Population Attributable Risk of Tuberculosis Vulnerabilities in Kerala, India

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Abstract

Background: A robust disaggregated understanding of the determinants of tuberculosis (TB) in each local setting is essential for effective health system and policy action to control TB. **Objectives:** The objective of the study was to identify population attributable risk (PAR) for TB disease based on the locally available evidences for Kerala, India. **Methods:** Systematic review was done for risk factors of TB in the state. The second set of searches was done to understand the prevalence of the identified risk factors in general population in Kerala. With all available studies and reports, an expert group consensus was made to finalize state-specific prevalence of risk factors. Population attributable fractions were calculated for identified risk factors. **Results:** PAR for TB disease in Kerala obtained was 24% for undernutrition, 15% for diabetes, 15% for tobacco use, and 1% for HIV. **Conclusion:** Kerala state's PAR for TB was comparatively lower for HIV but higher for diabetes mellitus. Similar exercises for summarizing population risk factors need to happen at all states for making plans to effectively combat TB.

Keywords: Population attributable risk, tuberculosis epidemiology, tuberculosis India

BACKGROUND

Tuberculosis (TB) remains as one of the top ten causes of death worldwide and the leading cause of death from a single infectious agent. Globally, an estimated 10 million people fell ill with TB. India contributes to 27% of global TB burden.[1] Government of India has rolled out National Strategic Plan for TB Elimination (2017–2025) to realize the mission of achieving Sustainable Development Goals related to TB in 2025, 5 years ahead of the global targets.[2]

Kerala, the Southern Indian state, with a population of 34.1 million, has made impressive improvements in its public health.[3] In Kerala, since inception, TB control program is fully integrated with general health system. Despite its large efforts to find out cases, TB notification started falling by 4% annually in the state since 2009.[4] Government of Kerala has decided to accelerate the impact of the program for TB elimination by launching "Kerala TB elimination mission" aligning with the Sustainable Development Goals.

Proper understanding of risk factors for new infection and progression of infection to active TB disease need to be understood clearly for planning TB elimination strategies. There exists wide diversity in the magnitude of TB disease and the prevalence of risk factors among the states within India. Population attributable fraction (PAF) is an epidemiologic measure widely used to assess the public health impact of exposures in populations. PAF provides important information about the potential impact of prevention programs and interventions in public health, being extremely useful for policymakers, managers, and decision makers. We made an attempt to understand the risk factors which contribute to TB disease at population level, specific to Kerala state to guide the policy makers and program managers for local planning and implementing vulnerability reduction strategies for TB elimination in the state.

METHODS

The review was conducted based on the PRISMA guidelines.[5] A review protocol was developed, with search strategy and data collection methods. Population, Intervention, Comparison,

Access this article online

Quick Response Code:

Website:
www.ijcm.org.in

DOI:
10.4103/ijcm.IJCM_336_19

Outcomes, and Setting (PICOS) elements to identify search terms were developed based on review questions. The PICOS identifiers in the research questions and related terms were used to search the Medline. Key terms generated were (all populations in Kerala OR Kerala) AND (contacts OR diabetes OR risk factors OR undernutrition OR tobacco OR alcoholism OR chronic respiratory diseases OR HIV OR HCW OR tribal) AND (tuberculosis). The search was carried out on September 25, 2018, and all studies including descriptive, cross-sectional, cohort, and randomized controlled trials were included irrespective of the publication type (original article, short communication, or letter to editor). Only studies published since 1990–2018 were included as our interest was in the recent situation, and earlier publications were difficult to access. Since the number of publications was less, we also searched Google Scholar to find out more publications. Reference lists of included papers, as well as review articles/editorials identified in the searches, were scanned. Reading abstract, studies done in Kerala were figured out and reviewed. Postgraduate dissertations and faculty research projects were searched for in all teaching hospital libraries. Information was obtained about studies from state TB cell from where permissions for using TB-related data are sanctioned. Investigators of studies, which are unpublished, were contacted for obtaining results. Two authors screened titles and abstracts for inclusion in the full-text review, with a third author resolving any discrepancies. All identified articles were screened for full-text review.

Two separate pro formas were used to extract the quality-related data and basic study data. Quality was assessed using the checklist based on center for reviews and dissemination, University of York.[5] Checklist included information on clear objectives, appropriate methodology including design, adequate sample size, sampling techniques and data collection, appropriate analysis, risk of bias in selection, and limitations discussed. Good, poor, and not assessed were marked for each item in the checklist. Grading was done for extracted quality data. When there was a major reason for concern regarding the validity of the study along with more than four out of eight "poor"/"not assessable" ratings in the checklist, the study was excluded. Two authors independently scored the studies, and disagreements were resolved through a discussion with third author.

Case-based program data in settings with active case finding in the state were analyzed to obtain relative risks for being in coastal area, slum, and tribal population as compared to general population. No state-specific risk factor studies were available for HIV, undernutrition, and chronic obstructive pulmonary disease, for which relative risks were obtained from recent cohort studies in similar settings.[6-8]

The second set of searches was to understand the prevalence of the identified risk factors in general population in Kerala. Reports of state-level and national-level surveys were referred to.[9-11] Population and ethnic group-wise details were obtained from census primary data.[12] PRISMA flow chart indicating the results of literature search is shown in Box 1. With all available studies and reports, an expert group consensus was made to finalize state-specific prevalence of risk factors using Delphi Technique. Experts included seven members from research, academic circles, and local public health managers. Expert group consensus has been widely accepted as a method for providing a basis for decision-making when there is a limited evidence or when there are doubts about the applicability of evidence that has been generated from other populations.[13]

Population attributable risk (PAR) for TB diseases was calculated for each individual factor.

Results

Summary of the TB risk factors and their PAR fractions for Kerala has been shown in Table 1.[14-21] PAR for undernutrition was obtained as 24%, diabetes 15%, tobacco 14%, alcohol 4%, and HIV 1%.

Discussion

PAR for TB estimated due to HIV for 22 high TB burden countries is 19%, malnutrition is 27%, diabetes is 6.3%, alcohol use is 13.1%, and active smoking is 22.7%.[22] In the current exercise, Kerala state's PAF for TB was comparatively lower for HIV but higher for diabetes mellitus. The PAF for TB risk factors may vary from state to state.

Undernutrition tops the list in Kerala with PAF of 24%. It has been estimated that PAF of undernutrition exceeded 50% in most states in India.[23] Addressing the problem of endemic undernutrition in India could help reduce the incidence of TB in India. The findings also highlight the potential importance of diabetes mellitus as a risk factor for TB in Kerala. Efforts to eliminate TB in Kerala need to focus more on prevention and control of diabetes mellitus along with other major risk factors such as undernutrition and tobacco.
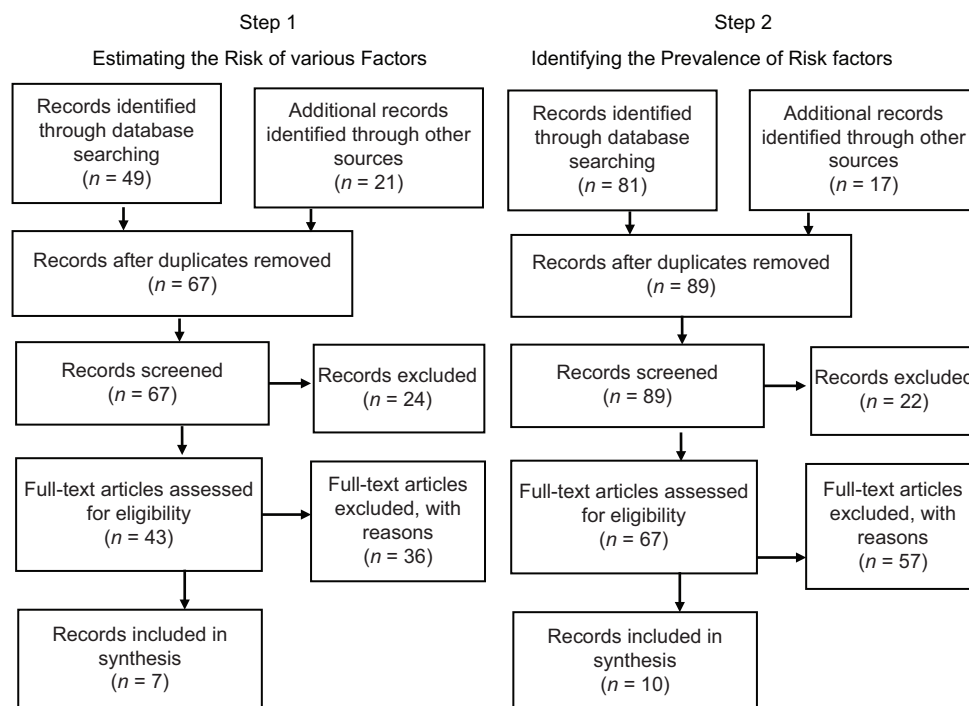
Action to effectively combat TB in India requires availability of state- and district-specific plans based on local epidemiological situation. Evidence-based planning emphasizes the importance of using local data or information available in the district or state. No systematic and comprehensive analysis of the state-level variations for these is available to inform specific state-level planning. We have done it for the state of Kerala with available evidences. The state has used this information for preparing TB elimination strategies. As "one size shoe doesn't fit all," similar exercises for summarizing population risk factors need to happen at all states in India for making plans to effectively combating TB.

Despite being the best available source of data on total prevalence of risk factors in Kerala, some of the estimates are based on old and relatively small population-based studies and hence must contain a large degree of uncertainty. Meta-analysis would have been the ideal solution to get estimates of relative

Table 1: Risk factors for tuberculosis disease in Kerala

	Estimate of relative risk	Prevalence of the risk factor (%)	Population attributable risk (%)
Undernutrition	4.49[6]	9.1[9]	24
Recent close contact	4.83 (2.08-11.20)[14]	5[11]	16
Diabetes	2.12 (1.19-3.77)[14]	16[16,17]	15
Tobacco	2. 30 (1.29-4.10)[14]	12.7[11]	14
COPD	3 (2.4-4)[7]	6[18]	10
Alcoholism	2.94 (1.35-6.43)[14]	1.46[19]	4
HIV	10[8]	0.12[20]	1
Health-care worker	1.84[15]	4[11]	3
Tribal	3.92 (3.31-4.64)	1[12]	3
Coastal	2.5 (2.16-2.91)	2[12]	3
Slum	1.7 (1.12-2.42)	1[12]	1.5
Past history of TB	2.3[14]	1[21]	1.3

COPD: Chronic obstructive pulmonary disease, TB: Tuberculosis

Step 1

Estimating the Risk of various Factors

Step 2

Identifying the Prevalence of Risk factors

Records identified through database searching (*n* = 49)

Additional records identified through other sources (*n* = 21)

Records identified through database searching (*n* = 81)

Additional records identified through other sources (*n* = 17)

Records after duplicates removed (*n* = 67)

Records after duplicates removed (*n* = 89)

Records screened (*n* = 67)

Records excluded (*n* = 24)

Records screened (*n* = 89)

Records excluded (*n* = 22)

Full-text articles assessed for eligibility (*n* = 43)

Full-text articles excluded, with reasons (*n* = 36)

Full-text articles assessed for eligibility (*n* = 67)

Full-text articles excluded, with reasons (*n* = 57)

Records included in synthesis (*n* = 7)

Records included in synthesis (*n* = 10)

Box 1: PRISMA flowchart indicating the results of literature search

risk; however, it was not attempted due to a lack of studies and a lack of time and resources as the current exercise was undertaken for local planning for program managers and policy makers based on local data. Despite these limitations, the findings have public health implications while planning for TB elimination in the country. The methodology used is replicable for other states and countries.

To summarize, Kerala state's PAF for TB was comparatively lower for HIV but higher for diabetes mellitus. Development of state-specific estimates is essential for planning TB vulnerability reduction activities in the country.

Author statements

Ethical Approval: not applicable as this does not involve any human subjects.

Conflicts of interest

There are no conflicts of interest.

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