnosed with TB were counseled and referred to the suitable treatment [14].

Statistical Analysis

The SPSS version 25.0 was used to enter data and analyze it. A summary of the sociodemographic, environmental, and behavioral characteristics was summarized using descriptive statistics (mean, standard deviation, frequency, and percentage). TB prevalence was compared to risk factors using chi-square test and multivariate logistic regression analysis done to determine independent predictors of TB. Any p-value less than 0.05 was termed as significant [15].

RESULTS

Sociodemographic Characteristics

The study involved 600 participants (320 males, 53.3, and 280 females, 46.7). They included a mean age of 38.5 years (S = 14.2 years) and most 55% fell within the 15 to 40 years age bracket. The majority of the respondents (62% primary or none) had primary education or none, and 48% were engaged in informal work or daily wage jobs. The number of people living in a household was large (mean of more than 3) with overcrowding (more than 3 people in a room) experienced in 58 percent of households.

Prevalence of Tuberculosis

Tuberculosis was 6.5% (n = 39) in the entire population that was under study.

- Males (8.1% n = 26) and females (4.8% n = 13) were at a higher risk of prevalence.

- The prevalence of TB by age was high, 2.1% in 1525 years, 5.6% in 2640 years and 11.3% in persons over 40 years.
- Out of the confirmed cases, 70 percent were pulmonary TB and 30 percent were extrapulmonary TB.

Environmental and Behavioural Characteristics

- Overcrowding: 59 out of 39 TB cases (23) lived in households that had 3 or more occupants per room.
- Inadequate ventilation: 61 per cent of TB cases resided in ill ventilated houses.
- Smoking and alcohol consumption: 41% of TB cases smoked, and 28% consumers reported the use of alcohol.
- Malnutrition: 54% of all TB cases were underweight (BMI <18.5 kg/m 2).
- Past TB exposure: 31 percent had a history of close exposure to TB patient (Table 1, Figure 2).

Table 1: Association of Risk Factors with Tuberculosis

Chi-square analysis revealed significant associations between TB and several risk factors:

Risk Factor	Category	TB Cases (n=39)	Non-TB (n=561)	p-value
Age	≤40 years	15 (3.9%)	366 (96.1%)	0.001*
	>40 years	24 (11.3%)	189 (88.7%)	
Gender	Male	26 (8.1%)	294 (91.9%)	0.08
	Female	13 (4.6%)	267 (95.4%)	
Overcrowding	≥3 persons/room	23 (6.6%)	322 (93.4%)	<0.001*
	<3 persons/room	16 (4.3%)	339 (95.7%)	
Poor Ventilation	Present	24 (6.9%)	324 (93.1%)	0.002*
	Absent	15 (4.1%)	357 (95.9%)	
BMI	<18.5 kg/m²	21 (8.5%)	226 (91.5%)	0.01*
	≥18.5 kg/m²	18 (4.1%)	335 (95.9%)	
Smoking	Yes	16 (6.8%)	220 (93.2%)	0.04*
	No	23 (5.9%)	341 (94.1%)	
Previous TB Contact	Yes	12 (10.9%)	98 (89.1%)	<0.001*
	No	27 (5.0%)	463 (95.0%)	

*Significant at $p < 0.05$

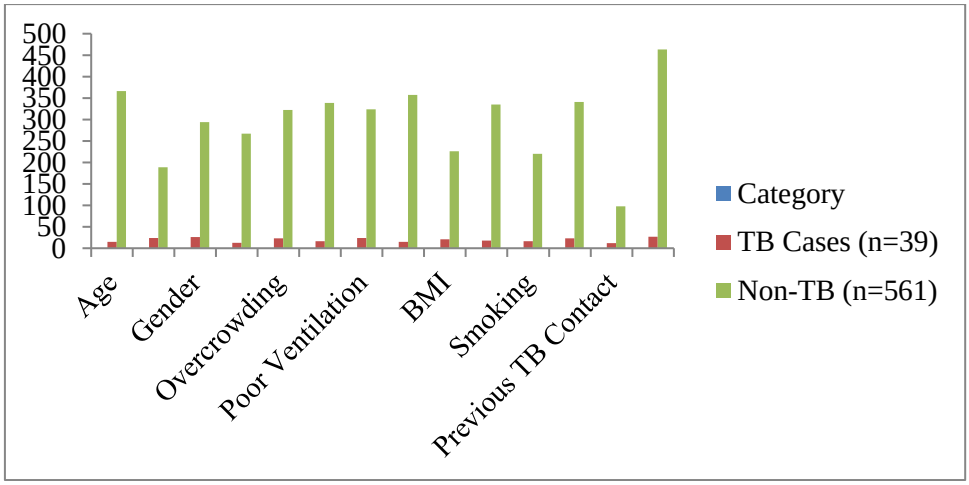


Figure 2: Graphical presentation of Association of Risk Factors with Tuberculosis

Multivariate Logistic Regression Analysis

On multivariate analysis, independent predictors of TB included:

- Overcrowding (OR = 2.4, 95% CI: 1.3–4.6, p = 0.005)
- Malnutrition (BMI <18.5 kg/m²) (OR = 1.9, 95% CI: 1.1–3.5, p = 0.02)
- History of contact with a TB patient (OR = 2.7, 95% CI: 1.4–5.3, p = 0.003)
- Poor ventilation (OR = 1.8, 95% CI: 1.1–3.2, p = 0.04

DISCUSSION

The present paper assessed prevalence of tuberculosis (TB) and risk factors associated with TB in slum dwellers where prevalence rate of TB in population was found to be 6.5 which is very high considering the reported prevalence of TB in national population (between 4 and 5%). This observation shows the burden of TB amongst poor populations that stay in low-income

and high-density locales. The prevalence is comparable to the others that have been conducted within the Indian urban slums with the prevalence of 5-8 percent and it reveals that these groups are prone to infection diseases [16].

The prevalence rates of TB were higher in male (8.1) as compared to female (4.6) but the difference was not found to be significant. The same gender patterns have been witnessed in other research due to the increased exposure to risk factors, including smoking, alcohol consumption, and occupational risks in the male gender. It was more common in old age, and the greatest burden was in those aged =40 and above years of age, as a result of accumulated exposure to risk factors and age related deterioration of immune systems [17].

Poor ventilation and overcrowding become an important environmental factor that predisposes TB in this research. Overcrowding (3 or more people in the room) carried a higher risk of TB than three and five times respectively, which was in line with the established airborne characteristics of TB spread. This was also increased by poor ventilation and Mycobacterium tuberculosis could survive longer in indoor air. The research evidence confirms findings of studies in slums across the globe where the housing conditions are essential in determining the epidemiology of TB [18].

Malnutrition was also a risk factor of TB with underweight people (BMI below 18.5 kg/m 2) having almost twice chances of being affected by TB compared to those of normal BMI. Deficiencies in nutrition undermine cell-mediated immunity making a person more susceptible to TB infection and development of active disease following latent disease. These findings have been supported in several community-based studies in India and southeast Asia which have all found similar associations between low BMI and TB [19].

Smoking was also linked to higher TB prevalence, probably because it had affected the mucociliary clearance and pulmonary immunity. Moreover, the history of intimate association with TB patient was a crucial risk factor, which highlighted the role of household and community-based transmission in high-density areas. The results support the importance of contact tracing and early screenings of the high risk members of the slum populations [20].

The prevalence in this study is greater than the rural but the same as other urban slum researches, which underlines the role of the socioeconomic and environmental factors in the TB spread. Although urbanization may enhance the availability of healthcare, semi-urban and slum settlements tend to be underdeveloped with regard to infrastructure, sanitation, and awareness, and the process of infection continues [21].

The research indicates that there is an acute necessity of the targeted interventions within the slum communities [22]:

- Enhancement of housing and indoor airflow to curb airborne infection.
- Education of nutrition supplementation to enhance immunity.
- Sensitization of the communities on the symptoms of TB and early health seeking.
- Active case identification and screening of contacts by mobile clinics or community health workers.

Certain constraints have to be admitted. Due to the cross-sectional study, the causality of risk factors and TB is not achievable. Smoking and alcohol consumption were self-reported which is prone to recall bias. The sputum tests were not carried out on all patients but rather the symptomatic patients and this could have underestimated the real figures of the asymptomatic or latent TB [23].

Despite these limitations, the research provides the crucial information regarding the high prevalence of the TB among the slum population as well as identifies the necessary risk factors that can be modified. They can be applied in policy making and community-based intervention in order to reduce TB transmission and improve the health conditions of the disadvantaged populations.

CONCLUSION

The existing literature has demonstrated that slum dwellers have high rates of TB (6.5) implying that there is a strong burden to the population health within the disadvantaged groups. Overcrowding, poor ventilation, malnutrition, smoking, and past exposure to TB patients are the risk factors that have been identified to be critical. These findings demonstrate the critical role of socioeconomic, environmental and behavioral determinants in TB spread. The reduction of the TB burden among the population of the slums should be implemented by means of the community based interventions, including the improvement of the living conditions, the promotion of the nutritional support, the promotion of the level of awareness, the active identification of the cases, the strengthening of the early diagnosis and treatment services. The specific interventions directed toward environmental and modifiable risk factors are imperative in effective TB control and progressing to elimination in the high-risk populations.

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