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Household food insecurity among patients with pulmonary tuberculosis and its associated factors in South India: a cross-sectional analysis

Reshma Ayiraveetil ,[1] Sonali Sarkar,[1] Palanivel Chinnakali,[1] Kathiresan Jeyashree,[2] Mathavaswami Vijayageetha,[1] Pruthu Thekkur,[3,4] Subitha Lakshminarayanan,[1] Selby Knudsen,[5] Natasha S Hochberg,[5,6] C Robert Horsburgh,[5,6,7] Jerrold Ellner,[8] Gautam Roy[1]

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For numbered affiliations see end of article.

Correspondence to
Dr Sonali Sarkar;
sarkarsonaligh@gmail.com

ABSTRACT

Objectives Food insecurity is 'the limited or uncertain availability of nutritionally adequate, safe foods or inability to acquire foods in socially acceptable ways'. Majority of tuberculosis (TB) cases of resource-poor settings experience food insecurity, which impacts treatment adherence and outcomes. We aimed to determine level of household food insecurity (HFI) and its associated factors in patients with pulmonary TB.

Design This is a cross-sectional analysis of data from an ongoing cohort study.

Setting National Tuberculosis Programme (NTP) in three districts of South India.

Participants All newly diagnosed pulmonary TB cases of the cohort enrolled in the NTP at the Designated Microscopy Centres (DMCs) and Primary Health Centres (PHCs) from October 2015 to October 2018.

Primary outcome measures The proportion of baseline HFI assessed using a validated HFI Access Scale was summarised as percentage with 95% CI. Possible association of sociodemographic, morbidity and behavioural characteristics with HFI was assessed using χ^2 test, and unadjusted prevalence ratios with 95% CI were calculated. The characteristics with values of p<0.2 in the univariate model were included in the multivariable generalised linear model (binomial function, log link) to derive adjusted prevalence ratios (aPRs) with 95% CI.

Result Of a total of 765 patients, 261 had HFI and the proportion was 34.1% (95% CI 30.8% to 37.6%). Mild, moderate and severe food insecurity was found in 17 (2.2%), 67 (8.8%) and 177 (23.1%) TB cases, respectively. Patients with TB who had monthly family income less than rupees 3000 (aPR 2.0; 95% CI 1.3 to 3.0), Karnofsky Score of 60 or less (aPR 1.5; 95% CI 1.1 to 1.9) and those who were employed (aPR 1.4; 95% CI 1.0 to 2.0) were independently associated with HFI.

Conclusions A high level of food insecurity was seen in households with TB cases. Additional food or cash assistance for this subgroup might improve food insecurity and thereby nutritional status.

Strengths and limitations of this study

- Use of a validated tool for assessing household food insecurity (HFI) which allows cross-country comparisons.
- We used data from a prospective cohort study which implemented quality assurance checks for data collection, entry and completeness that would have reduced missing data and data errors.
- We did not study the subgroup of previously treated patients with TB in whom levels of food insecurity could be higher due to financial loss caused by repeated episodes of TB.
- The study participants were from three selected districts in South India, so generalisability of the findings is limited.
- The model developed for assessing the factors associated with HFI was deficient due to the small sample size and unavailability of a few important confounding variables.

INTRODUCTION

Tuberculosis (TB) is the leading cause of death from a single infectious agent, ranking above HIV/AIDS, and is overall the ninth leading cause of death worldwide. In 2017, there were an estimated 1.3 million TB deaths among HIV-negative people. India contributes roughly 25% of global incident TB cases and there were an estimated 421 000 deaths annually due to TB in the year 2017.[1 2] In 2014, WHO endorsed the 'End TB strategy' in line with the Sustainable Development Goals developed by the United Nations (Goals 1, 2 and 3 deal with action on poverty, hunger and ensuring healthy lives and well-being of people) with a common aim to end the global TB epidemic.[1 3]

Food security is a state in which 'all people at all times have both physical and economic

access to sufficient food to meet their dietary needs for a productive and healthy life'.[4] Catastrophic health expenditure is a common consequence of TB diagnosis, treatment and care which can lead to impoverishment and in turn food insecurity for patients with TB. Food insecurity and undernutrition share a bidirectional relationship with TB; both cause TB and could be consequences of TB. Undernutrition in patients with active TB can lead to worsening of disease, drug toxicity, drug malabsorption, and death or relapse of disease.[5–7]

A recent national survey (2016) in Vietnam reported that 22% of households experienced food insecurity during TB treatment, this proportion being as high as 40% among the poorest wealth quintiles.[8] Food insecurity at the household level is common in India and is a strong risk factor for progression of latent infection to active TB in household contacts.[9] TB in India affects poor families and communities disproportionately, with a fourfold higher prevalence in those with a low standard of living index compared with those with a high standard of living index.[5] Food insecurity is also of greatest significance in households where levels of food insecurity and undernutrition are high at the time of diagnosis. Since food insecurity and undernutrition can coexist, patients with TB are unable to regain normal weight, despite effective treatment.

WHO (2013) in its guidelines 'Nutritional care and support for patients with tuberculosis' recommends assessment of food insecurity among TB cases and addressing the same with suitable packages including food assistance.[3] Recently, the Government of India has launched a cash assistance scheme for all TB cases to mitigate costs and improve nutritional status.[10] However, there may be households with more food insecurity that need more food assistance rather than equal assistance to all. In India, studies assessing household food insecurity (HFI) among TB cases are limited. Therefore, we aimed to determine the level of food insecurity and its associated factors using secondary data from a cohort of patients with pulmonary TB in South India.

METHODS

Study design

This is a cross-sectional analysis of data from a cohort study under Regional Prospective Observational Research for Tuberculosis (RePORT) India Consortium. Details of the study design have been previously reported.[11–14]

National Tuberculosis Programme

The study covers Puducherry district of the Union Territory of Puducherry (population ~1.3 million) and two adjoining districts of Tamil Nadu, that is, Villupuram (population ~3.5 million) and Cuddalore (population ~2.6 million). Under the National Tuberculosis Programme (NTP), TB diagnostic and treatment services are delivered through the designated microscopy centres (DMCs) and peripheral health institutions (PHIs) under tuberculosis units as nodal points for TB control activities at subdistrict level. Sputum smear microscopy remains the central component of TB diagnosis. Under NTP, both diagnosis and treatment are provided free of cost to the patients with TB. On diagnosis of TB, the patients are referred to the nearest PHI for initiation of treatment. Morbidity details (diabetes, HIV) and medication adherence, follow-up details and TB treatment outcomes of these patients are documented in individual TB treatment cards.

RePORT International

RePORT International represents a consortium of regional cohorts (RePORT India, RePORT Brazil, RePORT South Africa, RePORT China, RePORT Philippines and RePORT Indonesia) that are linked through the implementation of a common protocol for data and specimen collection. The objectives and composition of RePORT International are described elsewhere.[15]

One of the five teams under RePORT India, the Jawaharlal Institute of Postgraduate Medical Education and Research (JIPMER), Boston Medical Centre and Rutgers University, has established a pulmonary TB cohort of adults and children ≥6 years and their household contacts to identify biomarkers for risk of TB treatment failure and risk of development of TB in household contacts. TB cases diagnosed under NTP in the three districts (Puducherry, Cuddalore and Villupuram) were enrolled in the cohort at the DMCs and public health centres since 2014. Only newly diagnosed smear-positive and culture-positive pulmonary TB cases were included. Details on data collection and procedures were previously reported.[11–14]

Study population

For this analysis, we included all TB cases in the cohort enrolled from October 2015 to October 2018. Written informed consent was obtained from all participants before enrolment. Multidrug resistant and extremely drug resistant TB cases at diagnosis were excluded.

Study tool

The Household Food Insecurity Access Scale (HFIAS)[4] was used to assess food insecurity in the households in the past 30 days. The scale consists of nine items grouped under three domains: (1) Anxiety or uncertainty about the household food supply. (2) Insufficient quality. (3) Insufficient food intake and it's physical consequences.[4] The respondent is first asked an occurrence question, whether the condition in the question happened at all in the past 4 weeks (yes or no). If the respondent answers 'yes' to an occurrence question, a frequency-of-occurrence question is asked to determine whether the condition happened rarely (1–2 times), sometimes (3–10 times) or often (more than 10 times) in the past 4 weeks. Each item is scored on a range of 0 to 3; 0 for 'no occurrence' and 3 for 'often'. The minimum and maximum scores for a household are 0 and 27, respectively. The

scores were categorised into four levels of HFI: food secure and mild, moderately and severely food insecure[4] online supplementary file 1.

The Alcohol Use Disorders Identification Test (AUDIT)-C Questionnaire (a modified version of AUDIT)[16] was used to assess alcohol use among participants.

Data extraction, analysis and statistics

Of a total of 1229 TB cases enrolled in the cohort, we extracted data for 765 cases excluding two childhood TB cases; the initial 462 cases enrolled were not assessed for HFI because of not having the HFIAS in the study proforma during the initial phase of the project. The HFIAS was introduced in the revised study proforma after the 462 patients were already enrolled in the project. However, there was no difference in the baseline sociodemographic and clinical characteristics of the 462 patients excluded, compared with those included in the study.

Data were extracted from the RePORT India project database for the JIPMER site in a deidentified manner and analysed using Stata V.12.0 software. The proportion of HFI was summarised as percentage with 95% CI. Possible association of sociodemographic, morbidity-related and behavioural characteristics with HFI was assessed using χ^2 test, and unadjusted prevalence ratios with 95% CI were calculated. The characteristics with a value of p<0.2 in the univariate model were included in the multivariable generalised linear model (binomial function and log link) to derive adjusted prevalence ratios (aPRs) with 95% CI. The variables such as marital status, education, residence, number of earners in the household, HIV status, tobacco use, and alcohol use were not included for multivariate analysis.

Patient and public involvement

There was no patient or public involvement.

RESULTS

The mean (SD) age of the 765 individuals included in analysis was 44[14] years; 611 (80%) were male. Sociodemographic characteristics of the TB cases are described in table 1. Of the total participants, 131 (17%) did not have any formal education, about 77% were employed and 11% had monthly family income less than rupees 3000 (~US$43). Behavioural and disease-related characteristics are described in table 2. More than half (58%) were alcohol users (in the previous year) and 30% were current tobacco users. Of the total, 470 (61%) were underweight (body mass index (BMI) <18.5 kg/m2) and 5 patients (0.6%) were HIV-infected. The Karnofsky Score was 60 or less (require assistance for routine activities) in 29% of patients.

Overall, 261 patients had HFI and the proportion was 34.1% (95% CI 30.8% to 37.6%). Mild, moderate and severe food insecurity was found in 17 (2.2%), 67 (8.8%) and 177 (23.1%) TB cases, respectively. Components of food insecurity are described in table 3. Worry or anxiety about not having enough food was reported in 15% of TB households. In 21% of TB households, eating fewer meals in a day due to lack of enough food was reported.

Table 1 Sociodemographic characteristics of individuals with pulmonary tuberculosis (TB) in three districts of South India, 2015–2018 (n=765)

Characteristics	Frequency (%)
Age (in years)	
15–29	130 (17.0)
30–44	229 (29.9)
45–59	292 (38.2)
60 and above	114 (14.9)
Gender	
Male	611 (79.9)
Female	154 (20.1)
Marital status	
Never married	132 (17.3)
Married/living together	567 (74.1)
Separated/divorced/ widowed	66 (8.6)
Education (years of schooling)	
No formal education	131 (17.1)
1–5	160 (20.9)
6–10	317 (41.4)
>10	157 (20.5)
Employment	
Employed	588 (76.9)
Unemployed	177 (23.1)
Household Income per month (in rupees)	
<3000	80 (10.5)
3000–5000	296 (38.7)
5001–10000	279 (36.5)
>10000	94 (12.3)
Didn't answer	16 (2.0)
Number of individuals in house	
≤3	604 (78.9)
>3	161 (21.1)
Residence*	
Urban	338 (44.2)
Rural	409 (53.4)
Not recorded	18 (2.4)
Number of earners in the household	
None	15 (1.9)
One	509 (66.5)
Two or more	241 (31.6)
Religion	
Hindu	677 (88.5)
Christianity	54 (7.1)
Muslim	32 (4.2)
Others	2 (0.3)

Table 2 Morbidity and behavioural characteristics of individuals with pulmonary tuberculosis (TB) in three districts of South India, 2015-2018 (n=765)

Characteristic	Frequency (%)
Sputum smear grading at diagnosis	
1+	241 (31.5)
2+	255 (33.3)
3+	269 (35.2)
Karnofsky Score at diagnosis	
50–60	218 (28.5)
>60	547 (71.5)
HIV status	
Seropositive	5 (0.6)
Seronegative	760 (99.4)
RBS	
<200 mg/dL	531 (69.4)
≥200 mg/dL	234 (30.6)
Any other comorbidity*	
Yes	154 (20.2)
No	611 (79.8)
BMI	
<18.5	470 (61.4)
18.5–22.9	221 (28.9)
23–24.9	42 (5.5)
25 and above	29 (3.8)
Not recorded	3 (0.4)
Alcohol use†	
Ever	446 (58.3)
Never	319 (41.7)
Tobacco use‡	
Former	140 (18.3)
Current	231 (30.2)
Never	394 (51.5)

*Other comorbidities such as asthma, hepatitis, renal disease, cancer and breathing difficulty were reported by the participants.
†Alcohol use was measured for the past 1 year.
‡Current or prior habitual use of both smoking and smokeless forms of tobacco.
BMI, body mass index; RBS, random blood sugar.

Level of food insecurity in different subgroups is presented in table 4. In adjusted analysis, TB cases who had monthly family income less than rupees 3000 (aPR 2.0; 95% CI 1.3 to 3.0), Karnofsky Score of 60 or less (aPR 1.5; 95% CI 1.1 to 1.9) and those who were employed (aPR 1.4; 95% CI 1.0 to 2.0) had higher proportion of HFI.

DISCUSSION

Our study of newly diagnosed patients with pulmonary TB in the public sector in South India revealed that about a third of patients with TB experienced HFI and about one out of four patients experienced severe food insecurity at the time of diagnosis. Level of food insecurity was high in the low-income groups, those employed and those who had severe illness.

Prevalence of food insecurity in the general population of India is also high ranging from 45.5% to 77.2%.[17 18] Hence, HFI among patients with TB is common as it can be both a cause and consequence of TB. The national level survey from Vietnam (2016) reported 22% of patients with TB experienced HFI; lower levels of 6% were reported among patients with TB in Sri Lanka.[8 19]

Food insecurity was twice as high in low-income TB households (< rupees 3000) compared with their higher income counterparts. Catastrophic health expenditure, a consequence of TB diagnosis and treatment, can lead to worsening of food insecurity in low-income groups during the course of the disease.[5] These subgroups need to be provided additional assistance instead of 'equal for all' food or cash assistance benefits. Since income is usually under-reported, identifying such target groups may not be an easy task.

Food insecurity at the household level is a strong risk factor for progression of latent infection to active TB in household contacts.[9 20] Since food insecurity measures are applicable to all households, a wider approach of reducing food insecurity targeting all household contacts is needed.

In our study, about 60% of the patients with TB were underweight. Undernutrition is both an important risk factor for, and a common consequence of, TB. In food insecure households, undernutrition could be an intermediary step in the nutritional pathway of food insecurity leading to morbidity like TB. In India, undernutrition is highly prevalent in patients with TB and the dietary intake of calories is significantly lower (500–700 calories) than recommended.[21] As recommended by WHO, addressing undernutrition through nutritional counselling and support should be considered as part of the standard of care for people with TB. The recently launched 'Nikshay Poshan Yojana', a direct benefit transfer scheme by the government of India is a welcome step towards addressing undernutrition.[22] Our study did not include severely ill patients (Karnofsky Score <40) and previously treated patients with TB in whom undernutrition rates are expected to be high. This may partly explain why our study did not find an association between food insecurity and undernutrition, though previous studies have reported otherwise.[23–26] Also, we have assessed food insecurity at the household level, and BMI assessed is that of the individual patients. May be the patient's nutrition is maintained at the expense of other family members, so he or she may have had normal BMI. However, the temporality of the BMI, HFI and weight loss could not be established due to the cross-sectional nature of this study and we also failed to account for the sequence of these events during analysis. Thus, we fail to strongly comment on the causal pathways of association between HFI, BMI and weight loss. Also, we couldn't explore details on

Table 3 Components of household food insecurity among households of patients with pulmonary tuberculosis (TB) in three districts of South India, 2015–2018 (n=765)

	Occurrence*			
Occurrence questions	**No**	**Rarely**	**Sometimes**	**Often**
I.Worry or anxiety about food				
1.Worry that the household would not have enough food	648 (84.7)	52 (6.8)	62 (8.1)	3 (0.4)
II. Insufficient Quality of Food				
2.Any household member not able to eat the kinds of foods preferred because of lack of resources	636 (83.1)	67 (8.8)	60 (7.8)	2 (0.3)
3.Eating a limited variety of foods due to a lack of resources	680 (88.9)	40 (5.2)	45 (5.9)	0 (0.0)
4.Any household member having to eat some foods that they really did not want to eat because of lack of resources to obtain other types of food	611 (79.9)	53 (6.9)	91 (11.9)	10 (1.3)
III. Insufficient Quantity of Food				
5.Any household member having to eat a smaller meal than needed because there was not enough food	593 (77.5)	73 (9.5)	97 (12.7)	2 (0.3)
6.Eating fewer meals in a day because there was not enough food	601 (78.6)	89 (11.6)	73 (9.5)	2 (0.3)
7.There is no food of any kind to eat in your household because of a lack of resources to get food	625 (81.7)	73 (9.5)	60 (7.8)	7 (0.9)
8.Any household member going to sleep hungry at night because there was not enough food	643 (84.1)	70 (9.2)	51 (6.7)	1 (0.1)
9.Any household member going a whole day and night without eating anything because there was not enough food	631 (82.5)	73 (9.5)	57 (7.5)	4 (0.5)

*0=No, 1=Rarely (1–2 times in the past 4 weeks), 2=Sometimes (3–10 times in the past 4 weeks), 3=Often (more than 10 times in the past 4 weeks).

Table 4 Association of sociodemographic, morbidity and behavioural characteristics with household food insecurity among individuals with pulmonary TB in Puducherry, n=765

Characteristics	Total	Food insecurity*	Unadjusted PR† (95% CI)‡	Adjusted PR†, § (95% CI)‡
Total	765	261 (34.1)	–	–
Age (in years)				
15–29	130	48 (36.9)	1.4 (0.9–2.0)	1.2 (0.7–2.2)
30–44	229	86 (37.6)	1.4 (1.0–1.9)	1.4 (0.9–2.2)
45–59	292	96 (39.9)	1.2 (0.9–1.7)	1.2 (0.8–1.8)
60 and above	114	31 (27.2)	1.0	Ref
Gender				
Male	611	203 (33.2)	1.0	Ref
Female	154	58 (37.7)	1.1 (0.91.4)	1.2 (0.8–1.8)
Marital status				
Never married	132	42 (31.8)	0.9 (0.7–1.2)	–
Married/living together	567	196 (34.6)	1.0	–
Separated/divorced/widowed	66	23 (34.9)	1.008 (0.7–1.4)	–
Education (years of schooling)				
No formal education	131	40 (30.5)	1.0	–
1–5	160	54 (33.7)	1.10 (0.8–1.5)	–
6–10	317	114 (34.0)	1.2 (0.9–1.6)	–
>10	157	53 (33.8)	1.1 (0.8–1.6)	–
Employment				
Employed	588	206 (35.0)	1.1 (0.9–1.4)	1.4 (1.0–2.0)
Unemployed	177	55 (31.7)	1.0	Ref
Household income per month (in rupees)				
<3000	80	41 (51.3)	1.9 (1.3–2.4)	2.0 (1.3–3.0)
3000–5000	296	107 (36.2)	1.3 (1.0–1.6)	1.3 (0.9–1.7)
5001–10000	279	80 (28.7)	1.0	Ref
>10 000	94	24 (25.5)	0.9 (0.6–1.3)	0.9 (0.6–1.6)
Didn't answer	16	9 (56.3)	2.0 (1.2–3.1)	2.2 (1.1–4.5)
Number of individuals in the house				
≤3	604	198 (32.8)	1.0	Ref
>3	161	63 (39.1)	1.2 (0.9–1.5)	1.3 (0.9–1.8)
Residence¶				
Urban	338	114 (33.7)	1.0	–
Rural	409	143 (34.0)	1.03 (0.8–1.3)	–
Number of earners in the household				
None	15	5 (33.3)	1.0	–
One	509	177 (34.8)	1.04 (0.5–2.2)	–
Two or more	241	79 (32.8)	0.9 (0.5–2.1)	–
Sputum smear grading at diagnosis				
1+	241	68 (28.2)	1.0	Ref
2+	255	93 (36.5)	1.3 (1.0–1.7)	1.3 (0.9–1.7)
3+	269	100 (37.2)	1.3 (1.0–1.7)	0.4 (0.1–1.3)
Karnofsky Score at diagnosis				
50–60	218	97 (44.5)	1.5 (1.2–1.8)	1.5 (1.1–1.9)

Continued

Table 4 Continued

Characteristics	Total	Food insecurity*	Unadjusted PR† (95% CI)‡	Adjusted PR†, § (95% CI)‡
>60	547	164 (30.0)	1.0	Ref
HIV status				
Seropositive	5	3 (60.0)	1.0	–
Seronegative	760	258 (34.0)	0.6 (0.3–1.2)	–
RBS				
<200 mg/dL	531	197 (37.1)	1.4 (1.1–1.7)	1.1 (0.8–1.6)
≥200 mg/dL	234	64 (27.4)	1.0	Ref
Any other comorbidity				
Yes	154	53 (34.4)	1.01 (0.8–1.3)	–
No	611	208 (34.0)	1.0	–
BMI¶				
<18.5	470	177 (37.7)	1.2 (1.0–1.5)	1.06 (0.8–1.4)
18.5–22.9	221	68 (30.8)	1.0	Ref
23–24.9	42	12 (28.6)	0.9 (0.6–1.6))	0.9 (0.5–1.9)
25 and above	29	3 (10.3)	0.3 (0.1–1.0)	0.4 (0.1–1.3)
Alcohol use				
Ever	446	160 (35.9)	1.1 (0.9–1.4)	–
Never	319	101 (31.7)	1.0	–
Tobacco use				
Former	140	51 (36.4)	1.2 (0.9–1.5)	–
Current	231	86 (37.2)	1.2 (0.9–1.5)	–
Never	394	124 (31.5)	1.0	–

*Level of pood insecurity was assessed using the Household Food Insecurity Assessment Scale (HFIAS) for Measurement of Food Access-FANTAIII.
†PR, prevalence ratio.
‡CI.
§Adjusted for characteristics with a value of p<0.2 in the univariate model.
¶Residence—data are missing for 18 participants; Body Mass Index—data are missing for 3 participants.
BMI, body mass index; RBS, random blood sugar; TB, tuberculosis.

employment such as type of employment, which could be a risk factor for development of TB and could have influenced the income and thus the ability to purchase food items also.

Several studies support the notion that food insecurity negatively affects treatment adherence. Conditions of food insecurity (lack of adequate food, concern about daily food production) contribute to non-adherence to TB treatment as reported by qualitative studies.[27–29] Hence, identifying food insecurity at the time of diagnosis and linking the patients to food assistance or social security programmes is needed. We plan to report the effect of food insecurity on adherence and TB treatment outcomes in a separate paper.

Strengths of the study include use of a validated tool[4] for assessing HFI which allows cross-country comparisons. We used the data from a prospective cohort study which implemented quality assurance checks for data collection and entry that would have reduced missing data and data errors. There were a few limitations in the study. Our study included patients identified in the public sector alone and food insecurity levels may be different in patients accessing TB care in the private sector. Since, repeated episodes of TB may be a cause for financial loss leading to food insecurity, the levels could be higher in previously treated patients with TB and we did not study this subgroup. The study participants were from three selected districts in South India, so generalisability of the findings is limited. Being a cross-sectional analysis, causal relationships of factors with food insecurity cannot be inferred. The model we constructed for exploring factors associated with HFI was deficient as a few important confounding variables were included and also, the small sample size (power) was less for performing rational statistical analyses. Thus, the factors associated with HFI need to be interpreted with caution considering this major limitation in the multivariate analysis.

CONCLUSION

To conclude, HFI was experienced by one in three patients with TB and this was twice more in low-income groups. Additional food or cash assistance to food insecure patients with TB and household contacts will improve food insecurity and undernutrition.

Author affiliations
[1]Department of Preventive and Social Medicine, Jawaharlal Institute of Postgraduate Medical Education and Research (JIPMER), Puducherry, India
[2]Department of Community Medicine, Velammal Medical College, Madurai, Tamilnadu, India
[3]Centre for Operational Research, International Union Against Tuberculosis and Lung Disease, Paris, France
[4]The Union South-East Asia Office, New Delhi, India
[5]Section of Infectious Diseases, Department of Medicine, Boston University School of Medicine, Massachusetts, United States
[6]Department of Epidemiology, Boston University School of Public Health, Massachusetts, United States
[7]Department of Global Health, Boston University School of Public Health, Massachusetts, United States
[8]Department of Medicine, Rutgers University, New Jersey, United States

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ORCID iD
Reshma Ayiraveetil http://orcid.org/0000-0002-2417-6639

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