International Journal of Community Medicine and Public Health
Maurya AP et al. Int J Community Med Public Health. 2026 Sep;13(9):5396-5404
https://www.ijcmph.com
pISSN 2394-6032 | eISSN 2394-6040

DOI: https://dx.doi.org/10.18203/2394-6040.ijcmph20263232

Review Article

Social stigma and risk determinants associated with tuberculosis transmission to vulnerable residents in India

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Received: 06 May 2026
Revised: 06 August 2026
Accepted: 13 August 2026

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ABSTRACT

Due to enduring socioeconomic disparities and deep-rooted societal stigma, tuberculosis (TB) remains one of India's most urgent public health concerns. This review article assesses how societal stigma and important risk factors are linked to the onset and spread of TB, especially in vulnerable groups, including slum dwellers, migrants, and people with little access to healthcare. Stigmatization frequently leads to social isolation, non-adherence to treatment, and delayed diagnosis, all of which raise the risk of ongoing transmission within the community settings. Malnutrition, poverty, and co-infection with HIV increase the vulnerability to infection and the course of the disease. A misconception about TB is that it is an ethically motivated disease that discourages people from seeking treatment through healthcare organisations and reinforces discrimination in many Indian communities. Subsequently, failing to report and insufficient treatment remain major obstacles to controlling this disease. The perceived threat of TB infection transmission among susceptible inhabitants in both urban and rural India is highlighted in this article as a result of these intersecting social and epidemiological factors. Thus, it is imperative to develop stigma-reduction initiatives, integrate TB services into primary healthcare, and strengthen community-based awareness campaigns to break the chains of transmission and assert equal access to healthcare. To achieve India's aim of TB elimination, it is vital to address the combined problem of biological and social risk factors. Knowing the social aspects of TB transmission is essential for developing focused treatments that enhance treatment results and promote a more inclusive, stigma-free public health strategy.

Keyword: Tuberculosis, Social stigma, Risk factors, Drug resistant-TB, Epidemic, Transmission

INTRODUCTION

Tuberculosis (TB) remains one of the most critical and persistent public health challenges in India.[1] As the country with the biggest burden of TB globally, India is responsible for significant share of cases and deaths from TB every year, and affecting all ages yet primarily having impact on the younger and economically viable population.[2] TB is caused by *M. tuberculosis* which can be transmitted through inhalation of respiratory droplets and thus spread very quickly in the areas where people live in close contact, especially in resource limited areas. TB causes not only health problems, but also social and economic problems including the loss of productivity and promotion of poverty cycle.

Despite the reduction in TB death rates over the years, the health threat posed by TB is still daunting on both the global and national levels. The National TB Elimination Programme (NTEP) has been introduced by India to improve TB control measures by 2025.[3] The NTEP is operating on a framework that promotes early detection of TB, timely treatment, and transmission prevention

strategies.[4] However, the results still vary across different areas of the country.

The emergence of drug-resistant TB (DRTB) adds to the burden of the existing disease. Overall, DRTB is responsible for about 13% of deaths caused by AMR worldwide.[5] The highest number of DRTB cases is reported in India followed by China and the Philippines.[6] DRTB is caused by the direct transmission of resistant strains or by the development of resistance due to the insufficient or incomplete treatment of the patients.[7] The presence of these findings serves as an evidence of the need for new approaches in diagnostics, treatment protocols, and program efforts along with continued funding of health systems in the country.[7]

TB vulnerability in India is narrated with increasing use of the syndemic perspective, which shows the interaction of biological, psychological, and social determinants within the households affected by the disease.[7] Traditional methods of screening and biomedicine mostly disregard indirect effects of the disease, such the loss of income, malnutrition, and existence of comorbidities, making people more vulnerable to the disease and complicating recovery.[7] Such interlaced vulnerabilities do not only aggravate individual outcomes but perpetuate TB transmission and further entrench socioeconomic inequalities.

RESEARCH QUESTION AND OBJECTIVE

The current assessment review addresses the following question: what role do social stigma and some important social and biological determinants play in the delay of diagnosis, persistence of transmission and unequal TB outcomes in people at risk in India? The goal is to summarize multidisciplinary evidence in order to understand how stigma is connected with vulnerability and transmission and to determine the consequences for the TB programs in India.

REVIEW METHODOLOGY

This narrative review followed a structured approach to ensure transparency and conceptual accuracy: Electronic databases (PubMed, Scopus, Web of Science, Google Scholar) were searched for studies published between 2005 and 2025. Search terms included combinations of: TB, India, stigma, social determinants, poverty, gender, migration, drug-resistant TB, and transmission. Included sources were: Peer-reviewed pragmatic studies (qualitative and quantitative), Systematic reviews and meta-analyses, National surveys and policy documents, and Programmatic reports.

EPIDEMIOLOGICAL CONTEXT AND DISEASE SPECTRUM

Each year, about 10 million people develop TB.[8] Although this illness is widespread in many parts of the world, its impact is considerably more severe in low-to-middle income countries. Earlier studies suggest that six nations account for close to 50% of the global TB burden-India, Bangladesh, China, Nigeria, Indonesia, and Pakistan.[9] Additionally, it was reported that 13 million Americans could be suffering from latent TB infection (LTBI), which means that a large pool of individuals could develop active TB disease in due course.[10] About 5 to 10% of those with LTBI will eventually develop active disease, which is the stage responsible for most new TB cases, especially in low-incidence areas without treatment.[10]

INCIDENCE

Counting new cases of TB is one of the aims of the TB surveillance programme. TB cases in heavily affected countries are usually underreported or misdiagnosed.[11] The World Health Organization (WHO) uses different methods to assess the number of new cases of TB, e.g., prevalence surveys, modified notifications and inventory/capture-recapture approaches.[11] The WHO regions with the greatest share of new cases include South-East Asia (45%), Africa (23%) and Western Pacific (18%), while the lowest numbers of new cases are reported by the Eastern Mediterranean (8.1%), Europe (2.2%) and the Americas (2.9%).[11]

Recent reports documented that India accounted for 27.0% of all TB cases, followed by 10.0% by Indonesia, 7.1% by China %, 7.0% by the Philippines, 5.7% by Pakistan, 4.5% by Nigeria, and 3.6% by Bangladesh in 2022.[9] These countries were located in the WHO Southeast Asian, African, and Western Pacific regions.[9] However, it has been estimated that TB incidence has significantly decreased over the last 20 years in four WHO areas: Europe (54%), Africa (36%), South-East Asia (34%), and Western Pacific (32%). The American (22%) and Eastern Mediterranean (17%) regions have shown less of a decline.[12]

PREVALENCE

Currently, India has the highest burden of TB in the world.[3] Although the number of cases in India has significantly decreased, there is limited knowledge about how this change has influenced the mortality levels.[3] The incidence of TB is higher among men than women in India; however, due to under-nutrition, influenced by cultural barriers preventing from prioritizing health and nutrition, it is women who are more likely to get infected.[13]

In India, there were 1,933,381 TB cases in 2021, of which 6% of cases occurred in children aged 0-14, 58% in males, and 36% in females.[13] This makes addressing the gender gap in awareness about TB transmission even more crucial. Hence, in the year 2019, the Central TB Division (CTD) India developed new guidelines for the National Framework on Gender Responsive Approach to

TB in India aimed at advancing gender equality in accessing TB-linked healthcare.[14]

ACTIVE VERSUS LATENT TB INFECTION

Not all MTB-infected individuals become ill from inhalation. Both active TB disease and LTBI result from the bacterium's interaction with the host's immune system.[15] Both the sociological study of stigma and the epidemiological study of risk require an understanding of this disparity.[9] People who have the MTB infection but do not demonstrate any radiological or clinical evidence of the active disease have the condition known as LTBI which means that these individuals are non-infectious.[10] Under these circumstances, the bacilli are successfully contained by the host immune system within granulomatous masses, limiting active replication but leaving the organism intact.[16] LTBI patients have a 5-10% chance of developing active TB, with the risk being highest within the initial two years following infection or in immunocompromised conditions such as HIV infection, malnourishment, or diabetes mellitus.[11]

Active TB infection, on the other hand, happens when the host immune system is compromised, enabling MTB to multiply and gradually destroy tissue, especially in the lungs.[11] According to Luies and Preez (2020), people with active TB are frequently contagious and exhibit symptoms such as a persistent cough, high temperature, sweating throughout the night, exhaustion, decreased body weight, and hemoptysis in lung infections.[17]

TB TREATMENT COVERAGE AND OUTCOMES

Global treatment coverage has changed significantly over the past few years, going from 72% in 2019 to 59% in 2020 and 61% in 2021 (for both drug-susceptible TB and DR-TB).[18] The coverage rates for MDR/RR-TB are significantly lower, with an estimated one in three individuals receiving treatment developing MDR/RR-TB.[18]

India, Indonesia, the Philippines, Nigeria, and Pakistan account for more than half of the estimated 70% of the disparity in MDR/RR-TB incidence and treatment initiation that exists in these ten countries.[9] The overall first-line regimen treatment success rate in 2020 was 86%; the rate is higher (88%) in children (less than 15 years old) and lower (77%) for people living with HIV.[11]

COSTS

According to Indian government policy, all registered TB cases will receive "free" diagnosis and treatment, which includes anti-TB drugs and basic diagnostic tests (the most popular ones are sputum smear microscopy, chest X-rays, and rapid molecular tests).[3] Patients pay "out-of-pocket" for several other expenses, including consultation fees, non-TB medications, additional diagnostic tests (such as computed tomography scans, magnetic resonance imaging, and biopsies), travel costs before treatment begins (i.e., from the onset of symptoms to the start of treatment), travel costs to pick up TB medications, extra food or nutritional supplements, and managing side effects during treatment.[11]

It is crucial to lower the expenses that patients and their families must bear to guarantee that all TB patients can receive care and full treatment, which will ultimately reduce the number of unnecessary deaths from the disease.[11] Three high-level indicators of the incidence of TB (new cases per 100,000 population annually): 1). The number of TB deaths annually, 2). the proportion of patients, and 3). their households who incur catastrophic total costs due to TB disease milestones and targets included in the WHO End TB Strategy (2016-35).[19]

ENVIRONMENTAL, SOCIAL, AND BIOLOGICAL DETERMINANTS THAT INFLUENCE TB

The link between TB and socioeconomic factors is becoming more and clearer. An excellent illustration of a "social disease" that calls for social, economic, and environmental interventions is TB.[20] TB in high-income nations has been linked to measures to strengthen protection, and the disease is most common in developing countries, which are home to the world's poorest and most vulnerable citizens.[20]

There is mounting evidence that socioeconomic risk factors play a significant role in TB epidemiology, influencing every stage from exposure risk to clinical outcome. The WHO's most recent estimates indicate that five risk factors-undernourishment, HIV infection, alcohol use disorders, smoking, and diabetes.[12] These account for a significant percentage of new TB cases. In the sub-Saharan African region, undernourishment and HIV infection, the two biggest causes of new TB cases, exhibit geographic overlap, leading to a high burden of all three conditions.[12]

Homelessness, unemployment, hunger, and poverty are socioeconomic factors that contribute to this burden. According to the WHO, socioeconomic health determinants are non-medical variables that affect health outcomes.[21] Increased migration, rapid urbanization, and population growth are the upstream socioeconomic factors that contribute to the TB burden.[21] These factors then contribute to downstream disparities, including undernutrition or even food insecurity, substandard housing, and obstacles to accessing healthcare (such as lack of funds, travel time to facilities, and cultural norms).[21]

Further, poor ventilation, overcrowding, homelessness, and unstable housing, for example, raise the risk of contracting TB because they increase the chance of coming into contact with *M. tuberculosis*.[20] In addition to making TB more severe, poverty and hunger also make people more vulnerable to infection and disease

progression. The per capita economic growth and the incidence of TB are strongly correlated.[22] TB is an excellent illustration of a disease associated with poverty, even though it can afflict anyone.[20]

SOCIAL DEPRIVATION AND POVERTY

The primary cause of the TB epidemic is poverty. It is a general condition that causes and aggravates almost all other risk factors rather than a specific one.[23] Undernutrition, congested living circumstances, and restricted access to healthcare are all consequences of socioeconomic disadvantage that raise the risk of TB.[12] Both between and within countries, the poorest and most marginalized communities consistently have the highest incidence of TB.[12] It can only start to accelerate the progress made to abolish TB by addressing the root causes of ill health, such as poverty and a lack of social protection.[23]

SMOKING

Smoking significantly increases the risk of premature death for TB patients, especially in LMIC nations where the disease is highly prevalent.[24] The most recent TB care guidelines emphasize the significance of integrating tobacco-dependence treatment (TDT) and smoking cessation into TB care.[24] The "dual epidemics" of tobacco use and pulmonary TB are significant worldwide public health issues, particularly for LMIC nations.[25] In addition to being closely linked to MDR-TB, tobacco use raises the risk of active TB infection, development, and associated mortality.[24] Poor TB treatment outcomes, particularly treatment losses and morbidities, are positively correlated with smoking.[25]

Active smoking is strongly linked to recurrent TB and TB mortality, and it doubles or triples the risk of contracting TB. It has been noticed that, for TB patients, quitting smoking is crucial.[26] The best method for quitting smoking in general populations is behavioural support and medication, but there is no proof that this method works for TB patients who smoke.[25] Despite being highly advised, drugs are too expensive to be used in LMICs.[25]

RISK FACTORS FOR TB

When diagnosing TB and choosing the first course of treatment, potential for drug-resistant TB must be taken into account. Treatment regimens may be needlessly insufficient if the probability of drug-resistant TB is not taken into account until weeks after conventional DST results are available.[27] The following are the most significant determinants of drug-resistant TB in patients who have not yet begun taking anti-TB medications:

Treatment for TB in the past

Drug-resistant TB has been repeatedly demonstrated to be strongly associated with prior treatment (at least one month of one or more anti-TB medications).[27] The development of even more drug resistance during the previous treatment episode or, conversely, the resurgence of a drug-resistant isolate that was not identified and/or not properly treated could account for this association.[5] If available, the results of previous drug-susceptibility tests and a thorough history of previous TB treatment are crucial. Further, Records of previous treatment are kept by the TB program for patients who have been treated in any state or nation.[27] If active TB is not adequately ruled out beforehand, treatment of presumptive LTBI, even for a month, may result in drug resistance.[10]

Origin, past residency, prolonged or frequent travel to a nation with a higher prevalence of drug resistance

There are multiple explanations for the consequence of the large TB burden among immigrants: either active disease at arrival, resident transmission, or disease development because of the increasing prevalence of *M. tuberculosis* infection.[28] However, TB epidemiology in the expatriate community is particularly influenced by the acquisition of *M. tuberculosis* infection after exposure during travel.[28] Additionally, in a study, it was recorded that TB is most common in new (less than two years old) immigrants to the UK, most likely due to exposure just before migration.[29]

Possession of an individual who has been diagnosed with drug-resistant TB

Despite some evidence that suggests drug-resistant TB is less contagious or harmful once spread than drug-susceptible TB, other data suggest that this may not be the case and that adaptive mutations in drug-resistant TB or longer infectious durations in drug-resistant cases balance the risk of transmission.[5,7] Drug-resistant TB strains are transmissible, according to strong clinical evidence.[5]

Therefore, drug-resistant TB is observed as equally pathogenic and transmissible as drug-susceptible for clinical applications, such as contact tracing or treatment regimens.[7] Patients with a history of exposure to a person with TB disease who received treatment but experienced treatment failure or relapse, and whose DST results are unknown, should be regarded as having an elevated risk for drug-resistant TB in addition to exposure to confirmed drug-resistant TB.[5,7]

Population-level risk factors (like HIV infection, diabetes, and the population suffering from malnutrition) for TB

The main population-level risk factor for TB worldwide is undernourishment, which is estimated to be responsible for 2.2 million (20.8%) cases of TB in 2021.[30] In nations where TB is prevalent, the impact of undernutrition is predominantly significant.[31] Increasingly, undernutrition-a physiological consequence depending on patient dietary patterns and typically estimated as a body mass index of

less than 18.5 kg/m^2-is being used as a TB risk indicator in place of undernourishment, which is a national indicator of chronic hunger.[31]

The most significant immunosuppressive factor for the development of active TB is coinfection with HIV (Table 1).[32] HIV infection significantly raises the risk of TB recurrence through latent infection and, similarly, accelerates the course of TB following *M. tuberculosis* infection.[32] WHO estimates that the risk of disease progression is 26 times higher for people living with HIV (PLWHIV) who are latently TB-infected than for those who are not HIV-positive.[31] As a result, HIV and TB co-infection create a deadly synergy in which TB speeds up HIV replication and the morbidity and mortality consequences that are linked to it, while HIV significantly enhances susceptibility to TB and intensifies the disease's severity.[32]

HIV infection raises the risk of MDR-TB, and the previous pooled analysis revealed a trend toward higher risk.[33] MDR-TB development is further sparked by the poor treatment outcomes for TB-HIV co-infected patients.[32] MDR/RR-TB is estimated to be present in 3.4% of newly reported cases and 18% of TB cases that have already received treatment.[33]

According to the reports, diabetes increases the risk of active TB, and the chance of active TB is roughly double in people with suffering diabetes.[33] Diabetes and malnutrition, identified as significant risk factors for active TB, have been documented as two crucial elements that could hinder the goal of lowering TB incidence by 2035 on a global scale.[34] Low levels of body mass index (BMI) as well as untreated diabetes have been independently associated with higher risks for TB infection and poor treatment results, according to a body of primarily retrospective evidence.[34] As per the reports, 0.37 million TB cases in 2021 were linked to diabetes.[8] Diabetes affects several stages of TB, including a quicker progression to the disease, more severe symptoms, and a higher risk of recurrence, treatment failure, and even death.[8]

Further, several studies have linked a vitamin D deficiency to an elevated risk of TB.[35] A vitamin D deficiency may worsen the relationship between diabetes and TB because it has been associated with an increased risk of diabetes.[36] One possible explanation for this is that vitamin D has a regulatory effect on insulin secretion and signalling.[37] It also has an immunomodulatory effect by binding to the macrophage receptor and starting a cascade that kills intracellular *M. tuberculosis*.[37] Hence, both the course of TB and the results of TB treatment are at risk due to vitamin D deficiency.

Additional risk factors for TB

Exposure of healthcare workers to TB in hospital settings is one of the comorbidities for TB infection.[38] The likelihood of an infection developing into a disease is increased by other factors such as cancer, rheumatoid arthritis, kidney failure, and silicosis.[38] The necessary treatment for each condition affects the immune system, which reduces the patient's ability to contain an *M. tuberculosis* infection.[38]

Table 1: Risk factors and their contribution in the development of TB.

Risk factors	Explanation	Involvement to TB risk/transmission	References
Fear of contagion/perceived transmissibility	Many individuals, think that tuberculosis is extremely infectious and it is due to lack of the proper knowledge.	This fear results in TB patients avoiding social situations, being kept secret, and delaying diagnosis and treatment, all of which increase the risk of the disease spreading.	46, 47
Risk of exclusion/social marginalisation	More stigma and obstacles are faced by vulnerable groups, such as immigrants, undocumented people, and members of lower castes or ethnic groupings.	These individuals may have hidden illnesses, delayed diagnosis and treatment, increased risk of community transmission, and the creation of infection reservoirs.	48, 49
Low education/ poor knowledge	Poorer levels of education and ignorance regarding the causes, prevention, and treatment of tuberculosis.	Inadequate prevention and increased risk for vulnerable residents result from misconceptions (e.g., "TB is hereditary" or "sharing dishes causes TB").	50, 51
Treatment delay and non-adherence (linked to stigma)	Patients may postpone or discontinue treatment out of fear of stigma.	Treatment delays lengthen the infectious period and raise the risk of transmission to susceptible residents.	52-54
Social stigma (internalised and enacted)	When TB is stigmatized, it becomes a highly disparaging trait that causes discrimination and social exclusion.	In order to prolong the infectious time in communities, patients may conceal their symptoms, put off seeking care, or postpone treatment.	55, 56

Continued.

Risk factors	Explanation	Involvement to TB risk/transmission	References
Overcrowded/ poorly ventilated housing	Poor ventilation and cramped living quarters.	Facilitates the airborne transmission of TB bacteria to "sensitive residents" (elderly, children, and people with impaired immune systems).	57, 58
HIV co-infection and other comorbidities	TB frequently coexists with HIV, diabetes, malnourishment, etc.	These comorbidities raise the likelihood of transmission among susceptible individuals by increasing susceptibility and prolonging the infectious period.	2, 51
Low socio-economic status or poverty	Living conditions, low income, and poverty.	Causes overcrowding, malnourishment, weakened immune systems, increased exposure risk, and a lack of timely treatment access, all of which enhance the chance of transmission within the community.	59, 60
Misconceptions about TB cause	Trust that TB is inherited, that smoking is the only cause, or that it is a punishment from God.	These myths increase their dissemination throughout communities by decreasing early care seeking and effective preventative behaviors.	48, 56

THE FACES OF STIGMA: EXPERIENCES AND TYPES

The stigma associated with TB has several "faces," each of which reflects a different typology and life experience that significantly influences people's health-related behaviors and social well-being (Table 1).[39] Anticipated stigma (dread of rejection), enacted stigma (real experiences of discrimination), internalized stigma (shame and self-blame), and structural stigma (systemic injustices and institutional negligence) are the most common ways that TB stigma appears.[39] According to Courtwright and Turner, these types of stigma frequently lead to social exclusion, delayed diagnosis, and poor treatment adherence because they interact with gender, poverty, and cultural views.[40] For example, gender norms that associate TB with moral or physical impurity make women more stigmatized in numerous contexts, which can impact their social standing and marital prospects.[40]

Enacted stigma

This refers to overt instances of bias and discrimination that TB patients have to deal with.[39] It can involve rejection for marriage, losing a job, getting kicked out of housing, or being rejected by friends and family.[39] Enacted stigma can occur even within the healthcare system when medical personnel treat patients disrespectfully or negligently.[39] These discriminatory practices have serious and direct socioeconomic consequences.

Anticipated stigma

Anticipated stigma, which is the fear of having one's TB status revealed, is frequently more widespread than enacted stigma.[41] This fear is an effective behavior motivator. People are doing all in their power to hide their disease, stay away from social events, and not talk about it with anybody outside of their close social group in order to prevent possible rejection and embarrassment.[42] Contact tracking and treatment adherence are two public health initiatives that are directly harmed by this concealment.[42]

Internalized stigma

Through this process, people with TB internalize the negative social views and prejudices that are aimed at them, making them feel inferior, ashamed, or imperfect.[43] Depression, social disengagement, and a decreased desire to follow the drawn-out and difficult treatment plan can all be consequences of internalized stigma, which can cause intense emotions of shame, disgust, and low self-esteem.[43]

Gendered dimensions of stigma

Stigma has a strong gendered component and does not affect everyone equally.[44] Particularly in patriarchal cultures, women may have more severe consequences.[44] They could be accused of being the cause of the infection in the family and could be considered "unmarriageable" or subject to divorce or abandonment.[44] According to studies, women are more likely than men to avoid talking about their illness out of a concern of anticipating stigma and being viewed as strange or contagious.[45] Women are more vulnerable to delayed diagnosis and unfavorable treatment results as a result of this unequal burden.[44]

CONCLUSION

In conclusion, TB in India is more than just a medical issue; it is a complex socio-structural problem influenced by stigma, poverty, and unequal access to healthcare. Timely diagnosis and treatment adherence are severely hampered by persistent social stigma because people

frequently fear discrimination, social exclusion, and financial instability. Delays in seeking care are a contributing factor to long-term community transmission, especially in settings with limited resources and dense populations. Furthermore, marginalized populations are disproportionately more vulnerable due to factors like malnutrition, overcrowding, and coexisting medical conditions, which increase the risk of infection and the progression of disease. Therefore, a comprehensive policy approach that acknowledges the dual biological and social dimensions of TB is necessary to effectively address the disease.

Beyond clinical management, social protection, legislative actions, and active community involvement are all necessary components of a sustainable response. Initiatives in public health that dispel myths and raise awareness can be crucial in lowering stigma and promoting early diagnosis and treatment. Long-term control requires strengthening the healthcare system, making sure that vulnerable groups receive financial and nutritional support, and encouraging cooperation between communities, non-governmental organizations, and governmental institutions. To eradicate TB in India, stigma reduction must be integrated with preventive and curative measures. This will enable people and communities to stop the spread of the disease and help create a more resilient and equitable public health environment.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: Not required

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Cite this article as: Maurya AP, Mishra N, Kumar SR, Khan AM. Social stigma and risk determinants associated with tuberculosis transmission to vulnerable residents in India. Int J Community Med Public Health 2026;13:5396-404.