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Tuberculosis At The Margins: Rurality, Poverty, And Healthcare Access In Arunachal Pradesh

1.Bengia Seema, Guest faculty, Department of Sociology, Rajiv Gandhi University, Rono Hills, Arunachal Pradesh.

2. Haobijam Vokendro, Professor, Department of Anthropology, Manipur University, Imphal

Abstract

Tuberculosis continues to be a significant public health concern in India, particularly among socio-economically disadvantaged populations. This paper presents a detailed socio-economic, occupational, and geographical analysis of 418 TB patients in Arunachal Pradesh based on fieldwork conducted in 2021–2022. The findings indicate that students (47.36 per cent) and unemployed individuals (17.7 per cent) are the most affected occupational groups, while families dependent on small businesses and agriculture are disproportionately vulnerable. Nearly half of the TB-affected households earn less than ₹50,000 annually, underscoring the correlation between poverty and TB. Furthermore, the study identifies a higher prevalence of TB in rural and remote districts, with significant barriers to healthcare access and transport. Pulmonary TB (82.53 per cent) dominates the case distribution, but extra-pulmonary TB (17.46 per cent) remains a considerable concern. The study recommends tailored, income-sensitive public health interventions to address the socio-economic and spatial inequities that shape the TB burden.

Keywords: Tuberculosis, Socio-economic inequality, Occupational health, Rural health, Arunachal Pradesh, Pulmonary TB, Extra-pulmonary TB

1. Introduction

Tuberculosis caused by *Mycobacterium tuberculosis* (MTB) is a well-known and significant public health challenge globally, and is the leading cause of death from a single infectious agent (WHO, 2022). Accurate estimates of the TB burden are particularly crucial in India, as it holds the highest TB burden globally, accounting for more than a quarter of the world's TB cases in 2021 (WHO, 2022). The new End TB strategy highlights the importance of providing healthcare for everyone and offering social support as key steps in reducing TB cases and deaths (Uplekar, Weil, Lönnroth, et al., 2015). Despite widespread awareness and national control programs, socio-economic and geographical disparities continue to affect TB diagnosis,

treatment, and recovery outcomes. This study investigates 418 TB cases in Arunachal Pradesh to understand how occupational roles, income levels, transportation access, and place of residence influence TB patterns and public health responses.

2.Methodology

This study used a mixed-methods research design, combining qualitative and quantitative approaches to provide a comprehensive understanding of the issue. The data were collected from 2021 to 2022 in Arunachal Pradesh. Information on TB patients and their demographic profiles was collected from government and private health centres in urban and rural areas. The study looked at things like people's jobs, family income, where they live, how easily they can travel, and the type of TB that they were diagnosed with.

A total of 418 TB patients were covered in the study. These included individuals who were either currently being treated for TB or had already completed their treatment. Data was collected using carefully prepared semi-structured interviews. Written consent was obtained from all participants before the interviews. For children or teenagers, permission was obtained from their parents.

The study was approved as part of a PhD program (PhD Registration No. RGU/RS-764/2018). It was carried out among various indigenous communities in the Papum Pare and Itanagar Capital Region of Arunachal Pradesh. TB patients who had been diagnosed with any form of TB—whether pulmonary or extra-pulmonary—at any time in their lives were included. Most participants were selected from official records at the State Tuberculosis Centre, Naharlagun, and from various TB centres in the capital region. In cases involving minors, their parents or guardians spoke on their behalf to make sure their experiences were included.

3. Results and Analysis

3.1 Occupational Profile of TB Patients

The occupational distribution of TB patients in the study reveals that TB afflicts people of all walks of life. Students are the largest affected group (47.36%), followed by the unemployed (17.7%), farmers (11.4%), and both government and private-sector employees. While TB has historically been linked to poverty and poor living conditions (Lönnroth et al., 2009), the present findings emphasise its broader social impact, affecting individuals who are economically stable or pursuing education. The presence of TB among students may be linked to overcrowded living conditions, nutritional deficiencies, and stress-related immunosuppression often faced during academic life.

3.2 Occupation of Guardians and Household Impact

By analysing the occupations of guardians, the study highlights the indirect economic burden TB places on families. A significant number of guardians were engaged in business (25.83%) and farming (22.96%), followed by government employees (19.17%) and private-sector employees (17.7%). Since many of these occupations fall under the informal economy, the impact of TB often disrupts livelihood activities that lack social security nets. Such a higher occurrence of TB in lower socio-economic groups supports Uplekar et al.'s (2015) argument for adopting a multisectoral approach to TB control, incorporating social protection mechanisms for affected families.

3.3 Household Income Distribution

Household income data reveals stark economic vulnerabilities among TB-affected families. Nearly half (48.56%) reported annual incomes below ₹50,000, while only 8.61% reported incomes above ₹500,000. The correlation between low income and higher TB incidence is well-established (WHO, 2022). Financial hardship can lead to delays in diagnosis, poor treatment adherence, and an increased risk of transmission—factors exacerbated by out-of-pocket health expenditures and limited social support systems.

4. Spatial Patterns and Transport Access

4.1 Urban–Rural Distributions

The study found that 59.1% of TB cases originated in rural and semi-urban districts, while 40.9% originated in the Itanagar Capital Region. The findings indicate a heavy rural burden, likely due to weaker healthcare infrastructure, limited diagnostic facilities, and health-seeking behaviours shaped by cultural and geographical barriers. The End TB Strategy (WHO, 2022) calls for localised, community-based interventions—something particularly relevant in regions like Arunachal Pradesh, where geographical isolation can impede timely care.

4.2 Transportation and Accessibility

Access to transportation is critical for sustained TB treatment, which often spans several months. In this study, 43.06% of patients relied on public transport, and 3.35% walked to healthcare centres. Poor transportation options may discourage follow-up visits and increase treatment default rates, reinforcing the cycle of infection and resistance. Moreover, public transport may increase the risk of TB transmission, highlighting a public health concern beyond individual treatment (Lönnroth et al., 2009).

5. Clinical Dimension: Types of TB

Most patients (82.53%) had pulmonary TB, aligning with global trends (WHO, 2022). However, the presence of 17.46% extra-pulmonary TB cases points to the complexity of diagnosis and the need for enhanced medical training and infrastructure. Extra-pulmonary TB, being harder to detect, is often underreported, especially in resource-poor settings. The study thus reinforces the need for comprehensive diagnostic services, including access to imaging and biopsy services in rural health centres.

6. Discussion

Tuberculosis remains a significant public health challenge globally and in India, where the burden is highest. According to the *Global TB Report 2022*, India accounted for over 25% of the world's TB cases in 2021, reflecting both the scale of the problem and the structural inequalities that underpin it (WHO, 2022). This study, conducted in Arunachal Pradesh, provides important insights into the socio-economic, spatial, and clinical dimensions of TB, especially among indigenous communities in both urban and rural settings. The finding that students form the largest affected group (47.36%) is striking and invites reflection on the broader socio-environmental conditions in which TB thrives. While TB is traditionally associated with poverty and manual labor (Lönnroth et al., 2009), this evidence suggests a shift: academic stress, poor nutrition, crowded hostels, and weak immunity may be new determinants of vulnerability among youth (Pai et al., 2016). The presence of TB among government and private sector employees also points to a broader epidemiological reality—TB is no longer confined to the socioeconomically marginalised but is increasingly impacting the urban educated class as well (Kirenga et al., 2020). Such a finding aligns with the WHO's call for universal screening strategies that include all occupational categories (WHO, 2015). TB affects not just

individuals but entire households. The analysis of patients' guardians shows a high representation in small-scale business (25.83%) and agriculture (22.96%), sectors often outside the formal safety net. Families engaged in these occupations are particularly vulnerable to income shocks from long-term illness (Barter et al., 2012). Moreover, the inability to work during treatment, travel for medical care, and the social stigma associated with TB contribute to the indirect economic burden (Tanimura et al., 2014). As Uplekar et al. (2015) argue, TB control requires a **multisectoral approach** that addresses not only medical but also social and economic dimensions. The household income data paints a clear picture of vulnerability. Nearly half of the patients came from households earning less than ₹50,000 per year, well below the poverty line. The findings align with longstanding evidence that TB is both a cause and a consequence of poverty (Lönnroth et al., 2009; Oxlade & Murray, 2012). Low-income families are more likely to live in overcrowded, poorly ventilated homes, have inadequate nutrition, and delay seeking care due to financial constraints (Hargreaves et al., 2011). These factors not only increase TB incidence but also prolong infectiousness and drive community transmission. The *End TB Strategy* highlights the urgent need for **social protection mechanisms**—such as food support, conditional cash transfers, and job security for TB patients (WHO, 2022).

Higher frequency per cent of 59.1% of patients were from areas outside the Itanagar Capital Region. This suggests that rural and semi-urban populations bear a disproportionate burden of TB. Studies have shown that rural areas often lack adequate health infrastructure, diagnostic tools, and trained personnel (Creswell et al., 2011). The **geographic inaccessibility** of health centres in states like Arunachal Pradesh, characterised by hilly terrain and scattered settlements, exacerbates delays in diagnosis and interruptions in treatment (Zachariah et al., 2006). Transport accessibility emerged as another barrier to treatment adherence. While 45.69% used personal vehicles, a significant 43.06% relied on public transport—often over long distances. The burden of travel costs, time off work, and risk of exposure to others during long commutes can demotivate patients from completing the treatment regimen (Munro et al., 2007).

Furthermore, walking long distances (3.35% of cases) or borrowing vehicles (7.89%) underscores the fragile support systems in these communities. WHO has emphasised the need for **decentralised and community-based TB services,** especially in hard-to-reach regions (WHO, 2015; WHO, 2022). Consistent with global trends, most patients (82.53%) were diagnosed with **pulmonary TB,** the most infectious form. However, the 17.46% with **extra-pulmonary TB** indicates a substantial proportion of patients facing diagnostic and treatment challenges. Extra-pulmonary TB, affecting organs such as lymph nodes, bones, and the brain, is often harder to detect without advanced imaging or laboratory facilities, which are often unavailable in rural areas (Golden & Vikram, 2005). These cases are also associated with longer delays in diagnosis, more complex treatment regimens, and worse health outcomes if not managed properly (Sharma & Mohan, 2004). Addressing these challenges requires upgrading diagnostic capacity at the primary healthcare level and training healthcare workers in recognising diverse TB presentations.

Conclusion

The study highlights how TB continues to be a disease deeply rooted in **social and structural inequalities.** The impact of TB is seen not only in its clinical outcomes but in the daily lives of patients and families—particularly those in low-income, rural, and marginalised settings. Strengthening rural healthcare infrastructure, ensuring transport and economic support, and broadening diagnostic services to detect all forms of TB are crucial steps toward reducing the disease burden. Aligning national TB programs with the goals of **universal health coverage and social protection** is not just a health imperative but a moral one, as emphasised in the WHO's *End TB Strategy* (Uplekar et al., 2015; WHO, 2022).

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