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Human-Focused Solutions to Hunger and Disease: Tuberculosis and Food Insecurity in India

"We cannot address TB only with vaccines and medications... We must also address the root cause of tuberculosis, which is injustice." – John Green.

Introduction

This paper argues that breaking the harsh cycle between the infectious disease Tuberculosis (TB) and food insecurity is essential to achieving sustained progress against both in India. India is a multicultural and multiethnic nation located in South Asia (CIA World Factbook, 2026), where over 1.45 billion people live, making it one of the most densely populated countries globally (World Bank, 2024). India has the highest burden of TB cases in the world, with 187 cases per 100,000 people, accounting for 25% of the 10 million global active TB cases (WHO, 2025). Globally, over 343 million people experience food insecurity, 60% of whom are women and girls (World Food Programme). India ranked 102nd out of 123 countries in the 2025 Global Hunger Index (GHI), which generates an annual hunger score for all countries with sufficient data. 12% of India's population is undernourished, and with a score of 25.8 in the 2025 GHI, India has a hunger level considered serious (Hunger Index). This paper will explore how health and nutrition interventions can be designed to disrupt the bidirectional relationship between undernutrition and the progression and impact of tuberculosis, with full consideration of India's diverse population.

Background

India has an estimated annual population growth rate of 0.72% (CIA World Factbook, 2026). China, a similarly populated country at 1.4 billion people, has a growth rate of -0.22% ("China Population (2026) - Worldometer"). Annually, population growth in Indian rural areas is 0.4% and 1.8% in urban areas (World Bank, 2025). This rapid urbanization makes it harder to provide effective TB treatment and accessible food assistance for all. India has a doctor-to-patient ratio of 0.72 physicians per 1,000 persons (2020), and about 1.6 hospital beds per 1,000 population (2021 est.) (CIA World Factbook, 2026). Within the population, 31.5% of children younger than 5 are underweight (CIA World Factbook, 2026).

An estimated 63% of Indians live in rural areas, while 37% live in urban areas, with urbanization rising quickly due to economic migration (Statista, 2023). India has 28 states, more than 12 religions, and 22 recognized languages (QRCA, 2025), a diversity that shapes population research, as families and individuals across India follow different values and norms (QRCA, 2025). Notably, India does not follow a single cuisine; rather, it has overlapping food staples across regional groups, such as rice and legumes, depending on geography (Britannica, 2025).

Family life differs across the dozens of cultures in India, and households across all states average 4.44 people (Global Data, 2021). Attitudes toward familial gender roles differ across regional groups. Specifically, a Pew Research Center study surveying Indians across Gujarat and West Bengal showed that one in five adults agreed that men should be making the main decisions about family expenses – a fact relevant to how households consider food budgets and dietary choices (Evans, 2022). Family dynamics are connected to how food allocation in a home is shared, and traditional gender roles directly impact public health outcomes. Women and girls, especially in a significant portion of traditional and rural Indian households, often eat last and least (UNICEF). This can cause female members of households to

experience nutritional neglect because they are receiving fewer calories than needed to support a body ready to fight off TB infection (Sarpal et al.).

Although income per person in India has tripled in the last two decades, high levels of poverty and inequality remain. (WFP, 2025). Over a fifth of people, about 45 million, live on less than $1.90 a day (WFP, 2025), compared with the minimum average monthly food spending of $23.20 (Feedback, 2021). The estimated monthly costs for a family of four are $1,038.6 (₹99,152.9). Families typically allocate their monthly salaries as follows: 38.4% for groceries, 4.4% for utilities, 14.9% for rent, 15.4% for dining out, 2.8% for housing by price, 15.5% for transportation, 3.2% for clothing and shoes, and 5.5% for sports and leisure activities ("Cost of Living in India: Prices in India, 2026").

43.51% of Indians work in agriculture, while the remainder are in industry and services (Statista, 2023). Most farms in India are small, at 2-3 hectares, or about 5 football fields; this small size limits farming operations compared to larger farms in the United States of America, which average about 250 hectares (Desh Bhagat Institute, 2024). India is also highly prone to natural hazards such as floods and droughts, risking crop growth (CIA World Factbook, 2026). India is a significant contributor to global exports – in 2024-2025, total agricultural exports were valued at $48 billion, notably being one of the world's largest exporters of rice (IBEF, 2026).

Challenge and impact

Access to a healthy diet is hindered by barriers such as low availability of staple foods, expensive products, customer preferences, and unsupportive food environments. In India, there is a poor diversity of diets, even though food production and the economy have been growing (UNICEF India, 2025). Despite a 30% decrease in malnutrition since 2006, India continues to have high rates of repercussions from food insecurity: the rate of childhood muscle wasting is present in 18.7% of children, affecting over 21 million kids under 5 (DownToEarth, 2025). There are nearly 195 million undernourished people in India – around 12% of the population and 25% of the world's undernourished population (United Nations). Comparatively, India's geographic neighbours' respective undernutrition rates – Bangladesh (10.4%), Nepal (5.3%), and Sri Lanka (7.4%) – are mostly lower despite being in the same region, except for Pakistan at 16.5%. The same trend applies to India's economic peers' respective undernourishment rates: Brazil (<2.5%), China (<2.5%), Indonesia (6.3%), and South Africa (10.0%) (Hunger Index).

Hunger is not the only public health risk in India. Tuberculosis (TB) is an infectious, bacterial disease caused by *Mycobacterium tuberculosis*, a bacterium that can attack any organ but often infects the lungs, creating complications for breathing and other bodily functions (CDC, 2025). Globally, TB is the leading cause of death from an infectious disease, with 1.2 million TB-related deaths occurring in 2024 (Clark, 2025). Malnutrition is a cause and an effect of tuberculosis. A major risk factor for developing TB is undernutrition (NIH, 2022), which in turn is the most common reason for weakened immune systems in people throughout India (NIH, 2017). Susceptibility to TB increases with weakened immune systems, a factor common among babies, children, and seniors (CDC, 2024). Furthermore, TB can cause severe wasting and worsening of nutritional status (WHO, 2017), which is why proper and consistent access to nutrition is vital for both prevention and treatment of TB (NIH, 2022). Undernutrition increases the risk of drug malabsorption in people with active TB, which can progress latent TB into active TB (WHO, 2017). Some TB medications, such as Rifampicin, are less effective in people experiencing malnutrition (Fâcă et al.)

In food-insecure households without adequate and consistent nutritional support, undernourished people can get caught in a cycle of progressing disease from undernutrition and poverty caused by TB, as patients are unable to work or have to work less due to the physical effects of TB and the social stigma (WHO, 2017). Gender disparity in India also affects TB stigma and treatment, with 100,000 female TB patients being abandoned by their families after being diagnosed, left to go through treatment in isolation

without a social support system of family and friends. (Operation ASHA, 2025). Solutions to both food insecurity and high rates of TB in India will require innovations that break the cycle of bidirectionality of undernutrition-caused progression of TB.

According to the Dietary Guidelines for Indians Manual, developed by the Indian Institute of Nutrition to accommodate India's diverse cultural and dietary values, unhealthy diets linked to non-communicable and lifestyle-related chronic diseases – such as Type 2 Diabetes, Coronary heart disease, and hypertension – accounted for 56.4% of the national disease burden (Indian Institute of Nutrition, 2024). In 2021, the rate of obesity among 18- to 69-year-old women in India, according to the National Family Health Survey (NFHS), was 24%, and the rate for men was 22.9% (Indian Institute of Nutrition, 2024). TB and obesity are inversely related conditions; the resulting illnesses caused by being overweight can put a person at risk for activating latent TB (Lin et al.).

High rates of poverty limit access to healthcare and nutritious food (WHO, 2025). Ongoing social determinants of health also create barriers to total health, such as overcrowded housing, social stigma, and high rates of pre-existing diseases such as diabetes that increase disease susceptibility. Although India faces many struggles in achieving both a TB-free and food-secure nation, it has made commendable efforts despite the challenges of keeping a densely populated country both healthy and equitable across different genders, social classes, ages, and marginalized groups, such as the Scheduled Tribes. Scheduled Tribes are communities in India recognized under the Indian Constitution, distinct from other ethnic groups. People living in tribal communities experience higher rates of undernutrition, communicable disease, and maternal and child mortality due to geographic isolation, low access to health infrastructure, and language barriers (Narain).

Exploring solutions

Addressing existing efforts to eliminate and treat both TB and malnutrition is as important as creating new solutions. In the past, health interventions have been successful; however, they present gaps in the growing financial burden for patients. To overcome the economic challenges for individual food access, the Government of India introduced the Nikshay Poshan Yojana program (NPY), which provides Direct Benefit Transfer (DBT) as monthly monetary assistance for all patients across all States with TB (Institute for IAS Examination, 2024), to combat malnutrition for TB patients (NIH, 2024). Over ₹4,406 crores (500-530 million United States Dollars) have been distributed to over 1,37,00,000 NPY program participants since April 2018, as of November 2025 (PIB). Other program outcomes included about half of the patients positively receiving nutritional assistance, while the rest of the NPY recipients reported technological difficulties receiving NPY through DBT. (Kumar, 2020).

The World Health Organization (WHO) recommends nutritional analysis and counseling on a systematic level for anyone with TB, recognizing that a large percentage of people in households with TB may be facing undernourishment. Additionally, the WHO suggests that nutritional interventions be put into place with the intention of optimizing outcomes of TB disease progression, regardless of age, drug resistance, or pregnancy status (WHO, 2025). Drug resistance is an especially important factor to consider when multidrug-resistant TB (MDR-TB) – a much harder and costlier form of TB to treat patients, often with longer treatment times – affected over 400,000 people globally in 2023, 110,000 of whom were Indians (WHO, 2023).

Another WHO recommendation is the direct provision of food assistance in the prevention of TB in family members of people with TB in food-insecure environments, as suggested by outcomes supported by findings in the RATIONS (Reducing Activation of Tuberculosis by Improvement of Nutritional Status) study. The RATIONS study completed a trial of nutritional support in the form of rations with the intention of lowering TB cases in populations with high rates of malnutrition, specifically in Jharkhand, which is a state in Eastern India (NIH, 2021). Another method being implemented by the Central TB

Division within the Directorate General of Health Services in India through their National Tuberculosis Control Programme includes expanding and enhancing direct observed therapy (DOT). DOT is a method of ensuring adherence to treatment by having a healthcare worker be present while the patient takes TB medication (CDC).

Operation ASHA is a program focusing on seeking symptomatic people, assisting with access to testing and treatment, and providing DOT therapy. ASHA has been an extremely helpful effort in the fight to help Indians with TB. Treatment for TB includes a strict 6-month regimen of an antibiotic drug cocktail, for which incompletion of the drug course can lead to MDR-TB. By implementing DOT in TB-burdened areas and involving biometric confirmation of medication consumption – meaning that healthcare workers can keep track of patients' regimen progress by confirming they have taken their antibiotics with a fingerprint scan – ASHA provides a consistent and free option to medication distribution access on a local level, including to people in tribal areas with limited access to healthcare (Operation ASHA, 2025). Dr. Tereza Kasaeva, director of the WHO Department for HIV, Tuberculosis, Hepatitis, and STIs, suggests that to end TB, solutions must address undernutrition and food security and be family-centered. A comprehensive solution should integrate nutrition into treatment in the form of a systematic change to break the cycle of disease-causing poverty and poverty-causing disease (WHO, 2025). India has already shown its determination to end food insecurity among TB patients with success in its numerous government schemes and programs that are improving the care, treatment, and diagnosis rates of TB.

Recommendation

India is a diverse country with people from different regions, speaking different languages, with different comorbidities, and from varying socioeconomic backgrounds. Solutions should acknowledge the resulting social, physical, and financial limitations caused by illness. Reducing hunger among people with TB and the prevalence of TB itself requires a solution that supports TB prevention, financial assistance, and food support for people unable to work due to disease. A screening method that has already proved successful in increasing diagnosis rates is the implementation of mobile screening units (WHO, 2023). This proposed multi-step solution will start with the Indian government, using data from surveys distributed to hospitalized and homebound TB patients, conducting a risk assessment to estimate and understand the potential impact of this program and ensure that this initiative does not under-serve any marginalized populations, such as community members in Scheduled Tribes, low-income families, single-parent families, etc. 4.5% of households in India are single-parent households – that’s over 13 million households (“Progress of the World’s Women”). If the assessment shows that the assistance being recommended for these communities is significant on an eligibility scale created by the Institute of Nutrition and the Center for Statistics, funding can be achieved through smaller healthcare grants and allocated government funding for healthcare programs. The eligibility scale will be based on factors such as community size, TB burden, and community response. The Indian Institute of Nutrition will oversee grant searches and applications, and staff can also pursue international aid programs such as the United Nations Educational, Scientific and Cultural Organization and WFP for funding. Funding will be used for buying commercial vans and renovating them to accommodate the treatment and transportation of sick people and their families. Implementation would include vans that serve as DOT facilities and provide transportation for healthcare workers. Community health workers (CHWs) would go directly into communities at risk for high TB rates or that are already burdened with high infection rates. CHWs will be hired to run clinics in high-risk communities, even after the mobile clinic goes to the next region, as free diagnosis centers. CHWs familiar with a community's most commonly spoken language will be assigned there, and training will include how to provide a dignifying experience through the full cascade of care, from evaluation to speaking directly with community members to patient recuperation.

To create more opportunities for neighborhood connection and treatment enrollment, community leaders at the neighborhood level can receive training to facilitate conversations with residents about how the mobile clinics will work, where they will be, how the diagnostic process works, what the next steps are if

someone tests positive, and whether they are comfortable with the execution of this program. Using the Popular Opinion Leaders methodology, CHWs, such as nurses and doctors specializing in TB, can collaborate with community leaders to educate neighbourhoods about TB and lower stigma for the disease through a curriculum that highlights how TB crosses many barriers: socio-economic, gender, age, etc. This neighbourhood-centered approach can help mitigate barriers to diagnosis, care, and medical communication by developing trust and collaboration with trusted local leaders and residents.

These mobile clinics would simultaneously focus on nutritional assistance for families, both for those with TB to assist with treatment and for TB-negative at-risk individuals, as a prevention practice. Prevention in the form of nutrition is important in supporting a healthy immune system ready to combat TB infection. After diagnosis, food assistance through custom kits of food and nutritional supplements that match the specific health and cultural needs of the person and their family can be distributed to support treatment and immunity for those in close contact with TB-positive neighbors. Community leaders can also receive training on how to deliver lessons concerning supporting a healthy immune system through a good diet, especially in communities with higher TB rates. Considering the many regional cultures and diets, the kits should include multiple options, especially in the grain and meat categories. This means that to have the proper nutritional support that matches the recommended guidelines given by the Institute of Nutrition of India, alternative proteins should be considered, such as fish, especially in coastal communities, and legumes such as lentils. Pregnant people require more calories and nutrients than non-pregnant people (Johns Hopkins Medicine), and kits should be increased accordingly. Factors like flavor preferences, pregnancies, co-morbidities such as diabetes, and more can be learned about in an intake form for at-risk Indians interested and consenting to receive free meal kits before program implementation.

But how will this program ensure food-safe transport, stay economically appropriate, meet cultural and regional preferences, and ensure patient accessibility? The food provided should have multiple options of meats, grains, and vegetables, with a strong emphasis on nutrient-dense and commonly grown and consumed Indian legumes, rich in plant protein and fiber, nutrients vital in supporting a healthy immune system prepared to fight off TB. For transportation, there will be 3 types of vehicles: refrigerated trucks for food storage, medical vans with ambulance-style interiors, and passenger-focused vans for CHWs and TB patients, focusing on separate, safe travel options for people with TB. Provided food options will require minimal equipment to cook food in order to cover all different types of household needs, kitchen tool ownership, and access to electricity. Intervention outcomes will be measured through follow-up medical evaluations and rates of changes in Body Mass Index among TB patients over the course of 6 months. This solution ensures that the cascade of care all the way through aftercare is empowering, dignifying, and accessible. This intervention centers on creating custom nutritional treatment for those affected by this public health crisis: people with TB, food-insecure people, and families of those impacted by these social health risks.

Conclusion

TB is not just a historical disease – the world's biggest killer from a single pathogen is the past and present of public health, and now is the time to look at the future of a TB-free world. Tuberculosis and food insecurity are different problems, but they will always have overlapping causes. Poverty is a systemic issue, only fixable with human-centered and dignifying solutions. India is resilient in its agriculture, lifestyle, religions, languages, and cultural diversity. While there are many gaps to achieving a food-secure and TB-free world, India is on its way to being a healthy nation. With a revisit to productive existing programs by filling in the gaps of social, gender, and class disparity, solutions to fixing food insecurity in people who have TB can and will be attained.

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