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Sociodemographic, behavioral, and life-course risk factors for tuberculosis in older Indian adults: evidence from a nationally representative survey

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Informed consent: the original survey participants voluntarily provided signed informed consent, and the survey protocol received approval (LASI/12/1054) from the Institutional Review Board at the International Institute for Population Sciences (IIPS), Mumbai and the Indian Council of Medical Research, New Delhi.

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Abstract

While tuberculosis (TB) propagation is multifactorial, the intersection of biological vulnerability (undernutrition) and cumulative life-course adversities is increasingly recognized as a crucial modifiable determinant. This study aimed to identify the independent biological, socioeconomic, behavioral, and life-course determinants of self-reported TB prevalence among middle-aged and older adults in India.

We conducted a cross-sectional analysis using Wave 1 of the Longitudinal Ageing Study in India (LASI, 2017-18). The analytical sample included 59,910 adults aged 45 years and above with non-missing data on TB status and body mass index. The outcome was a self-reported TB diagnosis within the preceding 2 years. Survey-weighted logistic regression was used to examine factors associated with self-reported TB. Firth bias-reduced logistic regression was performed as a sensitivity analysis because of the low prevalence of self-reported TB.

Overall, 550 participants (0.92%) reported TB within the preceding two years. Undernutrition was more common among participants with self-reported TB than among those without TB. In adjusted survey-weighted models, undernutrition, history of being bedridden for 1 month or more during childhood, multimorbidity, and residence in the Western region were independently associated with higher odds of self-reported TB. The findings were broadly consistent in the Firth bias-reduced sensitivity analysis.

TB prevalence in older Indian adults is independently driven by undernourishment and the cumulative impact of early-life disease/deprivation, alongside the burden of multimorbidity. These findings underscore the need for the National TB Elimination Program to strengthen nutritional support and integrate TB prevention with comprehensive geriatric care and robust pediatric health investments to reduce adult vulnerability.

Key words: tuberculosis, childhood deprivation, multimorbidity, LASI, India.

Introduction:

Tuberculosis (TB) remains a formidable global health challenge and the leading cause of death from a single infectious agent worldwide. According to the World Health Organization (WHO), an estimated 10.8 million people developed TB in 2023, with 1.25 million succumbing to the disease [1]. Despite global progress, India continues to bear the highest burden of the disease, accounting for over a quarter of all incident cases and nearly one-third of TB-related deaths globally [1,2]. In 2023 alone, an estimated 2.7 million people in India developed TB, underscoring the persistent and urgent need for effective control strategies to meet the nation's ambitious goal of eliminating TB prior to SDG targets [2].

The propagation of TB, an infectious disease, is driven by a complex interplay of biological vulnerabilities and social determinants. Undernutrition, particularly, is the most important risk factor for active TB in low-income settings [3]. The relationship is bidirectional and synergistic: undernutrition impairs both innate and adaptive immune responses, increasing susceptibility to TB infection and progression to active disease, while the catabolic state induced by TB exacerbates malnutrition [3,4]. The meta-analysis by Saunders et al (2025) synthesizing data of over 24 million individuals demonstrated a strong inverse and nonlinear dose–response relationship between BMI and tuberculosis risk, with an estimated five-fold relative risk of tuberculosis associated with low BMI < 18.5 [5].

Beyond individual biology, TB thrives in conditions of social and economic deprivation. Adverse social determinants such as poverty, low educational attainment, and rural residence are consistently associated with a higher risk of TB, reflecting inequities in living conditions, health literacy, and access to care [3,5,6]. Behavioral risk factors, tobacco use, both smoked and smokeless, and harmful alcohol consumption are well-established factors that accentuate the risk of active TB risk and contribute to adverse treatment outcomes, including failure, relapse, and death [7-9].

Furthermore, a life-course perspective is crucial for understanding TB vulnerability, particularly in an aging population. Household food insecurity, a direct precursor to undernutrition, can severely impact tubercular treatment adherence and outcomes [10,11]. There is growing evidence that nutritional support during anti-tubercular therapy may improve patient health outcomes through enhanced pharmacokinetics and promoting treatment adherence [12-14].

Moreover, adverse conditions during formative years, such as childhood illness or socioeconomic deprivation, may have lasting immunological consequences that increase susceptibility to diseases like TB in later life [15]. This is particularly relevant for India's rapidly growing older adult population, a demographic that is disproportionately affected by TB due to immunosenescence, a higher prevalence of comorbidities, and the cumulative impact of lifelong risk exposures [16-18]. However, there exists a paucity of comprehensive, nationally representative research that simultaneously examines this multifactorial web of biological, socioeconomic, behavioural, and life-course determinants of TB among older Indian adults. This study aims to address this critical knowledge gap by leveraging data from the Longitudinal Aging Study in India (LASI), a nationally representative survey of older adults and geriatric population [19].

The specific objectives of this study were (i). To determine the association between undernutrition, as measured by low Body Mass Index (BMI), and the prevalence of self-reported tuberculosis among adults aged 45 and older in India, (ii). To assess the determinants of tuberculosis including sociodemographic characteristics, behavioural factors (tobacco and alcohol use), food insecurity, and childhood deprivation within this population.

Materials and Methods

This study utilized a cross-sectional analytical design, drawing data from the first wave (2017–18) of the Longitudinal Ageing Study in India (LASI). LASI is a comprehensive, nationally representative survey of over 73,000 adults aged 45 and older, and spouses regardless of age, spanning all states and union territories of India.

To ensure a representative sample reflecting India's geographic and socioeconomic diversity, LASI employed a multistage stratified random sampling design. The sampling framework was based on the 2011 Census of India. Primary Sampling Units (PSUs) were selected first, followed by a random selection of households within each PSU. The data collection methodologies and survey instruments used in LASI are harmonized with international standards to ensure cross-country comparability. Detailed information on the sampling design and data collection protocols is available in the official LASI Wave 1 report [19].

Study population and sample

The initial LASI Wave 1 sample included 73,396 individuals. Since the present analysis focused on adults aged 45 years and above, participants below 45 years of age were excluded. Respondents with missing information on either the outcome variable, self-reported tuberculosis status, or the primary exposure variable, BMI, were also excluded. After applying these criteria, the final analytical sample comprised 59,910 adults aged 45 years and above.

Among these, 550 participants (0.92%) self-reported a diagnosis of tuberculosis within the preceding two years, while 59,360 participants (99.08%) did not report tuberculosis (Table 1).

Variable definitions [20]

Outcome variable: tuberculosis

The outcome was a binary variable based on self-reported health status. Participants were asked to confirm if a healthcare professional had diagnosed them with tuberculosis within the preceding two years. The responses were coded as 'Yes' or 'No'.

Primary exposure: undernutrition

Nutritional status was assessed using Body Mass Index (BMI), calculated as weight in kilograms divided by height in meters squared. Based on the World Health Organization (WHO) Asia-Pacific classification guidelines, respondents were categorized as underweight (BMI<18.5), normal weight (BMI 18.5–22.9), overweight (BMI 23.0–29.9), or obese (BMI ≥30.0) [21]. For this analysis, a binary exposure variable was created: 'Undernourished' (defined as underweight, BMI <18.5 and 'Not Undernourished' (comprising normal weight, overweight, and obese categories; BMI ≥18.5)

Independent variables (covariates)

Sociodemographic factors:

- Age: Calculated from the respondent's date of birth
- Gender was self-reported and recorded as either Male or Female.
- Education: Highest level of educational attainment, grouped as: No formal education, Primary or less (up-to 5 years), Middle/Secondary (6-12 years), and Higher education (>12 years).
- Residence: A dichotomous variable (Rural or Urban) based on the official 2011 Census of India classifications used in the LASI dataset.

Socioeconomic Status (SES):

- Wealth Index: SES was operationalized using the standard LASI household wealth index. This composite measure is derived from information on household ownership of assets and housing characteristics (e.g., drinking water source, sanitation facilities). The continuous index score was categorized into population quintiles: Poorest, Poorer, Middle, Richer, and Richest [13].

Behavioural Factors:

- Tobacco Use: Based on self-reports of current consumption of both smoking and smokeless tobacco products. This was dichotomized into 'Current user' or 'Non-user'.
- Alcohol Use: Based on self-reports of current alcohol consumption, dichotomized into 'Current user' or 'Non-user'.

Explanatory Covariates:

- Food Insecurity: Household food insecurity was measured using a five-item module assessing experiences over the prior 12 months. The items evaluated phenomena such as reducing meal size, skipping meals, or experiencing hunger due to insufficient food. Affirmative responses ('Yes'=1, 'No'=0) to any of the five items were summed to create a score (range 0–5). This was then dichotomized into 'Food Secure' (score of 0) and 'Food Insecure' (score of 1–5) [13].
- Chronic disease status: Chronic disease status was derived from self-reported physician diagnoses of hypertension, diabetes mellitus, cancer, chronic lung disease, heart disease, stroke, bone or joint disease, neurological or psychiatric disorder, and high cholesterol. Each condition was coded as absent (0) or present (1), and a morbidity count was obtained by summing the individual conditions. Participants were subsequently categorized as having no chronic disease (0 conditions), one chronic disease (1 condition), or two or more chronic diseases (≥2 conditions), with the latter category representing multimorbidity.
- Childhood Deprivation: This was operationalized using three retrospective indicators:

1. Self-rated Childhood Health: Based on recall of general health before age of 16 years. The original five-point scale was collapsed into 'Good' (combining "very good" and "good"), 'Fair', and 'Poor' (combining "poor" and "very poor").
2. Prolonged Childhood Illness: A binary ('Yes'/'No') variable indicating whether the respondent had been bedridden for one month or more due to a health problem before age of 16 years.
3. Childhood SES: Based on the respondent's perceived family economic situation compared to others in their community during childhood, with categories: 'Pretty well off', 'Average', 'Poor', and 'Varied'.

Statistical analysis

All statistical analyses were performed using Stata version 15.1 (StataCorp, College Station, TX, USA). The analysis accounted for the complex multistage survey design of LASI by incorporating sampling weights, strata, and primary sampling units. The analytical sample was restricted to adults aged 45 years and above with non-missing information on tuberculosis status and BMI.

Categorical variables were summarized using frequencies and weighted percentages. Differences in participant characteristics according to tuberculosis status were assessed using design-adjusted chi-square tests. The outcome variable was self-reported tuberculosis diagnosis within the preceding two years. The primary exposure was undernutrition, defined as BMI <18.5 kg/m^2.

Survey-weighted logistic regression was used to examine factors associated with self-reported tuberculosis. Crude and adjusted odds ratios (ORs) with 95% confidence intervals (CIs) were estimated. Two adjusted models were fitted. Model I was a complete model adjusted for undernutrition, food insecurity, self-rated childhood health, childhood bedridden status, childhood economic status, age, gender, marital status, education, wealth index, religion, caste, working status, residence, chronic disease status, tobacco use, alcohol use, and region. Model II was a reduced model adjusted for undernutrition, childhood bedridden status, age, gender, residence, wealth index, caste, chronic disease status, and region.

Model performance was evaluated using discrimination, calibration, goodness-of-fit, and multicollinearity diagnostics. For the survey-weighted models, the AUC was 0.6755 (95% CI: 0.6382–0.7129) for Model I and 0.7027 (95% CI: 0.6803–0.7251) for Model II. Hosmer–Lemeshow goodness-of-fit testing showed no evidence of poor fit for Model I (χ^2=2.40, df=8, p=0.9664) or Model II (χ^2=10.08, df=8, p=0.2598). Multicollinearity was low, with mean VIF values of 1.60 in Model I and 1.41 in Model II, and maximum VIF values of 3.25 and 1.91, respectively. Calibration was further assessed by comparing observed and predicted tuberculosis probabilities across deciles of predicted risk. These diagnostic results are presented in *Supplementary Tables 1-3* and *Supplementary Figures 1-3*.

Given the low prevalence of self-reported tuberculosis and the relatively small number of tuberculosis cases, Firth bias-reduced logistic regression was additionally performed as a sensitivity analysis to assess the robustness of the primary findings. The same complete and reduced model specifications were used for the Firth models. For the Firth models, model 1A included 30,449 observations and showed an AUC of 0.7303 (95% CI: 0.6974–0.7633), while Model IIB included 57,765 observations and showed an AUC of 0.7154 (95% CI: 0.6935–0.7373). The Wald χ^2 values were 211.56 for Model 1A and 367.94 for Model 2B, with $p<0.001$ for both models. Calibration across deciles of predicted risk was also assessed for both Firth models. These findings are presented in *Supplementary Tables 4 and 5* and *Supplementary Figures 4 and 5*. Because Firth logistic regression does not account for survey weights, these analyses were interpreted as supportive sensitivity analyses, while the primary inference was based on the survey-weighted logistic regression models. A two-sided p-value <0.05 was considered statistically significant.

Ethical considerations

The LASI survey protocol (Wave 1) was approved by the Institutional Review Boards of the Indian Council of Medical Research (ICMR) and the International Institute for Population Sciences (IIPS). All participants provided written informed consent prior to data collection. As this study involved the secondary analysis of a publicly available, de-identified dataset, no separate ethical approval was required.

Results

The final analytical sample included adults aged 45 years and above with non-missing information on both tuberculosis status and BMI. After excluding participants below 45 years and those with missing data for either of these variables, 59,910 participants were retained. Of these, 550 participants (0.92%) reported a tuberculosis diagnosis within the preceding two years (Table 1).

Supplementary Table 6 presents the distribution of participant characteristics according to tuberculosis status. Undernutrition was more common among participants with self-reported tuberculosis than among those without tuberculosis (42.21% compared with 21.18%, p<0.001). A history of being bedridden for one month or more during childhood was also more frequently reported among participants with tuberculosis than among those without tuberculosis (12.72% compared with 5.81%, p<0.001). Childhood economic status differed significantly according to tuberculosis status (p<0.001), with a higher proportion of participants with tuberculosis reporting poor childhood economic status.

Males constituted a higher proportion of participants with tuberculosis than of those without tuberculosis (55.98% compared with 45.70%, p=0.004). Rural residence was more common among participants with tuberculosis than among those without tuberculosis (77.02% compared with 69.85%, p=0.031). Participants with two or more chronic diseases accounted for 29.85% of those with tuberculosis and 18.48% of those without tuberculosis (p<0.001). The distribution of tuberculosis status also varied significantly across regions (p<0.001).

Supplementary Table 7 presents the crude and Figure 1 shows the adjusted survey-weighted logistic regression estimates for factors associated with self-reported tuberculosis. Undernutrition showed a statistically significant association with self-reported tuberculosis in the crude analysis, and this association remained significant in both adjusted models. In the complete adjusted model, undernourished participants had higher odds of self-reported tuberculosis compared with participants who were not undernourished (Model I AOR 3.05; 95% CI: 2.05–4.54; p<0.001). A similar association was observed in the reduced model (Model II AOR 2.86; 95% CI: 2.04–4.00; p<0.001).

A history of being bedridden for one month or more during childhood was also associated with self-reported tuberculosis in the crude analysis and remained statistically significant in both adjusted models (Model I AOR 2.85; 95% CI: 1.49–5.44; p=0.002; Model II AOR 2.23; 95% CI: 1.48–3.37; p<0.001).

Participants reporting two or more chronic diseases had higher odds of self-reported tuberculosis in both adjusted models compared with participants reporting no chronic diseases (Model I AOR 2.30; 95% CI: 1.36–3.89; p=0.002; Model II AOR 2.83; 95% CI: 1.83–4.37; p<0.001). Participants reporting one chronic disease had higher odds in the reduced model (Model II AOR 1.51; 95% CI: 1.07–2.13; p=0.018), although this association was not statistically significant in the complete model.

Some associations observed in the crude analysis were attenuated after adjustment. For example, female sex, poorer wealth quintile, caste, urban residence, and region showed associations in crude analysis, but only selected associations were retained in the adjusted models. In the reduced model, female participants had lower odds of self-reported tuberculosis compared with male participants (AOR 0.67; 95% CI: 0.51–0.89; p=0.006), and participants in the poorer wealth quintile had lower odds compared with those in the poorest quintile (AOR 0.61; 95% CI: 0.39–0.95; p=0.030). Compared with participants from the North region, those from the West region had higher odds of self-reported tuberculosis in both adjusted models (Model I AOR 3.44; 95% CI: 2.00–5.90; p<0.001; Model II AOR 2.47; 95% CI: 1.71–3.58; p<0.001).

Firth bias-reduced logistic regression was performed as a sensitivity analysis (*Supplementary Table 8*). The findings were broadly consistent with the primary survey-weighted models. Undernutrition remained associated with higher odds of self-reported tuberculosis in both Firth models Model IA (AOR 4.09; 95% CI: 3.04–5.49; p<0.001); Model IIB (AOR 3.55; 95% CI: 2.94–4.29; p<0.001).

The association for childhood bedridden status was also retained in both Firth models Model IA (AOR 1.84; 95% CI: 1.21–2.81; p=0.005); Model IIB AOR 1.84; 95% CI: 1.39–2.45; p<0.001). Chronic disease status remained associated with self-reported tuberculosis in the sensitivity analysis, particularly among participants reporting two or more chronic diseases Model IA (AOR 2.17; 95% CI: 1.56–3.02; p<0.001); Model IIB (AOR 2.83; 95% CI: 2.26–3.54; p<0.001) (Figure 2).

The Firth models showed acceptable discrimination, with an AUC of 0.7303 for Model 1A and 0.7154 for Model IIB. Calibration by predicted-risk deciles showed broadly comparable observed and predicted probabilities of self-reported tuberculosis across increasing risk deciles.

Discussion and Conclusions

The present analysis identified undernutrition, childhood bedridden status, and multimorbidity as factors independently associated with self-reported tuberculosis among Indian adults aged 45 years and above. These findings suggest that tuberculosis in this population is linked not only with current nutritional status, but also with early-life health adversity and the burden of chronic disease in later life. Several sociodemographic and lifestyle factors that showed associations in unadjusted analyses were not retained after adjustment, indicating that their relationship with tuberculosis may be partly explained by underlying nutritional, socioeconomic, or comorbid health conditions.

The observed association between low BMI and self-reported TB is consistent with previous evidence linking undernutrition with TB in India and globally. The impairment of cell-mediated immunity is also a key mechanism explaining why undernourished individuals are more likely to progress from latent infection to active disease [22]. This is particularly relevant in India, where the burden of latent tuberculosis infection (LTBI) is high, with prevalence estimated at nearly 40% of the population [23]. In such a context, nutritional vulnerability may contribute to reactivation or progression among individuals already infected with Mycobacterium tuberculosis. In India, interventions towards addressing undernutrition through annual nutritional rehabilitation among 30% of affected individuals are estimated to reduce the cumulative TB incidence between 2023 and 2030 by 15.9% (95% UI 11.8–21.3) [24].

Furthermore, the present study findings suggest that undernutrition is a primary biological pathway through which socioeconomic deprivation may translate into TB disease. While proxies for poverty, such as rural residence, were associated with TB in initial analyses, their significance diminished after accounting for BMI and other covariates. This pattern suggests that socioeconomic disadvantage, nutritional status, and TB may be interrelated, although the direction of these relationships cannot be established. These findings support the importance of integrating nutritional assessment and support within broader social and health interventions for TB-affected populations.

The association between a history of being bedridden for one month or more during childhood and self-reported TB in adulthood is consistent with a life-course perspective. Serious childhood illness may reflect early-life health vulnerability, adverse living conditions, or cumulative disadvantage, which may be linked with later-life susceptibility. This finding particularly emphasizes the need for investment in robust pediatric healthcare, infection control, and nutritional support, apart from expansion of TB Preventive Therapy among child household contacts for long-term public health promotion [25].

Our finding that multimorbidity (two or more chronic diseases) more than doubles the odds of TB highlights the challenge resulting from a dual burden of persistent infectious diseases and increasing non-communicable diseases (NCDs) in rapidly aging population. The presence of other chronic illnesses can weaken the immune system, creating a favorable environment for TB reactivation or progression particularly relevant for older adults living with higher morbidities [26]. Studies in low-income-countries have documented high rates of multimorbidity among patients with TB, with common co-occurring conditions including diabetes, depression, and HIV [27].

In this study, rural residence and tobacco use were not statistically predictors of TB although previous evidence exists relating these risk factors with TB suggesting their role is largely mediated through more proximate biological determinants like undernutrition. The present study found self-reported food insecurity was not significantly associated with TB contradicts the evidence of some prior studies [10,11]. This is probably because in this study low BMI was the strongest predictor of TB, while only ~3% of the study participants reported difficult in buying or eating as much food as they preferred, reflecting low levels of global food insecurity prevalent in the study population. Consequently, the biological state of malnourishment is likely the strongest determinant of TB risk in Indian populations.

Strengths and limitations

The primary strength of this study is its use of the LASI Wave-1 data, a large-scale, nationally representative survey that provides high external validity to our findings for this demographic in India. However, the study has limitations. First, the cross-sectional design prevents any causal interpretation, particularly because the relationship between tuberculosis and undernutrition may be bidirectional. While undernutrition may increase susceptibility to tuberculosis through impaired immune function, active tuberculosis can itself cause weight loss, cachexia, and reduced BMI. Therefore, reverse causality cannot be excluded, and the observed association should be interpreted as an epidemiological association rather than evidence of a causal relationship. Second, tuberculosis status was based on self-reported diagnosis within the preceding two years and was not confirmed using clinical records or microbiological testing. This may have introduced recall bias, social desirability bias, underreporting, and possible misclassification. Although self-reported TB is commonly used in large population-based surveys, it has limited diagnostic validity compared with microbiologically confirmed TB. Third, the number of self-reported TB cases was extremely less, which may have reduced statistical power and produced wider confidence intervals, especially for variables with multiple categories or sparse events. To address this, we used parsimonious survey-weighted models and conducted Firth bias-reduced logistic regression as a sensitivity analysis; however, Firth models could not incorporate survey weights and were therefore interpreted only as supportive sensitivity findings.

In conclusion, Tuberculosis (TB) incidence in India amongst middle aged and older adults is predominantly driven by adverse social determinants especially undernourishment and history of severe childhood illness, apart from a multiple chronic disease burden.

These findings carry significant public health implications. First, the overwhelming evidence for undernutrition as a primary driver of TB necessitates stronger mechanisms for nutritional assessment, counseling, and direct nutritional support within India's National TB Elimination Programme (NTEP) [2]. Second, the significance of early-life adversity underscores that adult health is built on a foundation of childhood well-being, reflecting greater investments in enhancing child nutritional status by strengthening extant nutritional supplementation programs (such as the ICDS and NPY) with regular monitoring and surveillance of growth parameters, particularly weight and height [28,29]. Third, the strong link between TB and diabetes related multimorbidity calls for a move toward integrated, and holistic patient-centered care for an aging population targeting the strengthening of bidirectional screening towards improving patient outcomes [30]. Finally, the evidence from this study emphasizes the need for further longitudinal research to elucidate the causal life-course mechanisms linking early-life deprivation, food insecurity, and undernourishment to TB risk in India. Further, evidence from large-scale clinical trials establishing the effectiveness of different nutritional support packages in preventing TB progression and improving treatment outcomes warrant incorporation in public health policy.

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Online supplementary material

Supplementary Table 1. Diagnostic summary of survey-weighted logistic regression models.

Supplementary Table 2. Calibration of survey-weighted logistic regression models by deciles of predicted tuberculosis risk.

Supplementary Table 3. Hosmer-Lemeshow goodness-of-fit assessment by deciles of predicted tuberculosis risk.

Supplementary Table 4. Diagnostic summary of Firth bias-reduced logistic regression models.

Supplementary Table 5. Calibration of Firth bias-reduced logistic regression models by deciles of predicted tuberculosis risk.

Supplementary Table 6. Distribution of participant characteristics and bivariate associations with tuberculosis status (n=59910).

Supplementary Table 7. Determinants of tuberculosis status: logistic regression estimates for sociodemographic, health, and deprivation factors.

Supplementary Table 8. Sensitivity analysis of the association between undernutrition and self-reported tuberculosis among older adults in india using Firth bias-reduced logistic regression.

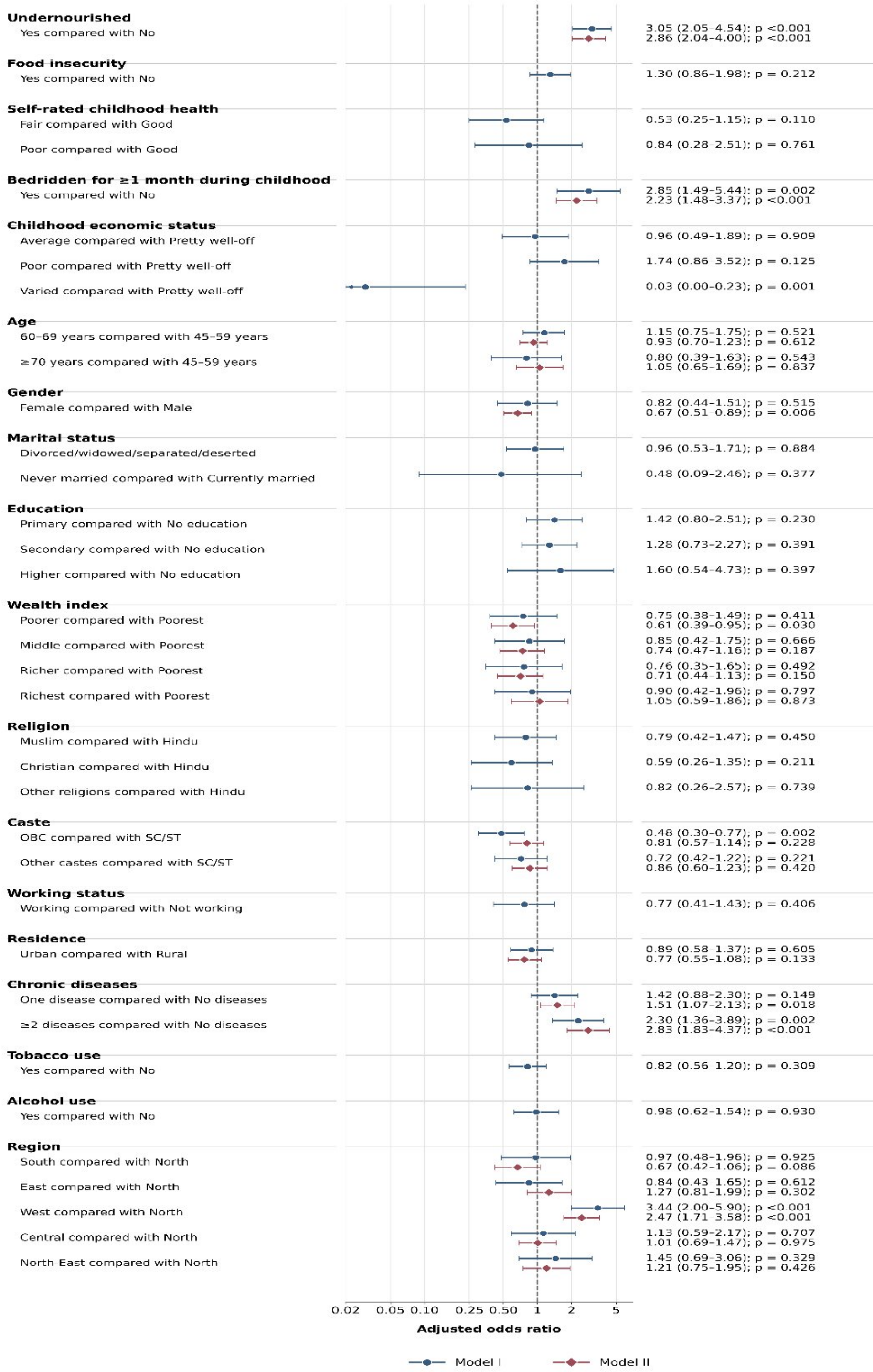
Supplementary Figure 1. Calibration of Model I and Model II for predicting self-reported tuberculosis.

Supplementary Figure 2. Goodness-of-fit plot for Model I and Model II across deciles of predicted tuberculosis risk.

Supplementary Figure 3. Receiver operating characteristic curves for Model I and Model II.

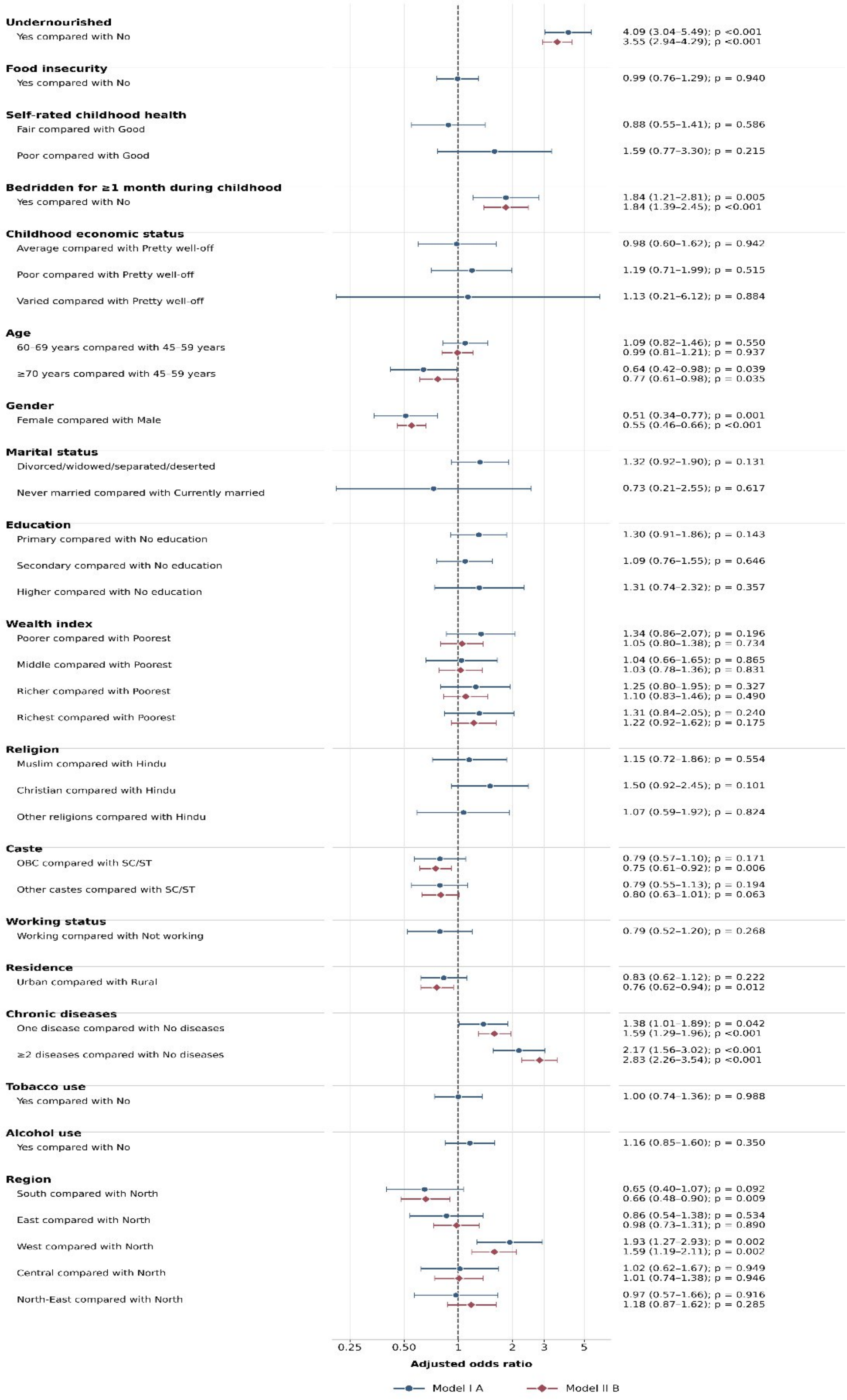
Supplementary Figure 4. Calibration plot comparing observed and predicted probabilities of self-reported tuberculosis across risk deciles for Firth Models 1A and 2B.

Supplementary Figure 5. Observed and predicted probabilities of self-reported tuberculosis across risk deciles for Firth Models 1A and 2B.



*Points represent adjusted odds ratios (AORs), and horizontal lines represent 95% confidence intervals (CIs). The dashed vertical line indicates the null value (AOR = 1.00).

Figure 1. Adjusted association between sociodemographic, behavioral, life course determinants and self-reported tuberculosis among older adults in India using logistic regression.



*Points represent adjusted odds ratios (AORs), and horizontal lines represent 95% confidence intervals (CIs). The dashed vertical line indicates the null value (AOR = 1.00).

Figure 2: Sensitivity analysis of the association between sociodemographic, behavioral, life course determinants and self-reported tuberculosis among older adults in India using Firth bias-reduced logistic regression.

Table 1. Selection of the primary outcome and exposure variables.

Variable	Initial Count	Missing Values	Participants below 45 years	Final Count*
Tuberculosis: absent	72,533	232	6,186	59,360
Tuberculosis: present	631			550
BMI: normal/overweight/obese	54,420	7,293		48,909
BMI: low	11,683			11,001
Final study population	—	—		59,910

*(After removing participants for missing value in either of the variables and participants below 45 years of age.