# Data for Action for Tuberculosis Key and Vulnerable Populations

# RAPID ASSESSMENT REPORT

## India (2018)

REACH
leading the fight against TB

Stop TB Partnership

hosted by UNOPS

# Data for Action for Tuberculosis Key and Vulnerable Populations

# Rapid Assessment Report

## India (2018)

This report is, in part, made possible by the support of the American People through the United States Agency for International Development (USAID).

DOTS
Pura course, Pakka ilaaj
Dr. K S SACHDEVA
Dy. Director General
Head, Central TB Division
Project Director, RNTCP

सत्यमेव जयते

Tel: 011-2306 3226
011-2306 2980
E-mail: ddgtb@rntcp.org
भारत सरकार
Government of India
स्वास्थ्य एवं परिवार कल्याण मंत्रालय
Ministry of Health & Family Welfare
निर्माण भवन, नई दिल्ली -110108
Nirman Bhavan, New Delhi- 110 108

# Foreword

2018 has been a milestone year for the TB response in India. In March 2018, the Honourable Prime Minister re-iterated India's commitment to eliminate TB by 2025. India's new National Strategic Plan for 2017-25 reflects this commitment and lays out an ambitious road-map for the country to implement a comprehensive response to TB.

I am pleased that India is one of the first countries to utilize the Communities, Rights and Gender Tools developed by the Stop TB Partnership. This is in keeping with our efforts to engage civil society and affected communities in the TB response through the creation of National, State and District TB Forums and involving TB Champions or Kshay Veers at various levels. An increased focus on the areas addressed by the CRG tools has the potential to not just increase case detection and treatment outcomes but also improve the overall quality of care.

In keeping with the global consensus on the need to recognize populations vulnerable to TB, India's NSP includes, for the first time, a separate chapter on Priority Populations. The NSP defines Priority Populations as those who are a "disadvantaged group of people as compared to others, due to their reduced access to medical services and the underlying determinants of health. Vulnerable, underserved or populations at risk of TB infection and illness constitute a challenge for TB control". Our ongoing Active Case Finding efforts are also focused on these priority populations and on increasing their access to TB services.

The Data for Action Framework on Key and Vulnerable Populations brings together what we know about TB among key populations in India through a rigorous review of literature and interviews with stakeholders. The report summarizes the perspectives of both service providers and key populations and identifies the challenges in ensuring their equitable access to TB services.

On behalf of the Central TB Division, I congratulate REACH on the publication of this document and look forward to continuing our work with the TB community to bring TB services closer to vulnerable populations in the country.

# Message from Stop TB Partnership

The tuberculosis (TB) response needs a paradigm shift – to become people and community centered, gender sensitive and human rights based. There is a need for country specific data and strategic information on key, vulnerable and marginalized populations. There is a need to facilitate an enabling environment to effective prevention, diagnosis, treatment and care – which requires legal and gender related barriers to be analyzed, articulated and alleviated.

The Stop TB Partnership CRG Assessments are the tool for National TB Programmes to better understand and reach their epidemics. With TB being the leading cause of infectious disease deaths globally, and with over 10 million people developing TB each year, this disease continues to be a public health threat and a real major problem in the world. The Stop TB Partnership's Global Plan to End TB and the World Health Organization (WHO) End TB Strategy link targets to the Sustainable Development Goals (SDGs) and serve as blueprints for countries to reduce the number of TB deaths by 95% by 2030 and cut new cases by 90% between 2015 and 2035 with a focus on reaching key and vulnerable populations. The Strategy and the Plan outline areas for meeting the targets in which addressing gender and human rights barriers and ensuring community and people centered approaches are central.

Ending the TB epidemic requires advocacy to achieve highly-committed leadership and well-coordinated and innovative collaborations between the government sector (inclusive of Community Health Worker programs), people affected by TB and civil society. Elevated commitment to ending TB begins with understanding human rights and gender-related barriers to accessing TB services, including TB-related stigma and discrimination. It has been widely proven that TB disproportionately affects the most economically disadvantaged communities. Equally, rights issues that affect TB prevention, treatment and care TB are deeply rooted in poverty. Poverty and low socioeconomic status as well as legal, structural and social barriers prevent universal access to quality TB prevention, diagnosis, treatment and care.

In order to advance a rights-based approach to TB prevention, care and support, the Stop TB Partnership developed tools to assess legal environments, gender and key population data, which have been rolled-out in thirteen countries. The findings and implications from these assessments will help governments make more effective TB responses and policy decisions as they gain new insights into their TB epidemic and draw out policy and program implications. This provides a strong basis for tailoring national TB responses carefully to the country's epidemic – the starting point for ending discriminatory practices and improving respect for fundamental human rights for all to access quality TB prevention, treatment, care and support services. The development of these tools could not be more timely, and the implementation of these tools must be a priority of all TB programmes.

**Dr. Lucica Ditiu,**

*Executive Director, Stop TB Partnership*

Stop TB Partnership hosted by UNOPS

RESOURCE GROUP FOR EDUCATION AND ADVOCACY FOR COMMUNITY HEALTH

# Preface

The TB response is continually evolving. In the last few years, we've seen new diagnostic tools, new algorithms to reduce delays in diagnosis, breakthrough research on latent TB and TB infection, new social welfare schemes to support those affected by TB and even two new drugs to treat TB. We've also seen, for the first time, the language of rights and equity enter the TB discourse.

Today, I am delighted to see that globally and in India, we are talking about adopting a rights-based approach to TB. Since REACH's inception almost two decades ago, we have tried to adopt a patient-centric approach in our response to TB. Over the last 19 years, working closely with those affected by TB and their families, we have witnessed and tried to address the many vulnerabilities that impact their health. We have been part of nascent discussions on issues affecting treatment literacy and the rights of affected communities.

I am grateful that REACH has had the opportunity to be part of this important conversation in India, by undertaking the Communities, Rights and Gender Assessments. The CRG assessments has given us an opportunity to study these vulnerabilities through a more structured framework and to contribute to the discussions on data collection and measurement. It has been a steep learning curve for us and allowed us to reflect on our own work, challenge ourselves and push ourselves to do better. I am thankful to the Stop TB Partnership for giving us this opportunity and for the leadership at the Central TB Division and the Ministry of Health and Family Welfare for welcoming these conversations.

I hope that the TB community in India will find the findings of these assessments useful and interesting, and that we can work together to translate the recommendations into concrete actions that will strengthen the TB response in this country. We look forward to your feedback and continued partnership.

Nalini Krishnan

**Dr. Nalini Krishnan**

*Director, REACH*

No.194, 1st Floor, Avvaishanmugam Salai Lane, Llyods Road, Royapettah, Chennai – 600 014.
E-mail: reach4tb@gmail.com | Phone: 044 – 65211047 / 28132099

# Acknowledgements

Rapid assessments and writing by Dr Ravi Kumar B

Edited by Dr.Jayalakshmi Shreedhar

Desk review of literatures supported by Dr.Muniyandi M.

*Funding Support:* The Stop TB Partnership

This report is, in part, made possible by the support of the American People through the United States Agency for International Development (USAID).

REACH gratefully acknowledges the support and guidance of the Central TB Division and senior officials at the Ministry of Health and Family Welfare, Govt. of India, as well as all State and District TB Officials and community representatives who supported this process. We especially acknowledge members of the Expert Advisory Group who provided invaluable inputs at different stages of this assessment. We also thank colleagues at the Stop TB Partnership for their support and advice.

## Acknowledgements from the author

Our thanks to REACH and especially Dr Ramya Ananthakrishnan and Anupama Srinivasan for conceptualising and guiding this process. We wish to express our gratitude and profound appreciation for the support extended by all the central, state and district level officials we approached for assistance and for collection of data. Our thanks in particular to officials at the Central TB Division, Ministry of Health and Family Welfare for facilitating the study process and ensuring seamless data collection. We would like to thank the STOs of the four states of Odisha, Maharashtra, New Delhi and Tamil Nadu for their participation and for facilitating meetings with different officials across the state. We are grateful to the DTOs as they have been pillars in providing vital information regarding the Key Populations and facilitating meetings across the DTC. We wish to thank colleagues from various partner organisations including NIRT, The Union, WHO, PATH, Touched by TB, and other NGOs for their support at different points during the data collection process. Finally, special thanks are due to all the participants of the study.

# Glossary

| | |
|---|---|
| ACF | Active Case Finding |
| AIDS | Acquired Immuno Deficiency Syndrome |
| ANM | Auxiliary Nurse Midwife |
| ASHA | Accredited Social Health Activist |
| CBNAAT | Cartridge Based Nucleic Acid Amplification Test |
| CDR | Case Detection Rate |
| CHC | Community Health Centre |
| DH | District Hospital |
| DM | Diabetes Mellitus |
| DMC | Designated Microscopy Center |
| DOTS | Directly Observed Treatment Short Course |
| DTC | District Tuberculosis Center |
| DTO | District TB Officer |
| EPTB | Extra Pulmonary TB |
| FBS | Fasting Blood Sugar |
| HIV | Human Immuno Deficiency Virus |
| HMIS | Health management Information Systems |
| HV | Health Visitor |
| ICDS | Integrated Child Development Services |
| IEC | Information Education and Communication |
| LMIC | Low-Middle Income Countries |
| LTBI | Latent TB Infection |
| LT | Lab technician |
| MDR | Multi-drug-resistant TB |
| MO | Medical Officer |

| | |
|---|---|
| MSW | Master of Social Work |
| NACO | National AIDS Control Organization |
| NCD | Non-Communicable Disease |
| NGO | Non-Governmental Organization |
| NHM | National Health Mission |
| NPCDCS | National program for prevention of Cancer, Diabetes, Cardiovascular Diseases and Stroke |
| NSP | National Strategic Plan |
| NSSO | National Sample Survey Office |
| OHA | Oral Hypoglycemic Agents |
| PHC | Primary Health Center |
| PLHIV | People Living with HIV |
| PP | Post Prandial |
| PPM | Public-private Partnership Management |
| RNTCP | Revised National Tuberculosis Control Program |
| SC | Sub-Centers |
| SDH | Sub-District Hospital |
| STO | State TB Officer |
| STLS | Senior TB Lab Supervisor |
| STS | Senior Treatment Supervisor |
| TB | Tuberculosis |
| UPHC | Urban Primary Health Center |
| VHN | Village Health Nurse |
| WHO | World Health Organization |

# Communities, Rights and Gender Assessments

The Communities, Rights and Gender (CRG) Tools were developed by the Stop TB Partnership in consultation with various partner and donor organisations. The CRG tools provide a guiding framework for undertaking rapid assessments of three different dimensions of our response to TB – gender; key and priority populations; and law and human rights. An increased focus on these aspects has the potential to not just increase case detection and improve treatment outcomes but also improve the overall quality of care available to those affected by TB.

***The three tools that form part of the CRG initiative are:***

1. Data for Action Framework for Key Populations, which focuses on measuring the burden of TB among key, vulnerable and priority populations in the country
2. Gender Assessment tool for national TB response, which applies a gender lens to TB in the country and assess ways in which gender affects and interacts with TB
3. Legal Environment Assessment Tool that looks to understand and examine the legal environment for TB through a rights-based framework

In 2017, the Stop TB Partnership hosted a workshop for partners from six countries including India, which would be the first to utilize the CRG tools. REACH participated in this workshop.

India's National Strategic Plan (NSP) for 2017-25, recently formulated by the Ministry of Health and Family Welfare, Government of India, lays out an ambitious road-map for the country to achieve TB elimination by 2025. The new NSP is a sign of renewed political commitment to the fight against TB in India and this is therefore an opportune time to introduce the Communities, Rights and Gender Tools. Each of these three tools provide an opportunity to reflect on a person-centred and rights based approach to TB.

**CRG Assessments Timeline in India**

| | |
|---|---|
| July 2017: | REACH Participation in CRG training workshop in Thailand |
| Sep – Oct 2017: | Preparatory discussions for rollout of CRG tools in India |
| October 2017: | Constitution of Expert Advisory Group |
| November 2017: | Consultative Meeting of Expert Advisory Group |
| December – March 2018: | Assessments underway with inputs from Expert Advisory Group members |
| April – August 2018: | Feedback and revision of assessment reports |
| September 2018: | Final consultative meeting and dissemination of reports with key findings |

***List of Expert Advisory Group Members***

- Mr Arun Kumar Jha, Economic Advisor, Ministry of Health & Family Welfare, Govt. of India
- Dr Kuldeep Singh Sachdeva, DDG-TB, Central TB Division, Ministry of Health & Family Welfare, Govt. of India
- Dr Sunil Khaparde, former DDG-TB, Central TB Division, Ministry of Health & Family Welfare, Govt. of India
- Dr. Sundari Mase, WHO Country Office, India
- Ms Blessina Kumar, CEO, Global Coalition of TB Activists
- Dr Sarabjit Chaddha, Deputy Regional Director, The Union South-East Asia Office
- Mr Subrat Mohanty, Sr. Manager - Project Coordination, The Union South-East Asia Office
- Dr Rama Baru, Professor, Centre of Social Medicine and Community Health, Jawaharlal Nehru University, New Delhi
- Dr Anuradha Rajivan, Former Advisor, Asian Development Bank, Strategic and Policy Department
- Dr Srinath Satyanarayana, Deputy Director (Research), Center for Operational Research, International Union Against TB and Lung Disease (The Union)
- Dr Beena Thomas, Department of Social and Behavioral Research, National Institute for Research in Tuberculosis
- Mr. Brian Citro, Assistant Clinical Professor of Law, Bluhm Legal Clinic, Northwestern Pritzker School of Law

# Contents

# Executive Summary

India contributes a fourth of all new cases of TB to the global burden each year. People who belong to communities that are vulnerable to TB, those who are under-served or unreached by TB services and those at risk of TB infection and disease account for most of the new cases of TB disease and are recognized as Key Populations by the Global Plan to End TB 2016-2022. For countries to progress towards the elimination of TB, it is critical that Key Populations gain equitable and affordable access to TB diagnostics, treatment and supportive care.

India's National Strategic Plan (NSP) for TB 2017-25 also recognizes such communities as 'key affected populations' and accords them high programmatic priority. In the NSP, priority populations are defined on the basis of the disadvantages they suffer such as increased exposure to TB due to the place where they live and/or work, their limited access to TB services or their increased risk of TB disease because of biological or behavioral factors which compromise immunity to TB.

The private health sector in India addresses the health needs of more than half the populace, including a considerable number of those belonging to Key Populations. In partnership with the private sector and civil society, India's Revised National Tuberculosis Program (RNTCP) is engaged in addressing the challenge of Drug Resistant TB (DR-TB) due to delayed diagnosis and inadequate adherence to treatment, by promoting the notification of all TB cases by private providers, supporting the provision of appropriate treatment to completion and encouraging supportive community level care.

This report comprises of the findings from a rapid assessment conducted among five selected Key Populations in Odisha, Maharashtra, New Delhi and Tamil Nadu and documents the issues related to data availability and access to TB care among them. The report also demonstrates methods of data collection and suggests a potential research agenda with regard to Key Populations. In addition to an extensive review of relevant literature, the report includes information gathered from three main sources: meetings with senior officials engaged in carrying out TB programs; in-depth interviews with key stakeholders involved with the implementation of TB schemes -- as well as the end users of TB services. The key findings are presented under four major areas, namely, (a) data availability and

the provision of services among Key Populations from the perspective of the health system; (b) Key Populations perspectives on services availed from TB programs (c) the challenges faced by health systems in providing services to Key Populations and (d) potential research opportunities that could be explored in future among Key Populations with the involvement of the RNTCP program.

## Tribal Populations

The country has a number of districts that are designated as tribal, however the case-notifications do not distinguish between those who belong to tribal communities and those who are from the general population. The introduction of ACF is enabling a better estimate of the TB burden among tribal communities. Local healers generally serve as the first point of health care despite the widespread availability of public health services, with the consequence that the diagnosis of TB is often delayed. Limited means of transport makes it challenging for RNTCP staff to access villages in order to trace the contacts of TB patients and to transport sputum. The services of NGO and missionary-run hospitals are also inadequately utilized and may serve as potential points of access by both the program implementers and the end users.

The prevalence of certain food fads and local health related beliefs and practices among tribal communities also serve as barriers to availing government run health services. IEC activities have been a challenge because of the non-availability of education materials in the multiplicity of dialects among tribal communities, often times within the same village.

## Urban Slum Dwellers

With the list of slums available, the population sizes were estimated in the recent census and subsequently revised upwards by 2% each year. However, we found the actual number in the field to be twice or thrice the number estimated by the DTOs. The data collected from the slums are yet to include the perspectives of Key Population. Patients are not able to provide information on the treatment they received during previous visits to private clinics before the start of the current regimen, as most of the treatment providers give them the drugs without prescription. Fearing discrimination against them on account of TB disease, the patients often refuse to trace their contacts or facilitate the provision of TB prophylaxis to children in the household. Some patients said that they avoid meeting the government staff at home and prefer to see them at the health facility or in a common meeting place. IEC activities need to be on multilingual platforms as the slums are home to people of various dialects.

## Migrant Populations

District officials consider certain district as to be predominantly occupied by migrants based on the nature of work the individuals are involved with and the frequent shift in location by these individuals due to the availability of jobs. Migrant population sizes are generally estimated on the basis of field reports, not scientific studies. The biggest challenge faced by the officials is obtaining the correct details from migrant TB patients and tracing them when they miss their ATT doses.

Many migrants are laborers and they avoid meeting the staff at or near their temporary homes, fearing stigmatization by their neighbors or at the work place. Few migrant workers know the location of the nearest health facilities, most visit various health care providers including private allopathic doctors or other healers.

## People with Diabetes Mellitus

A population level estimate of Diabetes Mellitus among TB patients is yet to become available among the RNTCP staff. Similarly, the district level NCD officers do not have a population level estimate of TB patients, which, if they did, could help them in planning services. The matching of cases in the two programs in their respective registers would facilitate cross referrals, but is yet to be undertaken. A focused IEC on TB in DM and DM in TB needs to be emphasized by both the RNTCP and the NCD control programs for so that the patients on both the sides could be benefited. A few DM patients who are symptomatic refuse to go to the DMCs, out of denial, or out of fear of TB related stigma.

## Workers from the Mining Community

There are currently no standard estimates on the numbers of people working in the mining industries at the district levels. Coordination between the industry and the district TB officials is needed to collect more than the basic information on those diagnosed with TB. ACF activities are yet to be carried out among the mining communities. There are functional DMCs in a few of the industry-based hospitals and they provide services to the employees of the mining company. However, there are other employees who are not recruited by the company who avail of the services from the government facility near the mines, for general health care and TB related services. IEC activities that focus on TB among miners needs to be developed in partnership with the industry.

## Potential Research Opportunities

1. Population and Burden Estimation: The population sizes of Key Population need to be scientifically estimated followed by surveys of the prevalence of TB among them to get a better idea of the TB burden among them.
    a. Tribal Communities: As a first step the population of the tribal communities at the district level could be estimated using the census data (2011) and from the annual tour of the health worker in the sub- center, who is responsible for collecting health information at house level from each village and hamlet. The two data sets may be matched to assess current population sizes of tribal communities in the district.
    b. Urban Slum Dwellers: The population sizes of slums in the specified block or TU could be estimated based on the census findings and from the annual tour of the field workers at that block level for the current number of people resident there; such data would also provide the number of individuals who have re-located to the slum.

c. Migrant workers: The number of migrants in a particular block could be assessed from the information provided by field workers on the number of people who have migrated into a particular locality.

d. People with Diabetes Mellitus: Data on the national and subnational burden of disease may be used as a reference for understanding the burden of DM in a particular state. Together with the assessments of the TB burden from the RNTCP, the dual burden of TB-DM in a particular state may be estimated.

e. Members of the Mining Communities: In coordination with the mining companies, information on the numbers of individuals employed in the mines could be obtained. Contractors could likewise serve as a source of information on the number of contract laborers in the vicinity who find frequent employment in the mines.

2. Knowledge and Behavior Study: KAPB studies among the miners, DM patients and migrants could augment understanding about the levels of awareness and behavioral practices related to TB.

3. Spatial Mapping: The coordinates of patients who are registered for treatment under DOTS could be mapped for one district of a city where there is huge burden of TB. By carrying out the exercise for all new patients registered in one quarter, the conglomeration of the cases in a particular block or slum may be better understood and supplemented with findings from ACF.

4. Those diagnosed with TB who do not begin ATT: In many instances, there is a delay in the initiation of treatment among slum dwellers and others diagnosed with TB. Based on the available data such as the date of diagnosis and date of the start of treatment, such patients may be identified and tracked to understand the reasons behind initial delays or non-initiation of treatment.

# Introduction and Methods

The National Strategic Plan (NSP) for 2017-22, formulated by the Ministry of Health and Family Welfare, Government of India, lays out an ambitious road-map for the country to achieve TB elimination by 2025[1]. The new NSP is a sign of renewed political commitment to the fight against TB in India. Current efforts to combat TB are further challenged by the rise of drug-resistant TB, which is more difficult and expensive to diagnose, treat and to care for and support.

The TB cases that are currently missed by the public health systems every year are likely to be disproportionally concentrated among individuals who are at higher risks of latent TB infection. This could be due to increased exposure to TB because of where they live and/or work, because of limited access to quality TB care or due to increased risk of TB because of biological or behavioral factors. To prioritize the needs of such communities, the NSP for the first time included a separate chapter on "priority populations". Priority populations are those who are a "disadvantaged group of people as compared to others, due to their reduced access to medical services and the underlying determinants of health. Vulnerable, underserved or populations at risk of TB infection and illness constitute a challenge for TB control". The NSP provides various strategies for intensifying TB control activities in these groups. However, there is a paucity of data on the burden of TB among some of the priority populations, on access to essential services of TB care and information related to treatment outcomes among priority populations.

## Rationale

Data for action from key and vulnerable populations is an important step in understanding the nature of problem among them. Untreated TB cases among Key Populations is detrimental to the physical and financial well-being of the individual with the disease and to their families. Besides, untreated TB in any population poses a risk to the health of other populations as the transmission of disease is maintained in the community. REACH (Resource Group for Education and Advocacy for Community Health) conducted a rapid assessment among Key Populations to understand the data gaps, technical challenges and operational issues in relation to the provision of quality TB care in select Key Populations.

# PART 1: DESK REVIEW

### *Objectives*

- To review the available information for the 25 TB key affected population through a process of systematic literature search in several databases for relevant studies published between 1991 and 2017.
- To collect information on certain variables in TB care namely, burden of disease, access to care and treatment outcome for these key affected population

### *Methodology*

### *Selection of topics*

Three key priority areas in which knowledge gaps hamper the optimal implementation of TB control activities are disease burden, identified risk factors and barriers to accessing services. We did a literature search for research studies done in these areas among key population in India between 1991 and 2017.

### *Search strategy and data extraction*

The search for literature was limited to PubMed, accessing primarily the MEDLINE database of references and abstracts on life sciences and biomedical topics. The search was limited to manuscripts published in English language during 1991 to 2017 only. The search strategy included was the key affected population identified above, tuberculosis, India, and three priority areas - disease burden (prevalence, incidence, infection), risk factors, barriers to accessing services. The search strategy employed was to use keywords in phrases, use alternative words of the main query words and terms within each phrase to search for the available literature using appropriate Boolean connectors. For example, the keywords used are TB and Prisoner and India. A similar approach was adopted for all key population. As the first step we collected the information on the number of available articles based on these key words. Subsequently relevant peer reviewed studies and scholarly journal articles were accessed. We looked for information on burden of disease, access to TB care and any other information related to treatment. We also studied other official policy documents, working papers, annual reports, project briefs, case studies, occasional papers and project reports on the TB among these key affected population available in the public domain published by the government as well as by multilateral organizations etc. After removing the duplicates, all the relevant papers screened by the researcher and accumulated information on objective of the study, salient findings and implications or recommendation from that study findings were shortlisted. All the data were entered in Excel sheet.

## PART 2: RAPID ASSESSMENT

### *Objectives*

1. To prioritize 5 Key Populations from among the 25-selected Key Population based on a consensus from experts working in TB care
2. To conduct a rapid assessment on the selected Key findings and 5 Key Population with regards to data availability and access to TB care.
3. To demonstrate methods for collection of data among the selected Key Population.
4. To develop an intervention package/framework/protocol for the selected Key Population.

### *Methodology*

Based on field experience, we divided the rapid assessment into two parts to understand which Key Populations needed to be assessed. In the first part, we prioritized the Key Populations based on TB burden, access to TB care and vulnerability to TB infection. This was followed by a rapid qualitative assessment.

### *Objective 1: Prioritize Key Population*

As a first step, we prioritized 5 Key Population among the selected 25 Key Populations. We designed a survey instrument which was sent to individuals working in TB control (NGOs, WHO consultants, state TB officials etc.) to identify the top five Key Population they considered are more vulnerable and in need of interventions, based on their field experience and other information (**Annexure 1**). Simultaneously we selected four states in the country based on the four zones namely North, South, West and East. We chose the states of Delhi, Tamil Nadu, Maharashtra and Odisha for geographical representativeness. Based on the ranking received for the individual Key Population we selected those which were accorded priority. While selecting the top five to assess, we also considered the availability of frameworks in certain Key Population, for example, such as those with HIV-TB, or DM. Following selection, the rapid assessment was conducted in the four states.

***Table 1. Prioritization of Key Populations by different experts in TB control***

| Key Populations | % Responded (ranking %) | Key Populations | % Responded |
|---|---|---|---|
| **Slum Dwellers** | 74% (1-12%, 2-41%, 3- 29% & 5-17%) | **Undocumented Migrants, Factory Workers and residents of hard to reach areas** | 22% |
| **PLHIV** | 56% (1-69%, 4-15%, 5- 15%) | **Sex workers, Health Care Workers and Children** | 17% |
| **Prisoners** | 48% (2-36%, 4-27%, 3&5-18%) | **Tobacco users, refugees and women** | 13% |

| Key Populations | % Responded (ranking %) | Key Populations | % Responded |
|---|---|---|---|
| **Undernourished adults** | 43% (1-50%, 2-20%, 4- 10% & 5-10%) | **Alcohol dependents, community volunteers, illegal miners and geriatric populations** | 8.7% |
| **Tribal communities** | 34% (1-25%, 4-13%, 5- 62%) | **Hospital visitors, Construction workers, Migrant Workers and those with Silicosis** | 4.4% |
| **Miners** | 30% (2-14%, 3- 29%, 4- 43% & 5-14%) | | |
| **DM** | 30% (2-14%, 3-43% & 4-43%) | | |

From the ranking obtained above we shortlisted the Key Population of Urban slum dwellers, Migrants, Tribal communities, those with Diabetes Mellitus and Miners. The populations were selected in concurrence with the Central TB Division (CTD), Ministry of Health and Family Welfare, Government of India in line with the program needs and to facilitate a targeted approach to certain key populations for rapid assessment.

### *Objective 2: Rapid Assessment*

A mixed method approach was adopted for the rapid assessment of the Key Populations. The study instrument was designed to capture information related to challenges and issues of access to TB care service in the selected Key Populations. (**Annexure 1**)

**Setting**: The assessments were done in Delhi, Maharashtra, Tamil Nadu and Odisha where REACH has a direct presence and also through the local partners. The selected states have a variable representation of the selected Key Populations and some have a considerable representation of specific Key Populations such as Odisha where Tribal Communities and Miners are to be found in large numbers). In the selected states we spoke with key stakeholders namely the STO, DTO and program managers. We also interacted with experts from the MOHFW, CTD, WHO, UNION and other agencies at the national level. Interviews with individuals belonging to Key Populations, NGOs having access to those Key Populations and people from Key Populations who had TB previously or are currently undergoing treatment were also conducted. The key stakeholders sample comprised of those who were available on the day of interview or their representatives. A structured interview was recorded with the key stakeholders and transcripts prepared and verbal informed consent was obtained from all participants

The Key Populations were interviewed with a separate set of questions focused on access to care, and on the gender and legal dimensions of the TB care they received. The individuals from the Key Populations were selected by snowball sampling. We interviewed representatives from the

Key Populations till an adequate response was obtained. The individuals from Key Populations interviewed were those who have had TB or who had availed of a TB service such as a sputum test or an X-ray. These respondents were identified through the NGO at the state level who was working among them. Key NGO representatives were also interviewed to gather information on the gender and legal dimensions of access to TB care.

### *Objective 3 & 4*

All the interviews were translated into English where required and the transcripts prepared. The findings from the interviews and the desk review were used to identify the opportunities and challenges involved in data collection methods for the selected Key Populations. The suggested interventions are based on the findings from interviews with stakeholders and Key Population representatives.

## Target Population

We conducted a key informant interview among the following people among the states where the rapid assessment was conducted.

***Table 2. Participants approached in four states***

| Officials | Number |
|---|---|
| State TB officer | 4 |
| District TB officer | 13 |
| Senior Treatment supervisor | 11 |
| TB medical officer | 7 |
| WHO consultants | 5 |
| Member from other organization (UNION, PATH, ICMR, CHAI) | 8 |
| TB survivors/patients | 22 |
| NGO in charge working for a particular Key Populations | 2 |
| MOHFW | 2 |

# Key Findings and Discussion

## DESK REVIEW

***Table 3. Main areas on TB among key population in India from 1991-2017***

| Sl. No. | Main areas | Frequency | Percent |
|---|---|---|---|
| 1 | Behaviour | 28 | 9 |
| 2 | Biological | 100 | 33 |
| 3 | Burden | 69 | 23 |
| 4 | Environmental | 14 | 5 |
| 5 | Human Rights | 51 | 17 |
| 6 | Legal/Economic | 43 | 14 |
| | Total | 305 | 100 |

***Table 4. Summary of TB research among various key population in India from 1991-2017***

| Sl. No | Key population | Frequency | Percent |
|---|---|---|---|
| 1 | Alcohol | 26 | 9 |
| 2 | Construction workers | 3 | 1 |
| 3 | Diabetes | 70 | 23 |
| 4 | Drug user | 1 | <1 |
| 5 | Factory workers | 1 | <1 |
| 6 | Gender | 108 | 35 |
| 7 | Geriatric | 7 | 2 |
| 8 | Hard to reach areas | 6 | 2 |
| 9 | Illegal migrant | 1 | <1 |
| 10 | Immunosuppressive | 15 | 5 |
| 11 | Migrant workers | 3 | 1 |
| 12 | Miners | 1 | <1 |
| 13 | Prisoner | 4 | 1 |

| Sl. No | Key population | Frequency | Percent |
|---|---|---|---|
| 14 | Refugees | 6 | 2 |
| 15 | Sex workers | 10 | 3 |
| 16 | Silicosis | 8 | 3 |
| 17 | Slum | 15 | 5 |
| 18 | Tobacco users | 8 | 3 |
| 19 | Tribals | 12 | 4 |
| | Total | 305 | 100 |

***Table 5. Summary of TB research among various key population on main areas in India from 1991-2017***

| Column1 | Behaviour | Biological | Burden | Environmental | Human Rights | Legal/Economic | Total |
|---|---|---|---|---|---|---|---|
| Gender | 8 | 9 | 26 | 3 | 35 | 27 | 108 |
| Diabetes | - | 56 | 12 | - | 2 | - | 70 |
| Nutrition | | | | | | | 41 |
| Alcohol | 13 | 8 | - | - | 1 | 4 | 26 |
| Immunosuppressive | - | 14 | 1 | - | - | - | 15 |
| Slum | - | - | 8 | - | 5 | 2 | 15 |
| Tribals | - | - | 10 | - | 2 | - | 12 |
| Sex workers | - | 7 | 3 | - | - | - | 10 |
| Silicosis | - | - | - | 8 | - | - | 8 |
| Tobacco users | 7 | - | 1 | - | - | - | 8 |
| Geriatric | - | - | 2 | - | - | 5 | 7 |
| Hard to reach areas | - | - | - | - | 2 | 4 | 6 |
| Refugees | - | 3 | 3 | - | - | - | 6 |
| Prisoner | - | - | 1 | - | 3 | - | 4 |
| Construction workers | - | - | - | 3 | - | - | 3 |
| Migrant workers | - | 2 | - | - | - | 1 | 3 |
| Drug user | - | - | 1 | - | - | - | 1 |
| Factory workers | - | 1 | - | - | - | - | 1 |
| Illegal migrant | - | - | 1 | - | - | - | 1 |
| Miners | - | - | - | - | 1 | - | 1 |
| | 28 | 100 | 69 | 14 | 51 | 43 | 305 |

*Figure 1. Number of studies in different key population*

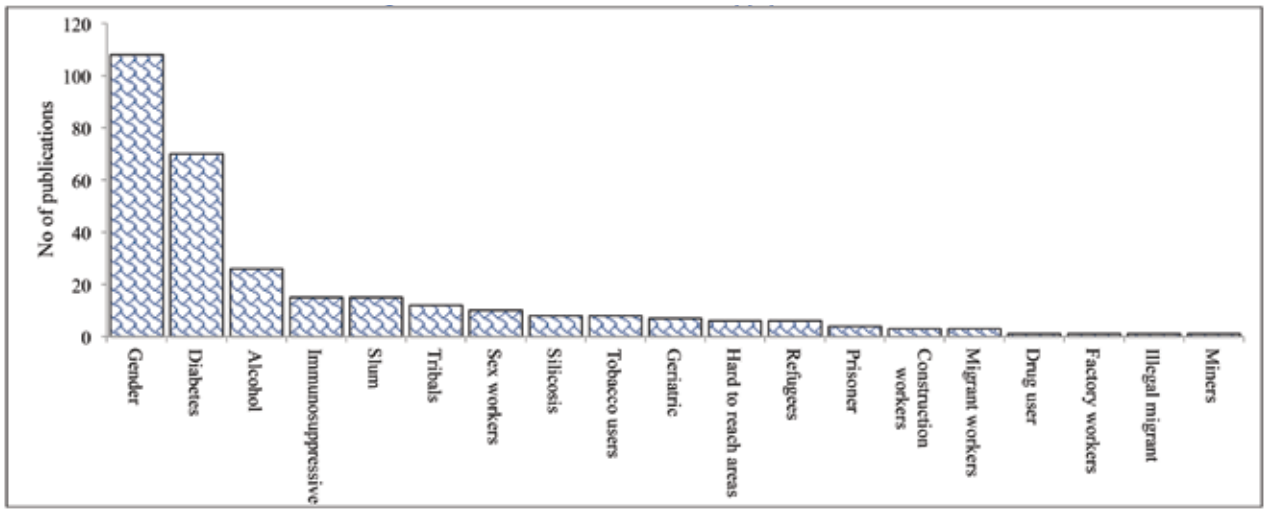



*Figure 2. Number of studies in different key population over a period*

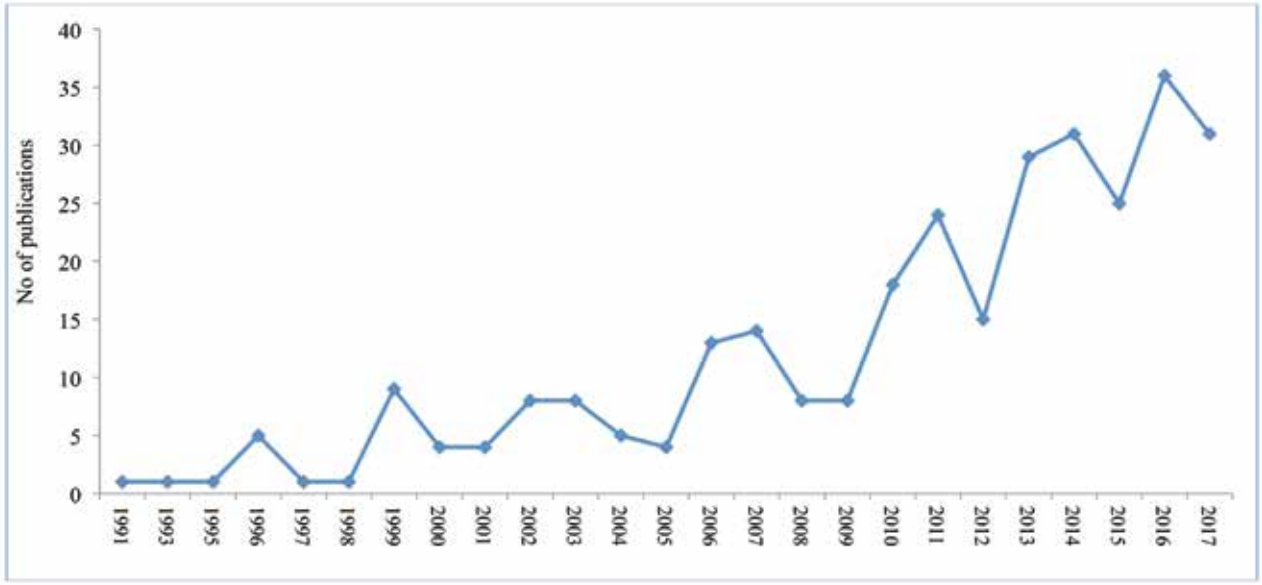
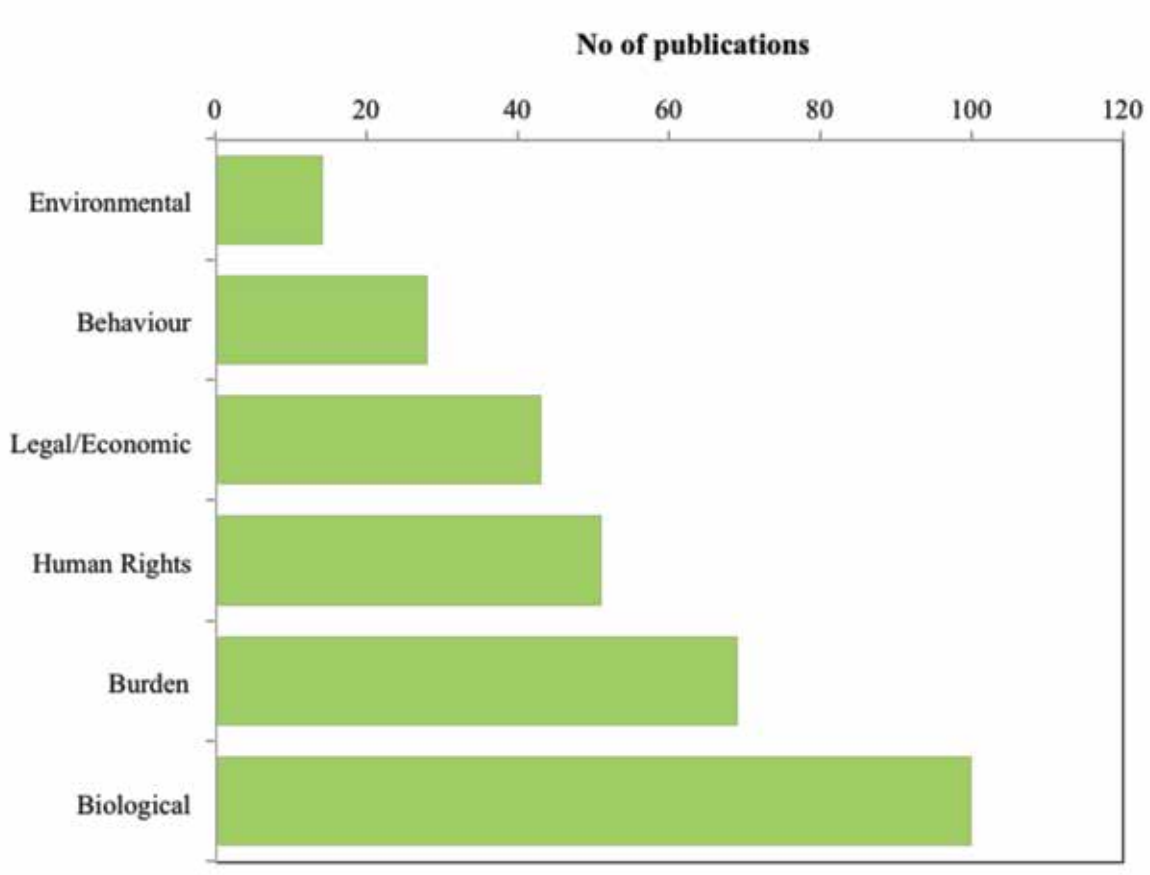


*Figure 3. Number of studies in different key population*




Of the total 305 studies identified, majority were on biological aspects of TB, followed by studies on the burden of TB, human rights legal/economic, behaviour and environment aspects. Very few studies were on migrants, miners, prisoner, silicosis, tobacco users, geriatric, illegal migrants, drug users, refuges, and factory workers. Among studies focused on gender aspects, majority were on human rights aspects, among diabetes on biological aspects, among alcoholics on behavioural aspects, among immunosuppressive on biological aspects and among tribals on burden of TB. It was observed that over a period, studies among these key population were increasing from around 10 per year in 1990s to **more than 30 studies per year currently. The key highlights from the desk review were**

- The studies on prevalence of alcoholism among TB patients showed that the burden of TB among alcoholics is of concern and has to be addressed. There is a direct association between greater consumption of alcohol and increased risk of mortality from alcohol-specific causes. It was reported that there was an increased incidence of pulmonary TB among those who smoke tobacco and drink alcohol. One-third of pulomonary TB patients were drinking alcohol during the treatment. Alcohol Use Disorders (AUD) among TB patients needs to be addressed urgently and the findings suggest the importance of integrating alcohol treatment into TB care and innovative interventions for screening patients for alcohol use.

- Very few studies have been conducted to find out the occupational risk on TB like community health workers, hospital staff, construction workers and quarry workers. In India, few studies have looked exclusively focussed on TB among the construction workers. A study from Kerala reported that prevalence of TB was higher among the construction workers than the general population. Among the quarry workers in Jodhpur, 21% were suffering from TB. Among the stone crushers the prevalence of TB was found to be 10.7% and among the slate pencil workers it was 22.5%. It was reported that silicosis is a common occupational disorder seen all over India, particularly in the central and western states. It is an important cause of respiratory morbidity. The problem has been highlighted on the national level as a major human rights concern in India. Those working in mines, construction work, stone-crushing and in other similar occupations where there is a greater level of exposure to silica dust are especially vulnerable for TB which need to be studied.
- Few studies have been looking TB in prison and it was reported that the prevalence of TB varies between 2% to 10.4% across different prisons in the country. The identified gaps are in relation to human resources, training needs, case finding, diagnostic and treatment services and limited coordination between prison authorities and RNTCP authorities. It was observed that 82% of the prisons had doctors, however only 65% of the available doctors were trained on National Tuberculosis Program.
- Studies have identified the prevalence of DM among TB patients was between 2% to 24% across different parts of the country in different study settings. Model-based study showed that the prevalence of DM in TB was 13% to 14%. Diabetes was found to increase the risk of rifampicin resistancs by three times and patient more than 40 years of age were found to be more at risk.
- Studies have assessed the burden of TB and other issues related to the access of TB services by people from the slum settlement. It was found that prevalence of TB among them was 7% to 13% in different parts of the country. The prevalence of TB infection in children residing in slums was found to be around 11% to 30%. MDR-TB was found to be 6% among TB patients from slums in Rajasthan and 78% among the HIV-TB patients from slums of Mumbai. Studies have also shown that people in the slums are likely to see multiple providers before being diagnosed with TB.
- People who are living in the remote tribal village or in hilly region with difficult access to the service provider poses a considerable challenge in addressing TB control. In hilly terrain like the state of Himachal Pradesh, though the state case detection rate has been above 75%, the inter-district performance of Kinnour, Chamba district was less than 75% as it was predominantly occupied by tribal and major areas in those districts was located in difficult geographical location makes it challenging for delivering the services with shortage of human resources. Apart from geography the occupational constraints of people living in these areas prevent

them from accessing the services. For individuals who are involved in brick kiln industry the longer the duration of stay in the chamber, higher the likelihood of seeking the care and shorter duration of stays was associated with frequent migration from one place to another, posing a challenge to timely seeking of health care. For individuals staying in tribal hamlet the delay in diagnosis was found to be exceeding two months among 13% of the patients of certain TU in the district. Poor awareness and limited access to the health care are the prominent issues in diagnostic delay for these patients. Studies in other tribal districts of Madhya Pradesh has identified that the case detection rates for these districts has been varying (53%, 45% and 56% for the year of 2010, 2011 and 2012 respectively). More than 50% of the tribal district were not able to achieve more than 85% of cure rate. Studies has suggested that in areas which are hard to reach, innovative methods like self-administered TB treatment is feasible and it has achieved 74% success outcomes among the patient in the district.

- The other key population vulnerable to TB are the immunosuppressive patients. Studies have identified the incidence and prevalence of TB among different transplant patients (kidney and liver) across different hospital setting in different part of the country. Pulmonary TB, extra-pulmonary TB and disseminated form of TB are also found to be associated with post-transplant patients. The incidence of TB in post-kidney transplants who are on immunosuppressive therapy was found to be between 7-11%.
- In India limited studies were done on drug users and all those available were focussed on injecting drug users and HIV co-infection. In one study among the HIV infected intra-venous drug users, 43.2% of the patients had TB. In another study, treatment outcomes among drug addicts reported that 5% died, 3.3% failed the treatment and 1.7% defaulted. Diagnosis of TB and provision of treatment for TB patients who are illicit drug users is a challenging task, as these patients have poor adherence and limited access to the treatment facilities. This is another important area which needs to be studied further.
- Few studies have focused on TB among the migrant workers; a study from eastern part of India among the migrant labors with HIV, found that 38.8% had TB. A study among migrant brick clin workers in southern India shown that prevalence of chest symptoms was 9.4% and it was found that the longer duration of the stay in the chamber was found to be significantly associated with chest symptoms.
- Among identified risk factors, male gender were independently associated with pulmonary TB. Special group like males in the age group of 15-49 years, patients who do not have any family support like migrants need special focused attention to ensure diagnosis and adherence to treatment.

- Special groups such as refugees and displaced population are at high risk for the development of TB. It was reported that TB incidence was very high among the Tibetan refugees. This area need to be studied further for strengthening TB control in this key population.
- There are limited studies on TB among sex workers. In a study done in Andhra Pradesh from 2008 to 2010 which included 53749 key population including female sex workers, men who have sex with men and transgender 88% of them received screening for TB. In the period of three years among the presumptives who were referred for TB screening 7.2%, 5.1% and 5.8% of them were diagnosed with TB, each year respectively. In a study on adherence to TB treatment in a slum in Mumbai, identified women who were engaged as sex workers were found to interrupt treatment as compared to others.
- The association between nutrition and TB, the role of nutrition has been discussed by many authors. But systematic studies are very limited on this aspects and there is a need to provide strong scientific evidence to support the importance of nutritional interventions. Studies done elsewhere across the country involving HIV-TB patient and non-HIV TB patient found that there was a better outcome in patients who were given nutritional supplements than patients without nutritional supplement, in the form of sputum conversion, cure rates, performance status and weight gain. In a model based study on Central India, different intervention scenarios brought about reductions in TB incidence and TB related mortality due to nutritional intervention.

# RAPID ASSESSMENT FINDINGS

# I. Tribal Populations

The tribal populations across the country are estimated to be at 100.5 million (8.6% of the total population) as per the 2011 census[2]. The population includes all those belonging to the Scheduled Tribes as well as those living in hard to reach locations. Considerable heterogeneity was observed among various tribes across a single state and also within districts of the same state. Some tribal communities earlier known as primitive tribes are classified as particularly vulnerable tribe groups (PVTG). Gaping disparities exist between tribal groups in the hilly regions and the inhabitants of the plains and cities in terms of health, socioeconomic variables and education[3]. Infectious diseases, malaria, anemia, STIs, high infant mortality and high maternal mortality are documented among tribal communities by many independent studies across the country. These could be mostly attributed to various behavioral, socioeconomic or environment factors. In addition, the poor health seeking behavior of tribal communities arising from stigma, misperceptions, lack of health awareness also places them at a high risk for ill health and specifically for communicable diseases like TB.

## Health in Tribal Populations

Health and nutritional challenges vary between tribes as well as within them. The government considers health as being critical to improving the socio-economic status of tribal populations. The government has also provided multiple grants to states for bridging the gaps in the health sector that serves tribal populations[4]. The health services for tribal communities are prioritized in districts where over 25% of the population are tribal. The norms for the provision of public health facilities are flexible so that tribal and hard to reach areas may be better served. There exists one sub-center for every 3000 people (5000 in the plains), one primary health center for every 20,000 people (30,000 in the plains) and one community center for every 80,000 people (120,000 in the plains) in the country. Tribal populations are currently served by 28096 SCs, 4012 PHCs and 1030 CHCs with a shortage of facilities varying from 21-30 % across the country (Rural Health Statistics 2015-16)[5]. The National Family Health Survey 4 found that among the scheduled tribes in rural India neonatal mortality, infant mortality and under five mortalities at 33.4, 47.3 and 61.3 per 100,000 are higher than the national figures [6]. A contributory factor to high mortality rates among tribal communities is their dependence on traditional medicine to treat minor and major illnesses alike.

## Tuberculosis Programs among Tribal Communities

The Revised National Tuberculosis Control Program introduced a targeted approach to TB care, implementing specific tribal action plans in the states that are home to large tribal populations. A critical feature is one Designated Microscopy Center (DMC) is for every 50000 population in hard to reach areas, compared with one per 100,000 population elsewhere. The government recently initiated ACF surveillance in hard to reach areas, to reduce delays in seeking health care. [7] In addition, the program provides incentives for TB patients from the tribal and hard to reach areas for the various TB services they use. The incentives also benefit individual volunteers and ASHAs who help them to initiate and complete treatment such as assisting with sputum transportation. Similar programs provide specific interventions among tribal population in project mode across various states in the country.

## Desk Review Findings about Tuberculosis Disease in Tribal Populations

A meta-analysis study found a pooled prevalence of TB among the tribal communities at 0.7%[8]. Independent studies from various parts of the country have identified the prevalence between 0.2% to 4.8%[9,10,11 ,12 & 13]. Prevalence of TB among men and women were estimated at 0.1% and 0.2% respectively[14]. A few studies identified MDR TB among tribal populations at 2.2% among new cases and 8.2% in previous TB cases and estimate that tribal populations' risk of MDR TB was 1.95-fold that of non-tribal populations[15&16] . Diabetes mellitus was estimated at 13.9% among tribal people[17]. The information that is currently available pertains mostly to states or particular districts; there is no national level information available on the issues related to TB care among tribal populations. Specifically, the data on tribal populations with TB is sparse and few independent studies have recorded the burden of TB and other issues related to the TB services that tribal population access.

## Findings from the Rapid Assessment of Health Systems

### *A. Data Requirement*

States categorize their districts as tribal or non-tribal for administrative purposes and provide special attention to members of tribal communities to help them access better care. It was found that except for the tribal populations no other Key Population sizes were estimated and since the whole district is classified as tribal, it was not considered necessary to separately estimate the sizes of the tribal communities within the district.

***"We collect RNTCP data routinely from the whole district and not specific to tribal populations as the district as a whole is a tribal district"***

District officials have collected disaggregated data based on age and sex from across the state. Though the data are available for detailed analysis, it is studied only per the requirement of the RNTCP program guidelines under a limited set of variables such as for example age less than or above fourteen years, the notification rate, new cases, old cases, those who have treatment completed and

so on. The cases are notified as a whole from district or block levels and not analysed on the basis of communities from tribal areas or hard to reach areas.

**"I have about 6 sub-centers in hard to reach areas in my block alone, with some 20000 population, who are difficult to reach. We analyze generally, but we don't look into or report specifically on the hard to reach area or tribal group."**

The data on the burden of disease namely, number of new cases detected, number of patient currently on treatment both drug sensitive and resistant, number of patients who completed treatment, number of patients cured, number of patients who are treatment failure or defaulted and number of deaths are all available at the district and state levels But they are not presented as per strict epidemiological parameters such as incidence or prevalence in particular Key Populations as the population size estimates of Key Populations is not used in the calculations.

**"Specifically, there is no system to look into the data. The data collection is being done but the analysis part is not done. But we are focusing on tribal patients, tribal population and tribal action plan, but still it is not sufficient."**

Following the introduction of Active Case finding (ACF) state officials are equipped with district level estimates of TB among tribal populations as compared with that of the general population in the district.

### *B. Service Delivery*

TB services are well staffed from the sub-center level till the district TB center which is considered as the end point at district level according to the RNTCP norms. The sub-centers are major contributors to the provision of DOTS with a few also acting as sputum collection centers. The collected sputum is later sent to the Designated Microscopy Centers (DMC) which may be located in some PHCs. The DMCs are located mainly at the CHCs in Odisha and in Block PHCs in Tamil Nadu, which have functional laboratories for diagnosis. In addition, the recent provision of CBNAT machines to 25 facilities in Odisha and one per district in Tamil Nadu (a few districts had more than one) are helping expedite TB diagnosis in retreatment cases, failure cases, among PLHIV, cases of pediatric TB and among cases for which diagnosis was difficult through conventional AFB smear tests or chest X-rays.

ASHAs who act as community DOTS providers, were the major drivers for success of the RNTCP program at the community level. The DOTS providers were found to be mainly tasked with identifying and motivating TB patients for the treatment, providing counseling and DOTS treatment, enrolling TB patients and maintaining records for reporting. However, there is marginal involvement of health workers from the general health system in managing the TB program.

**"The coordination between the ASHA and Village Health Nurse is good and they motivate and mobilize the population for treatment. This is because they get incentives if treatment is completed."**

Despite ASHAs being in place, officials mentioned that people from the tribal belt approach the

facility late. Early assessment of such patients becomes difficult as they first consult local healers, even though the public health facilities are the major source for health care provision.

**"They trust country medicine more than the allopathy and follow simple measures based on their own knowledge. They prefer to use local herbs. At the sign of any illness they always first visit the person who gives herbal medicine."**

An official from an NGO working with tribal communities mentioned that most would seek the facility after having cough for more than a month at least. This could be due to: 1) Belief in traditional medicines 2) long distances to the facility to avail of the services 3) lack of awareness about the disease and the facilities available in the facility. Educating patients about health issues in general, TB disease in particular, the nature of treatment and the time needed to cure was a challenging task according to the NGOs.

**"Sometimes in tribal areas the average duration from the onset of cough to the first visit to a health facility, is some 40 to 50 days. We struggle to give them simple Iron and Folic Acid tablets in pregnancy, so for a daily regimen or alternative day regimen for 6 months or more for TB is something that the patients are not ready to accept."**

The perennial challenge in finding accessible roads makes it difficult for the officials to make a visit to the village on a periodic and regular basis. Even if roads are available, the transport facility to the remotest of the village is very limited and the official may frequently end up spending the whole day in one particular village. Animals such as elephants are on the move after nightfall and the roads to the villages are often opened only from eight am in the morning till six pm in evening forcing either a late start or an early departure from the village.

**"Even if we could arrange vehicles to reach the villages we cannot go there before 8 am as the roads are blocked by the forest officials for fear of elephants and we have to finish the work early so that we can cross the check post by 6 pm to get back to town"**

The transportation of sputum from PHCs to a DMC and motivating the patient to visit the DMC to provide an early morning sputum sample pose their own set of challenges. There are volunteers available in the villages to help in transporting the sputum to the DMC, but this remains a challenge for health officials and patients alike, preventing both the service provider and the patient from utilizing the service.

**"There are some villages which 25 km are away from the PHCs, so collecting the sputum from these areas for diagnosis and CBNAT was challenging. We do have funds and it's not an issue but there is difficulty in finding a carrier either human or vehicles to transfer the sputum"**

Few officials at the district level mentioned that the IEC activities need to be strengthened based on local needs and levels of awareness. More interpersonal communication and counseling to the patients need to be provided in order to help patients complete treatment. The IEC activities need

to be dialect specific to make sense to tribal populations as the languages spoken by them vary and even if they speak the language of the state, the dialects seem different. Specifically, this is challenging in border districts where people speak of mix of the local language with that of the neighboring states

**"Language is a barrier for us as many language groups are found among the tribal as it is in border of the state. We have tribal people speaking three different languages, so we have to prepare the IEC accordingly."**

The officials mentioned that there were adequate numbers of STS, MOs and other personnel in the tribal district and that they had been provided with adequate training in handling the cases in their respective facilities. Sometimes a shortage would occur due to transfer of the officials due to seniority or promotion or deputation to other roles within the health department. However, there is a shortage of lab technicians in the facility, which could delay in the diagnosis of the disease and initiation of the treatment.

**"We need more labs in our block and need to create more DMCs in PHCS; LTs are limited in my block. Especially those lab technicians in the public/general health program needs to be utilized for TB control also."**

Specifically, the officials mentioned that there was a shortage of ASHAs in the field, especially in the hard to reach areas and those who are currently in place need to be more focused and trained on TB as most of them primarily manage the maternal and child health program.

The government provides cash incentives to TB patients for the treatment that they are avail of through the public health systems. But the officials are not able to provide the cash to them as it has to be done through bank transfer and most patients do not have bank accounts. They often face situations where the patients who consented to initiate treatment, threatened to stop treatment if the incentives were not provided.

**An honorarium of Rs. 1000 is given, but we are not able to give that to the patient as they do not have a bank account and we are not able to help them too. To reach the bank few need to travel more than 100km from their place of stay. We are able to convince them to start the treatment but when the issue of honorarium comes, people refuse treatment saying that the money is not been given. We are also not able to help them in opening the account."**

## Tribal Population Perspective

### *A. Information on Disease and Services*

Respondents from the tribal population mentioned that they were aware of a public health facility either near or far from the village where they resided. For many of them that was the only available facility to avail of the services, except in one district where we found a mission hospital providing both primary and secondary care services and which was located equidistantly from many villages.

The respondents said that they did not have much information of TB disease and the services related to the disease except for maternal and child health services in the nearest facility.

### *B. Access to Services*

An important factor that delayed the people from the tribal community to avail of public health services was the distance from their village to the nearest facility. For the villages that are close to the PHC, patients could easily go and avail the services. But for the villages that were located 15-20 kilometer away from the facility, they would avail the services only if they become sick.

**"For any illness they always visit the person who gives them some herbal medicines. They also approach the leader and local Headmaster for any issues in health. They approach the hospitals only if they become sick. They may not come for 3 to 6 months to seek help for cough."**

Adding to the challenge of distance is the availability of conveyance to the facility. Private van services sometimes ply between the villages and the PHC once a day, so the villagers are left with the option of paying for the transport services.

### *C. Availability of Services*

Patients from the tribal villages mentioned that they first visit the nearest facility when the symptoms don't improve following the intake of locally available medicines. In the facility, they would often be referred to the nearest government hospital for the lack of availability of investigations (X-ray, FNAC etc.). Sometimes they are referred from the GH to a medical college for further investigations. Later they would be started on Anti-TB treatment at the medical colleges and referred back to the respective PHCs for the continuation of the treatment. This scenario is most common in the case of extra pulmonary TB. For sputum positive TB, the patients provide spot sputum on the day of visit to the PHC, and the provision of an early morning sample is a challenge for them. This is due to the distance of the PHC or the DMC from their respective villages and lack of transportation to commute to the PHC in the morning or a combination of both. Under project AXHYA and ACF more cases are being identified with the help of volunteers who help in the transportation of sputum to the respective DMCs.

### *D. Stigma and Behavior towards TB*

Most of the patients mention that they would not reveal their disease status to the neighbors, but that they would not conceal it from their families. The service providers mentioned that a few patients refuse to provide sputum sample fearing loss of confidentiality and stigma following a TB diagnosis and would on the day of testing they say that they were not able to expectorate the sample. Sometimes the patient and the household member inform the concerned STS not to visit the patient's home, but to see them at the health facility or a convenient common place.

**"I was given proper care by my husband and mother in law and I did not face any difficulty at home, even the relatives were encouraging me to complete the treatment. But I did not inform my**

**neighbors as I feared that they may avoid me. I just said them I had a small surgery in the neck."**

The official mentioned that people from tribal communities commonly believed that there was no disease such as TB and that ill health was punishment for their sins. Others believed that going to the hospital for any kind of intervention would aggravate the disease condition and if their neighbors or the community came to know of the illness, they would be ostracized. The officials also mentioned that members of the tribal communities preferred to eat one particular type of food without any vegetables, even though the vegetables were available in plenty. The nutritional supplements provided through different government schemes were also not utilized by them.

**"Through the ICDs program, pregnant women in the tribal community are provided with nutritional supplements of 1 kg per month for the period of gestation. But most of the time it is not utilized and it is provided as a fodder to cattle."**

Usage of alcohol and tobacco is on the rise among the tribal populations similar to those of their peers in the plains. The consumption of alcohol and tobacco affects both the health of the people and those with TB disease, in addition to affecting the adherence to treatment. In some parts, the tribal communities prepared their own alcohol and in other parts they consumed the alcohol available in the general market.

**"Both men and women consume alcohol believing that it will control the cough. They drink country liquor and also the commercially available alcohol. They get money by selling honey from the forest. With the government providing rations, the money provided by the government is used for buying alcohol."**

## Lessons Learned and Way Forward

The RNTCP has been in place for decades and the program has been supportive especially for the tribal populations, considering the difficulty in both providing and receiving treatment. However, the areas that still need to be addressed would benefit from some alternative or innovative approaches.

### *Data Gaps*

The officials at the district level and the state level collect the data as a whole and they are not specific to Key Populations. But in those districts which are predominantly home to tribal populations, the DTOs have information on the number of people belonging to the tribal community or living in hard to reach areas. This information could be used at the district level in estimating the population sizes of the particular Key Populations and later assessing the TB burden among them. Also, the health workers posted in the sub-centers have population level information of all the villages that are covered by the sub-center, and such information may be utilized by both the MO as well as the DTO. With NIKSHAY as the primary data entry portal for TB reporting and additional information of the variables and KAP pertaining to Key Populations becoming better available, we may better shape the response to the challenge of TB among tribal communities.

### *Service Delivery*

The long-standing challenges in providing care to the tribal populations needs to be addressed through strong interdepartmental coordination and issues related to access to the villages need to be solved.

- **Transportation of Sputum**: Currently the patient is forced to make his or her own arrangements to reach the sputum to the DMCs for examination. The challenge is providing the early morning sputum as access to the DMCs at that time is difficult for tribal patients. With introduction of ACF in the last two years, state official have identified volunteers to help people in hard to reach areas to facilitate sputum transport and initiation of treatment once someone is diagnosed with TB. The services of volunteers could be enhanced by providing better incentives than those that are currently offered.
- **Utilization of NGO hospital or Mission hospital in the tribal area:** The RNTCP has provisions to engage private hospitals or NGOs in provision of services for TB care to people in hard to reach areas. In one of the districts, the medical officer had informally arranged to supply DOTS to the patients in the villages deploying the staff of the NGO hospital, which the tribal populations approached for other health complaints. This helped maintain the continuum of care once the treatment was initiated in the public health facility. "**On top of the mountain there is a SMART hospital which act as a DOTS provider, and patients listen to them more than to us. The hospital will inform us if there is a sick patient that needs to be transferred to the GH or the medical college. The cooperation is not 'official' but based on mutual understanding. This hospital is central to almost 5 villages, so people access it more."**
- **IEC Activities:** The program currently carries out IEC activities that are designed by the center and the state may modify them to suit local needs. However, at the district level there is diversity in languages and dialects that are not clearly known to the officials. The IEC activities needs to be tailored to suit the tribal populations so that they may understand about TB and the services available. The content of the IEC materials play a major role in helping communities understand the nature and course of TB disease, and their focus needs to address locally prevalent misconceptions and challenges such as of adherence to treatment till completion and dealing with the stigma associated with the disease. "**Also, the TB IEC should be based on visual and audio media, not written pamphlets as people are not literate. This needs to be done on periodic basis so we that can reinforce the message to people"**
- **Inter-sectoral/Interdepartmental Coordination:** At the programmatic level there is a coordination between the health department and other departments associated with the tribal populations, namely the Ministry of Tribal affairs, the Ministry of Women and Child Development and the Ministry of Social Justice and Empowerment. However, in the field there needs to be better and greater coordination between the ASHA and Anganwadi workers in helping the members

of the tribal communities to avail of services for health as a whole and TB in particular. "**The coordination between the ASHA and VHN is good in my block and they motivate and mobilize the populations for treatment. This is because they get incentives when a patient completes treatment. A multi-departmental approach similar to the one adopted by the education department may be useful to adopt and the ICDS needs to be better utilized."**

- **Counseling Services:** Currently there are provisions for counseling services for the patients of drug resistant TB as the disease requires a prolonged period of treatment and treatment interruptions are common. Counseling services need to be extended to patients of category 1 and 2 as they form the larger spectrum of the population and if they miss treatment, there is the ever-present danger of developing drug resistant TB. The government can provide counseling services in the PHCs located in hard to reach areas and the counseling could focus on general health, nutrition, TB treatment, follow up, adherence and abstinence from alcohol and tobacco.

# II. Urban Slum Dwellers & Migrants

According to the census of India, slums are defined as a compact area of at least 300 population or about 60-70 households of people living in congested tenements, in unhygienic environments with inadequate infrastructure and lacking in proper sanitary and drinking water facilities. In other words, slums are considered as settlements that are informal with inadequate housing and poor living conditions. Many have existed for years and are mostly located in the big cities. Based on the recent census and the NSSO survey there are around 65.5 million people living in the slums and this constitutes 5.5% of the population of the country and 17% of the total urban population[18]. There are 2613 slums in India with Tamil Nadu having the highest number of slums (507), but Maharashtra with 189 slums has the highest population dwelling in the slums (11.85) making it the most densely populated slums in the country with the highest proportion of slum population. Among cities in India, Mumbai has the highest slum population of about 5.2 million accounting for 8% of the total slum population of the country[19].

Due to economic growth and the industrial boom in certain states of the country there is an uneven distribution and migration of populations within and between the states. As per the census a person is considered to be migrant if he or she is enumerated at a place different from his/her place of birth. The new estimate of migrants stands at roughly 9 million people/annum in the country which is double the number estimated in the 2011 census. The flow of people from less affluent states to more affluent or economically stable states is high. Internal migration or in-migrations have surged in the southern states of Tamil Nadu and Kerala, whereas the out-migration has increased in the states of Madhya Pradesh, Bihar and Uttar Pradesh.

## Health issues among slum dwellers and migrants

The slum areas also host the majority of migrants, and the health problems associated with poor housing and unsanitary environments prevail in these areas. Overcrowding, substandard housing, poor ventilation, poor sanitation, lack of access to safe food and water and poor nutrition- all facilitate the spread of infectious disease like TB, hepatitis, dengue, other viral fever, pneumonia, cholera, malaria. More recently, diet related non-communicable diseases are also found to be prevalent among the slum dwellers. Economic deprivation exacerbates health and other risk factors among slum dwellers including migrants. Unplanned urban development puts them at higher risk for

disease associated with indoor and outdoor air pollution and road traffic injuries. Many of the risk factors mentioned above make people susceptible to TB disease.

## Desk Review of Tuberculosis among Slum dwellers and Migrants

Several independent studies have assessed the burden of TB and other issues related to the access of TB services by people from slum settlements. One study done across three metropolitan cities in India indicates that the prevalence decreased as the living standards increased[20]. Multiple studies have identified the prevalence of TB to be between 7% to 13% in different part of the country[21,22,23]. In children from the slums the prevalence of infection was found to be around 11% to 30% in different cities[21,24]. MDR TB was found to be about 6% among TB patients from slums in Rajasthan and 78% among the HIV-TB patients from the slums of Mumbai. In a study done in slums from Delhi 86% said they have heard about TB and those who were literate had better information on overcrowding (56.4%) and poor nutrition (45.4%) as risk factors for TB. Only 12% of respondents from one slum mentioned they knew of TB. In the same slum, 74% of the sample mentioned that they would avoid sharing food with TB patients and would stop the marriage of TB patients (27.6%). In another slum from Bangalore 72% of the sample approached the private health sector as the first point of service, 50% of them visited town health facilities before diagnosis and 87% visited two or more facilities before initiation of treatment.

The National Strategic Plan (2017-22) has identified slum dwellers and migrants as Key Populations that need to be provided specific interventions by the central TB division. However, specific intervention packages are yet to be designed for Key Populations both at national and state levels. The online portal NIKSHAY includes provisions for data on slum dwellers and migrants to be collected and registered and the database may be utilized in future. Slum dwellers and migrants are important Key Populations as there are many urban centers hosting them in large numbers. Their employment patterns and socioeconomic status poses serious challenges to the achievement of the objectives of the RNTCP and point to the need for newer strategies to manage TB among these populations. This rapid study assesses the gaps in TB data and information and TB service delivery among slum dwellers and migrants in the four states of Maharashtra, Delhi, Odisha and Tamil Nadu.

## Findings from the Rapid Assessment of Health Systems

### *A. Data Requirements*

The officials of the cities that host large slum populations have information on the number of slums both organized and unorganized and a count of the number of people living in them. However, the information available with them is based on the census that is done once in ten years. The census number is simply revised upward by 5% each succeeding year. However, it is acknowledged that the field reality is different and that the population size always exceeds the annual estimates.

**“We have 5 DMCs under the District TB center and the population served is estimated at 5 lakhs based on the census, but in reality, it is more than 2.5 times the number.”**

Officials consider certain districts or certain pockets to be predominantly occupied by migrants based on the nature of work the individuals are engaged in and the frequent shift in location of these individuals due to the availability of jobs. This information was available through the house visits made by the STS for treatment follow up.

**”In Cuttack district we have around 175 registered slums with people from different districts and from neighboring states. In fact, certain slum pockets are named after a particular district and new pockets are created within a slum on regular basis. Hence it is difficult to know the exact population size.”**

Sometimes the whole district is considered to be a slum and also mostly occupied by migrants particularly when it borders a neighboring state. Hence, the estimate that is done for the population of that district is considered to be for the slum dwellers with a proportion of them being migrants.

**“Our whole North Eastern district is slum area, so the whole population are slum dwellers. We have lots of migrants. Roughly 30% of the whole population is migrant in nature. We have both in and out migration.”**

Another challenges for TB care is that migrants change their place of residence frequently based on where they find employment and hence the information of a household or a person in one slum which was collected at the beginning of the year may not be found in that part of the slum when visited during the end or the later part of the year.

**“Among the total slum population no one is native to Maharashtra, almost all are from one state or the other; those recently migrated could be some 40% of the total slum population. They move from one slum to another slum such as living for 6 months in Govandi slum and then spend 6 months in Dharavi slum.”**

The data on burden of disease namely, the number of new cases detected, the number of patients currently on treatment of drug sensitive and DR TB, the number of patients who completed treatment, the number of patients cured, the number of patients who failed treatment or did not adhere and the number of TB related deaths are all available at the district and state levels. The analysis is not done on the basis of the Key Populations -- namely slum dwellers or migrants or a mix of both. One interesting finding from Chennai was that as per the official, a greater number of cases in the age group of less than 18 years get reported from the field especially among students in their early years of college or from the higher secondary classes. In all the four cities the officials mentioned that pulmonary TB was more prevalent, but in Delhi, Extra pulmonary TB was reported more often than other cities due to the greater availability of tertiary institutions with better diagnostic facilities that detect Extra pulmonary TB cases at an early stage. With the introduction of ACF and the completion

of three rounds of ACF surveillance in various different parts of the country, more information on slum dwellers including migrants will become available.

### *B. Service Delivery*

The majority of slums are located in the cities and the health centers that serve them do not follow the typical staffing pattern of the rural health centers. The health centers in the slums come under the administration of the municipality or the city corporation. However, the RNTCP staffing patterns remain the same across these centers as in other parts of the country. The urban PHCs or the Health units or dispensaries play a major role in identifying presumptive TB cases in a block of the city. These centers provide both preventive and curative care that addresses TB and other health ailments. Not all centers act as a DMC but all these centers provide DOTS, helping patients obtain the treatment from a center which is closest to home, during both the intensive and continuation phases of treatment.

Health visitors play a major role in mobilizing and motivating those presumed to have TB for diagnosis and facilitate regular follow up after initiation of treatment. Their work is not easy however, especially among male patients, despite regular visits. The HVs claim that some patients complain that the side effects of the AT drugs prevent them from working at their regular jobs; those who are alcohol dependent avoid taking treatment as the drugs interfere with their drinking behavior.

**"When we go for house visits we find patients refusing to see us, especially male patients. Sometimes we could not talk to them about continuing the treatment as they are under the influence of alcohol even during the day time"**

In all the four states the officials mentioned that the individuals from slum areas visit the government institutions only after seeking care at two or three private facilities. At such facilities, they are usually treated for infectious diseases that have symptoms and signs similar to TB. Qualified doctors run some of the private clinics, whereas others are run by quacks.

**"They come to the public facility only after visiting two or three private clinics. Here they are mostly treated with common antibiotics for generic respiratory infection. The patient is not able to tell us what drugs they have taken as the drugs are given loose in sheets of paper and without a prescription. This leads to two problems – one, they come to us with established TB disease and two, they would have consumed many antibiotics."**

The migrants in the slums also visit private clinics before availing of treatment for TB in the public facility. The officials said that the migrants in the slums are new to the community and they are not aware of the free TB services provided by the government. Most of the migrants come from various parts of the country and with limited knowledge of the local language, they are not able to make inquiries about where TB services may be found and where to access public health facilities The migrants begin random treatment in private clinics and usually get referred to the government hospitals when they are no more able to pay the doctor.

STSs said that in the slums, follow up and contact tracing is difficult, because the index patient sometimes refuses to consent to home visits by the concerned STSs. The patients would inform them that they prefer to see them in the hospital or in a common area far from their place of residence, fearing that their neighbors would come to learn that they suffer from TB. Similarly, during attempts to trace the children and other close contacts of the primary patient, many patients said that they do not have children or that they have sent the child away to a relative's place; attempts to inquire about adult contacts in the household is usually met with statements that the concerned person is out of town, and if in town - not at home or out of home for work.

**"When we go to their homes for follow up or contact tracing, the patients or their immediate relatives refuse us entry saying that they will meet us in the hospital or somewhere near the market. Sometimes they even go to the extent saying that such a patient does not live here, especially if the patient happens to be a girl."**

The follow up of migrant patients residing in slums is more challenging than follow up among other groups of patients because in most cases, migrants are unable to provide stable addresses where they may be contacted. The very nature of their jobs keeps them mobile and it is difficult to trace them. The migrants in the slums were observed to be of different types, one group being those who come from the neighboring states for daily wages and the second group comprising those who come to the city for contractual wages. The second group could be tracked more easily. A third group of migrants comprise those who come to the city in search of better health facilities and treatment and a fourth type of migrants are those who come into cities in search of jobs and settle in urban areas for a short period of time, frequently living with relatives or friends and taking on odd jobs, later leaving if they are unable to find work in a city or have found a job elsewhere. Among the different migrants, those who come for daily wages and those who work on a short-term period are pose the stiffest challenges to the providers of TB services as their stay in the cities is transient and for short periods. For patients who prefer to take TB treatment in the current city of residence, the officials motivate them to continue ATT in their villages or town, considering the long duration of treatment.

**"We counsel some patients from the neighboring districts to start the treatment at their village or district as it will be easy for the local TB services to follow them up. Some listen to us and start the treatment in their village, however the challenge is with those who do not listen to our advice, as we have to start the treatment as per program norms. These people come to their relatives' homes for starting the treatment after they have been diagnosed and after 2 or 3 months they leave the relatives' place without informing us."**

Patients who were well informed about the program communicate with the concerned STS or the DTO when they plan to relocate or move to their own villages and in those cases the officials are able to transfer them easily to the concerned DT in the rural areas.

The STOs and DTOs mentioned that the program staff numbers were adequate as per the program norms, but according to the burden of disease or case detection rate, the program is understaffed. The infrastructure for the program is adequate in all the states and the drug and re-agent requirements were satisfactorily met, but the staff were overburdened due to the case load from the cities especially in the slums. As per the program, counseling services are currently available for the drug resistant TB patients considering the duration of the treatment, but officials are of the opinion that counseling services need to be extended to drug sensitive patients too as this can help promote adherence to treatment among these patients.

**"We need counselors for drug sensitive TB patients and we can think of having interventions similar to HIV care programs such as targeted intervention for Key Populations. In one DMC alone we have 400 patients and it is difficult for the health visitor to monitor and counsel each one, as a result, the adherence rate is very low."**

Another suggestion from the officials was related to the staffing pattern in the health centers which though similar to the population norms of the particular district and tuberculosis unit, is insufficient to meet the demands of the large numbers of patients from the slums. This has overburdened the existing STSs and HVs and they find it challenging to follow up with the patients or make sufficient house visits. The DTOs said that the staffing needed to be planned to meet the case-load. In view of the rise in MDR TB and the consequent longer durations of treatment, there needed to be modifications in the staffing pattern for districts with a high burden of drug resistant and sensitive TB.

**"Any Public Health Institute in Mumbai has 50 MDR patients in a year, so cumulatively there are more than 100 patients in PHI but the number of STS, STLS, HV are the same. They have been given with multiple responsibilities and are hence overburdened. Mumbai has more than 60% of the cases of MDR TB in the state and human resources to cater to this number is a challenge as they are not sufficient to deal with the burden of TB in the city."**

Program staff are adequately trained as they are training on entry and undergo refresher trainings on a periodic basis. Program staff are also trained whenever there is a new development or guideline introduced into the RNTCP so that they may implement the new approaches in the field. Some DTOs were of the opinion that recruiting qualified staff would be helpful as they would understand the disease better and would also make the patients understand TB better. The management of the side effects of ATT and other illnesses associated with TB or without TB needs to be managed by the doctors in the dispensaries or the UPHCs. When such patients are referred to hospitals for further management, many avoid seeking care if the hospitals are far away, which in turn, can lead to poor treatment adherence.

**"Other medical illnesses among TB patients need to be tackled by the Medical officer TB, and if they come with symptoms he/she should be able to manage them. When we refer them to other hospitals, the patients often fail to go there and avail of treatment. All peripheral hospitals need to have facilities for managing TB patients with other diseases such as malaria, dengue, fracture etc."**

The STOs and DTOs carry out regular IEC activities in slum areas through the officials. However, a major barrier to increasing awareness about TB in the slums is that the residents do not understand the language used in the IEC material. Slums that are home to mixed languages require more than IEC materials in the state language, not only with regard to TB disease but also other diseases. The need is more acute in districts that border other states or if the slum is located in an industrial hub that attracts migrants from far and wide.

**"Any slum in Mumbai has people from all over India, you will find people from Kerala, Tamil Nadu, Andhra Pradesh, Odisha and NE states. We are not making IEC in regional languages for these people. We need the staff to talk to these people in their language. We need to translate the IEC materials into regional languages so that they can understand the message and the program."**

The officials also said that IEC activities needed to focus on specific issues in the program namely adherence to treatment, the quality of drugs in the facilities and the availability of TB services in the facilities. With more numbers of migrant worker settling in the slums, such information needed to in their language to help them access TB diagnosis and treatment.

**"Intensive IEC activities need to be carried out in slum areas and such activities should not be for a week or a month but be conducted on a continuous basis, because changes in perceptions about TB requires time - it cannot change over the night or over one month. It takes time."**

## Perspectives on TB from Slum Dwellers and Migrants

### *A. Information on Disease and Services*

People from the slum areas said that they were aware of the dispensaries and health units located in their blocks but the TB patients interviewed said that they knew very little about the disease as such or about the nature of the disease. The migrants living in the slums mentioned that they were neither aware of the disease or of the health services nearby. Some TB patients said that they are aware of the services that are available in the dispensaries and that they sometimes avoided going to the dispensaries because of the insensitive behavior of some of the staff.

**"We have a dispensary near our home, I first went there as the doctor advised a blood test and a sputum test for our daughter. One of the staff there shouted at us that we should cover our mouths with cloths. I was not aware why that had to be done and why he was asking me to do so and he kept on repeating the instruction without explanation. We decided we would never go there again and began going to another hospital even though it is far from our place."**

### *B. Access to Services*

Despite more dispensaries and other government hospitals available in the vicinity, both the slum dwellers and the migrants within the slum went to private clinics when they felt sick. An important barrier to accessing government-run facilities right away is that the timing of the facilities is inconvenient to them; they also find it difficult to take time away from work as waiting times are long at government facilities. Male patients who need to leave early for work in the morning and come home late in the evening find private clinics the only available place to seek treatment. Secondly people in the slums were under the impression that that they have to travel far to reach a government hospital as diagnostic facilities are not available in the dispensaries, whereas the neighborhood private clinics were equipped with diagnostic facilities.

**"I went to two private clinics near my home before TB treatment was started for me in this hospital. I was given tablets for cough initially and when it did not come under control I did a blood test suggested by the doctor in private clinic. But as the cough did not improve, he asked me to visit this government hospital"**

Accessing government hospitals was not a challenge to slum dwellers and migrants as there are regular transport services available for them to reach the hospital and though the dispensaries are near their home, the hospitals are located only a little further away and still easily accessible to them. The timing of these government institutions needs to change to suit the convenience of these Key Populations.

### *C. Availability of Services*

Services are provided in the dispensaries and the urban PHCs that are located in the block where particular slums are located. Both preventive and curative care was provided in the dispensaries and UPHCS, but diagnostic services were available only in the DMCs, which in the case of cities are located in the DTCs or some selected hospitals. People presumed to have TB disease, need to come to these centers to provide the sputum for AFB tests; following a positive result, they patients are referred to CBNAAT tests available in the district or municipality hospitals. Based on the sputum results, the patients are sent back to the respective dispensaries or UPHCs were they may be initiated on DOTS. However, some patients prefer seeking care at the hospitals rather than the dispensaries and UPHCs for the convenience of accessing all diagnostic services under one roof. Sometimes patients from neighboring districts and states too approach the facilities in the capital cities, believing that the quality of medicines is better, though the same drugs are distributed across the country.

**"Sometimes a few patients come here, saying that they are not getting supportive treatment for other diseases in their respective districts, even after transferring them out to their respective districts. Lot of people come from outside of Delhi for treatment, perceiving treatment is better here. Around 50% of patient admitted in TB hospital are from outside."**

### *D. Stigma and other behaviors related to TB*

Many patients said that they would reveal their disease status to their family member only and not to the neighbors or the community fearing that they may be discriminated against by society. Many patients come from neighboring districts or states to the capital city hospital for treatment saying that the treatment was better.

**"I am staying in my brother's place for some time now and after being diagnosed with TB I have decided I will stay here and finish the treatment and get back to my village. Even here sometimes the neighbor complains that I am coughing too much and I need to go for check-up, but I have not said them that I am having TB."**

A district official said that the demeanor of the patients usually changes upon learning that they have TB. The most common stigma is related to fear of the disease, with the patient and his or her parents fearing that if the identity of the TB patient is known to the surrounding or the community, there may be a chance that he or she may be ostracized or discriminated against. In certain instances, the marriage that has been arranged for the woman gets cancelled if the groom's family happens to learn that the bride has TB. When a woman is diagnosed with TB after marriage, she is often sent to her parent's home till completion of treatment. Sometimes, the couples hide her disease status from their in-laws till the treatment course is completed.

**"If you go to the field you cannot discuss TB with an unmarried girl -- especially if she is has TB! They prefer to step away and stand somewhere and answer the questions."**

Another important point mentioned by the DTOs was that while they advise TB patients to cover the mouth with a clean cloth while coughing or talking with someone, the patients obey when they are inside the house, but disregard the advice when they leave the house, fearing that their TB status may be revealed to the community; they speak to their neighbors with the mouth uncovered.

Migrant patients in the slums are mostly daily laborers or contractual laborers so they avoid meeting any of the program staff at or near their house to avoid the risk of revealing that they have TB disease. Being new to the locality, they fear that being known to have TB disease may endanger their chances of employment or housing. Similarly in the work place, they do not reveal their TB status, fearing they would lose their jobs and face discrimination from fellow employees.

## Lessons Learned and Way forward

Recent ACF activities has helped identify TB patients from various pockets within the slums that have been surveyed during three rounds of surveillance. Also, the routine services of the RNTCP that have been in place for decades, have since the last few years, begun to focus specifically on slum populations and migrants. Much attention is being paid to migrants among whom adherence to treatment is poor in order to cut the chain of TB infections and disease in the population. The areas which need to be addressed in the future are:

### *Data gaps*

The data collected from the slums and the entire population in the slum region is considered to be pertaining to slum dwellers and the majority of the migrants are located in the slum area of any city. However, a disaggregated level of analysis based on the Key Populations is yet to be done. One important reason for not doing so that officials shared is that the population estimates do not reflect the reality of the field, and in many cases, the actual population is almost double the estimate. The health officials of the corporation or the municipality collect household information on an annual basis to prepare the PIPs for their wards or blocks. Such population level information may be used as a denominator and the TB burden among slum dwellers estimated. Since the majority of migrants settle in the slum areas, such population estimates may be used to enhance the data collection among slum and migrant populations.
Household information from the municipality or corporation could be used in estimating the proportion of migrants within the slums and other epidemiological research could build on that data.

NIKSHAY is the primary data entry portal for TB reporting; it could serve a future source of data to understand the ground realities existing among slum dwellers including migrants, and plan effective management practices, once information on variables related to Key Populations and other social and behavior parameters are included in it. Problems that are unique to slum dwellers and migrants pose challenges to the RNTCP. There is a critical need for innovative strategies in order to ensure that people from the slums utilize the program to the maximum.

### *Service Delivery*

- **IEC Activities:** The slums across the four states we visited have a diverse group of people who are from different states of India. The IEC material mostly is in the regional language of the concerned state, but not of any other language or dialect. The concerned STOs and DTOs could make provisions in their PIPs to include a special budget for customizing the IEC materials based on the language group that is prevalent in the slums in the coverage areas. Since migrants within the slums are new both to the state as well as the slum, a multi-lingual approach to IEC activities would be beneficial for everyone in the slum. The content of the IEC materials and activities plays a major role in promoting the understanding of the nature and course of TB disease, so more focus is needed on the effects of TB, adherence to treatment and reduction of the stigma associated with the disease. **"In my block I have support for IEC especially in a school; the support is given by a medical officer in collaboration with an NGO. Currently TISS is supporting us with a MSW per each health post and they analyzed the level of awareness among the people in my district. Based on the level of awareness and type of people the IEC is planned."**
- **Counseling Services**: Currently the RNTCP provides counseling services for people with MDR TB in the slums and outside them. These services need to be extended to other TB patients too as it will help them in understanding the disease and the grasp the importance of adhering

to treatment till completion, helping to arrest the chain of TB transmission in the community. Counselors need to focus more on the migrant TB patients who reside in the slums, as they are forced to frequently shift elsewhere in search of employment. The counseling needs to focus on the importance of continuing treatment in their current place of residence and on obtaining contact details from them to follow up on treatment and facilitating them to transfer to treatment at other locations.

- **Coordination with private clinics/pharmacists in slums:** The first point of contact for any type of illness among slum dwellers was a private clinic or the local doctors. The corporation and the municipality needs to make efforts to identify these doctors and train them to identify presumptive TB cases and refer them to government institutions or other hospitals for appropriate diagnosis and further treatment. These doctors could be incentivized based on the work they have done. The RNTCP has already made provisions for incentivizing private doctors who notify the program when they diagnose a patient with TB and based on the other work done by them they are given further incentives. A similar approach any be adopted for the doctors and other practitioners catering to the slum populations; their services may help bring the presumptive cases of TB into the system, so that an early detection of cases could be done at the block level. Such work is happening in a few states and cities as discrete projects and these could scaled up based on feasibility and availability of resources. Similarly partnering with qualified and quality assured diagnostic centers could help bring services closer to community and also helps in optimal utilization of health resources.
- **Spatial Mapping of Cases:** It is well known that the population in the slum areas are densely packed, with many people living under the same roof. A mapping at the district level in the slums could help visualize pockets of the slum that have the highest aggregate of cases. This may help the TB program managers in identifying high-density areas of TB and intensifying community screening in those areas. Special focus in terms of counseling and creating awareness for those pockets may help in identifying the cases at an early stage. Within the slums there exist pockets with a greater number of TB cases as compared to other pockets and TB health staff can focus on the neighboring areas of these high-density pockets and initiate contact tracing or ACF in these areas.
- **Coordinating with places of work:** This could be done for contractual laborers who are migrants and resident in the slum. Some groups of laborers are bound by contract for a period of six months to one year. Information on these patients and their places of work could be collected and used to follow them up to track disease outcomes. For this the company or the contractor with whom the migrant labor is bound by employment contract also needs to be sensitized with regards to TB and sensitized on the necessity of treatment for the concerned laborer.

- **Human Resources:** A repeated concern is that current program norms provide for human resources as per the inaccurate population estimates for the block or district. However, the patient load in the district especially that within the slums is influenced by the actual population which is usually twice the number that is on paper. Also, number of cases in the slum areas is considerably higher compared to other regions of the city, hence the work load of the concerned STS and HV is higher. Due to the case -load the concerned staff face challenges in providing adequate follow up to the cases which could possibly lead to poor adherence to treatment. With the growing burden of MDR TB in the slums, RNTCP staff were found to be overburdened with both drug sensitive and resistant cases of TB. The government or the program could consider additional staffing for slum areas, especially for those with high TB notification rates.
- **Ease of TB Services for Migrants:** It is known that border district play host to the bulk of migrant populations due to both in-migration and out-migration on account of employment opportunities across the border. The DTOs of the border districts could make arrangements for registered migrants to access TB services in any of the TU's in the bordering districts. This could be managed by a communication from the concerned DTO/STS of the bordering district and TU so that the information of the patient and other relevant information is not lost.

# III. People with Diabetes

Diabetes is considered a leading cause of morbidity and mortality globally and in India. The number of individuals with type 1 and type 2 diabetes is on the rise with type 2 DM being widely prevalent. It is estimated that more than 80% of people with type 2 DM live in low and middle-income countries such as India. Globally, India has the second largest population of people with diabetes numbering around 69 million. The diabetes epidemic in the country is attributed to lifestyle changes including the consumption of un-healthy foods and physically inactivity. TB compounds the problem. India is known to have the highest number of TB patients and the TB-diabetes co-epidemic is a far more serious challenge to TB care when compared to other co-morbidities.

## The challenges of TB-Diabetes

Studies have identified a strong bi-directional linkage between TB and Diabetes. People with a weak immune system due to a chronic disease like diabetes are at a higher risk of progressing from latent TB to active disease. There exists a large proportion of people who have diabetes as well as TB and remain undiagnosed or are diagnosed at advanced stages; such individuals suffer complications due to both the diseases[25]. Each disease affects the body individually as well as in synergy, such as lengthening the time needed for sputum to turn negative; diabetes could also cause bodily complications in the presence of TB[26]. However, the precise mechanism by which DM predisposes to TB is not yet clear, though evidence exist for for other infections. Studies have identified that uncontrolled hyperglycemia places an individual at a higher risk for TB when compared to those with controlled blood glucose level[27&28]. According to an analysis of the data from the World Health Survey, individuals with diabetes from LMIC are more likely to have TB than non-diabetics (OR 1.81; 95% CI 1.37-2.39). Increase in TB prevalence and incidence over time was more likely to occur when diabetes prevalence was also increased[29].

## Desk Review of TB-Diabetes in India

Many studies have focused on the burden of TB in diabetic patients and vice versa across the country. All these studies pertained to particular regions, districts or hospitals but served as gateways to understanding the problem of TB-DM from a larger perspective. Studies have identified the prevalence of newly diagnosed DM in TB patients to be anywhere between 2 % to 24% across different part of

the country in different study settings[30-39]. Some model-based studies and studies which have been done at national level have identified the prevalence of DM in TB at 13% to 14%.[40&41] Diabetes was found to be increase the risk of rifampicin resistance by three times and patient more than 40 years of age were found to be more at risk.[42] Similarly among diabetes patient the prevalence of TB was found to be between 6% to 20% in multiple hospital and region based studies across the country [43]. Based on these studies the Central TB division has come up with a framework for managing TB-Diabetes co- morbidity[44]. The National Framework for joint TB-Diabetes collaborative activities is a joint effort by the RNTCP and the National program for prevention of Cancer, Diabetes, Cardiovascular Diseases and Stroke (NPCDCS). The Framework encompasses specific strategies and interventions for the management of TB-Diabetes patients such as the recording, reporting and delivery of services including preventive and curative care and outlines the responsibilities of the staff concerned for managing both the diseases. The states have implemented the program and it is currently it is in different phases of progress across the country.

The National Strategic Plan (2017-22) identifies people with diabetes as a Key Population and the RNTCP has already devised strategies to address TB-Diabetes through a National framework, in addition to the existing program norms so that there would be a better utilization of TB-Diabetes services. We did a quick assessment to understand the data related gaps and service related challenges existing in providing TB care to those people with TB and Diabetes Mellitus.

## Findings from Rapid Assessment of Health Systems

### *A. Data Requirement*

The states have implemented the TB-Diabetes program in all districts and all the DTOs have been advised to refer TB patients for diabetes screening according to the NPCDCS guidelines. The patient cards include a provision for recording the information related to diabetes screening including the results of both random blood sugar as well as fasting blood sugar. Based on the diabetic status of the patient, the treatment given is also recorded on the patient card. Such data is currently being collected at the district level.

**“We have the information on how many patients we are sending for diabetic screening and based on the results the sugar level is noted and if they are put on treatment that information is also recorded.”**

Similarly, the NCD officer at the district level has the information on the number of patients from the NCD clinic who are referred to the TB clinic for sputum examination. The patients are referred based on the criteria set out by the RNTCP. From both sides the patient related data could be retraced based on the age and sex at PHC, CHC and district level. Similarly, at the city level, with the corporation or municipality taking care of the patient’s health needs, the data on the number of TB cases based on age and sex are available. The DTOs also have information regarding the number of TB patients from within their administrative boundaries, who are currently on treatment for diabetes. However,

the burden of TB-Diabetes in the particular block or district is not known to them. The data namely, the number of new cases detected, the number of patient currently on treatment for TB-DM (both drug sensitive and drug resistant TB), the number of patients who have completed treatment, the number of patients cured, the number of patients who have failed treatment and the number of deaths are all available at the district and state levels. This information is not available in the form of incidence or prevalence data as the estimates of the overall population remain unknown to them.

**"We have started collecting data on the number of TB patients with diabetes and the treatment they are getting for DM. But we have not looked into the burden of the TB-DM in my locality. We have information on the date of diagnosis of DM and new and old DM cases, but not on the burden"**

Similarly, the NCD officer of the states also mention that the data on the number of TB symptomatics referred to DMC for sputum examination and number of those being diagnosed as confirmed TB cases and the number of TB patients referred to NCD clinic for DM evaluation is currently collected from the NCD clinic. But there was no information of the burden of TB-DM specifically and no attempt was made earlier to collect it. However, the burden of DM is now available through the Global burden of Disease Study for Indian States, and it is being used for the management of DM in the states.
Diabetes and TB have been recently included in the reporting systems and officials say that getting data on diabetes and TB would not be difficult as it is a part of the routine reporting in the RNTCP and NPCDS programs.

**"We coordinate with the officials from the NCD program run by the government, and we can get data on TB among diabetics or the vice versa on any population group in the near future"**

### *B. Service Delivery*

The integration of the two programs has been recent and is happening in several places across the states since the last year. The staff of the RNTCP and NCD clinics in the respective districts are trained and sensitized in this new area of integration. The PHCs act as the major sources of patients for the NCD clinics as the screening for the DM happens at the PHC level. Similarly, all the PHCs which function as DOTS centers or DMCs refer the diagnosed TB patient or the patient who is already on treatment, but whose DM status is not known, to the NCD clinic for screening of DM. Based on the diagnosis the patient is put on insulin therapy till the date the DOTS is completed. In the NCD clinic they refer the TB symptomatic patients who are diagnosed as DM and already on treatment for DM to RNTCP center for sputum examination.

**"As a Medical officer since I see both the group of patients I refer them based on the disease status and the presence of symptoms. It is working in bi-directional fashion in the PHCs "**

In the RNTCP centers, all the eligible TB patients are routinely sent to the NCD clinics for the screening of DM, but in the NCD clinic the referral of TB symptomatics for sputum examination needs to be strengthened. Many patients come to the NCD clinic for getting their weekly or monthly

requirement of oral hypoglycemic agents (OHAs) of previously diagnosed DM, and do not always the get consultations from the doctor or nurse. In such situations the chances of missing TB symptomatic among DM patients are high, if the staff do not inquire about symptoms.

**"Sometimes the symptom of tiredness and weakness is always thought of as due to the DM disease or because of taking the medications at the wrong time. Also, patients fail to mention cough thinking that is not related to DM -so why discuss in the NCD clinic"**

When the symptomatic patients are referred from the NCD clinic to the DOTS center to rule out TB, some refuse saying they do not have the disease or that the symptom is only occasional.

Except for hard to reach areas/tribal region, in all the other areas the facilities were easily accessible for both the diseases. Under the NPCDCS program the PHCs are supplied with the OHAs and insulin for patient use. Both the TB drugs and the DM medication were available in the PHCs barring the occasional shortage. Those who need insulin are required to come to the facilities to take their injections.

**"Currently patients who are on the intensive phase or in the continuation phase of TB treatment who need insulin have to come to the facility to get injected. We have insulin and OHAs procured through the NCD program."**

Program staff working in NCD and TB care namely the STS, STLS, MO, DTO and NCD nurses said that they all had all been trained in their respective programs and also trained on the recent framework of TB-DM and appeared competent to manage the cases in the district facilities.

**"All the Urban PHCs have the facility for checking the FBS and PP with the medical officers trained and sensitized. But we do not have a register to check the number"**

Since the program is a recently integrated service, specific IEC services dedicated for TB- DM are yet to be developed. Individually TB and DM awareness is promoted through IEC activities through their respective programs, but a combined TB-DM based IEC activity was not observed. However, the STS, medical officers and other staff involved in the delivery of the services in both the programs provide information to the patients on the risk of co-morbidity of TB-diabetes. The DTOs mentioned that they inform the concerned staff about the importance of strengthening IEC activities as well as to training them to advise TB patients on the importance of screening for DM.

The staff said that not all patients who are referred for particular tests go and get the tests done. The DM patients in the NCD clinic in particular, if found to be symptomatic or considered to be a presumptive case of TB are referred to the DMC for evaluation, but refuse to go saying that they have only DM and do not accept that they need to a sputum examination. Among those who do some state spurious reasons for not being able to provide a sputum sample.

**"We do capture data on how many patients get tested for DM test but not on the treatment outcomes such as the percentage of successes and failures. Similarly, there is the common problem**

**of collecting sputum from DM patients as they may not have full-blown disease; some patients refuse to provide sputum saying that they do not have any other illnesses but DM"**

## Population Perspectives

### *A. Information on Disease and Services*

The patients mentioned that they were aware about TB and Diabetes as separate diseases but that they did not know about the TB-DM disease as a co-morbidity. All the patients mentioned that they were aware about the range of services provided by the nearby public health facilities including treatment and diagnostic services. When questioned specifically about TB related services, however, they said they were not aware about TB specific services.

### *B. Access to Services*

The patients we interviewed were from the cities, so all of them mentioned that the health facilities whether private or governmental, were easily approachable by road. Most of the facilities are within the distance of 3 km from their places of stay, and thus easily accessible. Most of the facilities had both treatment and diagnostic services in them hence all services were availed by them in one place. But all the patients mentioned that they visited multiple doctors before the start of the current treatment.

**"I first visited a private hospital where they missed the TB but they informed me that my sugar was high and I was started on treatment for it. Later I visited my family doctor who examined my X-ray and suggested that I may have TB and referred me to a PPM hospital where I was put on TB treatment."**

Patients from urban areas preferred private facilities more than the government facilities as most of them mentioned that it was easy to approach the private clinic at times convenient to them.

### *C. Availability of Services*

Patients mentioned that they first visited the private hospital for their initial complaints. Based on their doctor's suggestions they visited other hospitals or labs for any investigation that was advised by the doctor. They said that not all the services were available in the same facility so they visited different centers for investigation, if not for treatment. The DTOs said that the UPHCs had the facilities to provide treatment for both TB and DM but for diagnosis, patients needed to come to a DMC or any other hospital where both sputum and blood could be examined.

### *D. Stigma and behavior towards TB/DM*

Patients said that they had informed only to their families about their disease status. Most mentioned that they had informed their neighbors about their DM status but not their TB status fearing stigma. They also mentioned that there was no difference in the way the family members treated them after they shared their diagnosis.

**"I informed my family about both the diseases and they have not treated me differently. But, I have not told my neighbors about my diseases, I don't know how they will react."**

The officials said that patients with DM who had symptoms related to TB, were often not interested in going to the DMCs for sputum examination. They said it was important that the patient be persuaded to accept the facts about TB-DM and encouraged to go to DMCs.

## Lessons Learned and Way Forward

The RNTCP has been in place for decades and manages a large TB program from the grassroots upwards to the national level, effective across the country. With the introduction of NPCDCS in the country since 2010, the non-communicable disease control programs have been rolled out at state level. Since March 2017 the government has specified a framework for the management of TB-DM together, entrusting both the RNTCP and the NPCDCS with greater responsibilities to manage the TB-DM co-epidemic.

### *Data Gaps*

The officials at the district level and the state level collect the data pertaining to the population as a whole and do not disaggregate the data specific to Key Populations. Considering the newness of the program data gaps exist.

Though the RNTCP has begun collecting data on the diabetic status of the TB patient, the NCD program is currently in the phase of including the variable on TB status in its reporting formats. While officials have the information on the number of patients from the NCD clinic who were sent for the evaluation of TB or the vice versa to the DMC for evaluation of DM status, they said that the data sometimes do not match mostly with regard to the number of patients referred for sputum examination or the fasting blood sugar test. As the program is still new, program staff could manually verify the number of patients referred from both the side and update the status on a monthly or quarterly basis. With NIKSHAY acting as a primary source of data in the RNTCP program, information on diagnosed patients would become available from this portal. Similarly, the NCD based HMIS or data portal could have a provision for mentioning the TB status of the DM patient so that the officer managing the NCD program is aware of the patients TB status.

### *Service Delivery*

- **Inter-sectoral Coordination**: Both RNTCP and NPCDCS actively provide preventive and curative services across the country in their own domains, with trained STSs, SLTs, medical officers and health workers. However, the coordination of these two programs at the field level needs to be strengthened. Currently both the programs treat patients and when patients are referred from one program to the other, they are managed sometimes and referred back at other times. The field level staff in both the programs need to be adequately trained in understanding the dual burden of TB-DM and its management, to promote adherence to treatment.

- **IEC activities**: Current IEC activities are focused on the individual diseases -- the RNTCP focuses on TB and the NPCDCS on DM. A unified approach needs to be adopted in disseminating the information on TB-DM disease so that the community is made aware of the dimensions of the dual disease. The content of the IEC activities need to make the community understand the nature and course of the diseases, so more attention needs to should be paid to promoting awareness on the effects of the diseases on each other, adherence to treatment, the availability of services and on reduction of stigma associated with TB.
- **Counseling Services**: Counseling services are provided to MDR TB patients and HIV- TB patients through the RNTCP and NACO, respectively for TB patients. The NCD clinic staff nurse provides preventive and curative services and in some facilities NCD counselors are available who provide counseling on NCDs. Their services should be utilized in providing counseling services to the patients with TB-DM as it will help them understand the disease better and encourage them to adhere to treatment.

# IV. Mine workers

The mining industry is among the most important segment of the Indian economy. From the time of independence there has been a rapid growth in the sector in both quantity and value. The industry provides a considerable opportunity for employment in several states. Mining has been considered a hazardous profession, owing to the occupational risks involved. The hazards of working in the mines depends on the factors like the type of the mineral mined, related geological formations, the techniques employed and the general health of the workers. Many studies have provided evidence linking mining and lung diseases. Not all mines and mined products cause respiratory diseases.

## Health among Miners

In India the health of miners came under the spotlight following the diagnosis of a large number of cases of silicosis among mine workers in the Kolar Gold Fields. From 1940-46 around 3472 silicosis cases were found among the gold field workers[45]. The finding gained further importance when silicosis was linked to tuberculosis. Silicosis is a progressive interstitial lung disease caused by the reaction of lung tissue to inhalation of silica dust which is generated in the quarrying, manufacturing and building industries. The exposure to silica goes un-noticed as the symptoms are developed late in the course of illness. Silico-tuberculosis is a public health issue in LMICs[46]. Exposure to silica dust increases the risk of TB infection among workers and aggravates pre-existing TB. Diagnosis is a challenge as the symptoms are similar to TB and the bacteria are difficult to recover in the sputum as silicotic fibrosis prevents the discharge of bacilli into the sputum[47].

## Desk Review of TB among Miners

The relationship between mining and occupational lung diseases has been studied for years. The disease depends upon the product that is mined, the level of exposure to the particles, the period of exposure and the presence of any co-existing illness, environmental conditions and lifestyle, all of which influence the development of the disease[48]. Though not all the mining industries are associated with TB[49], coal and silica miners are found to be associated TB diseases compared with persons working in other fields. Few studies have focused on coal and silica in the development of TB among workers. In one of the earliest studies of workers in eleven Indian coal mines, around 126 of the workers had TB and pneumoconiosis. The prevalence of pneumoconiosis-TB was 1.4% and it

rose with the length of time the workers had been engaged in the coal mine. The prevalence was 2.5 times higher among those who were working underground than on the surface[50]. In another study among coal fields in Odisha, symptoms of TB were reported in 121 out of 205, 129 out of 212 and 145 out of 220 workers for the year 2005, 2006 and 2007, respectively. Also, the rate of TB infection increased from 59% to 65.9% from 2005 to 2007[51].

Tuberculosis was the common complication reported in the studies done on silicosis and the odds of association between silicosis and TB was 2.75[52,53]. In many studies done across different states, active TB was found in 5.5% to 12% and old TB was found in 47% of mine workers[54,55]. Based on the type of industry, and the different levels of exposure to silica dust, TB was found among 10.7% of workers involved in stone crushing and among 22.5% of slate pencil workers[56]. Studies also identified other forms of Mycobacterium in addition to Mycobacterium tuberculosis among silicosis patients. In one study in Rajasthan, of the 300 cases of silicosis, 46% were confirmed to have TB by AFB smear examination and later when cultured 53.65% were positive for M.Tuberculosis and the remaining were positive for atypical mycobacteria namely M.kansasi, M.scrofulaceum, M.ulcerens and M.fortutium[57].

Miners are among the Key Populations that are prioritized by the RNTCP. We conducted a rapid assessment in a mining district in Odisha where the state government provides services through all three tiers of the health system. We did a quick assessment to identify data related gaps and service related challenges in providing TB care to those who are involved in the mining industry.

## Findings from Rapid Assessment of Health Systems

### *A. Data Requirement*

We visited the district of Angul in Odisha which is known for mining and other metal-based industries. The TB program has been in place in the district since inception and data regarding TB case detection and other RNTCP parameters are routinely collected. There is no information on the number of individuals who are involved in the mining industry or any other metal industry. The current patient treatment card has a provision for recording information about the Key Populations including miners.

**“We routinely collect the patient details from the field through the STS, but we never analyze it based on the proportion of cases in miners compared to general population and other industries in the district”**

The DTO said that mining companies have established township hospitals that provide preventive and curative care for the employees and other individuals. These hospitals report TB cases that are diagnosed among the workers who are involved in the industry.

**“Very minimal case detections happen at these hospitals and a very small number of cases are referred for CBNAAT and other services.”**

The government facilities in the district namely the CHC, PHCs, SDH and DH routinely report cases

of TB. The data namely, the number of new cases detected, the number of patient currently on treatment for both drug sensitive and drug resistant TB, the number of patients who completed treatment, the number of patients cured, the number of patients who are treatment failure or who have failed to adhere to treatment and the number of TB deaths are all available at the district and state levels This information is not available as incidence or prevalence data pertaining to miners alone, as the population estimate is not known.

### *B. Service Delivery*

The industry-affiliated hospitals provide their employees with a health card which makes them and their immediate family members avail of preventive, diagnostic and curative care. Through this card they can avail of both in- patient and outpatient care from the hospitals. If required they may be transferred to higher centers in Bhubaneshwar or Cuttack for treatment, free of charge.

There are around 7 dispensaries and one central hospital for the regular employees of the coal mines. There are other employees in the same campus, but they are not recruited by the company and are contractual laborers who are hired by a contractor to work in the areas around the mines collecting scraps and other types of work. These types of laborers do not have any health cards. Contractual laborers avail of consultations from the industry affiliated hospitals by paying a sum of Rs.2/-, however, they are not provided free medicines from these hospitals and seek care at government facilities or at private clinics.

The PHCs, CHCs, SDH and the DH are equipped to provide both diagnostic and curative care for TB. The district currently has 17 DMCs that provide diagnostic services for TB; three DMCs are located in the public-sector hospitals. The district has one CBNAAT machine which is functional and located in the DH. There are three DMCs located in the hospitals that are affiliated to three industries in the district. However, only two DMCs report cases to the DTO and the numbers reported are miniscule.

**“We get minimal referrals from these hospitals; even if there is a functional DMC in two of the centers, the number of cases coming from them are few. Over the last five years the number of cases reported from the coal mine hospitals have come down.”**

The medical officer in the industry -affiliated hospital said that there were very few cases of TB in the township, where the industry workers lived. Many contractual laborers used to visit the clinic, and were referred to the CHCs or SDH or seek further care in private hospitals. He also said that all the employees of the coal industry were advised a mandatory X-ray chest to rule out any pulmonary pathology.

**“We have reported some 100 TB patients, of which only 30 are involved in mining work, the rest are from the general population, that is the family of the miners or other laborer who work outside the mine field.”**

Once the cases are diagnosed by these hospitals the concerned STS of the area is informed about them to facilitate follow up and motivate them to visit the hospitals for periodic sputum examination. These hospitals provide regular DOTS treatment as per the RNTCP guidelines, however some also receive the non-DOTS form of treatment as per the wish of the patient. Similarly, for Extra Pulmonary TB, the doctors prescribe the medicines based on the progress of disease.

Governmental and industry-affiliated hospitals are all easily accessible by road. The industry-based dispensaries are located close to the residential quarters of the employees; hence they serve the first point of contact for any type of illness. Even those who are not recruited by the industry and working as a contractual laborers outside the industry avail of services from these dispensaries. But for DOTS and other TB related diagnosis and treatment these laborers approach the government facility, namely the CHC or SDH.

The staff in the RNTCP program at the government facilities are adequately trained in the TB program as they have incoming training and refresher training on a periodic basis. Also, the staff in the program are trained whenever there is a new development or guideline introduced in the program, so that it could be managed by them in the field.

The most common form of TB seen in these areas was pulmonary TB as many were involved in mining industry. However, from the hospital that was affiliated to non-mining industries, a large number of extra-pulmonary TB cases were diagnosed.

**"We get more cases of pulmonary TB; those cases of pneumoconiosis which further progresses to pulmonary TB are common here."**

The officials said that IEC activities were mostly undertaken in the places where the industry personnel are absent. The industry-based hospital, has information on TB in the DOTs center and in the hospital; no other places has any information related to TB disease and to other services provided to the patient regarding TB. Limited IEC activities happen in the mining areas and among the employees. However, plans are underway to carry out innovative IEC activities in the near future.

## Key Populations Perspectives

### *A. Information on Disease and Services*

The patients we met mentioned that they were aware about the problem of TB and many of them instead spoke of asthma and COPD. The miners said that they were aware of the services provided in the hospitals that are attached to the industry. However, the contractual laborers who were also in the vicinity of the same campus though aware about the disease said they were not aware about the services that are provided in the hospital.

**"We go to the central hospital, but after consultation we are not provided with other services as we are not regular employees. We will then go to the Talcher hospital where they do testing and later provide us with medicine."**

### *B. Access to Services*

For the regular employees of the mining industry and other industries in the district, all the hospitals are located in the campus of their residence only. In addition, the dispensary is the first point of contact closest to their homes. The contractual laborers access industry-based hospitals, and then seek diagnostic services and treatment at the CHC or the SDH which is some 5 km distance from their place of stay. The timing of the hospital is also not an issue for them as the working hours allow them to seek care at the hospital.

**"In the open cast mines I have 6 to 8 hours of work time so based on the shift I go to the hospital for the problems I have. Even if I go to a mine site distant from my home I can go to the dispensary or hospital in the evening too."**

However, contractual labors mostly seek government facilities and their hours of work sometimes delay their consultation with the doctors.

### *C. Availability of Services*

The miners said that the hospital in the campus had diagnostic and curative services and they did not have to any other facility to avail services. For specialty services such as cardiology or neurology, they would be referred to private hospitals in Bhubaneshwar or Cuttack. The CHCs and SDH are functional in providing both the diagnostic and curative services to TB care and the contractual labor avail of the services from these hospitals.

### *D. Stigma and behavior towards TB*

Patients mentioned that all their family members knew about their disease status as did their fellow miners. As there is a mandatory X-ray done for all the miners once in three years they are familiar with TB. Contractual laborers live in a different location from that of the township and the information about TB disease is not always shared with fellow workers and neighbors.

## Lessons Learned and Way Forward

Though there are many hospitals within the district which can provide TB services to the miners and other industrial workers in the district, the DTO office had a limited role in managing the cases from the mining community. However, in other part of the districts and with other laborers the RNTCP is as functional as in any other district or state.

### *Data Gaps*

The officials at the district level and the state level collect the data as a whole and such data is not specific to the mining population. The data is presented for the entire district population and not disaggregated on the basis of the Key Population. Though the officials obtain data from the DMC affiliated to the mining companies, the data is not provided in disaggregated form as the number of TB cases among miners and the general population. If information is collected in this way, this would help in understanding the exact problem of the disease in the mining community. Secondly,

the information on the number of miners who are currently working in the city could be collected. The data needs to be on miners who are employed in the open cast mines, who work underground, and also on the number of contractual labors hired by the local contractors. This would help the DTO understand the population he is managing as currently the population number available is based on the census and the health workers visits.

### *Service Delivery*

- **Inter-sectoral Coordination**: Both the RNTCP and the different mining organizations need to work on managing the burden of TB among the miners and other industries based in the state. The program need to be better coordinated. A few DMCs have been established within the hospitals that are affiliated to the industry. However, some of these centers are not functional and even the functional DMCs don't always report the cases and additional information as is done in other hospitals of the district. The state TB cell and the district TB cell needs to ensure the labs and the reporting practices of DMCs, through direct interaction with higher officials.
- **IEC activities**: Currently the IEC activities are focused among the general population and are based in the government facilities. We did not find any IEC information on TB in the industry-affiliated hospitals. It is important to coordinate with CMOs of those hospitals to conduct IEC activities in partnership with the state department within the campus and among the miners after seeking permission from the higher authorities in the industry. The content of the IEC plays a major role in making the mining community understand the nature and course of the disease, so more focus should be made on the effects of TB, adherence to treatment, the availability of TB services and reducing the stigma associated with the disease.
- **Counseling Services**: The industry-based hospitals should ensure that counselors are appointed to motivate all patients diagnosed with TB irrespective of their sensitivity status, to adhere to treatment till completion.. Considering the work of the miners, the counselors should focus more on the adherence to treatment and to the need for good nutrition.

# Conclusion

Tuberculosis is a persistent challenge in India and a major public health issue both in the country and across the world. The management of the disease has undergone many changes both in diagnosis and treatment. With many changes in the overall program, the approach to patient management too has adopted the approach of reaching Key Populations. Recently the RNTCP included a framework to reach diabetics and tobacco users and this is being implemented across the country. However, there are many other Key Populations needing attention. Though TB services are provided to all the patients across populations including Key Populations, the program has adopted the successful HIV management strategy of targeted interventions. This rapid assessment identifies a few areas pertaining to selected Key Populations that require to be addressed in a a Key Populations approach to managing TB.

We currently do not have information on the population sizes of Key Populations at the district or state levels, except for data on PLHIV, a Key Population. Available data on Key Populations comes from research studies or the recently implemented ACF.

This assessment identifies the analysis of the data from the perspective of Key Populations as being critical to program implementation. Except for HIV data, RNTCP data is rarely assessed and analyzed through a Key Populations perspective, even though the district is predominantly occupied by a particular type of Key Population. The current data collection portal NIKSHAY has provisions for collecting TB data with information on Key Populations. This could be a first step in understanding the issue of TB among Key Population. Either through small projects or as a pilot study, the burden of TB in particular Key Populations may be studied in a district or in a state. As such information flows into the program, it could inspire new approaches and changes in the management and delivery of services to specific Key Populations. This approach could help realize the intent of the government to eliminate TB by 2025 and attain the sustainable development goal of ending the epidemic of TB by 2030.

## Future work and Potential Research Opportunities

The rapid assessment has helped to identify key areas where the program could work to deliver better TB care to Key Populations. These areas could be researched to further understand the

issues associated with Key Populations and interventions could be designed in project/pilot mode to understand how they work in the field settings. We recommend research in the following areas:

A. **Population and Burden Estimation: We are yet to** develop a mechanism to estimate the burden of TB among Key Populations. The actual population or the estimated population of Key Populations needs to be enumerated at state and district levels as follows:

- **Tribal communities:** At the first step the population of the tribal in the district could be estimated using the census data (2011) and using the information collected at the household level by the health workers in the sub centers during their annual tour through each village and hamlet. This could be matched to assess the current population of tribal people in the particular district or block. After making the estimation, the number of TB cases detected in the village or block for the previous five year period could be used to arrive at a holistic understanding of the burden of TB disease and other programmatic parameters.
- **Slums and Migrants:** The population of the particular slum block or TU could be estimated based on the census findings and the ATP of the field worker of the particular block for the current number of people living in the slums, which would also give information of all individuals who have re-located to the current slum. This could be matched to the census population to understand the population level in the slum which will incudes slum dwellers as well as the migrants. Based on these population estimates, we may study the burden of TB and assess other epidemiological indicators among the slum dwellers and the migrant populations.
- **Diabetes:** The national and subnational burden of disease data could be used as a reference to understand the burden of the DM population in a particular state. This information could be used in understanding the dual burden of TB-DM in a particular state based on the information of burden of TB from the RNTCP. Information on public sector hospital would be available through the reporting system of the NPCDCS program and the number of DM cases in a particular state could be obtained from it. As many DM patients avail treatment in private sector, IMS data on the sale of OHAs and insulin in the private market could be used in understand the burden of DM in the private sector.
- **Mining**: Due to the non-availability of information on the number of miners in the districts, we could estimate the current population of the mining community and other individuals who work around the mines as a first step. As this information becomes available, it could be used to estimate the burden of TB among miners and other industry workers based in the specific district.

B. **Mapping of villages or hamlets where Key Populations reside:** With coordination from other departments the villages and hamlets where the tribal community lives could be mapped. This will help in assessing the distances they need to travel from the village to avail of services in the

public health facility associated with the village and locate alternative public health facilities which are closer to his place of stay. This can help in understanding the distances travelled by the individual from a village to a health facility and should there be a public health facility present near his village, but which belongs to another block or district or state, arrangements could be made so that he or she can avail of treatment from that facility closest to him. This can help in maintain adherence to treatment and follow up.

C. **Spatial Mapping :** Once the patient belonging to the slum or migrant community is registered for treatment under DOTS, based on the address, his coordinates could be mapped. This may be done for one district of a city where there is huge burden of TB. This has to be done for all new patients registered in one quarter to understand the conglomeration of the cases in a particular block or slum and later ACF could be deployed in the neighboring block to trace the contacts of the patient traced effectively.

D. **Initial Loss to Follow up:** In some instances, in the slum and migrant populations, the patient delay initiation of ATT after being diagnosed with TB. Available data on the date of diagnosis and the start of treatment could help identify such patients and the reasons for non initiation of ATT could be assessed by tracking the patient.

E. **Knowledge, attitude and behavior studies :** Studies could be conducted to understand the knowledge, attitudes and behavior of the miners and diabetics with regard to TB disease. A similar exercise needs to be conducted among TB patients for their knowledge and practice with regard to diabetes. This could be done by the district TB cell or the state TB cell with the help of students from the medical college and it can provide better insights into the world of Key Populations, their perceptions of TB and DM, and help inform the development of appropriate IEC materials and activities.

# Annexure 1

## Survey Questions

Which according to your experience are the top five priority populations among the shortlisted group by NSP? (Please give a rank of 1 to 5 for the choices given. Please do not gave the same value for two or more choices) For the population selected what according to you are the challenges/ difficulties faced in addressing the issue of TB. Please write the codes of challenges in the order of difficulty (Challenges: a) Lack of data [burden], b) Environment Risk [over crowded, poorly ventilated space, reside in zoonotic TB area], c) Faced with Biology Risks [reduced immunity, poor nutrition], d) Faced with behavior risk [inhaling exhaling from/into others mouth, sharing smoking equipment], e) legal & economic barrier to access the service [stigma, discrimination])

| Key Populations | Rank | Challenges | Key Populations | Rank | Challenges |
|---|---|---|---|---|---|
| Prisoners | | | Geriatric Population | | |
| Sex workers | | | Physically Challenged | | |
| Slum Dwellers | | | People living in hard to reach areas | | |
| Miners | | | Tribal | | |
| Hospital Visitors | | | Refugee or internally displaced | | |
| Health Care Workers | | | Illegal miners | | |
| Undocumented migrants | | | Diabetes | | |
| Silicosis | | | Undernourishment | | |
| Tobacco users | | | Inject drugs | | |
| Factory Workers | | | Women in setting of gender disparity | | |

| Key Populations | Rank | Challenges | Key Populations | Rank | Challenges |
|---|---|---|---|---|---|
| Construction Workers | | | Children | | |
| Community health Workers | | | PLHIV | | |
| Migrant Workers | | | Immunosuppressive therapy | | |
| Alcohol disorder | | | | | |

# Annexure 2

## Study Instrument for Rapid Assessment on Data for Action on Key affected population

### *Key Informant Interview*

### *Stakeholders (including program manager, WHO consultants, STS, MO, district and state TB officers)*

### *Data gaps/requirements*

1) Except a few Key Populations (PLHIV, DM, e.t.c) there is a lack of information on the other Key Populations. As a program manager how do you plan to assess the situation in these Key Populations?
2) Do you have any kind of data for the Key Populations at your level? (age, sex, region, burden)
3) What are the challenges in getting the data from/on these Key Populations in relation to TB care?
4) According to you what has to be included in addition to the existing data collection framework for TB to collect information on Key Populations?
5) Do you plan to estimate the size of these Key Populations in your administrative area? What data would you be particularly requiring for providing quality TB care?

### *Socio-Economic and Behavioral Factors*

1) Is there any kind of practice or behavior by the individuals of these Key Populations which could place them at an increased risk for TB? Or is there any kind stigma or behavior in these Key Populations which prevents them from availing TB care or general health care from health facilities? Could you explain if there are any.
2) Does economic background of these Key Populations prevent them from availing the services?

### *Gender and Legal Aspect*

1) In relation to gender, do female gender from these Key Populations avail the TB services without any difficulty? If so what kind of difficulty they have excluding the one which the Key Populations has as a whole?

2) Do you think we need to create a special legal framework or policy for the Key Populations to avail the services? Are you aware of any government policy or framework which includes these Key Populations for availing services?

***Health system requirements***

1. Is there a difficulty in providing any type of TB services (screening/diagnosis/Rx) to these Key Populations? If so what are the issues in providing the services?
2. Do you have adequate and trained HR for providing TB services to these Key Populations? If not what type of HR services are required to provide TB services?
3. Does your state/district have adequate diagnostics, consumables and drugs for providing TB services to these Key Populations? If not what type of additional resources do you require for providing services?
4. Have you coordinated with any private providers or NGOs for addressing the issues related to TB care in these Key Populations? If so what type of work done?

## Key informant interview or FGD

***Members from the Key Populations or the individual who liaises with them***

***Health system factors***

1) Do you have a health care facility nearby to avail health care services? If so is the facility government or private?
2) How far is the health facility for you to access health care services?
3) Is the facility easily approachable by road?
4) Do you find any difficulty in availing the services in these facilities? If so what are the difficulties faced by you in accessing the services?
5) Does the nearest health care facility provide services for TB care?
6) Did anyone of you had TB before or any of your family members had TB before?
7) Are you aware of the services provided for TB care in the nearest facility? If so what services you are aware of?
8) Have you availed TB care in these facilities? If yes what type of services did you avail? If no where did you avail the services?
9) How much time did it take for you get the sputum examination/results/initiation of treatment?
10) Did you find any difficulty in availing these services related to TB care? If so what are those difficulties? Or where you referred to any other facility to avail these services?

## Gender/Legal/Socio-economic factors

1. Did you have any financial implication (travel, food, medicine etc.) to avail the TB services in the facility you were treated? (if government only)
2. Is there any restriction from your family side or community for you to avail the services related to TB? If yes what type of restrictions you faced?
3. Do females in your community avail TB care or other medical care without any restriction? If not, why they do not avail?
4. Where you denied treatment or other services related to TB care anytime due to your current status? If so what are they?

# References


[1] National Strategic Plan for Tuberculosis Elimination 2017-2025. Central TB Division, Ministry of Health and Family Welfare, New Delhi (March 2017)

[2] Accessed from http://www.censusindia.gov.in/2011census/population_enumeration.html

[3] Annual Report 2016-17, Ministry of Tribal Affairs, Government of India, New Delhi

[4] Twelfth Five Year Plan (2012-17) Social Sectors, Planning Commission, Government of India

[5] Rural Health Statistics (2015-16), Ministry of Health and Family Welfare, Government of India

[6] International Institute for Population Sciences (IIPS) and ICF. 2017. National Family Health Survey (NFHS-4), 2015-16: India. Mumbai: IIPS.

[7] Revised National TB control Program Technical and Operational Guidelines for Tuberculosis Control in India (2016). Central TB Division, Directorate General of Health Services, Ministry of Health and Family Welfare, Government of India

[8] Thomas BE, Adinarayanan S, Manogaran C, Swaminathan S. Pulmonary tuberculosis among tribals in India: A systematic review & meta-analysis. Indian J Med Res. 2015 May;141(5):614-23.

[9] Datta M, Radhamani M P, Sadacharam K, et al. Survey for tuberculosis in a tribal population in North Arcot District. Int J Tuberc Lung Dis 2001; 5: 240–249

[10] Rao V G, Bhat J, Yadav R, Gopi P G, Selvakumar N, Wares D F. Diagnosis of pulmonary tuberculosis by symptoms among tribals in central India. Natl Med J India 2010; 23: 372–373.

[11] Yadav R, Rao V G, Bhat J, Gopi P G, Selvakumar N, Wares D F. Prevalence of pulmonary tuberculosis amongst the Baigas—a primitive tribe of Madhya Pradesh, Central India. Indian J Tuberc 2010; 57: 114–116

[12] Rao V G, Bhat J, Yadav R, Gopi P G, Selvakumar N, Wares D F. Prevalence of pulmonary tuberculosis among the Bharia, a primitive tribe of Madhya Pradesh, central India. Int J Tuberc Lung Dis 2010; 14: 368–370.

13 Sharma P, Jain S, Bamezai R, Tiwari P. Increased prevalence of pulmonary tuberculosis in male adults of Sahariya tribe of India: a revised survey. Indian J Community Med 2010; 35: 267–271.

14 Kaulagekar A, Radkar A. Social status makes a difference: tuberculosis scenario during National Family Health Survey-2. Indian J Tuberc 2007; 54: 17–23

15 Bhat J, Rao VG, Yadav R, Muniyandi M, Sharma R, Karfarma C, Luke C. Situation of drug resistant tuberculosis in Saharia tribe of central India. Indian J Med Res. 2015 May;141(5):636-9

16 Prakash R, Kumar D, Gupta VK, Jain S, Chauhan DS, Tiwari PK, Katoch VM. Status of multidrug resistant tuberculosis (MDR-TB) among the Sahariya tribe of North Central India. J Infect Public Health. 2016 May-Jun;9(3):289-97

17 Manjareeka M, Palo SK, Swain S, Pati S, Pati S. Diabetes Mellitus among Newly Diagnosed Tuberculosis Patients in Tribal Odisha: An Exploratory Study. J Clin Diagn Res. 2016 Oct;10(10)

18 National Sample Survey 69th Round, Ministry of Statistics and Program Implementation, National Statistical Organization, October 2014

19 Slums in India- A Statistical Compendium-2015, Ministry of Housing and Urban Poverty Alleviation, Government of India

20 Marimuthu P. Tuberculosis prevalence and socio-economic differentials in the slums of four metropolitan cities of India. Indian J Tuberc. 2016 Jul;63(3):167-170.

21 Dholakia Y, Mistry N. Active tuberculosis case finding in a migrant slum community, Mumbai, India. Int J Tuberc Lung Dis. 2016 Nov;20(11):1562.

22 Marimuthu, P. “Tuberculosis prevalence and socio-economic differentials in the slums of four metropolitan cities of India.” Indian J Tuberc 201763(3): 167-170.

23 Shrivastava, S. R. and P. S. Shrivastava “Tuberculosis: active case finding survey in an urban area of India, in 2012.” J Res Health Sci 13(1): 19-23.

24 Bhagyalaxmi A, Kadri AM, Lala MK, Jivarajani P, Patel T, Patel M. Prevalence of tuberculosis infection among children in slums of Ahmedabad. Indian Pediatr. 2003 Mar;40(3):239-43.

25 Stevenson CR, Critchley JA, Forouhi NG, Roglic G, Williams BG, et al. Diabetes and the risk of tuberculosis: a neglected threat to public health? Chronic Illn. 2007;3:228–45.

26 Jeon CY, Murray MB. Diabetes mellitus increases the risk of active tuberculosis: a systematic review of 13 observational studies. PLoS Med. 2008;5:e152.

27 Harries A D, Lin Y, Satyanarayana S, et al. The looming epidemic of diabetes associated tuberculosis: learning lessons from HIV-associated tuberculosis. Int J Tuberc Lung Dis 2011; 15: 1436–1444.

28 Leung C C, Lam T H, Chan W M, et al. Diabetic control and risk of tuberculosis: a cohort study. Am J Epidemiol 2008; 167: 1486–1494.

29 Goldhaber-Fiebert JD, Jeon CY, Cohen T, Murray MB. Diabetes mellitus and tuberculosis in countries with high tuberculosis burdens: individual risks and social determinants. Int J Epidemiol. 2011 Apr;40(2):417-28.

30 Khanna A, Lohya S, Sharath BN, Harries AD. Characteristics and treatment response in patients with tuberculosis and diabetes mellitus in New Delhi, India. Public Health Action. 2013 Nov 4;3(Suppl 1):S48-50.

31 Prakash BC, Ravish KS, Prabhakar B, Ranganath TS, Naik B, Satyanarayana S, Isaakidis P, Kumar AM. Tuberculosis-diabetes mellitus bidirectional screening at a tertiary care centre, South India. Public Health Action. 2013 Nov 4;3(Suppl 1):S18-22.

32 Naik B, Kumar AM, Satyanarayana S, Suryakant MD, Swamy NM, Nair S, Isaakidis P, Harries AD. Is screening for diabetes among tuberculosis patients feasible at the field level? Public Health Action. 2013 Nov 4;3(Suppl 1):S34-7

33 Siddiqui AN, Khayyam KU, Sharma M. Effect of Diabetes Mellitus on Tuberculosis Treatment Outcome and Adverse Reactions in Patients Receiving Directly Observed Treatment Strategy in India: A Prospective Study. Biomed Res Int. 2016;2016:7273935

34 Kumpatla S, Sekar A, Achanta S, Sharath BN, Kumar AM, Harries AD, Viswanathan V. Characteristics of patients with diabetes screened for tuberculosis in a tertiary care hospital in South India. Public Health Action. 2013 Nov 4;3(Suppl 1):S23-8

35 Balakrishnan S, Vijayan S, Nair S, Subramoniapillai J, Mrithyunjayan S, Wilson N, Satyanarayana S, Dewan PK, Kumar AM, Karthickeyan D, Willis M, Harries AD, Nair SA. High diabetes prevalence among tuberculosis cases in Kerala, India. PLoS One. 2012;7(10):e46502

36 Nair S, Kumari AK, Subramonianpillai J, Shabna DS, Kumar SM, Balakrishnan S, Naik B, Kumar AM, Isaakidis P, Satyanarayana S. High prevalence of undiagnosed diabetes among tuberculosis patients in peripheral health facilities in Kerala. Public Health Action. 2013 Nov 4;3(Suppl 1):S38-42.

37 Raghuraman S, Vasudevan KP, Govindarajan S, Chinnakali P, Panigrahi KC. Prevalence of Diabetes Mellitus among Tuberculosis Patients in Urban Puducherry. N Am J Med Sci. 2014 Jan;6(1):30-4.

38 Viswanathan V, Kumpatla S, Aravindalochanan V, Rajan R, Chinnasamy C, Srinivasan R, Selvam JM, Kapur A. Prevalence of diabetes and pre-diabetes and associated risk factors among tuberculosis patients in India. PLoS One. 2012;7(7):e41367. doi: 10.1371

39 Chachra V, Arora VK. Study on prevalance of diabetes mellitus in patients with T.B. under DOTS strategy. Indian J Tuberc. 2014 Jan;61(1):65-71.

40 India Tuberculosis-Diabetes Study Group. Screening of patients with tuberculosis for diabetes mellitus in India. Trop Med Int Health. 2013 May;18(5):636-45.

41 Stevenson CR, Forouhi NG, Roglic G, Williams BG, Lauer JA, Dye C, Unwin N. Diabetes and tuberculosis: the impact of the diabetes epidemic on tuberculosis incidence. BMC Public Health. 2007 Sep 6;7:234.

42 Mehta S, Yu EA, Ahamed SF, Bonam W, Kenneth J. Rifampin resistance and diabetes mellitus in a cross-sectional study of adult patients in rural South India. BMC Infect Dis. 2015 Oct 26; 15:451.

43 Ezung T, Devi NT, Singh NT, Singh TB. Pulmonary tuberculosis and diabetes mellitus--a study. J Indian Med Assoc. 2002 Jun;100(6):376, 378-9.

44 National Framework for Joint TB-Diabetes Collaborative Activities, Directorate General of Health Services, Ministry of Health and Family Welfare, Government of India, March 2017

45 Annual Report (2016-17), National Institute of Miners Health, Nagpur

46 Kulkarni GK. Prevention and control of silicosis: a national challenge. Indian J Occup Environ Med 2007;11(3):95–6.

47 Silicosis – an uncommonly diagnosed common occupational disease. ICMR Bulletin. September 1999;29(9). Available from: http://icmr.nic.in/busep99.htm

48 Ross MH, Murray J. Occupational respiratory disease in mining. Occup Med (Lond). 2004 Aug;54(5):304-10.

49 Segarra-Obiol F, Lopez-Ibanez P, Perez Nicolas J. Asbestosis and tuberculosis. Am J Ind Med 1983;**4:**755–757.

50 Singh HK. Pneumoconio-tuberculosis among Indian coal miners (observations on 126 cases). J Assoc Physicians India. 1973 Aug;21(8):671-80.

51 Mohapatra H, Goswami S, Dey D. Coalmine dust concentration and rate of tuberculosis infection around Ib Valley Coalfield, Orissa, India. J Environ Biol. 2010 Nov;31(6):953-6.

52 Jindal, S. K. (2013). “Silicosis in India: past and present.” Curr Opin Pulm Med 19(2): 163-168

53 Chaudhury, N., et al. “Co-morbidities among silicotics at Shakarpur: A follow up study.” Lung India **29**(1): 6-10

54 Tiwari, R. R., et al. (2007). “Tuberculosis among workers exposed to free silica dust.” Indian J Occup Environ Med 11(2): 61-64

55 Sivanmani, K. and V. Rajathinakar “Silicosis in Coimbatore district of Tamil Nadu: A passive surveillance study.” Indian J Occup Environ Med **17**(1): 25-28.

[56] Tiwari, R. R., et al. (2007). "Tuberculosis among workers exposed to free silica dust." Indian J Occup Environ Med 11(2): 61-64.

[57] Chopra K, Prakash P, Bhansali S, Mathur A, Gupta PK. Incidence and prevalence of silicotuberculosis in western Rajasthan: A retrospective study of three years. National Journal of Community Medicine. 2012;3(1):161–3.

# Desk Review

The tables in this section list a selection of studies on various key populations that were identified using relevant key words.

# 1. Alcohol Disorders &TB

| S. No | Author | Year | State | Area | Population | Methods | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Thapa, P | 2015 | Karnataka | Udupi | Alcohol | Cross sectional | To assess the prevalence, pattern and associated factors of alcohol use among tuberculosis patients | 20.3% (n=25) participants were alcoholic. 44% were low risk drinkers, 32% were hazardous drinkers, 4% were harmful drinkers & 20% were alcohol dependent. Age, sex, occupation, tobacco use, perceived health status & discrimination due TB positive status were significantly associated with alcohol use. On logistic regression sex, tobacco use, perceived health status and facing discrimination due infection with TB were found to be factors associated with alcohol use. | This study found a high prevalence of alcoholism among TB patients which is of concern and has to be addressed. |
| 2 | Pednekar, M. S. | 2011 | Maharashtra | Mumbai | Alcohol | Cohort | To examine the association between alcohol, alcohol and tobacco, and mortality in a large adult population | Compared with those who never drank alcohol, alcohol drinkers had 1.22 times higher risk of mortality, with the highest risk observed for liver disease (hazard ratio [HR]=3.19). Among ever drinkers, risk of mortality varied according to types (country/desi), frequency (four or less times a week, HR=1.39), and quantity of alcohol consumed (>100 ml) per day. In addition, country/desi drinkers (HR=1.34) had the highest mortality risk compared with all other types of alcohol (HR=0.97). Alcohol drinkers had increased risk of mortality for tuberculosis (HR=2.53), cerebrovascular disease (HR=1.83), and liver disease (HR=3.19). | The results of this study show a direct association between greater consumption of alcohol and increased risk of mortality from alcohol-specific causes. In addition to individual effect, this study demonstrates the synergistic interaction between alcohol and tobacco use in various forms on mortality. |
| 3 | Anand, A C | 2011 | Maharashtra | NA | Alcohol | Case control | The clinical risk factors predicting the development of hepatotoxicity in Indian patients with tuberculosis on antituberculosis treatment | Age, Sex, history of alcohol intake and BMI were not found to be related to development of hepatotoxicity. Presence of HBV infection or an underlying silent chronic liver disease were found to significantly increase the risk of development of ATT-induced hepatotoxicity. Continuation of ATT after development of jaundice was associated with a high fatality rate. It was possible to re-introduce isoniazid in 96% and rifampicin in 88% of patients with ATT induced hepatotoxicity. | ATT-induced hepatitis is common and is potentially fatal. It is likely to occur in those with underlying silent chronic liver disease, HBV infection and have been given ATT without a definite evidence of tuberculosis. Discontinuation of ATT leads to rapid recovery in most cases and drugs can safely be introduced after recovery in a majority of cases. |
| 4 | Gajalakshmi, V. | 2009 | NA | NA | Alcohol | Case control | Smoking, drinking and incident tuberculosis in rural India | 81.5% of the cases and 55.2% of the controls had ever smoked, yielding a standardized ever- vs never-smoker TB incidence RR of 2.7. Among control ever-smokers 96% still smoked, 71% used only bidis & 28% used only cigarettes. After additional adjustment for alcohol, this RR was 2.2, but even among those who had never drunk alcohol the standardized ever- vs never-smoker RR was 2.6. The corresponding RRs for ever- vs never-drinking were somewhat less extreme: 2.2 without adjustment for smoking, 1.5 with adjustment for smoking and 2.1 among those who had never smoked. Among control ever-drinkers, | Demonstrates an increased incidence of pulmonary TB among those who smoke and among those who drink. The effects of smoking after adjustment for drinking were more definite than those of drinking after adjustment for smoking. |

| S. No | Author | Year | State | Area | Population | Methods | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|
| 5 | Veerakumar, A. M. | 2015 | Pondicherry | NA | Alcohol | Cross sectional | To study the prevalence and pattern of alcohol use among the PTB patients registered under RNTCP | Prevalence of alcohol use among PTB patients at the time of diagnosis was 59% and during treatment was 31.5%. Around 54% PTB patients had alcohol use disorders (AUD) during diagnosis, whereas the same during treatment was 26.4%. Among drinkers at the time of diagnosis (n=139), 80% modified and 20% did not modify their alcohol use even after TB diagnosis. Male gender was significantly associated with alcohol use (p</=0.001). Univariate analysis showed that lower level of education, lower SES, unemployed/unskilled/ semiskilled/skilled occupational group, and Category II were significantly associated with alcohol use among male patients (p<0.05). Multivariate analysis showed that none of the variables were associated | One-third of PTB patients were drinking alcohol during the treatment. Though 80% modified alcohol use after TB diagnosis, the rest 20% did not modify. Necessary interventions need to be planned to screen for alcohol use. |
| 6 | Bhushan, B | 2014 | Punjab | NA | Alcohol | Cohort | To elucidate the profile of adverse drug reactions (ADRs) associated with second-line anti-tubercular treatment for drug-resistant tuberculosis | Out of total 195 adverse events, 63.58%, 18.46% and 17.94% were of mild, moderate and severe types respectively. Gastrointestinal events, hepatitis, hearing impairment, arthralgia, psychosis, hypothyroidism, visual disturbances, giddiness, peripheral neuropathy, skin reactions, swelling or pain at injection site, anorexia and sleep disturbances were important amongst these. High proportion of drug and/or alcohol abuse was an important observation. The offending drug(s) had to be terminated in 12.08% of the patients. | Early detection, management and pharmaco-vigilance reporting of ADRs remain key factors in the management of drug-resistant tuberculosis with remarkable relevance of the need for early diagnosis and treatment of 'drug-sensitive tuberculosis', to prevent emergence of drug-resistant tuberculosis. |
| 7 | Suhadev, M. | 2011 | Tamil Nadu | Chennai | Alcohol | Cross sectional | To estimate prevalence of alcohol use and AUDs among TB patients | Out of 490 TB pts, 29% (141) were found to consume alcohol. Among 141 current drinkers 52% (73) had an AUDIT score of >8. Age (>35 years), education (less educated), income (<Rs 5000 per month), marital status (separated/divorced) and treatment category (Category 2) were statistically significant for TB patients with alcohol use than those TB patients without alcohol use | Alcohol Use Disorders (AUD) among TB patients needs to be addressed urgently and the findings suggest the importance of integrating alcohol treatment into TB care. |
| 8 | Thomas, B. | 2011 | Tamil Nadu | Chennai | Alcohol | Qualitative | Feasibility of an alcohol intervention programme for TB patients with alcohol use disorder (AUD) | TB patients with AUD report excessive alcohol intake as one of the reasons for their vulnerability for TB. Peer pressure has been reported by many as the main reason for alcohol consumption. The influences of alcohol use on TB treatment has been elaborated especially with regard to the fears around the adverse effects of alcohol on TB drugs and the fear of being reprimanded by health providers. The need for alcohol intervention programs was expressed by the TB patients, their families and health providers. Suggestions for the intervention programmes included individual and group sessions, involvement of family members, audiovisual aids and the importance of sensitization by health staff. | The findings call for urgent need based interventions which need to be pilot tested with a randomized control trial to bring out a model intervention programme for TB patients with AUD. |

| S. No | Author | Year | State | Area | Population | Methods | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|
| 9 | Thomas, B. | 2017 | Tamil Nadu | Chennai | Alcohol | Intervention | Alcohol intervention strategy among tuberculosis patients | Of 872 TB patients, 298 (31%) were found to have alcohol use disorders. The numbers of TB patients in the experimental and control arms were respectively 113 (38%) and 185 (62%). The proportion of patients with favourable treatment outcomes was higher in the intervention than in the control group (87% vs. 62%, P = 0.04). Overall adherence to anti-tuberculosis treatment was significantly higher in the intervention group (P = 0.02). | Study findings suggest that alcohol interventions could be effective in ensuring favourable TB treatment outcomes and adherence. |
| 10 | Jain, K. | 2014 | Gujarat | Ahmedabad | MDR | Observational | To evaluate the treatment outcome of second line drugs used in DOTS | Smoking habit (P < 0.05) and alcohol consumption (P < 0.05) were negative predictors of successful treatment outcome. | The treatment outcome of standardized regimen in MDR-TB patients was low. The long duration of treatment and defaulters are major challenges for a successful outcome. |
| 11 | Davies, P. D | 2006 | NA | NA | Smokers | Review | Link between tuberculosis and smoking | Where an association has been found there seems to be an increase in tuberculosis case rates of between two- and four-fold for those smoking in excess of 20 cigarettes a day, but it may be difficult to control for other factors, particularly alcohol consumption. A likely possibility is that nicotine turns off the production of TNF-alpha by the macrophages in the lungs, rendering the patient more susceptible to the development of progressive disease from latent Mycobacterium tuberculosis infection. A likely possibility is that nicotine turns off the production of TNF-alpha by the macrophages in the lungs, rendering the patient more susceptible to the development of progressive disease from latent Mycobacterium tuberculosis infection. | NA |

| S. No | Author | Year | State | Area | Population | Methods | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|
| 12 | Prabhakar, H. | 2005 | NA | NA | Tribal | Model | Evaluates a current healthcare model for tribals, and explores it in combination with the health status of the target population, placing emphasis on the long term sustainability and cross-implementation of the model. | Gender susceptibility patterns revealed disparities in anaemia and tuberculosis besides fluctuations in gastrointestinal disorders, tuberculosis and typhoid. A combination of gender- and age-susceptibility patterns revealed specific age intervals for mental health-related disorders. Mortality patterns indicated an Increase in youth deaths and suicide, with an overall reduction in infant mortality. However, an increased tribal confidence in allopathic medicine was noted after implementation of the health system | Gender susceptibility patterns revealed disparities in anaemia and tuberculosis besides fluctuations in gastrointestinal disorders, tuberculosis and typhoid. A combination of gender- and age-susceptibility patterns revealed specific age intervals for mental health-related disorders. Mortality patterns indicated an Increase in youth deaths and suicide, with an overall reduction in infant mortality. However, an increased tribal confidence in allopathic medicine was noted after implementation of the health system The formulation of mental health programmes and long term educational initiatives at the village level are critical to reducing suicide and infant mortality. |
| 13 | Dhanaraj, B. | 2015 | Tamil Nadu | Chennai | Urban | Cross sectional | Risk factors for adult pulmonary tuberculosis in a metropolitan city of South India | Bacteriologically positive PTB was estimated to be 228, 259 & 349 per 100,000 population, respectively. Prevalence of smear, culture, and bacteriologically positive PTB was highest. Multivariate analysis showed that occurrence of both culture and bacteriologically positive PTB disease was significantly associated with: age >35 years, past history of TB treatment, BMI <18.5 Kgs/m2, solid cooking fuel, and being a male currently consuming alcohol. | TB is a major public health problem in this urban area of south India, and support the use of intensified case finding in high risk groups. Undernutrition, slum dwelling, indoor air pollution and alcohol intake are modifiable risk factors for TB disease. |
| 14 | Marak, B. | 2016 | Meghalaya | East Garo Hills District | Alcohol | Cross sectional | To estimate the prevalence of tobacco, alcohol use, hypertension and diabetes among tuberculosis (TB) patients | Prevalence of ever smoking was 74.5% and 55.4%; alcohol consumption 31.0% and 22.3%; hypertension 24.5% and 17.3%; diabetes 7.5%, 4.5% among TB patients and non-TB subjects, respectively. | NCD and TB programmes need integration in the primary care for screening, counselling and treatment of NCD comorbidities. |
| 15 | Kumpatla, S | 2013 | Tamil Nadu | NA | Diabetes Mellitus | NA | To compare the socio-demographic, clinical and biochemical characteristics in DM patients with and without tuberculosis | DM-TB patients were older, and had lower education level and economic status, a higher frequency of alcohol use, lower body mass index, a longer duration of DM, a greater likelihood of receiving insulin and poorer glycaemic control. | Screening of DM patients for TB was feasible in a tertiary care hospital. The yield of new TB cases was low and merits further investigation. Socio-demographic and clinical characteristics were different in patients with DM and TB compared to those with DM only. |

| S. No | Author | Year | State | Area | Population | Methods | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|
| 16 | Shamanna, S. B. | 2016 | Pondicherry | NA | HIV | Descriptive | The causes of liver disease in HIV-infected patients and short-term outcome in them | Six patients had probable hepatic involvement due to tuberculosis. Ten patients had antituberculosis drug-induced hepatotoxicity. One patient had acute hepatitis B and seven patients had chronic hepatitis B. The cause could not be established in 10 patients (20 %). After a median period of 8 months of follow up, 23 patients had improved, 19 patients (37 %) had died, and six patients had been lost to follow up. Of the patients who had died, 11 patients (58 %) had tuberculosis, and 6 patients (30 %) had decompensated alcoholic liver disease | Liver disease in HIV-infected patients was associated with high mortality. Alcohol abuse, tuberculosis, and antituberculosis drugs were the major causes. |
| 17 | Hiregoudar, V. | 2016 | South India | NA | HIV | Sample | To find out the proportion and determinants of TB in HIV-positive subjects | On bivariate analysis, 136 (42.4%) married subjects and those from rural areas were more commonly affected by TB compared to subjects who were unmarried and from urban areas with odds ratio (OR): 1.555, confidence interval (CI): 1.077-2.246 and OR: 1.523, CI: 1.061-2.185, respectively. The proportion of TB was high among subjects who lived in overcrowded houses 130 (44.2%), and who had a habit of alcohol use compared to others with OR: 1.731, CI: 1.734-2.179 and OR: 1.524, CI: 1.045-2.223, respectively. Logistic regression analysis showed that TB among people living with HIV/AIDS was highest in persons living in overcrowded houses (OR: 1.706, CI: 1.185-2.458) and those who consumed alcohol (OR: 1.605, CI: 1.090-2.362). | Demographic factors like male gender, middle age, living in the rural areas, consumption of alcohol, and living in overcrowded houses were found with a higher proportion of TB. The use of highly active ART appeared to progressively decrease but did not completely eliminate the risk of TB. |
| 18 | Kolappan, C. | 2007 | Tamil Nadu | Tiruvallur | Rural | Cross sectional | Selected biological and behavioural risk factors associated with 66Spulmonary tuberculosis | The adjusted PORs (with 95%CI) for age, sex, smoking and alcoholism were 3.3 (2.7-4.1), 2.5 (1.9-3.3), 2.1 (1.7-2.7) and 1.5 (1.2-2.0), respectively. | Risk factors such as age, sex, smoking and alcoholism are independently associated with pulmonary TB. Risk factors age and sex show a stronger association than smoking and alcoholism. |
| 19 | Sharma, S. K. | 2002 | Delhi | AIIMS | TB patients | Comparative study | The major histocompatibility complex (MHC) class II alleles and clinical risk factors for the development of hepatotoxicity | Patients with high alcohol intake had threefold higher odds of developing hepatotoxicity. In multivariate logistic regression analysis, older age (odds ratio [OR] 1.2), moderately/far advanced disease (OR 2.0), serum albumin < 3.5 g/dl (OR 2.3), absence of HLA-DQA1*0102 (OR 4.0), and presence of HLA-DQB1*0201 (OR 1.9) were independent risk factors for DIH | The risk of hepatotoxicity from antituberculosis drugs is influenced by clinical and genetic factors. |

| S. No | Author | Year | State | Area | Population | Methods | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|
| 20 | Shetty, N. | 2006 | Karnataka | Bangalore | TB patients | Case control | To evaluate potential socio-demographic risk factors for TB | Significant risk factors were low education level (OR 0.30; 95%CI 0.11-0.82), not having a separate kitchen (OR 3.26; 95%CI 1.25-8.46) and chronic disease, mainly diabetes (OR 2.44; 95%CI 1.17-5.09). High income, cooking with biomass fuels, history of smoking and alcohol consumption were not significant on multivariate analysis. Patients were respectively 11 and seven times more likely to have a BMI <18.5 (95%CI 5.62-21.98) and mid-arm circumference <24 cm (95%CI 3.87-11.89). | TB was associated with low education level, kitchen type and diabetes, reflecting the complex interaction between non-communicable disease, urbanisation and a changing economic climate in Bangalore. The relationship between TB, the use of biomass cooking fuels and gender differentials related to fuel exposure merit further exploration. The study underscores the poor nutritional status of patients. |
| 21 | Gaude, G. S. | 2015 | NA | NA | TB patients | Cohort | Drug-induced hepatitis and the risk factors for liver injury in pulmonary tuberculosis patients | The prevalence of DILI in the present study was 3.8%. It was observed that DILI patients were older and their serum albumin levels were lower, and they had multiple co-morbid conditions. Regular alcohol intake, more extensive disease associated with radiological and female gender were observed to be independent risk factors for the development of DILI. | Of the various risk factors analyzed, advanced age, hypoalbuminemia, regular alcohol intake and advanced nature of the disease were independent risk factors for the development of DILI. The risk of development of hepatitis is increased in the presence of one or more of these risk factors. |
| 22 | Pande, J. N. | 1996 | Delhi | NA | TB patients | Case control | To assess the role of age, sex, disease extent, nutritional status, past history of liver disease, infection with hepatitis viruses, acetylator status, 2and high alcohol intake as risk factors in the development of hepatotoxicity in patients with PTB | High alcohol intake was more common among the cases, they had more extensive disease radiologically, and the proportion of slow acetylators was higher. No differences were observed between the two groups in the other risk factors analysed. | Only advanced age, hypoalbuminaemia, high alcohol intake, slow acetylator phenotype, and extensive disease were risk factors for the development of hepatotoxicity. The risk of hepatitis in the presence of one or more of these risk factors may be increased. |
| 23 | Jaggarajamma, K. | 2007 | Tamil Nadu | Tiruvallur | Alcohol | Cohort | Reasons for non-compliance among patients treated under RNTCP | Sixteen (9%) had completed treatment, 25 (13%) died after defaulting, and 4 (2%) could not be traced. Main reasons given by the remaining 141 patients and their DOT providers were: drug related problems (42%, 34%), migration (29%, 31%), relief from symptoms (20%, 16%), work related (15%, 10%), alcohol consumption (15%, 21%), treatment from other centers (13%, 4%), respectively. Risk factors for default were alcoholism (P<0.001), category of treatment (P<0.001), smear status (P<0.001), type of disease (P<0.001) and inconvenience for DOT (P<0.01) | This study has identified group of patients vulnerable to default such as males, alcoholics, smear positive cases, and DOT being inconvenient. Intensifying motivation and counselling of this group of cases are likely to improve patient compliance and reduce default. |

| S. No | Author | Year | State | Area | Population | Methods | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|
| 24 | Weiss, M. G. | 2008 | NA | NA | TB patients | Exploratory model | To identify and compare socio-cultural features of tuberculosis (TB) and the distribution of TB-related experiences, meanings and behaviours with reference to gender across cultures in three high-endemic low-income countries | Female patients reported more diverse symptoms and men more frequently focused on financial concerns. Most patients reported psychological and emotional distress. Men emphasised smoking and drinking alcohol as causes of TB, and women in Malawi reported sexual causes associated with HIV/AIDS. In Bangladesh, exaggerated concerns about the risk of spread despite treatment contributed to social isolation of women. Public health services were preferred in Malawi, and private doctors in India and Bangladesh. | Health systems benefit from sex-disaggregated epidemiological data complemented by cultural epidemiological study, which together clarify the role of gender and contribute to the knowledge base for TB control at various levels. |
| 25 | Dolma, K. G. | 2012 | Sikkim | NA | TB patients | Case control | Determinants for the retreatment groups of pulmonary tuberculosis patients treated in a DOTS programme | 45% reported TB is caused by germs. 81.4% stated TB presents only as cough. 94.8% of the case & 90.8% of the control stated it is a transmissible disease. Sharing food with TB patients (64% of case, 55% of the control), inadequate diet (16.4% of case , 9.6% of the control) were mentioned as modes of transmission. 66% case & 56.8% of the control mentioned use of DOTS for prevention & control. 66% control regarded TB as a life threatening condition. TB was considered as a completely curable disease by 96.4% of the case 40.6% of the respondents agreed to be in contact with a TB infected person. 64% of the retreatment group discontinued their treatment due to frequent travelling for work. | The study revealed lack of knowledge, positive attitude and inappropriate health seeking behaviours among of the tuberculosis patients, irrespective of their categorization. |
| 26 | Rao, V. G. | 2011 | Madhya Pradesh | Sheopur | Tribal | Cross sectional | Selected risk factors associated with pulmonary tuberculosis among Saharia tribe | Persons aged >/=45 years, males, smokers and alcohol consumers had higher risks of developing TB disease. | There is an urgent need to develop and implement culturally appropriate awareness raising activities to target smoking and alcohol consumption to support the efforts to control TB in this community |

# 2. Community Health Workers & TB

| S.No | Author | Year | State | Area | Theme | Subject | Methods | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Fathima, F. N. | 2015 | Karnataka | NA | Access | Behaviour | Cross sectional | To assess adherence to selection criteria in the recruitment of ASHA workers and to assess their performance against their job descriptions in Karnataka state, India | Performance was moderate (40-60%) for: drug provision for tuberculosis, caring of children with diarrhoea or pneumonia, and organizing village meetings for health action. Performance was low (<25%) for advice on: contraceptive-use, obstetric danger sign assessment, and neonatal care. This was self-reported by ASHAs and corroborated by mothers. In conclusion, ASHA workers were largely recruited as per preset selection criteria with regard to age, education, family status, income, and residence. | The ASHA workers were found to be functional in some areas with scope for improvement in others. The role of an ASHA worker was perceived to be more of a link-worker/facilitator rather than a community health worker or a social activist. |
| 2 | Kulkarni, P | 2013 | Maharastra | Mumbai | Risk | Behaviour | Cohort | Non-adherence of new pulmonary tuberculosis patients to anti-tuberculosis treatment | 50%) were non-adherent to anti-tuberculosis treatment (ATT). Independent risk factors for non-adherence were identified as male gender (P = 0.035) and lack of knowledge of importance of regular treatment (P = 0.001). Being female sex worker (FSW) was also an absolute risk factor for non-adherence. | There is immense need for continuous, effective and reinforcing health education to the patient and his family. Special groups like males in the age group of 15-49 years, patients who do not have any family support like migrants, FSW need special attention to ensure adherence to ATT. |
| 3 | Singh, A. | 1995 | Haryana | NA | Burden | Chronic disorders | Sample survey | Estimation of chronic disease load in a rural area of Haryana | Tuberculosis, diabetes, hypertension and asthma were significantly more prevalent in higher age group. Consultation rate was high in tuberculosis, asthma, hypertension and diabetes. | NA |

| S.No | Author | Year | State | Area | Theme | Subject | Methods | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|---|
| 4 | Dandona, R. | 2004 | Andra Pradesh | Hyder-abad | Access | Legal/ Economic | Cohort | Utilization of and barriers to public sector tuberculosis services in India | The odds of not completing the process of diagnosis of tuberculosis were significantly higher for patients > 50 years of age, those who were never married or married currently, those with symptoms for < or = 15 days, those who had gone alone for diagnosis, and those who were not informed about a suspicion of tuberculosis by the health personnel at the time of diagnosis. Among the reasons for not completing the process of diagnosis of tuberculosis, health provider-related barriers were cited most frequently (45.9%), followed by improvement in symptoms. Health provider-related barriers were also cited most frequently (40.4%) by those who had completed the process of diagnosis but did not start treatment in the RNTCP facility. the odds of not completing the treatment of tuberculosis were significantly higher for men, those who were ever married, those who were not informed that tuberculosis was curable, those who were not informed of the duration of treatment at the time of starting treatment, those who were dissatisfied with the DOTS provider, and those who had health facility staff as the DOTS provider compared with those who had an anganwadi/health worker. Medicine-related barriers were cited most frequently by patients who had defaulted in the intensive (37.1%) or continuation (23.1%) phase of treatment | Of the persons utilizing the RNTCP services, about one-third are women. The health services-related factors indicated in the multivariate analysis for less than optimal utilization of the RNTCP services, and the health provider-related and treatment-related barriers to utilization of the RNTCP services at various levels cited by the patients suggest the need to adopt a patient-centred approach to improve utilization of the RNTCP services. |
| 5 | Kamineni, V. V | 2011 | Odisha | NA | Access | Legal/ Economic | Rapid assessment and response (RAR) | To identify the impact of project interventions including the use of 'Interface NGOs' and involvement of community groups such as women's self-help groups, local government bodies, village health sanitation committees, and general health staff in promoting TB control efforts. | A combination of factors including the involvement of Interface NGOs, coupled with increased training and engagement of front line health workers and community groups, and dissemination of community based resources, contributed to improved awareness and knowledge about TB in the targeted districts. Project activities also contributed towards improving health worker and community effectiveness to raise the TB agenda, and improved TB literacy and treatment adherence. Engagement of successfully treated patients also assisted in reducing community stigma and discrimination. | Kamineni, V.Vetal. "A rapid assessment and response approach to review and enhance advocacy, communication and social mobilisation for tuberculosis control in Odisha state, India." BMC Public Health 11: 463. |

| S.No | Author | Year | State | Area | Theme | Subject | Methods | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|---|
| 6 | Kapoor, S. K. | 1996 | Haryana | Ballav-garh | Access | Legal/ Economic | Descriptive | Time utilisation pattern of staff of two primary health centres | The MPWs spend about 3.3 minutes in each house. Child care (immunisation, Vit. A and folifer distribution) is the main activity being carried out by both male as well as female worker. Other important activities for male worker are: family welfare (18%), malaria work (11%) and collection of vital statistics (10%). For the female worker Antenatal care (25%) and family welfare (20%) were other important activities. For the HAs also child care was an important activity. However for the male HA malaria related work was the most important. The Medical Officer spends about 60% of this time in administrative and supervisory work. | Immunisation programme is getting the maximum input from workers, which is reflected in > 90% coverage of all vaccines. Family Welfare and Tuberculosis activity are not getting the emphasis which they deserve. Some rethinking about the strategy is essential if all round progress in achieving the targets |
| 7 | Singh, V | 2002 | Delhi | NA | Burden | Poverty, Vulnerability | Descriptive | TB control, poverty, and vulnerability in Delhi, India | The cure rates for the clinics were 71 and 75% with a default rate of 6 and 11%, respectively. An important finding was that health workers screened patients to determine their ability to conform to the direct observation of treatment element of the RNTCP. If the health worker was confident that the patient would comply and/or be easy to trace in the community in the event of 'default', they were provided with short-course treatment under the RNTCP. Other patients, largely those who were in absolute poverty, socially marginalized, itinerant labourers, poorly integrated in the city, were put on standard tuberculosis (TB) treatment as for the previous National TB Programme. The programme was evidently excluding the most vulnerable from the best available care. | These findings demonstrate the potential dangers of target-driven programmes where there is an absence of support to both frontline health workers and patients. The paper also highlights the importance of operations research in helping to identify problems within TB programmes. |

# 3. Construction Workers & TB

| S. No. | Author | Year | State | Area | Population | Methods | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Gupta, P. | 1999 | NA | Jodhpur | Quary workers | Observational | Ventilatory functions in stone quarry workers | The presenting complaints included cough with sputum (55%), chest pain (79%), bodyache (31%) and 21% gave the history as suffering from TB. The observed lung functions were also found to be lower on comparison with the normative data from Rajasthan. However, no difference in observed lung function results of smokers and nonsmokers were obtained. | The reported lower values of lung functions independent of smoking habits, may be due to occupational stone dust exposure. |
| 2 | Tiwari, R. R. | 2007 | Gujarat | Ahmedabad | Silicosis | Cross sectional | Active TB among free silica exposed workers | Among stone crushers the prevalence of TB was found to be 10.7% while among slate pencil workers it was as high as 22.5%. Among the quartz stone-crushers the workers aged >/=35 years, those exposed for >/=3 years and those who were smokers had higher risk TB while among the slate pencil workers, only those exposed for >/=10 years had higher risk. Though the FVC and FEV(1) values of the workers having TB were lower than those having normal radiographs, the differences were found to statistically non-significant. | Those working in mines, construction work, stone-crushing and in other similar occupations where there is a greater level of exposure to silica dust are specially vulnerable. |
| 3 | Jindal, S. K. | 2013 | NA | NA | Silicosis | Review | Burden of the problem of silicosis and its clinical manifestations | There are over 3 million workers exposed to silica dust, whilst 8.5 million more work in construction and building activities, similarly exposed to quartz. Several recent reports on lung function assessment show both restrictive and obstructive patterns. Tuberculosis is a common complication reported in India | Silicosis is a common occupational disorder seen all over India, particularly in the Central and Western States. It is an important cause of respiratory morbidity. The problem has been highlighted on the national level as a major human-rights concern in India. |

# 4. Diabetes & TB

| S.No | Author | Year | State | Area | Population | Methods | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Harries, A. D. | 2015 | NA | NA | Diabetes Mellitus | Review | Diabetes mellitus and tuberculosis: programmatic management issues | Key programmatic challenges include the following: whether screening should be directed at all patients or targeted at those with high-risk characteristics; the most suitable technologies for diagnosing TB and diabetes in routine settings; the best time to screen TB patients for DM; how to provide an integrated, coordinated approach to case management; and finally, how to persuade non-communicable disease programmes to adopt a cohort analysis approach, preferably using electronic medical records, for monitoring and evaluation | The link between DM and TB and the implementation of the collaborative framework for care and control have the potential to stimulate and strengthen the scale-up of non-communicable disease care and prevention programmes, which may help in reducing not only the global burden of DM but also the global burden of TB. |
| 2 | Harries, A. D. | 2013 | NA | NA | Diabetes Mellitus | Review | The epidemiology and interactions of these two diseases, | Undiagnosed, inadequately treated and poorly controlled DM appears to be a much greater threat to TB prevention and control than previously realised, and the problem needs to be addressed. Prevention of DM through attention to unhealthy diets, sedentary lifestyles and childhood and adult obesity must be included in broad non-communicable disease prevention strategies. | Collaborative framework provides a template for action, and the recommendations now need to be implemented and evaluated in the field to lay down a firm foundation for the scaling up of interventions that work and are effective in tackling this dual burden of disease. |
| 3 | Khanna, A. | 2013 | Delhi | Lok Nayak Hospital | DM-TB | Descriptive | Characteristics and treatment response in patients with tuberculosis and diabetes mellitus in New Delhi, India | Of 458 TB patients, 66 (14%) had DM. In those with dual disease, age >/=40 years, smear-positive pulmonary TB and recurrent TB were significantly more common. There was no effect of DM on TB treatment outcomes, although there was a trend towards smear non-conversion at 2 months. | Screening for DM works well, and certain patient characteristics are more common in those with dual disease. |
| 4 | Mehta, S. | 2015 | Andhra Pradesh | Arogyavaram | DM-TB | Cross sectional | Rifampcin resistance and diabetes mellitus | Among patients with confirmed TB (n = 194), diabetes was associated with 3.0-fold higher risk of rifampin resistance (95 % CI 1.3-6.7). Considering Xpert MTB/RIF the gold standard, AFB had lower sensitivity (72.2 vs. 82.5 %) and higher specificity (96.4 vs. 37.0 %) compared to QFT-G for diagnosing TB | The increased risk of rifampin resistance in patients with diabetes highlights the need for integrated diabetes surveillance in TB programs, particularly in settings undergoing the epidemiological transition. |
| 5 | Prakash, B. C. | 2013 | Karnataka | Bangalore | DM-TB | Descriptive | To assess the feasibility and results of TB-DM bidirectional screening. | Of 510 TB patients, 32 (6.3%) had been previously diagnosed with DM. Screening among the remaining 478 patients yielded 15 (2.9%) with pre-diabetes and 15 (2.9%) newly diagnosed cases of DM. A higher prevalence of DM was found among patients aged >/=40 years, patients with pulmonary TB and smokers. Of the 47 TB-DM patients, 45 were enrolled in DM care. Of 1670 DM patients followed up in DM clinics, 45 already had TB. Among the remaining 1625 patients screened, 152 (9%) had symptoms suggestive of TB; two of these were found to have the disease. | Bidirectional screening for DM and TB is feasible and produces a high yield for DM among TB patients. The yield of TB among DM patients was low and needs future research using new, improved TB diagnostic tools. |

| S.No | Author | Year | State | Area | Population | Methods | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|
| 6 | Mahishale, V. | 2017 | Karnataka | Belgaum | DM-TB | Sample | Effect of Poor Glycemic Control in Newly Diagnosed Patients with Smear-Positive Pulmonary Tuberculosis and Type-2 Diabetes Mellitus | A total of 630 individuals who met the inclusion criteria were analyzed; of which 423 patients had poor glycemic control (PGC) and 207 patients had optimal glycemic control (OGC). The average HbA1c was 10+/-2.6 and 5+/-1.50 in the PGC and OGC groups, respectively. The mean symptom score was significantly higher in the PGC group compared with patients in the OGC group (4.55+/-0.80 vs. 2.70+/-0.82, P<0.001). PGC was associated with more extensive lung disease, lung cavitation, and positive sputum smear at the baseline. In PGC, sputum smears were significantly more likely to remain positive after 2 months of treatment. PGC patients had significantly higher rates of treatment failure (adj. OR 0.72, 95% CI 0.58-0.74, P<0.001) and relapse (adj. OR 2.83, 95% CI 2.60-2.92, P<0.001) | Poor glycemic control is associated with an increased risk of advanced and more severe TB disease in the form of lung cavitations, positive sputum smear, and slower smear conversion. It has a profound negative effect on treatment completion, cure, and relapse rates in patients with pulmonary tuberculosis. |
| 7 | Kumar, A. K. | 2016 | Tamil Nadu | Chennai | DM-TB | Sample | Anti-tuberculosis drug concentrations in tuberculosis patients with and without diabetes mellitus | The median (IQR) INH [6.6 (3.9-10.0) and 7.8 (4.6-11.3)] and PZA [31.0 (22.3-38.0) and 34.1 (24.6-42.7)] microgram per milliliter concentrations were significantly lower in diabetic than non-diabetic TB patients ($p < 0.001$ for both drugs). Blood glucose was negatively correlated with plasma INH ($r = -0.09$, $p < 0.001$) and PZA ($r = -0.092$, $p < 0.001$). Multiple linear regression analysis showed RMP, INH and PZA concentrations were influenced by age and drug doses, INH and PZA by DM, RMP by alcohol use and PZA by gender and category of ATT. DM reduced INH and PZA concentrations by 0.8 and 3.0 mug/ml, respectively. | TB patients with DM had lower INH and PZA concentrations. Negative correlation between blood glucose and drug concentrations suggests delayed absorption/faster elimination of INH and PZA in the presence of elevated glucose. |
| 8 | Kumar, N. P | 2016 | Tamil Nadu | Chennai | DM-TB | NA | Characterized the frequency of DC and monocyte subsets in individuals with PTB with (PTB-DM) or without coincident diabetes mellitus (PTB-NDM) before, during and after completion of anti-TB treatment | PTB-DM is characterized by diminished frequencies of plasmacytoid and myeloid DCs and classical and intermediate monocytes at baseline and 2 months of anti-TB treatment but not following 6 months of treatment completion in comparison to PTB-NDM. DC and monocyte subsets exhibit significant but borderline correlation with fasting blood glucose and glycated hemoglobin levels. | Coincident diabetes alters the frequencies of innate subset distribution of DC and monocytes in TB-DM co-morbidity and suggests that most of these changes are reversible following anti-TB therapy. |

| S.No | Author | Year | State | Area | Population | Methods | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|
| 9 | Kumar, N. P. | 2016 | Tamil Nadu | Chennai | DM-TB | NA | To study the association of angiogenic factors with TB-DM, we examined the systemic levels of VEGF-A, VEGF-C, VEGF-D, VEGF-R1, VEGF-R2, VEGF-R3 in individuals with either TB-DM (n = 44) or TB alone (n = 44) | Circulating levels of VEGF-A, C, D, R1, R2 and R3 were significantly higher in TB-DM compared to TB individuals. Moreover, the levels of VEGF-A, C, R2 and/or R3 were significantly higher in TB-DM with bilateral or cavitary disease or with hemoptysis, suggesting an association with both disease severity and adverse clinical presentation. The levels of these factors also exhibited a significant positive relationship with bacterial burdens and HbA1c levels. In addition, VEGF-A, C and R2 levels were significantly higher (at 2 months of treatment) in culture positive compared to culture negative TB-DM individuals. Finally, the circulating levels of VEGF-A, C, D, R1, R2 and R3 were significantly reduced following successful chemotherapy at 6 months | TB-DM is associated with heightened levels of circulating angiogenic factors, possibly reflecting both dysregulated angiogenesis and exaggerated inflammation. |
| 10 | Kumar, N. P. | 2014 | Tamil Nadu | Chennai | DM-TB | NA | Type 2 diabetes mellitus is associated with altered CD8(+) T and natural killer cell function in pulmonary | B-DM is characterized by elevated frequencies of mycobacterial antigen-stimulated CD8(+) T cells expressing type 1 [interferon-gamma and interleukin-2 (IL-2)] and type 17 (IL-17F) cytokines. We also found that TB-DM is characterized by expanded frequencies of TB antigen-stimulated NK cells expressing type 1 (tumour necrosis factor-alpha) and type 17 (IL-17A and IL-17F) cytokines. In contrast, CD8(+) T cells were associated with significantly diminished expression of the cytotoxic markers perforin, granzyme B and CD107a both at baseline and following antigen or anti-CD3 stimulation, while NK cells were associated with significantly decreased antigen-stimulated expression of CD107a only. | Pulmonary TB complicated with type 2 DM is associated with an altered repertoire of cytokine-producing and cytotoxic molecule-expressing CD8(+) T and NK cells, possibly contributing to increased pathology. |
| 11 | Pavan Kumar, N. | 2016 | Tamil Nadu | Chennai | DM-TB | Sample | Type 2 diabetes mellitus coincident with pulmonary or latent tuberculosis results in modulation of adipocytokines | PTB-DM or LTB-DM is characterized by diminished circulating levels of adiponectin and adipsin and/or heightened circulating levels of leptin, visfatin and PAI-1. In addition, adiponectin and adipsin exhibit a significant negative correlation, whereas leptin, visfatin and PAI-1 display a significant positive correlation with HbA1C levels and random blood glucose levels | PTB-DM or LTB-DM is characterized by alterations in the systemic levels of adipocytokines, indicating that altered adipose tissue inflammation underlying Type 2 diabetes potentially contributes to pathogenesis of TB disease. |
| 12 | Prada-Medina, C. A. | 1999 | Tamil Nadu | Chennai | DM-TB | Sample | Systems Immunology of Diabetes-Tuberculosis Comorbidity Reveals Signatures of Disease Complications | Transcriptional profiling revealed elements in common with published TB signatures from cohorts that excluded DM. Neutrophil count correlated with the molecular degree of perturbation, especially in TBDM patients. Body mass index and HDL cholesterol were negatively correlated with molecular degree of perturbation. Diabetic complication pathways including several pathways linked to epigenetic reprogramming were activated in TBDM above levels observed with DM alone | Our data provide a rationale for trials of host-directed therapies in TBDM, targeting neutrophilic inflammation and diabetic complication pathways to address the greater morbidity and mortality associated with this increasingly prevalent dual burden of communicable and non-communicable diseases |

| S.No | Author | Year | State | Area | Population | Methods | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|
| 13 | Viswanathan, V | 2014 | Tamil Nadu | Chennai | DM-TB | Case control | To assess the effect of diabetes on tuberculosis (TB) treatment outcome and sputum conversion among new smear-positive (NSP) cases registered under Directly Observed Treatment Short Course in South India. | Among 245 selected TB patients, 93.5% were cured, 1.6% completed TB treatment, 2% had TB treatment failure (TF), and 0.4% had treatment default (TD), 0.4% with MDR-TB and 2% death rate. At the end of intensive phase of TB treatment, 14.7% remained sputum positive in the TBDM group, whereas it was 3.5% in the TBnonDM group. Mean duration (days) for sputum conversion was higher in the TBDM group (64.2 +/- 10.5) compared to the TBnonDM group (61.5 +/- 7.5) (p<0.001). TF rate was higher (4.2% vs 0.7%) and MDR-TB (1%) was also seen in the TBDM group. No death and TD were seen among DM whereas it was 3.4 and 0.7% in TBnonDM | Delayed sputum conversion and high TB treatment failure rates were common in NSP cases with diabetes. |
| 14 | Viswanathan, A. A | 2014 | Tamil Nadu | Cuddalore | DM-TB | Case control | To compare treatment outcomes among TB patients with diabetes with those without diabetes | Bi-variate (unadjusted) analysis showed similar treatment success rates in the two groups. But, the adjusted odds ratios for successful treatment among diabetic patients were significantly lower (0.191, 95% CI 0.04-0.90) for pulmonary TB patients and for smear positive pulmonary TB patients (odds ration 0.099, 0.013-0.761). Diabetes was found to be predictor for sputum positivity at end of treatment | Diabetes increases risk of poor treatment outcomes among pulmonary TB patients. The study highlights need of screening of TB patients for diabetes. There is need to see the effect of glycemic control on treatment outcomes among diabetics. |
| 15 | Rawat, J. | 2011 | Uttarakhand | Dehradun | DM-TB | Case control | Effect of age on presentation with diabetes: Comparison of nondiabetic patients with new smear-positive pulmonary tuberculosis patients | Patients in the PTB-DM group were significantly older (53.34 +/- 14.06 year) in comparison to their nondiabetic counterparts (PTB group) (44.35 +/- 18.14 year) (P < 0.001). The former group also had a lower male:female ratio, although the difference was not statistically significant (1.16:1 vs. 2.05:1, P = 0.101). Tuberculin positivity was significantly higher in the PTB group, compared with patients in the PTB-DM group (P < 0.004). The proportion of patients with lower lung field involvement (P = 0.003) and cavitations (P = 0.005) was also higher in the former group compared with the latter. | Diabetic patients with tuberculosis were relatively older, had lower tuberculin positivity, and higher proportion of lower lung field involvement and cavitation in comparison to nondiabetic patients. |
| 16 | Kota, S. K | 2011 | Andhra Pradesh | Hyderabad | DM-TB | Sample | We evaluated the effects of vitamin D supplementation on type 2 diabetes mellitus patients with pulmonary tuberculosis (PTB | Group 1 subjects received oral cholecalceferol (60,000 units/week) and calcium carbonate (1g/day) along with anti tubercular treatment (ATT), while group 2 subjects did not. Sputum was checked at interval of 2 weeks for 12 weeks. Sputum smear conversion was 6 weeks in group 1 versus 8 weeks in group 2 (p=0.067). Glycated hemoglobin levels reduced from 11.1+/-1.3 to 7.7+/-0.9 in group 1 versus 10.3+/-1.2 to 7.8+/-1.1 (p>0.1). | Vitamin D can serve as adjuvant treatment of tuberculosis in diabetics with vitamin D deficiency. Further studies are required to validate this observation and define a cut off for vitamin D level to prevent immunological alterations. |

| S.No | Author | Year | State | Area | Population | Methods | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|
| 17 | Meenakshi, P | 2016 | Andhra Pradesh | Hyderabad | DM-TB | Sample | Effect of IFN-gamma, IL-12 and IL-10 cytokine production and mRNA expression in tuberculosis patients with diabetes mellitus and their household contacts | IFN-gamma and IL-12 cytokine production markedly decreased and that of IL-10 increased after Ag85A M.tb stimulation, however anti TB treatment reconstituted the response in TBDM and PTB patients. The household contacts revealed cytokine gene expression similar to that of patients and two of them developed the disease during follow-up. | Cytokine responses of the patients retained after treatment highlighting the antigen importance, hence further studies with recombinant cytokines may help in coming up with a biomarker. Analogous immune responses of household contacts with the TBDM and PTB patients may assist in recognizing the high risk individuals. |
| 18 | Ponnana, M. | 2017 | Andhra Pradesh | Hyderabad | DM-TB | Case control | Determines the association of IL-6 and IL-18 cytokine gene variants of TB patients with diabetes mellitus (TBDM) and their HHC | At IL-6 -174G>C variant, GG genotype, G allele in TBDM and TBDM HHC, at -572G>C variant, C allele in TBDM and GG haplotype in TBDM HHC were showing positive association, however DM have not shown any association at IL-6 polymorphic sites. With respect to the IL-18 gene polymorphisms, at -137 G>C variant, GG genotype was positively associated in PTB while at -607 C>A variant positive association was shown with AC genotype in TBDM, their HHC and DM; GACC diplotype in TBDM and GCGC in PTB. | Our findings suggest that susceptible combination of IL-6 and IL-18 cytokine genes associated with disease in the HHCs highlight their risk of inclination towards the disease. |
| 19 | Naik, B | 2013 | Karnataka | Kolar | DM-TB | Cohort | To assess the feasibility and results of screening patients with tuberculosis (TB) for diabetes mellitus (DM) at peripheral level | Of 362 TB patients, 358 (99%) were assessed for DM and 62 (17.1%) had the diseases-53 (14.6%) had a previous history of DM and 9 (2.9%) were newly diagnosed. All new DM patients were enrolled into DM care. Higher DM prevalence was found among TB patients aged >/=40 years, smokers and those with smear-positive pulmonary TB. To detect a new case of DM, the number needed to screen (NNS) among TB patients was 40 | Screening of TB patients for DM was feasible and effective in a peripheral setting. The availability of trained laboratory technicians and free services at every PHI made the intervention feasible. The study has contributed towards a national policy decision in this regard. |
| 20 | Kumari, P | 2014 | Delhi | NA | DM-TB | NA | Factors affecting susceptibility to Mycobacterium tuberculosis: a close view of immunological defence mechanism | There are various causes which increase the susceptibility to Mycobacterium tuberculosis infection; these include weakened immune system which occurs through various diseases and medications like human immunodeficiency virus (HIV)/acquired immunodeficiency syndrome (AIDS), type II diabetes, end-stage kidney disease, alcoholism and intravenous drug use, certain cancers, cancer treatment such as chemotherapy, malnutrition and very young or advanced age. Some other factors include tobacco use, which increases the risk of getting TB and dying from it | All the alterations occurring in immune system at cellular and molecular level which occur due to infection, metabolic changes and chemical exposure, which increase susceptibility to mycobacterial infection. |
| 21 | Siddiqui, A. N. | 2016 | Delhi | NA | DM-TB | Sample | Effect of Diabetes Mellitus on Tuberculosis Treatment Outcome and Adverse Reactions in Patients Receiving Directly Observed Treatment Strategy | Out of 316 patients, the prevalence of DM was found to be 15.8%, in which 19.4% and 9.6% were PTB and EPTB patients, respectively. DM patients have observed higher sputum positivity (OR 1.247 95% CI; 0.539-2.886) at the end of 2-month treatment and poor outcome (OR 1.176 95% CI; 0.310-4.457) at the completion of treatment compared with non DM patients | Presence of DM was significantly associated (OR 3.578 95% CI; 1.114-11.494, p = 0.032) with the development of ADRs. DM influences the treatment outcome of PTB patients in our setting and also on the ADR incidence. |

| S.No | Author | Year | State | Area | Population | Methods | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|
| 22 | Marupuru, S | 2017 | Manipal | NA | DM-TB | Cross sectional | To determine the protective effect of metformin against TB in DM patients and also, to investigate the relationship between poor glycemic control and TB | The mean (SD) age of both CG and SG were 55.54+/-11.82 and 52.80+/-11.75, respectively. Majority of the subjects in the study were males. The mean hospital stay of SG and CG were 7 days and 6 days, respectively. Poor glycemic control (HbA1c>8) observed in SG (51.7%) vs CG (31.4%). HbA1c value <7 is associated protective factor for TB occurrence [OR=0.52 (95% CI 0.29-0.93)]. The protective effect of metformin against TB was 3.9-fold in diabetics (OR=0.256, 0.16-0.40). | Poor glycemic control among diabetics is a risk factor for TB occurrence. The result shows metformin use is a protective agent against TB infection in diabetics. Hence, incorporation of metformin into standard clinical care would offer a therapeutic option for the prevention of TB. |
| 23 | Prince, L | 2016 | NA | NA | DM-TB | NFHS | Risk of self-reported symptoms or diagnosis of active tuberculosis in relationship to low body mass index, diabetes and their co-occurrence | In NFHS, diabetic individuals had higher predicted tuberculosis risks (diabetic vs. non-diabetic: 2.50% vs. 0.63% at low BMI; 0.81% vs. 0.20% at normal BMI; 0.37% vs. 0.09% at high BMI), which were not significantly different when modelled independently or allowing for risk modification with diabetes/low BMI co-occurrence. WHS findings were generally consistent. Population-level analysis found that diabetes/low BMI co-occurrence may be associated with elevated tuberculosis risk, although its predicted effect on tuberculosis incidence/prevalence was generally </=0.2 percentage points and not robustly statistically significant | Concerns about the additional elevation of tuberculosis risk from diabetes/low BMI co-occurrence and hence the need to coordinate tuberculosis control efforts around the nexus of co-occurring diabetes and low BMI may be premature. However, study findings robustly support the importance of individually targeting low BMI and diabetes as part of ongoing tuberculosis control efforts. |
| 24 | Shewade, H. D. | 2017 | NA | NA | DM-TB | Systematic review | Effect of glycemic control and type of diabetes treatment on unsuccessful TB treatment outcomes among people with TB-Diabetes: A systematic review | An Indian study reported 30% fewer unsuccessful treatment outcomes (aOR (0.95 CI): 0.72 (0.64-0.81)) and 2.8 times higher odds of 'no recurrence' (aOR (0.95 CI): 2.83 (2.60-2.92)) among patients with optimal glycemic control at baseline. A Peruvian study reported faster culture conversion among those with glycemic control (aHR (0.95 CI): 2.2 (1.1,4)). Two poor quality studies reported the effect of insulin on TB treatment outcomes. | We identified few studies that were free of the risk of bias. There were limited data and inconsistent findings among available studies. We recommend robustly designed and analyzed studies including randomized controlled trials on the effect of glucose lowering treatment options on TB treatment outcomes. |
| 25 | Singh, S. P | 2016 | North India | NA | DM-TB | Cohort | Association of tuberculosis and diabetes Mellitus: an analysis of 1000 consecutively admitted cases in a tertiary care hospital of North India | The study found that a significant proportion of diabetic patients had coexistent tuberculosis (65.5%). Rural population was predominantly affected in both the genders. The study observed that the coexistence of these two conditions increased with advanced age | The coexistence of Diabetes Mellitus with Tuberculosis needs to identified early and adequately addressed. The rural population needs to be educated about these two conditions and seek timely medical care. |
| 26 | Kornfeld, H | 2016 | South India | NA | DM-TB | Cohort | High Prevalence and Heterogeneity of Diabetes in Patients With TB in South India: A Report from the Effects of Diabetes on Tuberculosis Severity (EDOTS) Study | Of 209 eligible patients, 113 (54.1%) were classified as diabetic, 44 (21.0%) with impaired glucose tolerance, and 52 (24.9%) as normoglycemic. More patients with diabetes were detected by OGTT than by HbA1c. Diabetes was a newly received diagnosis for 37 (32.7%) in the DM group, and their median HbA1c (6.8%) was significantly lower than in those with previously diagnosed DM (HbA1c, 10.4%). Among 129 patients monitored for 3 months, HbA1c declined in all groups, with the greatest difference in patients with a newly received diagnosis of DM | Glycemic control heterogeneity has implications for the TB-DM interaction and the interpretation of TB studies relying exclusively on HbA1c to define diabetic status. |

| S.No | Author | Year | State | Area | Population | Methods | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|
| 27 | Kumpatla, S. | 2013 | Tamil Nadu | NA | DM-TB | Cohort | Characteristics of patients with diabetes screened for tuberculosis in a tertiary care hospital in South India | Of 7083 DM patients, 38 already had TB. Of the remainder, 125 (1.8%) had TB symptoms; 71 were investigated and 12 were newly diagnosed with TB. Of the 50 TB patients, 64% had smear-positive pulmonary TB (PTB). DM-TB patients were older, and had lower education level and economic status, a higher frequency of alcohol use, lower body mass index, a longer duration of DM, a greater likelihood of receiving insulin and poorer glycaemic control | Screening of DM patients for TB was feasible in a tertiary care hospital. The yield of new TB cases was low and merits further investigation. Socio-demographic and clinical characteristics were different in patients with DM and TB compared to those with DM only. |
| 28 | Mathur, M | 2017 | Punjab | Patiala | DM-TB | Cross sectional | To evaluate and compare the computed tomography chest features of pulmonary tuberculosis in between immunocompromised patients and immunocompetent patients. | In immune competent patients, 36.7% had radiologically atypical presentation,90% had nodular opacities, 73.3% had consolidation, 23.3% had lymphadenopathy, 60% had cavitation and cavitatory lesion were single in 94.4% patients. Isolated upper lung field were involved in 60% patients. In immunocompromised patients 76.7% had radiologically atypical presentation, 66.7% had nodular opacities, 46.7% had consolidation, 63.3% had lymphadenopathy, 20% had cavitation and cavitatory lesions were multiple in 60% patients. Isolated lower lung field were involved in 23.3% patients. | Immuno compromised patients have more atypical involvement of lung fields, higher prevalence of lymphadenopathy as compared to immunocompetent patients. Diabetic patients have multiple cavitatory lesions as compared to non-diabetic patients. HIV seropositive patients have more prevalence of lymphadenopathy as compared to HIV seronegative patients. |
| 29 | Mave, V | 2017 | Maharastra | Pune | DM-TB | Cohort | Tuberculosis screening among persons with diabetes mellitus in Pune, India | Among 630 adults approached for screening, median age was 60 (interquartile range (IQR), 57-64) years and 350 (56%) were females. Median hemoglobin A1c (HbA1c) was 8.7% (IQR, 6.7-9.9) and 444 (70.5%) were poorly controlled DM (HbA1c > 7). Forty-four (7%) had prior history of TB but the proportion with TB risk factors at screening was low (<5%). While 18% of participants reported any TB symptoms, none of these patients were diagnosed with culture confirmed TB. | Our study failed to yield any active TB cases using a WHO-recommended questionnaire among people with DM. High TB risk populations among people with DM must be identified if TB screening is to be feasible in settings such as India where the DM epidemic continues to rise. |
| 30 | Siddiqui, A. N | 2017 | Delhi | Slumn | DM-TB | Sample | Diabetes prevalence and its impact on health-related quality of life in tuberculosis patients | In 316 patients, the overall DM prevalence was 15.8%, of whom 9.5% were known to have diabetes, and 6.3% were diagnosed at TB treatment initiation. DM was more common among patients of older age (P < 0.001), with higher BMI (P < 0.001), with PTB (P = 0.02) and with poor psychological status. HRQoL was significantly poor in the socio-psychological & exercise adaptation domain in patients with DM >50 years of age at each visit. Older age, poor literacy, loss in workdays, alcohol use and socio-economic status significantly predict poor HRQoL scores in patients with DM. Uncontrolled DM patients demonstrated poor HRQoL at the end of the intensive phase (P = 0.04) of treatment and at its completion (P = 0.03) compared to those with controlled DM. | Addressing screening measures and glycaemic control along with social determinants such as literacy level and alcohol consumption could be an important means of improving the HRQoL of TB with DM patients. |

| S.No | Author | Year | State | Area | Population | Methods | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|
| 31 | Kumpatla, S. | 2013 | Tamil Nadu | Urban | DM-TB | Cohort | To evaluate the performance of A1c and fasting plasma glucose (FPG) tests for screening newly diagnosed diabetes (NDD) defined by OGTT among tuberculosis (TB) cases in India. | Prevalence of NDD was 10.8%. The areas under the curve (AUC) were 0.754 [95% confidence interval (CI) 0.68-0.83] (p<0.001) for A1c and 0.662 (95% CI 0.58-0.74) for FPG (p<0.001) in NDD subjects. The HbA1c cut-off point of >/=47.5mmol/mol gave a sensitivity of 59.1% and specificity of 91.7%, and the respective values were 34.8% and 97.5% for FPG in subjects with NDD. | HbA1c performed better than FPG as a screening tool for newly diagnosed diabetes among subjects with TB. |
| 32 | Subhash, H. S. | 2003 | Tamil Nadu | Vellore | DM-TB | Sample | Drug resistant tuberculosis in diabetes mellitus: a retrospective study from south India | There were: 361 subjects with positive mycobacterial culture and susceptibility tests results over a 3-year period; 267 (74%) acid-fast bacillus smear positive; and 94 (26%) smear negative cases. One hundred and seventy-seven (49%) had resistant isolates to any one first line antiTB drugs (resistant group) and 184 (51%) had isolates sensitive to all drugs (non-resistant group). In the resistant and non-resistant subjects the mean duration of TB symptoms was, respectively, 22 months and 4.5 months, past history of TB 126 (71%) and 48 (26%), past antiTB drug therapy 126 (71%) and 47 (25%), inadequate anti TB drug therapy 42 (24%) and 23 (13%), HIV positive six and 13 subjects. There were 72 diabetic subjects [35 and 37, respectively] with a duration of diabetes 5.8 +/- 7.5 years and 3.7 +/- 5.0 years in the resistant and non-resistant groups. Twenty-six per cent of the diabetic subjects (19/72) had multi-drug resistantTB | Drug resistance to first line anti-TB drugs was not found to be associated with diagnosis or duration of diabetes mellitus. |
| 33 | Mave, V. | 2018 | NA | Western India | DM-TB | Cohort | To estimate the prevalence and risk factors of pre-diabetes mellitus (DM) and DM, and its associations with the clinical presentation of tuberculosis | Among 1793 participants screened, 890 (50%) had microbiologically confirmed TB. Of these, 33% had pre-DM and 18% had DM; 41% were newly diagnosed. The median HbA1c level among newly diagnosed DM was 7.0% vs. 10.3% among known DM (P < 0.001). DM (adjusted OR [aOR] 4.94, 95%CI 2.33-10.48) and each per cent increase in HbA1c (aOR 1.42, 95%CI 1.01-2.01) was associated with >1+ smear grade or </=9 days to TB detection. | Over half of newly diagnosed TB patients had DM or pre-DM. DM and increasing dysglycemia was associated with higher bacterial burden at TB diagnosis, potentially indicating a higher risk of TB transmission to close contacts. |
| 34 | Harries, A. D | 2016 | NA | NA | General | Commentry | Addressing diabetes mellitus as part of the strategy for ending TB | Diabetes mellitus (DM) triples the risk of TB and increases the probability of adverse TB treatment outcomes such as failure, death and recurrent TB. The rapidly escalating global epidemic of DM means that DM needs to be addressed if TB-related milestones and targets are to be achieved. | More evidence is required to answer important questions about bi-directional screening, optimal ways of delivering treatment, integration of DM and TB services, and infection control. This should in turn contribute to better and earlier TB case detection, and improved TB treatment outcomes and prevention. DM and TB collaborative care can also help guide the development of a more effective and integrated public health approach for managing non-communicable diseases. |

| S.No | Author | Year | State | Area | Population | Methods | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|
| 35 | Gupta, S. | 2011 | Karnataka | Manipal | HIV-TB-DM | Seondary data | Diabetes mellitus and HIV as co-morbidities in tuberculosis patients of rural south Indi | The mean age of the pulmonary TB patients was 41.11+/-15.7 years, with significantly higher (p<0.0001) preponderance of DM (31.8%) over HIV (8.9%). 72.13% of the diabetic patients belonged to the age group of 41-60 years. Extra-pulmonary TB patients had a mean age of 34.62+/-12.9, years with a significantly higher (p<0.006) HIV prevalence of 32.43% over DM (5.4%). 75% of the HIV patients belonged to the age group of 41-60 years. Occupationally, the majority of the pulmonary TB patients were agricultural labourers (25.2%) while the majority of the extra-pulmonary TB patients were housewives or self employed (18.92%). | Though more importance is being given to HIV-TB coinfection, we cannot overlook DM, which showed a significantly higher prevalence in pulmonary TB patients compared to HIV. The rising prevalence of DM in high TB burden countries may adversely affect TB control. |
| 36 | Aravindhan, V. | 2015 | Tamil Nadu | NA | Microvascular complications | Sample | Estimated the levels of LPS and its translocation markers in T1DM subjects with and without microvascular complications (MVC) and correlate them with clinical parameters of T1DM and serum inflammatory cytokine levels (TNF-alpha, IL-6, IL-1beta and GM-CSF) | Compared to NGT, T1DM subjects (both with and without MVC) had significantly higher levels of LPS, reduced levels of LBP and EndoCAb along with significant increase in the levels of IL-1beta, IL-6, TNF-alpha and GM-CSF (p<0.05). No significant change was seen in the levels of these biomarkers between T1DM subjects with and without MVC | Decreased levels of EndoCAb and LBP suggest sustained endotoxin activity in T1DM subjects even before the onset of microvascular complications. |
| 37 | Goyal, R. | 2013 | NA | NA | NA | Commentry | Tuberculosis and non-diabetic hyperglycemia: a challenge to public health management | But the diagnostic criteria for diabetes is based on microvascular complications of diabetes and does not reflect the level of hyperglycemia which affects infectivity of Mycobacterium tuberculosis. | The study protocols focussing on these comorbidities need to be reviewed |
| 38 | Stevenson, C. R. | 2007 | NA | NA | NA | Epidemiological mpodel | Diabetes and tuberculosis: the impact of the diabetes epidemic on tuberculosis incidence | In India in 2000 there were an estimated 20.7 million adults with diabetes, and 900,000 incident adult cases of pulmonary tuberculosis. Our calculations suggest that diabetes accounts for 14.8% (uncertainty range 7.1% to 23.8%) of pulmonary tuberculosis and 20.2% (8.3% to 41.9%) of smear-positive (i.e. infectious) tuberculosis. We estimate that the increased diabetes prevalence in urban areas is associated with a 15.2% greater smear-positive tuberculosis incidence in urban than rural areas - over a fifth of the estimated total difference | Diabetes makes a substantial contribution to the burden of incident tuberculosis in India, and the association is particularly strong for the infectious form of tuberculosis. The current diabetes epidemic may lead to a resurgence of tuberculosis in endemic regions, especially in urban areas. This potentially carries a risk of global spread with serious implications for tuberculosis control and the achievement of the United Nations Millennium Development Goals. |
| 39 | Marak, B. | 2016 | Meghalaya | East Garo Hills District | Out patient TB clinic | Cross sectional | To estimate the prevalence of tobacco, alcohol use, hypertension and diabetes among tuberculosis (TB) patients in comparison to the non-TB patients in East Garo Hills District, Meghalaya, India | Prevalence of ever smoking was 74.5% and 55.4%; alcohol consumption 31.0% and 22.3%; hypertension 24.5% and 17.3%; diabetes 7.5%, 4.5% among TB patients and non-TB subjects, respectively | NCD and TB programmes need integration in the primary care for screening, counselling and treatment of NCD comorbidities. |

| S.No | Author | Year | State | Area | Population | Methods | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|
| 40 | Gupta, S. | 2010 | Karnataka | Manipal | PTB | Seondary data | Role of risk factors and socio-economic status in pulmonary tuberculosis: a search for the root cause in patients in a tertiary care hospital, South India | Diabetes mellitus (DM) (30.9%) was the most prevalent condition and significantly more common than other risk factors like smoking (16.9%), alcoholism (12.6%), HIV (10.6%), malignancy (5.8%), chronic liver diseases (3.9%), history of contact with TB (3.4%), chronic corticosteroid therapy (2.9%), chronic kidney diseases and malnourishment (1.5%). There were 82 patients (39.6%) with no underlying risk factor. Men (M:F = 3.7:1) and patients older than 40 years had a higher incidence of co-existing conditions. PTB was significantly more common in blue-collar (44%) and white-collar (27.1%) workers than household workers (12.1%), students (10.6%) and retired/unemployed people (6.3%). | Pulmonary tuberculosis had a significant impact and predominated in male patients co-existing with DM. Patients with DM and suggestive pulmonary symptoms should be screened for tuberculosis. More stringent health education and awareness programme should be implemented at the grass root level. |
| 41 | Pednekar, M. S. | 2012 | NA | Belapur | TB Patients | Cohort | Tobacco use or body mass--do they predict tuberculosis mortality in Mumbai, India? Results from a population-based cohort study | Tobacco use in any form and low-BMI had joint effect on tuberculosis mortality and the interaction effect was synergistic in men and antagonistic in women. Self-reported tuberculosis was associated with increased risk of tuberculosis mortality. In contrast, no such association was observed for self-reported diabetes persons. The risk pattern remained unchanged even after excluding tuberculosis deaths occurred within 1(st) two years of follow-up | Around 27% male tuberculosis deaths were attributable to their being underweight and smoker, while 22% male and 37% female deaths were attributable to their being underweight and smokeless tobacco user. |
| 42 | Hemanth Kumar, A. K. | 2016 | Tamil Nadu | Chennai | TB Patients | Sample | The pharmacokinetics of rifampicin (RMP), isoniazid (INH) and pyrazinamide (PZA) in adult tuberculosis (TB) patients and examine factors that influence drug pharmacokinetics. | RMP peak concentration (Cmax) was sub-therapeutic (<8 mug/ml) in 88% of the patients. The Cmax of RMP, INH and PZA at 2 h was observed in respectively 83.2%, 97.0% and 92.1% of the patients. The Cmax and area under the curve from 0 to 8 h (AUC0-8) of PZA was lower in TB patients with diabetes mellitus than in non-diabetics | A high proportion of TB patients had RMP Cmax below the expected range, which is a matter of concern. |
| 43 | Jonnalagada, S. | 2011 | Andhra Pradesh | Hyderabad | TB Patients | Cohort | The timing of death in patients with tuberculosis who die during anti-tuberculosis treatment | Case-fatality was higher in those previously treated (12%) and lower in those with extra-pulmonary TB (2%). There was an even distribution of deaths during anti-tuberculosis treatment, with 28% of all patients dying in the first 8 weeks of treatment. Increasing age and new as compared to recurrent TB disease were significantly associated with “early death”. the treatment of the disease itself, raising concerns about drug adherence, quality of anti-tuberculosis drugs or the presence of undetected drug resistance and ii) co-morbidities, such as HIV/AIDS and diabetes mellitus, which are known to influence mortality. | More research in this area from prospective and retrospective studies is needed. |

| S.No | Author | Year | State | Area | Population | Methods | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|
| 44 | Chakraborty, P. P | 2015 | West Bengal | Kolkatta | TB Patients | Case study | An unusual presentation of tuberculosis in a diabetic lady | Fine needle aspiration from the lesion was performed and acid-fast bacilli were demonstrated in the smear using Ziehl-Neelsen stain. The explanation of her arthritis was therefore tuberculous arthritis in left sternoclavicular joint and reactive arthritis in the rest of the joints. A diagnosis of Poncet's disease was considered in her case. | We treated her with standard anti-tuberculosis drugs and the arthritis resolved within a few days. She remained symptom-free at her 2 years' follow-up. |
| 45 | Chaudhary, S. | 2014 | West Benga | Kolkatta | TB Patients | Sample | Vitamin D status of patients with type 2 diabetes and sputum positive pulmonary tuberculosis | Mean vitamin D levels were not different between groups with TB, diabetes mellitus or combination of both, but the prevalence of severe vitamin D deficiency was higher in the group with both diabetes and TB (45%) as compared with the group with only TB (26.66%) and diabetes (17.39%) and healthy controls (7.69%). | The prevalence of patients with severe vitamin D deficiency is higher in patients with dual affection of TB and diabetes mellitus as compared with either disorder alone implying that patients with type 2 diabetes with the most severe vitamin D deficiency are the one of the most predisposed to pulmonary TB. |
| 46 | K V, Nandakumar | 2013 | Kerala | Malappuram | TB Patients | Cohort | Outcome of tuberculosis treatment in patients with diabetes mellitus treated in the RNTCP | DM status was recorded in 90% of TB cases and 667 (24%) had DM. 17% of DM patients and 23% of patients with unknown DM status had unfavourable outcomes but this difference was not statistically significant. Unadjusted RR for poor glycemic control or unknown control status for unfavourable outcome were (2.00; 95% CI 0.97-4.13) and (2.14; 95% CI 1.11-4.13 | This study could not confirm an adverse association between DM or its control during treatment and the course of response to TB treatment.DM screening in TB cases and recording of DM care needs to be improved to enable more conclusive evidence |
| 47 | Indira, P. | 2015 | Karnataka | Mangalore | TB Patients | Cohort | To compare the common opportunistic infections (OIs) between People Living with HIV with DM (PLHIV-DM) and PLHIV without DM (PLHIV). | Cryptococcal meningitis (19% of PLHIV-DM and 16% of PLHIV); Pneumocystis jiroveci pneumonia (5% of PLHIV-DM and 18% of PLHIV); extra pulmonary tuberculosis (22% of PLHIV-DM and 34.5% of PLHIV); and Cerebral toxoplasmosis (11% of PLHIV-DM and 13.5% of PLHIV). Microbiological testing of samples from PLHIV-DM, | Study did not identify any significant difference in profile of opportunistic infections (OIs) between PLHIV with and without Diabetes. |
| 48 | Dhanwal, D. K. | 2010 | Delhi | Medical College | TB Patients | Case study | To evaluate hypothalamic pituitary abnormalities in newly diagnosed patients with TBM. | Thirty-two (42.7%) cases showed relative or absolute cortisol insufficiency. Twenty-three (30.7%) cases showed central hypothyroidism and 37 (49.3%) cases had hyperprolactinemia. No patient had evidence of diabetes insipidus. Multiple hormone deficiency was seen in 22 (29.3%) cases. MRI of hypothalamic pituitary axis using dynamic scanning and thin cuts revealed abnormalities in 10 (13.3%) of the cases. CT adrenal gland was normal in all the patients. | Tubercular meningitis is associated with both hormonal and structural abnormalities in the hypothalamic pituitary axis at the time of diagnosis. |
| 49 | Dayal, D. | 2015 | Chandigarh | NA | TB Patients | Case study | Acute Hypercalcaemia and Hypervitaminosis D in an Infant with Extra Pulmonary Tuberculosis | The hypercalcaemia may be precipitated by usually recommended vitamin D and calcium supplementation in patients with tuberculosis. We report here an infant with tubercular meningitis who developed hypercalcaemia 12 days after starting routine vitamin D and calcium supplementation. | This communication highlights the importance of close monitoring of calcium levels in patients with tuberculosis, especially if started on vitamin D and calcium replacement before anti-tubercular therapy |

| S.No | Author | Year | State | Area | Population | Methods | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|
| 50 | Jali, M. V. | 2013 | Karnataka | NA | TB Patients | Cohort | Diabetes mellitus (DM) and smoking are risk factors for adverse outcomes in the treatment of tuberculosis (TB | Of 307 TB patients, 35.5% were found to have DM, 9.8% were current smokers, and 3.6% had DM and were also smokers. | Measures to assess and address both these factors need to be taken into account during TB treatment. |
| 51 | Balakrishnan, S. | 2012 | Kerala | NA | TB Patients | Cross sectional | To determine the prevalence of DM. | Among 552 TB patients screened, 243(44%) had DM - 128(23%) had previously known DM and 115(21%) were newly diagnosed - with higher prevalence among males and those aged >50 years. The number needed to screen(NNS) to find one newly diagnosed case of DM was just four. Of 128 TB patients with previously known DM, 107(84%) had HbA1c >/=7% indicating poor glycemic control. | Nearly half of TB patients in Kerala have DM, and approximately half of these patients were newly-diagnosed during this survey. Routine screening of TB patients for DM using HbA1c yielded a large number of DM cases and offered earlier management opportunities which may improve TB and DM outcomes. However, the most cost-effective ways of DM screening need to be established by futher operational research. |
| 52 | Aravindalochanan, V | 2013 | NA | NA | TB Patients | Review | Association of diabetes and tuberculosis--a major public health challenge | There is an increased risk for diabetic subjects to have active form of tuberculosis compared to their normal counterparts. The chance of reactivation of past tuberculosis infection is also common among the people with diabetes. In addition to that, few studies had reported that proportion of poor tuberculosis treatment outcomes such as treatment failure and death was higher in people with both tuberculosis and diabetes. A recent report from Tamil Nadu showed a very high prevalence of diabetes and prediabetes among tuberculosis patients. These findings strongly suggest the need of universal screening for diabetes among tuberculosis patients | To summarise and discuss the available evidences and to define the area of future research to identify a cost-effective screening method for diabetes among tuberculosis patients and the best mode of reporting and managing the two diseases for the better control of tuberculosis and diabetes. |
| 53 | Banerjee, D. | 2014 | NA | NA | TB Patients | Review | Statin therapy may prevent development of tuberculosis in diabetic state | It seems that statin therapy in diabetes mellitus has the potential to prevent the increased occurrence of tuberculosis in diabetic state. | It seems that statin therapy in diabetes mellitus has the potential to prevent the increased occurrence of tuberculosis in diabetic state. |
| 54 | Harries, A. D. | 2011 | NA | NA | TB Patients | Review | The looming epidemic of diabetes-associated tuberculosis: learning lessons from HIV-associated tuberculosis | Persons with diabetes have a significantly increased risk of active tuberculosis (TB), which is two to three times higher than in persons without diabetes | The Framework provides a template for action, and it is now up to donors, policy makers and implementers to apply the recommendations in the field and to 'learn by doing'. |
| 55 | Jali, M. V. | 2013 | NA | NA | TB Patients | Observational | To assess the feasibility and results of screening diabetes mellitus (DM) patients for tuberculosis (TB) and TB patients for DM within the routine health care setting | 19.54% were known cases diabetes, and 15.96% were newly diagnosed cases of diabetes. Total of 4,118 diabetes patients were screened for TB in which 111 patients found to have TB. | The strengths of this study are that we implemented screening within the routine health system. It is feasible to screen DM patients for TB resulting in high rates of TB detection. |
| 56 | Banurekha, V | 2017 | Tamil Nadu | Tiruchirapalli | TB Patients | Cohort | To estimate the proportion of sputum smear conversion and successful treatment outcomes among diabetic-TB patients treated under RNTCP | Diabetes was documented in 163 (14%) of 1131 TB patients. Sputum conversion was in 107 (94%) of 114 smear positive-TB patients. Successful TB treatment outcome was in 116 (85%) of 136 patients and 107 (86%) of 124 new TB patients | Sputum conversion was as per RNTCP target while treatment success rate among the new TB patients with diabetes was suboptimal. |

| S.No | Author | Year | State | Area | Population | Methods | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|
| 57 | Raghuraman, S. | 2014 | Pondi-cherry | Kathirkamam | DM-TB | Cross sectional | Prevalence of Diabetes Mellitus among Tuberculosis Patients in Urban Puducherry | The prevalence of diabetes in tuberculosis patients was found to be 29% (known diabetics - 20.7%, new Diabetes cases - 8.3%). Diabetes was significantly associated with older age, family history of diabetes, consumption of alcohol and sputum positivity. | Screening patients with Tuberculosis for fasting blood sugar estimation will help in early detection of diabetes. |
| 58 | Nair, A. | 2016 | Delhi | NA | DM-TB | Sample | The prevalence of PTB in patients with type-1-diabetes attending the outpatient-clinic in a tertiary-care hospital. | 5/151 patients had respiratory symptoms and radiographic findings suggestive of PTB. 20/151 patients were asymptomatic but had history of PTB. Four of the five symptomatic patients and 12 with past PTB were positive for sputum M.tb by culture, giving a prevalence of 10.6 % sputum culture positive in type-1-diabetes. Average HbA1c was comparable in patients with and without positive sputum culture. ESR and Mantoux test were not discriminatory in these groups. Four clinically symptomatic M.tb culture positive and four asymptomatic patients with sputum culture positive for M.tb on two occasions (6 weeks apart) were put on antitubercular treatment (ATT). Patients who were culture positive for M.tb only on one occasion were kept on a close follow up | Patients with type-1-diabetes mellitus in India have high prevalence of PTB. They need to be actively screened for PTB by sputum M.tb culture in order to initiate early treatment and to prevent transmission in the community. |
| 59 | Zheng, C. | 2017 | NA | NA | DM-TB | NA | Diabetes and pulmonary tuberculosis: a global overview with special focus on the situation in Asian countries with high TB-DM burden | We identified the DM prevalences among TB patients as ranging from approximately 5% to more than 50%, whereas TB prevalences among diabetic patients were 1.8-9.5 times higher than in the general population in developing Asian countries. Evidence from studies designed to address diagnosis and treatment of the dual disease in these critical regions is scarce as well as the evidence related to possible DM patients' genetic and acquired predisposition for TB. | More prospective studies specifically designed to address adequate screening techniques, identify patients at risk, and define an adequate treatment of dual disease in this region are needed without delay. |

| S.No | Author | Year | State | Area | Population | Methods | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|
| 60 | Viswanathan, V | 2012 | Tamil Nadu | NA | DM-TB | Cohort | To determine diabetes prevalence among a cohort of TB cases registered under Revised National Tuberculosis Control Program in selected TB units in Tamil Nadu | DM prevalence was 25.3% (95% CI 22.6-28.5) and that of pre-diabetes 24.5% (95% CI 20.4-27.6). Risk factors associated with DM among TB patients were age (31-35, 36-40, 41-45, 46-50, >50 years vs <30 years) [OR (95% CI) 6.75 (2.36-19.3); 10.46 (3.95-27.7); 18.63 (6.58-52.7); 11.05 (4.31-28.4); 24.7 (9.73-62.7) (p<0.001)], positive family history of DM [3.08 (1.73-5.5) (p<0.001)], sedentary occupation [1.69 (1.10-2.59) (p = 0.016)], and BMI (18.5-22.9, 23-24.9 and >/=25 kg/m(2) vs <18.5 kg/m(2)) [2.03 (1.32-3.12) (p = 0.001); 0.87 (0.31-2.43) (p = 0.78); 1.44 (0.54-3.8) (p = 0.47)]; for pre-diabetes, risk factors were age (36-40, 41-45, 46-50, >50 years vs <30 years) [2.24 (1.1-4.55) (p = 0.026); 6.96 (3.3-14.7); 3.44 (1.83-6.48); 4.3 (2.25-8.2) (p<0.001)], waist circumference [<90 vs. >/=90 cm (men), <80 vs. >/=80 cm (women)] [3.05 (1.35-6.9) (p = 0.007)], smoking [1.92 (1.12-3.28) (p = 0.017)] and monthly income (5000-10,000 INR vs <5000 INR) [0.59 (0.37-0.94) (p = 0.026)]. DM risk was higher among pulmonary TB [3.06 (1.69-5.52) (p<0.001)], especially sputum positive, than non-pulmonary TB | Nearly 50% of TB patients had either diabetes or pre-diabetes. |
| 61 | Nair, S. | 2013 | Kerala | Trivandrum | DM-TB | Cohort | High prevalence of undiagnosed diabetes among tuberculosis patients in peripheral health facilities in Kerala | Of 920 TB patients, 689 (72%) were male and the mean (standard deviation) age was 47.6 (16.4) years. Of these, 298 (32.4%) were diabetic: 235 (26%) had previously known DM and 63 (7%) were newly diagnosed. During the screening at PHIs and tertiary care hospitals, respectively 30/183 (16.4%) and 33/737 (4.5%) were newly diagnosed with DM (OR 3.71; 95%CI 2.17-6.32). Overall, age >50 years and pulmonary tuberculosis were independently associated with a higher prevalence of diabetes. | As nearly one in three TB patients had DM, we recommend that TB patients should be routinely screened for DM in Kerala. As the proportion of new DM was higher among TB patients diagnosed at PHIs, we would recommend that specific attention and investment be directed to PHIs. |
| 62 | Goldhaber-Fiebert, J. D | 2011 | NA | NA | NA | World Health Survey | Diabetes mellitus and tuberculosis in countries with high tuberculosis burdens: individual risks and social determinants | In lower income countries, individuals with diabetes are more likely than non-diabetics to have TB [univariable odds ratio (OR): 2.39; 95% confidence interval (CI): 1.84-3.10; multivariable OR: 1.81; 95% CI: 1.37-2.39]. Increases in TB prevalence and incidence over time were more likely to occur when diabetes prevalence also increased (OR: 4.7; 95% CI: 1.0-22.5; OR: 8.6; 95% CI: 1.9-40.4). | Given the association between diabetes and TB and projected increases in diabetes worldwide, multi-disease health policies should be considered. |

| S.No | Author | Year | State | Area | Population | Methods | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|
| 63 | Chachra, V. | 2014 | Delhi | Ghaziabad | TB Patients | Cross sectional | Study on prevalance of diabetes mellitus in patients with T.B. under DOTS strategy | The prevalence of diabetes was 12.6% (n=88), which is quite high. When category-wise analysis of diabetic subjects was done, it was found that patients under Category-I were 11.7% (n=47), patients under Cat-II were 15.5% (n=39) and those under Cat-III were 3.9% (n=2). The higher percentage of patients in Cat-II indicates the poor outcome of Cat-I patients, probably due to diabetes as a co-morbid disease | The higher prevalence of diabetes mellitus in DOTS patients raises immediate concerns in preventing the morbidity due to both the diseases. |
| 64 | Agarwal, A. K. | 2017 | Madhya Pradesh | Gwalior | TB Patients | Cross sectional | The coexistence of DM and TB in persons with established TB under RNTCP | DM/TB co-morbidity was noted in 85 individuals and these made up 15.4% of the study population. The mean age was higher in DM patients with TB (43.4 +/- 15.4 vs. 33.1 +/- 16.2 years, P = 0.000); the mean duration of symptoms of TB with DM was more (124 +/- 16.4 vs. 107.49 +/- 10.3 days). Multinomial logistic regression analysis showed that increasing age, positive family history of diabetes, sedentary occupation, and presence of pulmonary TB were significantly associated with diabetes among TB patients. | Diabetes is an important co-morbid feature to be sought in patients with TB. This study re-echo the need to raise awareness on screening for DM in persons with TB. |
| 65 | Ezung, T | 2002 | Imphal | NA | TB Patients | Sample | The prevalence of pulmonary tuberculosis with the age-and the sexwise distribution in diabetes mellitus patients | The prevalence of pulmonary tuberculosis in diabeties was 27% by radiological diagnosis and 6% by sputum positivity. Out of the 27 patients with radiological findings 11 had minimal lesions, 7 had moderate lesions and 9 patients were found to have far advanced lesions; cavitation was found in 3 patients, fibrosis in 4, homogeneous opacities in 6, heterogeneous opacities in 10, pleural effusion in 3 and consolidation and Fibrosis in only one patient. Mean duration of diabetes mellitus was 7.6 years (SD +/- 6.24). Duration of diabetes mellitus did not correlate well with the prevalence of pulmonary tuberculosis. | No correlation could be found with the history of contact with tuberculosis. |
| 66 | India Tuberculosis-Diabetes Study Group | 2013 | NA | NA | TB Patients | Cohort | To assess feasibility and results of screening patients with tuberculosis (TB) for diabetes mellitus (DM) within the routine healthcare setting | 1084 (13%) were found to have DM; of these, 682 (8%) had a previously known diagnosis of DM and 402 (5%) were newly diagnosed. There was a higher prevalence of DM in patients with TB diagnosed in tertiary care hospitals (16%) than in those diagnosed in tuberculosis units (9%) (P < 0.001) and amongst those from South India (20%) than from North India (10%) (P < 0.001). The screening and referral process worked well although significantly more patients with DM diagnosed in hospitals were referred to DM care (96%) than patients diagnosed in tuberculosis units (92%) (P < 0.05 | It is important and feasible to screen patients with TB for DM in the routine setting, resulting in earlier identification of DM in some patients and opportunities for better management of comorbidity. A policy decision has since been made by the National TB Control Programme of India to implement this intervention countrywide. |

| S.No | Author | Year | State | Area | Population | Methods | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|
| 67 | India Tuberculosis-Diabetes Study Group | 2013 | NA | NA | TB Patients | Cohort | To assess feasibility and results of screening patients with tuberculosis (TB) for diabetes mellitus (DM) within the routine healthcare setting | A total of 254 patients were identified with TB, of whom 46% had smear-positive pulmonary disease. There were 18 patients newly diagnosed with TB as a result of screening and referral, with the remainder being patients already diagnosed from elsewhere. TB case rates per 100,000 patients attending the DM clinic each quarter were 859, 956 and 642. Almost 90% of patients with TB were recorded as starting or being on anti-TB treatment. Major implementation challenges related to human resources and recording systems | It is feasible to screen patients with DM for TB resulting in high rates of TB detection. More attention to detail, human resource requirements and electronic medical records are needed to improve performance. |
| 68 | Achanta, S. | 2013 | Andhra Pradesh | Vizianagaram | TB Patients | Cross sectional | To assess among tuberculosis (TB) patients: 1) the feasibility of screening for diabetes mellitus (DM), 2) the prevalence of DM, 3) the demographic and clinical features associated with DM, and 4) the number needed to screen (NNS) to find one new case of DM | 19 (5%) were found to have DM (12 were newly diagnosed and 7 had a previous diagnosis of DM). The only characteristic associated with DM was age >/=40 years. The NNS to detect a new case of DM among all TB patients was 31; among those aged >/=40 years, the NNS was 20, and among current smokers it was 21 | Screening of TB patients for DM was feasible and effective, and this should inform national scale-up. Other key considerations include the continued provision of free TB-DM screening, with co-location and integration of ser3vices. |
| 69 | Manjareeka, M. | 2016 | Odisha | Malkangiri | Tribal | Cross sectional | To investigate the prevalence of diabetes in newly diagnosed pulmonary TB patients of tribal ethnicity in Odisha | The prevalence of diabetes and IFG are found to be 13.9% and 8.9%, respectively. A significant difference ($p<0.05$) was observed between the mean ages of the TB only (45.9 years) and TB-DM co-morbidity patients (53.8 years). No significant association was found between gender and diabetes. Clinical characteristics of TB were similar in TB and TB-DM co-morbidity patients. | The prevalence of high FBS was found to be higher in newly diagnosed pulmonary TB patients of tribal ethnicity thus indicating the need for intensified bidirectional screening. Further studies should be undertaken towards the risk profiling of diabetes and other lifestyle diseases in this population. |
| 70 | Vaz, M. | 2006 | Karnataka | Bangalore | Students | Qualitative | Perceptions of stigma among medical and nursing students and tuberculosis and diabetes patients at a teaching hospital in southern India | Patients with TB prefer not to disclose their illness, while DM is not perceived of as stigmatising by patients. As a group, medical and nursing students attached excessive stigma to patients with both DM and TB, and this may mean that medical professionals subconsciously do harm through their interactions with patients and the attitudes they project to society. The perceptions of stigma were linked to the patient's socioeconomic background, apart from the medical condition itself. The students recognised that they lacked the skills to understand and address stigma. | The subject of stigma be integrated into the curriculum of medical and nursing students. |

# 5. Factory Workers & TB

| S. No. | Author | Year | State | Area | Population | Methods | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Mehra, R. | 2005 | NA | NA | Factroy workers | Occupational | Cadmium concentrations in the hair were determined using atomic absorption spectrophotometer. | Health effects, such as acidity, hypotension, hypertension, dermatitis, ophthalmic problems, cardiac disease, indigestion, diabetes, tuberculosis, hepatitis B, respiratory troubles, psychological and liver problems were found in subjects. Significant levels between the unhealthy and normal subjects were determined by applying a parametric test, the student's t test at a significant level of $p < 0.05$. | The significant difference in cadmium levels were observed in subjects suffering from acidity, ophthalmic problems, hypertension, psychological problems, tuberculosis and their respective controls. |

# 6. Gender & TB

| S. No. | Author | Year | State | Area | Population | Methodss | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Lavigne, M. | 2006 | NA | NA | Gender | Convenience sample | The impact of smoking on adherence to treatment for latent tuberculosis infection | 320 patients were recruited, and 302 (94%) completed the questionnaire. Smoking prevalence was 21%. 72% of patients were adherent to LTBI treatment. Women (OR = 2.0; 95% CI: 1.2-3.3) and non-smokers (OR = 1.8; 95% CI: 1.0-3.3) were associated with adherence to LTBI treatment. Only gender was found as an independent predictor of adherence after adjusting for age and smoking status (OR = 1.9; 95% CI: 1.06-3.3). | Males and smokers need to have extra supervision to ensure compliance with LTBI treatment. |
| 2 | Kolappan, C. | 2007 | Tamil Nadu | Tiruvallur | Gender | Cross sectional | Selected biological and behavioural risk factors associated with PTB | The adjusted PORs (with 95%CI) for age, sex, smoking and alcoholism were 3.3 (2.7-4.1), 2.5 (1.9-3.3), 2.1 (1.7-2.7) and 1.5 (1.2-2.0), respectively. | Risk factors such as age, sex, smoking and alcoholism are independently associated with pulmonary TB. Risk factors age and sex show a stronger association than smoking and alcoholism. |
| 3 | Pande, J. N. | 1996 | Delhi | NA | Gender | Case control | To assess the role of age, sex, disease extent, nutritional status, past history of liver disease, infection with hepatitis viruses, acetylator status, and high alcohol intake as risk factors in the development of hepatotoxicity in patients with pulmonary tuberculosis receiving antituberculosis treatmenT | Of the various risk factors analysed, only advanced age, hypoalbuminaemia, high alcohol intake, slow acetylator phenotype, and extensive disease were risk factors for the development of hepatotoxicity. | NA |
| 4 | Vijay, S. | 2010 | Karnataka | Bangalore | Gender | Case control | To identify predictors of default among new smear positive TB patients registered for treatment | Factors independently associated with default were alcoholism [AOR-1.72 ], illiteracy [AOR-1.40], having other commitments during treatment [AOR-3.22 , inadequate knowledge of TB [AOR-1.88], poor patient provider interaction [AOR-1.72], lack of support from health staff [AOR-1.93], having instances of missed doses [AOR-2.56], side effects to anti TB drugs [AOR-2.55] & dissatisfaction with services provided [AOR-1.73 | Majority of risk factors for default were treatment and provider oriented and rectifiable with appropriate interventions, which would help in sustaining the good programme performance. |

| S. No. | Author | Year | State | Area | Population | Methodss | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|
| 5 | Sarangi, S. S. | 2014 | West Bengal | Paschim Medinipur | Gender | Random sample | Risk factors associated with default among retreatment tuberculosi | Risk factors for default at 95% confidence interval: male-sex limit: [aOR 3.957 (1.162-13.469)], alcoholic inebriation[ aOR6.076 (2.088-17.675)], distance from DOT centre [aOR 4.066 (1.675-9.872)], number of missed doses during treatment [aOR 1.849 (1.282-2.669)] and no initial home visit [aOR 10.607 (2.286 -49.221) | Initial home visit, patient provider meeting, retrieval action, community-based treatment as per RNTCP guidelines are required to uplift the programme. |
| 6 | Santha, T | 2002 | Tamil Nadu | Tiruvallur | Gender | Community survey | Risk factors associated with default, failure and death among tuberculosis patients | Higher default rates were associated with irregular treatment (adjusted odds ratio [AOR] 4.3; 95%CI 2.5-7.4), being male (AOR 3.4; 95%CI 1.5-8.2), history of previous treatment (AOR 2.8; 95%CI 1.6-4.9), alcoholism (AOR 2.2; 95%CI 1.3-3.6), and diagnosis by community survey (AOR 2.1; 95%CI 1.2-3.6) | Male patients and those with alcoholism were at increased risk of default, as were patients identified by community survey. To prevent default, directly observed treatment should be made more convenient for patients. To reduce mortality, the possible role of nutritional interventions should be explored among underweight patients. |
| 7 | Thapa, P. | 2015 | Karnataka | Udupi | Gender | Cohort | To assess the prevalence, pattern and associated factors of alcohol use among tuberculosis patients | On logistic regression sex, tobacco use, perceived health status and facing discrimination due infection with tuberculosis were found to be factors associated with alcohol use. | A high prevalence of alcoholism among tuberculosis patients which is of concern and has to be addressed. |
| 8 | Rao, V. G. | 2011 | Madhya Pradesh | Sheopur | Gender/ Tribal | Cross sectional | The risk factors associated with the development of TB disease | Persons aged >/=45 years, males, smokers and alcohol consumers had higher risks of developing TB disease | There is an urgent need to develop and implement culturally appropriate awareness raising activities to target smoking and alcohol consumption to support the efforts to control TB in this community. |
| 9 | Stevenson, C. R. | 2007 | NA | NA | Gender | Modelling | Potential impact of diabetes as a risk factor for incident pulmonary tuberculosis | Diabetes accounts 14.8% of PTB & 20.2% of smear-positive TB. Increased diabetes prevalence in urban areas is associated with a 15.2% smear-positive TB incidence in urban than rural areas | Diabetes makes a substantial contribution to the burden of incident tuberculosis in India |
| 10 | Manjareeka, M. | 2016 | Odisha | Tribal district (Malkangiri) | Gender | Cross sectional | The association between Diabetes Mellitus (DM) and Tuberculosi | The prevalence of diabetes and IFG are found to be 13.9% and 8.9%, respectively. A significant difference ($p<0.05$) was observed between the mean ages of the TB only (45.9 years) and TB-DM co-morbidity patients (53.8 years). No significant association was found between gender and diabetes. | The prevalence of high FBS was found to be higher in newly diagnosed pulmonary TB patients of tribal ethnicity thus indicating the need for intensified bidirectional screening. Further studies should be undertaken towards the risk profiling of diabetes and other lifestyle diseases in this population. |
| 11 | Anand, A. C | 2006 | NA | NA | Gender | Cohort | Evaluates the clinical risk factors predicting the development of hepatotoxicity in Indian patients with tuberculosis on antituberculosis treatment. | Age, Sex, history of alcohol intake and BMI were not found to be related to development of hepatotoxicity. | NA |

| S. No. | Author | Year | State | Area | Population | Methodss | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|
| 12 | Hussain, T. | 2007 | Uttar Pradesh | Agra | Gender | Cohort | Seroprevalence of HIV infection among paediatric tuberculosis patients | Seroprevalence of HIV infection among paediatric TB patients in Agra is 8.51% (23/270). The HIV infection was found to be significantly higher, i.e. 82.61% in male children than in female children, i.e. 17.39% | Nil |
| 13 | Alvarez-Uria, G. | 2014 | Andhra Pradesh | Anantapur | Gender | Cohort | Incidence and mortality of tuberculosis before and after initiation of antiretroviral therapy | In a multivariable analysis, women had a lower risk of TB in both groups | The high incidence and mortality of TB seen in this study underscore the urgent need to improve the prevention and diagnosis of HIV-associated TB in India. |
| 14 | Gupta, A. | 2007 | Maharastra | Pune | Gender | Cohort | Postpartum tuberculosis incidence and mortality among HIV-infected women and their infants | 24/715 HIV-infected women who were followed up for 480 postpartum person-years developed TB, yielding a TB incidence of 5.0 cases per 100 person-years. 3/24 (12.5%) women with TB died, compared with 7/691 (1.0%) without TB (IRR, 12.2). Four infants with mothers with TB died (IRR, 4.71). Women with incident TB and their infants had a 2.2- and 3.4-fold increased probability of death. | Among Indian HIV-infected women, we found a high incidence of postpartum TB and associated postpartum maternal and infant death. Active screening and targeted use of isoniazid preventative therapy among HIV-infected women in India should be considered to prevent postpartum maternal TB and associated mother-to-child morbidity and mortality. |
| 15 | Andries, A. | 2013 | Maharastra | Mumabi | Gender | Cohort | To determine the frequency of and risk factors associated with hypothyroidism in HIV/MDR-TB co-infected patients | 37/69 (54%) had hypothyroidism after at least 90 days of treatment. Age, gender, CD4 counts and stavudine-based ART were not associated with the occurrence of hypothyroidism in multivariate models. | Need for TSH screening at baseline, three months, six months, and every six months thereafter for HIV-infected patients on MDR-TB treatment regimens containing PAS and/or ethionamide, until newer, safer and more efficacious MDR-TB regimens become available. |
| 16 | Atre, S. R. | 2011 | Maharastra | Mumabi | Gender | Case control study | To assess risk factors associated with MDR - TB among Category I, new sputum smear-positive cases, at the onset of therapy. | Multivariate analysis indicated that infection with the Beijing strain (OR = 3.06) and female gender (OR = 1.68) were significant predictors of MDR-TB at the onset of therapy. | Baseeline to further examine the usefulness of these risk factors as screening tools in identifying individuals with MDR-TB |
| 17 | Singla, R. | 2010 | Delhi | NA | Gender | Case control | To assess the role of these putative risk factors in the development of hepatotoxicity (DIH) in patients receiving anti-TB treatment. | Significantly higher percentage of cases had moderate to far advanced disease severity on chest radiograph (P<0.01). On multivariate logistic regression, the adjusted odds were significant (P<0.01) for age>35 yr, MAC<20 cm and hypoalbuminaemia (albumin<3.5 g/dl). | Older age, poor nutritional status including baseline hypoalbuminaemia were independent predictors of occurrence of anti-TB DIH. Clinicians should be vigilant for occurrence of hepatotoxicity in this high risk group |
| 18 | Shashidhara, A. N. | 2004 | Odisha | NA | Gender | Cross sectional | Estimate the average annual risk of tuberculous infection (ARTI) | ARTI in the state was estimated at 1.7-1.8%. The children residing in urban areas were observed to be at a significantly higher risk of infection than those in rural areas. | High rates of transmission of tuberculous infection and calls to attention the need for intensification of concerted and sustained tuberculosis control efforts. |

| S. No. | Author | Year | State | Area | Population | Methodss | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|
| 19 | Jadhav, R. N. | 1999 | NA | NA | Gender | Case report | Presentations and treatments | There was a female predominance, with a male/female ratio of 1:6. Painless swelling and discharging sinuses over the scalp were the most common presenting features. One patient presented with osteomyelitis and sinus formation, with associated meningitis. All patients recovered well after surgery and antituberculous chemotherapy, except for one patient who discontinued drug treatment. | Although calvarial tuberculosis is rare, the possibility of this disease should be considered when patients report previous histories of tuberculosis or are from areas in which the disease is endemic. |
| 20 | Pardeshi, G. | 2009 | NA | Yavatma | Gender | Cohort | The survival pattern of patients on Directly Observed Treatment-Short course (DOTS) according to categories, age and sex of patients | There was a significant difference in the survival curves amongst the three DOTS categories (log rank statistic= 7.26, d.f..= 2, P=0 0.02) and amongst the different age groups [log rank statistic= 8.78, d.f.= 3, P= 0.012). There was no difference in the survival curves of male and female patients (log rank statistic= 0.05, d.f.= 1, P= 0.80) and according to type of disease (log rank statistic= 5.63, d.f.= 2, P= 0.05). | Pardeshi, G. (2009). "Survival analysis and risk factors for death in tuberculosis patients on directly observed treatment-short course." Indian J Med Sci 63(5): 180-186. |
| 21 | Purohit, M. R. | 2009 | Madhya Pradesh | Ujjain | Gender | Random sample | Gender differences in the clinical diagnosis of tuberculous lymphadenitis- | Seventy-five percent of the patients were aged between 14 and 35 years, with a male to female ratio of 1:2.1. One or more constitutional symptoms were present in 56.6% of patients on presentation. There were more men with clinical symptoms than women. Fever was the most common manifestation in both gender groups. Fever for more than 30 days, cough, weight loss, and night sweats were significantly more common in men. | Constitutional symptoms were more frequently reported by men than by women and showed a correlation with necrotic granulomas on cytology. |
| 22 | Jagannathan, L. | 2011 | Karnataka | Bengalore | Gender | Cohort | To investigate HLA associations in a cohort of HIV seropositive individuals with and without TB | The ratio of males and females in HIV cohort was comparable (50.4% and 49.6%). But the incidence of TB was markedly lower in females (12.6%,) than males (25.6%). Further, HLA-B*57 frequency in HIV cohort was significantly higher among females without TB (21.6%, 19/88) than males (1.7%, 1/59); P = 0.0046; OR = 38. CD4 counts also were higher among females in this cohort. | HIV positive women with HLA-B*57 have less occurrence of TB as compared to males |
| 23 | Rajasekaran, S | 2009 | Tamil Nadu | Tambaram | Gender | Cohort | To study the incidence of post-HAART tuberculosis in HIV patients and to identify the possible risk factors | Post HAART TB occurred predominantly in men (67.6%) and in 31-44 years age group (69.8%) with 100-person year risk being 3.26 and 2.83 respectively. | Tuberculosis was found to occur pre-dominantly in adult male patients with HIV during the first year after the initiation of HAART. Significantly, occurrence of Post HAART TB remained almost the same (5%) among patients treated for TB prior to the initiation of HAART. |

| S. No. | Author | Year | State | Area | Population | Methodss | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|
| 24 | Radhakrishna, S. | 2003 | Tamil Nadu | Tiruvallur | Gender | Population surveys | To determine the association of initial tuberculin sensitivity, age and sex with the development of TB. | Males had a substantially higher incidence (Adj RR 3.0). The risk of culture-positive TB over 15 years in survivors was 3.3% (5.0% in males & 1.6% in females), & increased substantially with tuberculin sensitivity at intake. In those with > or = 12 mm at intake, the approximate lifetime risk was 6.1% (8.6% in males & 3.1% in females). | Males had a significantly higher risk than females in every PPD-S group and the overall risk was three-fold higher. |
| 25 | Balasubramanian, R. | 2004 | Tamil Nadu | Tiruvallur | Gender | Community survey | Gender differences in tuberculosis among adult | The prevalence of smear-positive TB 568 & 87/100,000, among males and females. More females felt inhibited discussing their illness with family (21% vs. 14%) & needed to be accompanied for DOT (11% vs. 6%). Males had twice the risk of treatment default (19% vs. 8%). | Despite facing greater stigma and inconvenience, women were more likely than men to access health services, be notified under DOTS and adhere to treatment. Men and elderly patients need additional support to access diagnostic and DOT services. |
| 26 | Kolappan, C. | 2006 | Chennai | Chennai | Gender | Cohort | To measure the mortality rate and excess general mortality as well as identify groups at high risk for mortality among TB patients | The mortality rate was 60/1000 person-years. The excess general mortality expressed as standardized mortality ratio (SMR) was 6.1. Younger, men, patients with Category II disease, patients who defaulted on, or failed courses of treatment, and male smokers who were alcoholics, all had higher mortality ratios when compared to the rest of the cohort. | The excess mortality in this cohort was six times more than that in the general population. Young age, male sex, smear-positivity, treatment default, treatment failure and the combination of smoking and alcoholism were identified as risk factors for tuberculosis mortality |
| 27 | Kolappan, C. | 2016 | Andhra Pradesh & Orissa | NA | Gender | Random sample | To estimate general mortality rate (GMR) and the tuberculosis mortality rate (TMR) among the general population | The GMR for AP and Orissa was 636 (95% CI: 610-662) and 616 (95% CI: 588-643) per 100,000 person years (p-ys) respectively. The TMR for AP and Orissa was 76 (95% CI: 67-85) and 41 (95% CI: 34-48) per 100,000 p-ys respectively. The difference in TMR between the states was statistically significant (P<0.0001). | TB accounted for 12% and 7% of deaths in AP and Orissa respectively. Focused strategies are needed to reduce mortality due to tuberculosis. |
| 28 | Kolappan, C | 2016 | Tamil Nadu | Tiruvallur | Gender | Random sample | Tuberculosis mortality in a rural population | A total of 719 deaths were registered. The GMR and TB mortality rate (TMR) were 648 & 39 per 100,000 p-yrs, respectively. The GMR increased with age, and was higher in males than females at all ages. The TMR was higher in males than females and the overall male:female ratio was 5:1 | Strategies to reduce TB death should be implemented and the impact should be monitored by repeat verbal autopsy studies. |
| 29 | Sadacharam, K | 2007 | Tamil Nadu | Tiruvallur | Gender | Cohort | To describe the status of cases 2-3 years after the initiation of treatment under DOTS | The overall mortality rate was 15.0% and among the remaining 18.6% had active disease. In multivariate analysis, a higher mortality rate was independently associated with age, sex, occupation, treatment outcome and initial body weight of patients. | The mortality and morbidity rates are still high during follow-up and needs to be curtailed by addressing these issues effectively in TB control programme. |
| 30 | Ferri, C. P. | 2012 | NA | NA | Gender | Cohort | Socioeconomic factors and all cause and cause-specific mortality among older people | Chronic diseases were the main causes of death, together with tuberculosis and liver disease, | Social protection for older people, and the effectiveness of health systems in preventing and treating chronic disease, may be as important as economic and human development. |

| S. No. | Author | Year | State | Area | Population | Methodss | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|
| 31 | Gajalakshmi, V. | 2003 | Tamil Nadu | NA | Gender | Case control | To assess age-specific mortality from smoking among men | Excess mortality among smokers, a third involved respiratory disease, chiefly tuberculosis (4.5, smoking-attributed fraction 61%), a third involved vascular disease (1.8, smoking-attributed fraction 24%), | Smoking, which increases the incidence of clinical tuberculosis, is a cause of half the male tuberculosis deaths in India, |
| 32 | Kalita, J., | 2014 | NA | Lucknow | Gender | Cohort | To evaluate the frequency and predictors of paradoxical tuberculoma in definite TBM and its influence on TBM outcome | After adjustment of covariates, only female sex was independently associated with paradoxical tuberculoma (OR 0.06, 95%CI 0.004-0.79, P= 0.03). Paradoxical response, however, did not influence 6-month outcome. | Paradoxical tuberculoma occurs in two thirds of patients with definite TBM, and in 50% it is asymptomatic. Females are more susceptible to paradoxical tuberculoma; however, 6-month outcome is not influenced by paradoxical tuberculoma. |
| 33 | Sawant, S. S. | 2011 | Maharastra | Mumabi | Gender | Sample | To determine the seroprevalence of HIV infection among TB confirmed patients | The prevalence of co-infection was higher among females (9.4%) than the male (8.7%) patients and highest amongst those aged 21to40 years (13.7%). | This high prevalence calls for routine screening of TB patients for HIV infection |
| 34 | Bhat, J. | 2009 | Madhya Pradesh | NA | Gender | Community survey | Prevalence of pulmonary tuberculosis amongst the tribal population of Madhya Pradesh, central India | The prevalence increased with age and was also significantly higher among males (554/100,000; 95% CI: 415-693) as compared with females (233/100,000; 95% CI: 101-364) (P < 0.001) | TB remains a major public health problem amongst the tribal population and there is a need to maintain and further strengthen TB control measures on a sustained and long-term basis. |
| 35 | Sharma, P. | 2010 | NA | NA | Gender | Sample | Prevalence of pulmonary tuberculosis in male adults of sahariya tribe | In Sahariya, the prevalence of smear-positive pulmonary TB was found increased significantly (P<0.005) to 0.454 as against 0.274 estimated in the earlier survey (1991-92). Males, particularly, appeared most affected (P<0.005; 0.382), especially adults (0.260). In contrast, among Bhil, the prevalence was very low. | Sahariya tribe indicate the high incidence rate and faster transmission of infection, especially in male sex. |
| 36 | Sharma, P. P. | 2010 | NA | NA | Gender | NFHS | Gender differentials in the prevalence of tuberculosis | Overall, the prevalence of TB has remained almost same in the two surveys [432/lakh in NFHS-2 and 418/ lakh in NFHJS-3; Z=1.19, P=0.275. The gender gap has increased to 217/lakh in NFHS-3 in comparison to 145 per lakh in NFHS-2. The increase in gender gap is significantly higher in rural areas [of 98 per lakh;167/ lakh in NFHS-2 vs 265/lakh in NFHS-3; P<0.05] as compared to corresponding increase in urban areas [of 30 per lakh; 88/ lakh in NFHS-2 vs118/ lakh in NFHS-3, P>0.05]. The increase in delta (D) (difference in gender gap in two surveys) is accounted for as 88% by the rural areas and 12% by the urban areas. | The increase in gender gap in the prevalence of TB is more in rural areas as compared to urban areas. The increase in rural areas is mainly contributed by Hindus, SC and ST and low and medium SLI categories and in urban areas, the contribution is mainly by Hindus, other castes and high SLI categories. |
| 37 | Gopi, P. G. | 2003 | Tamil Nadu | Tiruvallur | Gender | Community survey | Prevalence of culture-positive and smear-positive tuberculosis | Prevalence was substantially higher in males than in females at all ages; the overall male:female ratio was 5.5 for culture-positive and 6.5 for smear-positive tuberculosis. | Tuberculosis is a major problem in this rural community in south India |

| S. No. | Author | Year | State | Area | Population | Methodss | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|
| 38 | Narang, P. | 1999 | Maharastra | Wardha | Gender | House-to-house survey | Prevalence of sputum-positive pulmonary tuberculosis in tribal and non-tribal populations | The prevalence of smear and/or culture-positive tuberculosis/100000 population was 133 in the tribal and 144 in the non-tribal population. The prevalence of cases in both groups was higher in males than females; however this difference was significant only in the tribal group (P = 0.05). Only two of the 46 tribes encountered, the Mana and Pawara tribes, showed a high prevalence, of 730 and 612/100000. The three other tribes with positive cases (the Gond group) had prevalences comparable to that of the nontribal population | The prevalence of tuberculosis in tribal people was comparable to that of the non-tribal population. |
| 39 | Radhakrishna, S. | 2001 | Tamil Nadu | Tiruvallur | Gender | Community survey | Of study trends in the prevalence and incidence of TB | The prevalence of culture-positive tuberculosis decreased by 1.4% per annum to 694/100,000, while that of smear-positive tuberculosis showed no significant decrease from 457/100,000. The annual incidence of culture-positive tuberculosis decreased by 4.3%/annum to 189/100,000 and that of smear-positive tuberculosis decreased by 2.3%/annum to 113/100,000. Decreases in incidence occurred exclusively in those with abnormal radiographic findings suggestive of TB at the start of the period. The annual risk of TB infection (ARTI) was initially 2%, and showed no sign of decline over the period. | The prevalence of tuberculosis and ARTI showed little or no decrease over the 15-year period. |
| 40 | Raj, P. | 2012 | Central India | NA | Gender | Community survey | Prevalence of pulmonary tuberculosis (TB) in a high-risk rural area of central India | The overall RR of developing smear-positive disease was 1.4-fold higher (95% confidence interval 1.1-1.7; P < 0.005) in males than females in all the study groups. The highest prevalence of TB was observed in subjects aged 15-34 years. | Hindu tribes and males of working age are still at high risk of smear-positive TB. |
| 41 | Jain, R. | 2017 | Delhi | Delhi | Gender | NA | To identify risk factors for microbiologically confirmed intrathoracic tuberculosis in children | Microbiological positivity was associated with female gender, higher mean, parenchymal lesion on chest radiograph, low body mass index for age, having symptoms of cough and weight loss, lower mean hemoglobin and higher mean monocyte: lymphocyte ratio. On multivariate analysis, microbiological positivity showed significant association with low body mass index for age & higher monocyte: lymphocyte ratio | Low body mass index for age and higher monocyte: lymphocyte ratios were associated with microbiological confirmation in children with intrathoracic tuberculosis |
| 42 | Rao, V. G. | 2010 | Madhya Pradesh | Sheopur | Gender/ Tribal | Community survey | Prevalence of pulmonary tuberculosis | The overall prevalence of pulmonary TB disease was 1518 per 100,000 population. Prevalence increased with age and the trend was statistically significant (p<0.001). The prevalence of pulmonary TB was also significantly higher in males (2156/100,000) than females (933/100,000) (p<0.001 | TB disease remains a major public health problem in the Saharia 'primitive |

| S. No. | Author | Year | State | Area | Population | Methodss | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|
| 43 | Janagond, A. B | 2017 | Tamil Nadu | Madurai | Health care workers | Cohort | To assess the risk of TB infection among HCWs who directly engage in medical duties | A total of 206 HCWs 36.8% (76/206) were infected with TB using a TST induration >/=10 mm; 2 HCWs developed PTB. Age, duration of employment as a health-care professional, literacy status, and working in medical wards/OP/Intensive Care Unit were significantly associated with TB infection. | The depth of knowledge of TB prevention and control among HCWs should be improved by regular infection control training. |
| 44 | Kolappan, C. | 2009 | Tamil Nadu | Tiruvallur | Gender | Case control | To quantify the association between biomass fuel usage and sputum-PTB | The unadjusted OR measured from univariate analysis for biomass fuel is 2.9 (95% CI 1.8 to 4.7). The adjusted OR measured from multivariate analysis using Cox regression is 1.7 (95% CI 1.0 to 2.9). Thirty-six percent of cases are attributable to biomass fuel usage. | Improvement in standards of living brought about by economic development will lead to more people using cleaner fuels for cooking than biomass fuel which in turn will lead to a reduction in the occurrence of pulmonary tuberculosis in the community. |
| 45 | Mishra, V. K. | 1999 | NFHS | NA | Gender | NFHS | To examine the relation between use of biomass cooking fuels (wood or dung) and prevalence of active tuberculosis | Primarily use biomass for cooking fuel have substantially higher prevalence of active TB than persons living in households that use cleaner fuels OR= 3.56. This effect is reduced somewhat when availability of a separate kitchen, house type, indoor crowding, age, gender, urban or rural residence, education, religion, caste or tribe, and geographic region are statistically controlled (OR = 2.58). Fuel type also has a large effect when the analysis is done separately for men (OR = 2.46) and women (OR = 2. 74) and separately for urban areas (OR = 2.29) and rural areas (OR = 2.65). The analysis also indicates that, among persons age 20 years and over, 51% of the prevalence of active TB is attributable to cooking smoke. | Use of biomass fuels for cooking substantially increases the risk of tuberculosis in India |
| 46 | Shetty, N. | 2006 | Karnataka | Bangalore | Gender | Case-control | To evaluate potential socio-demographic risk factors for TB | Significant risk factors were low education level (OR 0.30), not having a separate kitchen (OR 3.26), diabetes (OR 2.44). Patients were respectively 11 and seven times more likely to have a BMI <18.5 & mid-arm circumference <24 cm | The relationship between TB, the use of biomass cooking fuels and gender differentials related to fuel exposure merit further exploration. |
| 47 | Arora, V. K | 2003 | Delhi | Delhi | Gender | Cohort | Profile of geriatric TB patients under RNTCP | The male : female ratio of 315 geriatric TB patients enrolled under DOTS was observed to be 3 : 1 as against the 1.4 : 1 in younger TB patients. | A lower reported prevalence amongst females, poor sputum conversion as well as cure rates and higher exclusion as well as default rates. Further studies are needed to address the issues under operational conditions of Indian RNTCP. |
| 48 | Gupta, A. | 2001 | NA | NA | Gender | NA | The clinical characteristics of PCR-positive tubercular retinal vasculitis | There were 9 (69.2%) male and 4 (30.7%) female patients | Polymerase chain reaction-positive tubercular retinal vasculitis had varied associated fundus findings. |
| 49 | Zodpey, S. P. | 1999 | Maharastra | Nagpur | Gender | Case control study | Effectiveness of BCG vaccination in the prevention of childhood pulmonary tuberculosis | BCG was nonsignificantly more effective in underfives, among males | Moderate effectiveness of BCG vaccination in prevention of childhood pulmonary tuberculosis |

| S. No. | Author | Year | State | Area | Population | Methodss | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|
| 50 | Nair, D. | 2016 | Tamil Nadu | Chennai | Gender | Cohort | Yield of household contact screening and the approaches used in high incidence settings | Age group > 44 years, male gender and siblings of the index case was associated with abnormal chest radiograph whereas age group between 15-44 was significantly associated with developing TB disease among household contacts. | Active screening among household contacts is an effective way to improve TB case detection. |
| 51 | Atre, S. R. | 2004 | Maharastra | Mumabi | Gender | Explanatory Model | To clarify concepts of gender, culture, and TB | Emotional and social symptoms were frequently reported for both vignettes, but most distressing for the female vignette; specified problems included arranging marriages, social isolation, and inability to care for children and family. Job loss and reduced income were regarded most troubling for the male vignette. Men and women typically identified sexual experience as the cause of TB for opposite-sex vignettes. With wider access to information about TB, male respondents more frequently recommended allopathic doctors and specialty services. | Discussion considers the practical significance of gender-specific cultural concepts of TB. |
| 52 | Gosoniu, G. D. | 2008 | Maharastra | Mumabi | Gender | Explanatory Model | To compare the interval from symptom onset to diagnosis of TB for men and women | With adjustment for confounding, female sex (Bangladesh), and status of married woman (India) and housewife (Malawi) were associated with problem delay. | The study identified gender- and illness-related features of diagnostic delay. Further research distinguishing patient and provider delay is needed. |
| 53 | Latief, M. | 2017 | Kasmir | NA | Gender | Sample | To study the occurrence and risk factors of DILI in patients on ATT by regular clinical and biochemical monitoring | Female gender and extrapulmonary tuberculosis were found to be associated with increased risk of ATT-induced DILI, whereas age, BMI, and serum albumin were not found to significantly increase DILI risk. | DILI is a common problem among patients on ATT in our population. Early detection not only reduces the risk of developing Hepatic Failure but also prevents mortality. |
| 54 | Anupriya, A. | 2010 | Tamil Nadu | Vellore | Gender | Cohort | To identify any factors which can predict this complication in patients with TBM. | On the multivariate logistic regression analysis, female sex ($P < 0.037$), age less than 27 ($P < 0.008$) years and protein content in the CSF > 260 mg% ($P < 0.021$) were the factors predisposing toward this complication. | Young women with a high CSF protein content seem to be more prone for this complication. |
| 55 | Sarpal, S. S. | 2015 | Punjab | Chandigarh | Gender | Cohort | Gender disparities in retreatment patients of tuberculosis | Male to Female ratio 1.8:1. The proportion of male patients notified was significantly higher than females ($Z = 5.93$, $P < 0.001$). The proportion of extrapulmonary cases was higher in the females (28.4%) as compared with males (17%) ($P < 0.001$). Males outnumbered females in all the unfavorable outcomes death, default, and failure. The default in males was significant as compared to the females ($Z = 5.21$, $P < 0.001$) | The findings of this study suggest a sex difference in the notification rate of retreatment cases of TB. Reasons for a better outcome and low notification rate for TB in females are more due to epidemiological factors than a differential access of the health care. |

| S. No. | Author | Year | State | Area | Population | Methodss | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|
| 56 | Weiss, M. G | 2008 | NA | NA | Gender | Explanatory Model | To identify and compare socio-cultural features of tuberculosis (TB) and the distribution of TB-related experiences, meanings and behaviours with reference to gender across cultures in three high-endemic low-income countries | Female patients reported more diverse symptoms and men more frequently focused on financial concerns. Most patients reported psychological and emotional distress. Men emphasised smoking and drinking alcohol as causes of TB, and women in Malawi reported sexual causes associated with HIV/AIDS. In Bangladesh, exaggerated concerns about the risk of spread despite treatment contributed to social isolation of women. Public health services were preferred in Malawi, and private doctors in India and Bangladesh. | Health systems benefit from sex-disaggregated epidemiological data complemented by cultural epidemiological study, which together clarify the role of gender and contribute to the knowledge base for TB control at various levels. |
| 57 | Muniyandi, M. | 2007 | Tamil Nadu | Tiruvallur | Gender | Cohort | To assess the HRQoL of tuberculosis (TB) patients one year after treatment completion | The well-being scores were significantly related to age, sex, education, employment and persistent symptoms. | This study suggests that the HRQoL of TB patients one year after successful completion of treatment under the TB control programme was normal for most of the domains studied and was associated with age, literacy and employment, income, smoking, alcoholism and persistence of symptoms. |
| 58 | Balaji, G. | 2013 | NA | NA | Gender | Case report | Isolated Tubercular Osteomyelitis of Scapula | There is no difference with respect to gender | NA |
| 59 | McArthur, E. | 2016 | Madhya Pradesh | Bhopal | Gender | Qualitative study | To characterize socio-cultural and knowledge-based barriers that affected TB diagnosis for women | Women, especially younger women, faced socio-cultural barriers and stigma, causing many to hide their symptoms. Older women had little awareness about TB. Women often sought treatment from private practitioners, resulting in delayed diagnosis. | Understanding these diagnostic and help-seeking behaviors barriers for women is critical for development of a gender-sensitive TB control program. |
| 60 | Narasimhan, P. | 2017 | Tamil Nadu | Vellore | Gender | Cohort | We aimed to compare TB transmission rates between case and community households | LTBI positivity was similar between the two groups using both tests, with only moderate concordance observed between QFT and TST. Children of HHC (<15 years) were at a higher risk for LTBI (odds of 2.37 [1.15-4.89] and 3.02 [1.22-7.45] for TST and QFT respectively). Among adults, both age in decades (odds of 1.33 and 1.16 for TST and QFT, respectively) and the interaction of male gender, smoking and alcohol consumption (odds of 4.06 and 2.59 for TST and QFT, respectively), were associated with increased risk of LTBI. | Assessment of risk factors for infection need increased examination as prophylactic treatment of LTBI are being considered. |
| 61 | Nair, D. | 2017 | NA | NA | Gender | Cohort | Predictors of unfavourable treatment outcome in patients with multidrug-resistant | Of 788 patients, 68% were male, 70% were aged 15-44 years, 90% had failed previous anti-tuberculosis treatment or were retreatment smear-positive, 60% had a body mass index < 18.5 kg/m(2) and 72% had additional resistance to streptomycin and/or ethambutol. | Long delays from sputum collection to treatment initiation using conventional methods, along with poor treatment outcomes, suggest the need to scale up rapid diagnostic tests and shorter regimens for MDR-TB. |
| 62 | Andrade, N. N. | 2011 | NA | NA | Gender | Cohort | To evaluate clinical signs and symptoms of orofacial tuberculosis | Forty-six cases with a positive diagnosis of orofacial tuberculosis. The male:female ratio was 0.917, with no gender predilection | In a tuberculosis-prevalent country such as India, it is very important to be aware of tubercular lesions involving the orofacial region. |

| S. No. | Author | Year | State | Area | Population | Methodss | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|
| 63 | Khan, K. B. | 2011 | Delhi | Delhi | Gender | Qualitative study | Understanding the gender aspects of tuberculosis: | I bring forth the "genderization" of TB and the associated sufferings for women. With my findings I demonstrate how gender, in conjunction with other social forces, influences the disease outcomes and stigmatizes women, how lives in slums are uniquely organized by multiple discourses that contribute to the gender makings of TB, and, finally, how women strategize to reduce their burden of illness. | Nil |
| 64 | Vivekanand, K. | 2017 | Andhra Pradesh | Tirupati | Gender | Observational study | Study of the structure and functioning of referral mechanism of patients receiving treatment and records linkage under RNTCP | There was no statistically significant difference in gender distribution; availability of phone numbers; type of disease; & type of case. . | Our findings suggest that text messaging reminders may be an important tool to achieve optimal feedback response in resource-limited settings. |
| 65 | Gupta, S. N. | 2014 | Himachal Pradesh | NA | Gender | Cohort | To evaluate the performance of the program | The tuberculosis cases have fallen down from 6,462/100, 000 in 1999 to 2,195/100, 000 in 2005 following the introduction of RNTCP in 1999. Age specific (15-55 years) and sex-wise males were more affected than the females (59-64%). | Continue investment in the program to sustain progress achieved. I |
| 66 | Kaulagekar, A. | 2007 | NA | NFHS | Gender | NFHS | Social status makes a difference: tuberculosis scenario | In the entire sample 1735 males and 1266 females are reported to suffer from TB. Reporting of TB is significantly (p=0.000) more among males having charecteristics with lower standard of living, scheduled tribes from rural area and illiterate population. It increases with age. Significant difference (p=0.002) is observed between urban and rural female's treatment seeking for TB. In case of females as age increases, treatment seeking goes down (p=0.007). Treatment seeking for currently married women is less frequent than that of all other women. | Apart from economic status and living conditions, place of residence (urban / rural) and ethnic identity made people more vulnerable in terms of reporting the disease and access to treatment. |
| 67 | Atre, S. | 2011 | Maharastra | Western Maharashtra | Gender | Explanatory Model | Examined community perceptions of TB-related stigma | Concealment of disease was explained as fear of losing social status, marital problems and hurtful behaviour by the community. For the female vignette, heredity was perceived as a cause for stigmatising behaviour. Marital problems were anticipated more for the male vignette. Anticipation of spouse support, however, was more definite for men and conditional for women, indicating the vulnerability of women. Community views acknowledged that both men and women with TB share a psychological burden of unfulfilled social responsibilities. | The distinction between public health risks of infection and unjustified social isolation (stigma) was ambiguous. Such a distinction is important for effective community-based interventions for early diagnosis of TB and successful treatment. |

| S. No. | Author | Year | State | Area | Population | Methodss | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|
| 68 | Somma, D. | 2008 | NA | NA | Gender | Explanatory Model | Assess indicators of TB-related stigma and socio-cultural and gender-related features of illness associated with stigma. | The overall stigma index was highest in India, lowest in Malawi and greater for women in Bangladesh. In India and Malawi, women were more likely to be concerned about impact on marital prospects. Associations with HIV/AIDS were linked to TB stigma in Malawi, where sexual contact as a perceived cause was more associated with stigma for men and less for women. | Cultural epidemiological methods clarify cross-cutting and local features of stigma and gender for TB control. |
| 69 | Dhingra, V. K. | 2010 | Delhi | Delhi | Gender | Cohort | Effect of social stigma in TB patient's treatment | Stigma was more among females ($p<0.05$) than in males | Need to supplement the efforts in advocacy, communication and social mobalization for reducing the stigma |
| 70 | Shivapujimath, R. | 2017 | Karnataka | Udupi | Gender | Cross sectional | To assess the stigma experienced by tuberculosis patients and to find the factors associated with stigma | Age, education, and smear status of the patient were found to be associated with stigmatization ($P<0.05$), whereas factors like gender, income, occupation, family history, and marital status were found to be not significantly associated with stigmatization. | Effective counseling measures are recommended for tuberculosis patients with advancing age and education which can help reduce stigmatization and thereby improve quality of life. |
| 71 | Das, Mrinalini | 2014 | Nagaland | NA | Gender | Cohort | Treatment outcomes in TB program | Females (81%), pulmonary TB patients (75%) and those on a Category I regimen (79%) had better treatment success rates than males (67%), | National TB programmes should consider allowing SAT strategies for delivery of TB treatment to 'hard-to-reach' populations, which could in turn help to achieve universal coverage and contribute to global TB elimination by 2050. |
| 72 | Shiotani, R. | 2014 | NA | NA | Gender | Qualitative study | To identify sociocultural and gender influences on DOT adherence | Tthe mismatch between cultural norms & DOTS treatment provision & the divide between providers' and patients' perspectives on treatment default. scheduled tribes. | Improving the efficacy of DOT depends upon acknowledging & addressing underlying cultural influences |
| 73 | Jain, K. | 2014 | Gujarat | Ahemadabad | Gender | Cohort | To evaluate the treatment outcome of second line drugs used in DOTS | Out of 89 patients with sputum culture conversion, majority (73) turned negative within first 3 months. Female gender ($P < 0.05$), conversion of sputum culture from positive to negative ($P < 0.0001$), and radiological improvement ($P < 0.0001$) were found to be positive predictors of a successful treatment | The treatment outcome of standardized regimen in MDR-TB patients was low. The long duration of treatment and defaulters are major challenges for a successful outcome. |
| 74 | Ramachandran, G. | 2017 | Tamil Nadu | Chennai | Gender | Cohort | Factors Influencing Tuberculosis Treatment Outcome in Adult Patients Treated with Thrice-Weekly Regimens in India | Factors associated with treatment outcome were category II ATT (aOR, 2.39), low body weight (aOR, 0.96), alcohol use (aOR, 2.17), male gender (aOR, 1.92;), and baseline INH resistance (aOR, 5.74), which significantly increased the likelihood of an unfavorable outcome | Studies are needed to optimize anti-TB drug dosages and improve cure rates. Drug susceptibility testing at the baseline and attention to undernutrition and alcohol dependence are other important interventions. |
| 75 | Patra, S. | 2013 | Delhi | Delhi | Gender | Cohort | To compare the profile and treatment outcomes between elderly (>/=60 years) and non-elderly (15-59 years) TB patients | Elderly patients were more likely to be male (63.2% vs 51.1%) and have smear-positive TB (56.0% vs 47.4%). Adverse outcomes were more frequent among elderly patients (adjusted OR 1.9, 95% CI: 1.5-2.4), specifically deaths (adjusted OR 5.0, 95% CI: 3.1-8.1) and lost-to-follow-up (adjusted OR 1.4, 95% CI: 1.0-1.9). | The profile and worse outcomes of elderly Indian TB patients may be indicative of co-existing NCDs. This needs further investigation and likely calls for a more comprehensive and intensive approach to their management. |

| S. No. | Author | Year | State | Area | Population | Methodss | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|
| 76 | Joseph, N | 2011 | Karnataka | Mangalore | Gender | Cross sectional | To find out the sputum conversion rates, treatment outcomes and sociodemographic factors | Gender and place of residence did not have a significant influence on treatment outcomes among NSP patients. Among retreatment patients, age, gender and place of residence did not have a significant influence on treatment outcomes. | Among the sociodemographic factors, age was found to significantly influence treatment outcomes in Category I patients. |
| 77 | Kulkarni, P. | 2013 | Maharastra | Mumbai | Gender | Cohort | Non-adherence of new pulmonary tuberculosis patients to anti-tuberculosis treatment | 78 (50%) were non-adherent to anti-tuberculosis treatment (ATT). Independent risk factors for non-adherence were identified as male gender (P = 0.035) and lack of knowledge of importance of regular treatment (P = 0.001). Being female sex worker (FSW) was also an absolute risk factor for non-adherence. | There is immense need for continuous, effective and reinforcing health education to the patient and his family. Special groups like males in the age group of 15-49 years, patients who do not have any family support like migrants, FSW need special attention to ensure adherence to ATT. |
| 78 | Dholakia, Y. N. | 2012 | Maharastra | Mumbai | Gender | NA | To predict outcome in new and treatment failure PTB | Failures demonstrated associations between extensive lesions and high glycosylated hemoglobin (GHb) levels (P=0.028) and male gender (P=0.03). | The use of X-rays as an additional tool to shorten diagnostic delay and shortlist MDR suspects amongst nonresponders to TB treatment should be explored in a setting with limited resources coping with a high MDR case load such as Mumbai. |
| 79 | Rao, S. | 2009 | NA | NA | Gender | Retrospective study was undertaken by screening medical records | Profile of pulmonary tuberculosis patients with respect to gender | The male to female ratio in patients of pulmonary tuberculosis was 2:1, which was also maintained when smear positive and smear negative were studied separately. The ratio of smear positive to smear negative patients was statistically significant at 4.4:1 | Two-thirds of all female smear-positive patients were found in the young and reproductive age group has strong implications in tuberculosis control strategies because of higher chances of mother to child transmission and higher probability of complications because of attendant antenatal and postnatal morbidity. |
| 80 | Mukherjee, A | 2012 | West Benga | NA | Gender | Cohort | To find out the sex differences in the notification rates and treatment outcomes of TB patients registered under the RNTCP | 2498/3605 (69.3%) were male male female ratio of 2.25:1. In patients <20 years of age, the notification rates among males and females were similar. In the other age groups, males were more likely to be notified compared to females and the difference was statistically significant. While new smear positive and retreatment cases were significantly more than in males, among females, new smear negative and new extrapulmonary cases were significantly higher. Among the new smear positive patients 89.4% of females were cured compared to 85.8% of males which was again significant statistically. Male patients outnumbered females in all the unfavorable outcomes like death, failure, and default although none of the differences were statistically significant. | The present study demonstrates a gender difference in the notification rates, clinical presentations and treatment outcomes of patients with tuberculosis. Integrated research is necessary to find the reasons for these differences. |

| S. No. | Author | Year | State | Area | Population | Methodss | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|
| 81 | Arvind, C. | 1993 | Tamil Nadu | Chennai | Gender | Retrospective cohort | Burden of intracranial tuberculomata | 1247 cases of CT diagnosed intracranial tuberculomata were analysed retrospectively. The male to female ratio was approximately 60:40. | Left sided lesion were more common when compared with the right (statistically significant). We postulate that this increased occurrence of left sided lesions is due to the hematogenous mode of infection and increased blood flow to the dominant hemisphere. |
| 82 | Gaude, G. S. | 2015 | Karnataka | NA | Gender | Prospective nested case control | Drug-induced hepatitis and the risk factors for liver injury in pulmonary tuberculosis | Regular alcohol intake, more extensive disease associated with radiological and female gender were observed to be independent risk factors for the development of DILI | The risk of development of hepatitis is increased in the presence of one or more of these risk factors. |
| 83 | Narayanan, P. R. | 2006 | Tamil Nadu | Chengalpet | Gender | RCT | To estimate the efficacy of BCG in preventing tuberculosis | The failure to protect was seen in both males and females, and in children and adults. However, in a subset of over 40,000 subjects who were also nonreactors to PPD-B, BCG had a low level of protection, i.e., 32 per cent (95% CI=3-52%), 29 per cent with the Danish strain and 34 per cent with the French strain. | BCG was of little value in preventing sputum-positive cases of PTB |
| 84 | Sudha, G | 2003 | Tamil Nadu | Chennai | Gender | In-depth interviews | Factors that influence the care-seeking behaviour of chest symptomatics in urban and rural area | Private health care facilities were the first & preferred point of contact for 57% of urban & 48% of rural participants; the major reasons were proximity to residence & their perception that good-quality care would be available there. Symptomatics who did not seek care attributed their inaction to insufficient severity of symptoms (51%), unaffordability (46%) & lack of time due to work pressures (25%). Socio-economic factors such as literacy & family income significantly influenced care-seeking behaviour. | Need to involve privare practitioners & create awareness on symtoms of TB |
| 85 | Samal, J. | 2016 | NA | NA | Gender | Systematic review | Gender based health seeking behaviour | NA | Health seeking behaviour and related delays are of utmost importance in TB care from two important perspectives; firstly TB requires timely treatment and secondly it requires protracted treatment |
| 86 | Dhanaraj, Baskaran | 2015 | Tamil Nadu | Chennai | Gender | Cross sectional | Measured the community prevalence and risk factors of adult PTB | Multivariate analysis showed that occurrence of both culture and bacteriologically positive PTB disease was significantly associated with: age >35 years, past history of TB treatment, BMI <18.5 Kgs/m2, solid cooking fuel, and being a male currently consuming alcohol. | Intensified case finding in high risk groups is useful. Undernutrition, slum dwelling, indoor air pollution and alcohol intake are modifiable risk factors for TB disease |
| 87 | Dhingra, V. K. | 2004 | Delhi | Delhi | Gender | Cohort | Health care seeking of tuberculosis patients | No significant differences were observed in health seeking delay in relation to sex | Extensive health education activities can reduce this period of delay in health seeking and result in reduction of transmission of tuberculosis to healthy members of the family and community. |

| S. No. | Author | Year | State | Area | Population | Methodss | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|
| 88 | Mistry, N. | 2016 | Maharastra | Mumbai | Gender | Population-based retrospective survey | Durations and Delays in Care Seeking, Diagnosis and Treatment Initiation in Uncomplicated Pulmonary Tuberculosis | The mean duration for the total pathway was 65 days with 29% of patients being outliers. Importantly the mean duration of first care seeking was similar in new (24 days) and retreatment patients (25 days). | Achieving positive behavioural changes in providers (especially non-allopaths) and patients needs to be considered in TB control strategies. Specific attention is required in counselling of TB patients so that timely care seeking is effected at the time of relapse. Prioritizing improvement of environmental health in vulnerable locations and provision of point of care diagnostics would be singularly effective in curbing pathway delays. |
| 89 | Das, D. | 2017 | Odisha | Rayagada | Gender | Cross sectional | To find out the extent of delay in diagnosis among pulmonary TB patients of a tribal dominated district | The delay in health seeking by the patients was not differentiated by sex, | Poor awareness of patients about the disease and limited access to health care are the bottom-line in apparent diagnostic delay of TB patients. Increased awareness of the disease is crucial in improving health-seeking behavior in these areas. |
| 90 | Basa, S. | 2016 | Odisha | NA | Gender | Cohort | Patient and Healthcare System Delays in the Start of Pulmonary Tuberculosis Treatment | Median patient, health system and total delay were 24, 3 and 24 days respectively. Gender is not a risk factors that were significantly associated with patient delay | Public awareness in tribal dialect about chest symptoms and availability of free diagnostics services should be increased along with involvement of traditional healers. |
| 91 | Gupta, S. | 2010 | NA | Manipal | Gender | Cohort | Determine the frequency of underlying risk factors and the socio-economic impact based on occupation in the development of tuberculosis. | Men (M:F = 3.7:1) and patients older than 40 years had a higher incidence of co-existing conditions. PTB was significantly more common in blue-collar (44%) and white-collar (27.1%) workers than household workers (12.1%), students (10.6%) and retired/unemployed people (6.3%). | PTB had a significant impact & predominated in male patients co-existing with DM. Patients with DM and suggestive pulmonary symptoms should be screened for TB. More stringent health education & awareness programme should be implemented at the grass root level. |
| 92 | Yang, W. T | 2014 | NA | NA | Gender | Review | Barriers and delays in tuberculosis diagnosis and treatment services | Women faced greater barriers (financial: 64% versus 36%; physical: 100% versus 0%; stigma: 85% versus 15%; health literacy: 67% versus 33%; longer delays (presentation to diagnosis: 45% versus 0%) than men. | No quantitative gender-related differences in barriers & delays limiting access to TB services. When differences were identified, women experienced greater barriers and longer delays than men. |
| 93 | Arora, N. | 2012 | Andhra Pradesh | Kakinada | Gender | Cohort | Tuberculosis knowledge among HIV-infected patients in a high HIV prevalence region | Low education attainment, female sex, and less frequent television exposure were associated with low TB literacy. | Scale-up of patient-directed educational programs is necessary to help control TB in India. |
| 94 | Kulkarni, P. | 2015 | Jharkhand | Singhbhum | Gender | Cross sectional | Knowledge and awareness of tuberculosis (TB) among the general population, understand gender differences and inform intervention activities for the improvement of TB control programmes in tribal-dominant hard-to-reach areas | Significant gender differences were observed in knowledge and awareness levels | Study findings point to the importance of urgent intensification of culturally congruent and gender-sensitive advocacy, communication and social mobilisation activities. |

| S. No. | Author | Year | State | Area | Population | Methodss | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|
| 95 | Ganapathy, S. | 2008 | Tamil Nadu | NA | Gender | Qualitative study | Perceptions on the disease and behaviour towards TB patients | The stigma of TB is more visible in women than men when it comes to marriage. Men and children were perceived to get preferential attention by their families during illness. While the younger age group, irrespective of gender, accessed care from private providers, the older group preferred a government facility. Awareness of TB was acceptable but it seemed more associated as a respiratory disease and the common symptom associated with TB was cough | The need for gender specific intervention strategies to enhance better access of TB services. |
| 96 | Agarwal, A. | 2017 | Delhi | NA | Gender | NA | To find a possible answer to the above query, we investigated serial serum 25 hydroxy vitamin D concentrations in children suffering from osteoarticular tuberculosis treated with multidrug antitubercular drugs. | The mean vitamin D levels were higher in male patients when compared to female patients at all times | Vitamin D levels were low at initiation of treatment and did not significantly improve during multidrug antitubercular treatment. Further, tuberculosis healed well with antitubercular therapy despite persistence of low serum levels of vitamin D. |
| 97 | Aggarwal, A. N | 2013 | North India | NA | Gender | NA | To quantify impairment in health-related quality of life (HRQoL) of PTB patients at the time of diagnosis and during treatment, and to assess the utility of these assessments as a measure of outcome under programme conditions. | HRQoL domain scores were generally better among men, urban residents, younger patients, patients with higher socio-economic status and those with less severe disease. | HRQoL is impaired in patients with PTB, and improves rapidly and significantly with programme-based treatment. HRQoL assessment can be used as an adjunct outcome measure for patients treated by the RNTCP |
| 98 | Batra, S. | 2017 | North India | NA | Gender | Cohort | We evaluated the pattern and predictors for paradoxical response(s) (PR) peripheral lymph node TB | 68/110 patients with peripheral lymph node TB were included. | PR was observed more in younger age group, female gender ($p > 0.05$), unilateral lymphadenopathy ($p > 0.05$) and those with positive AFB on initial examination ($p < 0.01$). |
| 99 | Gupta, S. | 2013 | West Benga | Kolkata | Gender | Cross sectional | To identify rifampicin and INH resistant mycobacteria in the sputum samples of category II treatment failure tuberculosis patients | Among them, 68.9% were male patients and 55.6% were in the economically productive age group. Most of them (73.3%) were malnourished (BMI < 18.5); 62.2% of patients belonged to 'below poverty line' (BPL) category and 82.2% patients lived in overcrowded room. Majority of them (82.3%) either had past history of tuberculosis or history of contact or both. | Apart from the biological reasons of drug resistance, the sociodemographic and economic factors are no less important for the spread of drug resistant tuberculosis. |
| 100 | Finch, P. J. | 1991 | NA | NA | Gender | NA | Risk of tuberculosis in immigrant Asians | PTB was more common among Hindu women than Hindu men. Hindus were also at a significantly greater risk of TB at all sites than Muslims (Hindu:Muslim risk ratio 5.5 for women and 3.7 for men). | The increased susceptibility to tuberculosis of Hindus, particularly Hindu women, may be related to a culturally acquired immunodeficiency caused by vegetarianism and associated vitamin deficiency |

| S. No. | Author | Year | State | Area | Population | Methodss | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|
| 101 | Rajeswari, R. | 1999 | Tamil Nadu | Chennai | Gender | Descriptive study | The socio-economic impact of tuberculosis on patients and their families | Both rural and urban female patients faced rejection by their families (15%). Eleven per cent of schoolchildren discontinued their studies; an additional 8% took up employment to support their family. | Care giving activities of female patients decreased significantly, and a fifth of schoolchildren discontinued their studies |
| 102 | Gorityala, S. B. | 2015 | NA | NA | Gender | Cross sectional | Treatment interruption among pulmonary TB | The study revealed that most of the defaulters were in the age group between 35 and 60 years, male gender, illiterates, daily wage labor, and married. | The treatment interruptions were minimized by putting the efforts to improve direct supervision; pretreatment counseling and retrieve treatment interrupters were recommended. |
| 103 | Samuel, B. | 2017 | West Bengal | NA | Gender | Cohort | Relationship between Nutritional Support and Tuberculosis Treatment Outcomes | Of 173 TB patients provided nutritional support, 15 (9%) had unsuccessful treatment outcomes, while 84 (21%) of the 400 not provided nutrition support had unsuccessful treatment outcomes ($p < 0.001$). After adjusting for age, sex and previous treatment, those who received nutritional support had a 50% reduced risk of unsuccessful treatment outcome than those who did not receive nutritional support (Relative Risk: 0.51; 95% Confidence Intervals: 0.30 - 0.86 | Under programmatic conditions, monthly rations of rice and lentils were associated with lower risk of unsuccessful treatment outcome among impoverished TB patients. Given the relatively small financial commitment needed per patient ($10 per patient per month), the national TB programme should consider scaling up nutritional support among TB patients living below the poverty line. |
| 104 | Reddy Satti, S. B | 2016 | Telangana | Nalgonda | Gender | Cohort | Risk Factors for DOTS Treatment Default Among New HIV-TB Coinfected Patients | Significant risk factors associated with defaulting included unskilled occupation [adjusted odds ratio (AOR: 3.56; 95% confidence interval (CI): 1.1-11.56], lower middle class socioeconomic status (AOR: 17.16; 95% CI: 3.93-74.82), small family size (AOR: 21.3; 95% CI: 6.4-70.91), marital disharmony (AOR: 6.78; 95% CI: 1.93-23.76), not being satisfied with the conduct of health personnel (AOR: 7.38; 95% CI: 2.32-23.39), smoking (AOR: 8.5; 95% CI: 2.31-31.21), and side effects of drugs (AOR: 4.18; 95% CI: 1.35-12.9). | Unskilled occupation, marital disharmony, small family size, lower middle class socioeconomic status, not being satisfied with the conduct of health personnel, smoking, and drug side effects were significantly associated with defaulting. Information on the pattern of tuberculosis (TB), the outcome of anti-tuberculosis treatment |
| 105 | Bhargava, A. | 2015 | All | NA | Gender | NFHS | Undernutrition and the incidence of tuberculosis in India: national and subnational estimates of the population-attributable fraction related to undernutrition | The overall prevalence of undernutrition in 15-49 years was 35.6% among women & 34.2% among men. About half (55.4%) of all cases of active TB among women & 54.4% among men were attributable to undernutrition. In 15-19 years, the population-attributable fraction (PAFs) for undernutrition were 62% and 67% among women & men, respectively. The PAF of undernutrition was higher in rural areas, in scheduled castes, scheduled tribes and other backward classes, & in the lower quintiles of the wealth index. | Addressing the problem of endemic undernutrition among adolescents and adults in India could complement the current TB control strategy based on case management, and help reduce the incidence of TB in India |
| 106 | Dandona, R. | 2004 | NA | NA | Gender | Cohort | The utilization of and barriers to the RNTCP | Diagnosis: 29279/ 83,099 were women (35.2%). Sputum-positive diagnosis was lower in women (10.8%) than men (17%). For the treatment of TB: 6789/21592 (31.4%) women; new smear-positive TB, 79.9% of women & 74.4% of men were cured. Treatment outocme were significantly higher for men. | Of the persons utilizing the RNTCP services, about one-third are women. need to adopt a patient-centred approach to improve utilization of the RNTCP services. |

| S. No. | Author | Year | State | Area | Population | Methodss | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|
| 107 | Ahmed, J. | 2009 | Karnataka | Bellary District | Gender | Cohort | To find out the utilization of RNTCP services by age, sex and distance from residence to designated microscopy centres and treating health centres. | Lesser No. of males accessed the health care services. Larger No. of males with PTB smear positive cases utilized RNTCP services than females in the ratio of 1.6:1 and 2.5:1. | There is need to make health services available to the male working population at convenient hours and to be more vigilant to screen persons with PTB, Supervision & motivation of treatment for male TB cases & those residing more than 20 kms from the treating health centres requires to be strengthened. |
| 108 | Anand, T. | 2017 | Delhi | Delhi | Gender | Cohort | To assess the decadal impact of DOTS strategy on some epidemiological factors such as age and gender of new sputum positive (NSP) TB patients in Delhi. | The case detection rate has also shown a considerable increase from 196/100,000 population in 2001 to 306/100,000 population at the end of Quarter 3 of 2011. The number of NSP male and female patients have increased in all age groups from 2001 to 2011 except in 25-34 years age group. NSP male patients on DOTS aged 15-44 years showed a left ward shift in increase, a significant right ward shift was noted in increase in female NSP patients of similar age group. | The decadal assessment of DOTS in Delhi on TB epidemiology has pointed towards beginning of epidemiological transition in TB control in India. |

# 7. Geriatrics & TB

| S. No. | Author | Year | State | Area | Population | Methods | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Rakhi Ludum | 2015 | Odisha | Bhubaneshwar | Geriatric | Cross-sectional | Prevalence of elderly PTB diagnosed at the department of pulmonary medicine | Prevalence-50% Incidence (Male) | The elderly population contribute substantially to the incidence of TB. More over co-morbidities being more frequently in the geriatric age group, there is further overlap of symptoms leading to late diagnosis. |
| 2 | HL Gupta | 2002 | Delhi | NCR | Geriatric | Cross-sectional | Prevalence of health problems in asymptomatic elderly individuals | Prevalence - 16% | NA |
| 3 | Sandhyaranai Moharana | 2017 | Odisha | Baripuda | Geriatric | Cross-sectional | To find out the difference in manifestation of PTB in between adults & geriatric population. | Treatment outcome (Cured, not cured, failure and death) were better in 18-59 years than >60 years ($p<0.05$) | TB in geriatric population is a bigger problem with regards to its presentation and treatment. Lower lobe TB is more common in the elderly population and there are more chances of multidrug resistance TB in the geriatric population. |
| 4 | Swapnil Shivam | 2014 | West Benga | Burdwan | Geriatric | Retrospective Analysis | To compare the profile& treatment outcome of geriatric & young tuberculosis patients. | Treatment Outcome (cured, not cured, failure and death) were poor in geriatric patients following CAT 1 treatment regimen($p<0.0001$). No significant difference in CAT 2 between yoing and geriatric age group | Geriatric and pediatric tuberculosis patients differ in diseases characteristics and outcome |
| 5 | Khwakja Ubedullah Shaik | 2015 | Andhra Pradesh | Kuppam | Geriatric | Prospective Analysis | The clinical, bacteriological & radiographic features of PTB geriatric population | Poor Cure rate in geriatric age group ($p<0.05$). Other variables though higher but not statistically significant | Geriatric patients experienced more frequent occurrence of adverse reactions, failure of treatment and mortality |
| 6 | VK Arora | 2003 | Delhi | NCR | Geriatric | Retrospective Analysis | To study the profile of geriatric TB patients under RNTCP | Sputum Convesrion rate, Cure rate were found to be low and Death rate to be high in the geriatric group ($p<0.01$) | Lower reported prevalence amongst females, poor sputum conversion as well as cure rates and higher exclusion as well as default rates. Further studies are needed to address the issues under operational conditions of Indian RNTCP |
| 7 | Banu Rekha Vaithilingam Velayutham | 2014 | Tamil Nadu | Thiruvalluvar | Geriatric | Retrospective Cohort analysis | To compare the clinical profile, presentation & response to anti-TB treatment among elderly TB patients treated under RNTCP | Increased loss to follow up, side effects and death rates in elderly ($p<0.05$) | Elderly TB patients are less likely to have smear positive disease. Newly diagnosed elderly TB patients are more likely to be lost to follow-up or die and report drug side effects. Suitable interventions need to be developed for effective management and better treatment outcomes of TB in the elderly. |

# 8. Hard-to-Reach areas & TB

| S. No. | Author | Year | State | Area | Population | Methods | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Thomas, B. E. | 2014 | Tamil Nadu | Tiruvallur | Brick kiln workers | Cross sectional | Prevalence of chest symptoms amongst brick kiln migrant workers and care seeking behaviour | Chest symptomatics identified, 50.4% took action to get relief from their symptoms. The duration of over 6-month stay in the chamber was significantly associated with taking action (OR, 5.5, 95% CI: 2.3, 13.3). | The TB control programme needs to further explore how to extend its services to such 'hard to reach' groups. Active case finding to ensure early diagnosis and treatment initiation amongst such groups needs consideration. |
| 2 | Das, D | 2017 | Odisha | Rayagada | Tribal | Cohort | To find out the extent of delay in diagnosis among pulmonary TB patients of a tribal dominated district | The delay in health seeking by the patients was not differentiated by sex or resistance profile, although more men attended the DMC for diagnosis. We found that 12.9% of patients had a delay exceeding 2months, and 50% of them had high sputum grade. | Poor awareness of patients about the disease and limited access to health care are the bottom-line in apparent diagnostic delay of TB patients. Increased awareness of the disease is crucial in improving health-seeking behavior in these areas. |
| 3 | Gupta, D. | 2006 | NA | NA | Hard to reach areas | Commentry | Case detection rate targets under DOTS: the Indian experience | The partnerships have significantly contributed to the case detection rates in the country, especially the medical colleges, which have contributed up to 5%-15%. | There is a need to forge new initiatives, strengthen existing partnerships and make special efforts to access the poorer, vulnerable and hard-to-reach sections of society more effectively. |
| 4 | Das, D. | 2014 | Odisha | NA | Hard to reach areas | Sample | Transport sputum specimens within two weeks from hard to reach areas (The use of cetylpyridinium chloride (CPC) effectively sustains the viability of mycobacteria) | CPC containing sputum samples processed within two weeks showed 88.6% culture positivity, while positivity was significantly affected beyond two weeks. | CPC is cheap, easy to use, inhibits the growth of other organisms and can effectively be used to transport sputum specimens within two weeks from hard to reach areas to central locations without compromising culture positivity. Bus transport services can also help in reducing delay and the cost of transportation from remote areas. |
| 5 | Das, M. | 2014 | Nagaland | Mon District Hospital | | Cohort | To detail treatment outcomes in TB program supported by Medecins Sans Frontieres (MSF) and using an alternative model of TB treatment delivery in Mon district | Overall, 74% of patients (175/238) had successful outcomes, being cured or having completed their treatment. Females (81%), pulmonary TB patients (75%) and those on a Category I regimen (79%) had better treatment success rates than males (67%), extra-pulmonary TB patients (62%) and patients on a Category II regimen (61%). The univariate and bivariate analyses found age, sex and TB treatment regimen significantly associated with unsuccessful TB treatment outcomes (defined as death, loss-to-follow-up and failure). | Study suggests that self-administered TB treatment is feasible for patients living in areas with limited or no access to health services. The relatively low number of patients with adverse outcomes suggests that SAT models are safe; other advantages include the need for fewer resources and less frequent movements by patients. National TB programmes should consider allowing SAT strategies for delivery of TB treatment to 'hard-to-reach' populations, which could in turn help to achieve universal coverage and contribute to global TB elimination by 2050. |
| 6 | Muniyandi, M. | 2015 | All | NA | Tribal | Cohort | To assess the performance of RNTCP in terms of case detection and cure rates in areas dominated by tribal groups | Among tribal districts 53 per cent in 2010, 45 per cent in 2011 and 56 per cent in 2012 had CDR of new smear positive <70%. It was also observed that 26 per cent of tribal dominated districts had CDR of <51 per cent in 2012. More than 50 per cent of tribal districts were not able to achieve more than 85 per cent of cure rate | The findings of this study suggested that the overall RNTCP performance in tribal areas was not optimal, and the target of >85 per cent of core rate was achieved by less than half of the tribal districts. Equitable access, implying a preference for the most hard-to-reach groups particularly for tribal areas, is a major concern for RNTCP. |

# 9. Health Care Workers & TB

| S.No | Author | Year | Country | State | Area | Subject | Methods | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Fochsen, G. | 2004 | India | NA | NA | Behaviour | Qualitative | To analyse how the implementation strategy of direct observed treatment short course (DOTS) has shaped and influenced patient-provider encounters in a district tuberculosis centre (DTC) | The findings showed that the TB doctor seemed to be working with a dilemma, defined as conflicting accountabilities, in the medical encounters. In an organization perceived as inefficient and resource-constrained, the doctor struggled to find a balance between meeting the obligations of the DOTS programme and meeting the needs and expectations of the patients. Strategies to deal with these conflicting accountabilities were identified as limiting patients' involvement, struggling to maintain authority, and transferring responsibility | Professional involvement and patient participation were seen as part of a linked process in this study, and the importance of empowering doctors and health care workers who are implementing DOTS is emphasized. The development of DOTS guidelines needs to be based on the actual process of health care delivery, and staff empowering efforts should also include strengthening of public health care infrastructure. |
| 2 | Kumar, B. A. | 2017 | India | NA | NA | Behaviour | Observational | Rehabilitation of treated TB patients: Social, psychological and economic aspects | The side effects of TB medication (especially DR-TB) are sometimes extreme, and require extensive therapy and/or rehabilitation. Some side effects such as hearing-loss are often permanent. Nutritional support is another key factor that receives little attention in national programs. Adding to all these physiological challenges is the constant stigma and discrimination that individuals face from friends, family and even healthcare workers. Returning to jobs or to their education is a challenge as many workplaces and educational institutions do not provide for extended periods of leave or absence. This is costly both in terms of time and money. In families where the primary "bread winner" needs to undergo intensive treatment, the reduced income can have a devastating effect | it is necessary that robust systems for post-treatment rehabilitation are put in place, and are designed based on the needs of those affected. Peer to peer counselling can be a low-cost high-impact strategy to address some of these issues. Institutional provisions, under the national response in each country, must be put in place if individuals are to successfully complete treatment, and return to their normal lives. |
| 3 | Panda, R. | 2015 | India | Andra Pradesh, Gujarat | NA | Behaviour | Exploratory | Explores whether auxiliary nurse midwives (ANMs) adhere to the 3As from the recommended 5As model for tobacco cessation | Majority of ANMs reported that they were aware of respiratory illnesses, tuberculosis, lung and oral cancer as conditions caused due to tobacco consumption. Awareness of adverse reproductive and child health effects associated with tobacco use was very low. Only about one third of respondents informed all patients about harmful effects. Only 16% of ANMs reported having ever received any on-job training related to tobacco control. ANMs who reported receiving training in tobacco control were about two times more likely to provide information on health effects of tobacco as compared to those who reported not being trained in tobacco control in the state of Gujarat. | A majority of ANMs ask patients about tobacco use but provide advice only to patients suffering from specific diseases. A context-specific capacity building package needs to be designed to equip ANMs in recommended 5As approach in tobacco cessation. |

| S.No | Author | Year | Country | State | Area | Subject | Methods | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|---|
| 4 | Porter, J. D | 2002 | India | Odisha | Koraput | Behaviour | Qualitative | The perceptions of communities and providers about leprosy and tuberculosis services. | LEPRA staff from top management to the outreach workers were also approached for their views. Patients and communities noted that physical access to treatment was a major constraint, while the existence of local providers and family support structures facilitated health and health care. Providers expressed a willingness to collaborate (with LEPRA and the government), but lacked training, adequate staff support and the appropriate equipment/technical resources. Also lacking were adequate information campaigns to inform the public about these diseases and their treatment. This information has provided LEPRA with an understanding of how they might best fill gaps in the existing system and therefore assist in the process of integrating services in their own organization and through the primary health care structure. | LEPRA will increasingly become involved in developing relationships and partnerships with government in the delivery of training and services and in infrastructure development. |
| 5 | Rakesh, P. S | 2017 | India | Kerala | Kollam | Behaviour | Quasi experimental | Explore the perception of people with Tuberculosis in Kerala regarding DOT, mechanisms to make the treatment of TB more patients centered and to identify the preferable mechanisms to ensure adherence. | Patients who were on a strict DOT were unhappy about the issues of confidentiality, patient inconvenience and provider centered approach. A flexible, patient centered approach were a family member can act as the DOT provider with guidance from a trained health worker was evolved as the most acceptable and comfortable mode of treatment to majority of the TB patients. They felt that a strict external monitor as a DOT provider was not a necessity in majority of the cases. Only practical way to effectively incorporate ICT in monitoring patient compliance in current scenario was identified as daily phone call reminders. Patients also expressed their concerns in keeping the medicines for entire duration at home. | A flexible patient wise individualized system based on patient's behavior, literacy and awareness along with attitude of family members is needed to ensure adherence to anti TB drugs. |

| S.No | Author | Year | Country | State | Area | Subject | Methods | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|---|
| 6 | Janagond, A. B | 2017 | India | NA | NA | Environment | Cohort | Screening of health-care workers for latent tuberculosis infection in a Tertiary Care Hospital | A total of 206 eligible HCWs signed the informed consent and completed the questionnaires between January 2014 and December 2015. The age of the participants ranged from 18 to 71 years, with a mean age of 27.13 years. TST induration size (mean 6.37 mm) the TST results suggested that 36.8% (76/206) were infected with TB using a TST induration >/=10 mm as a cut-off point. All 76 TST-positive HCWs showed no evidence of active TB in clinical evaluation and chest radiography. However, during the study, two HCWs developed pulmonary TB (both TST baseline test negative). Statistical analysis suggested that age, duration of employment as a health-care professional, literacy status, and working in medical wards/OP/ Intensive Care Unit were significantly associated with TB infection | Many studies propose serial tests of LTBI as effective occupational protection strategies. However, practically, it is not feasible because it has to be done at frequent intervals, but how frequently to be done is not clear. Another concern is even if found to have LTBI, there are no clear consensus guidelines about the treatment in high prevalence settings. The prevalence of LTBI is so high in countries like India that affected HCWs could not be exempted from working in high-risk areas. The depth of knowledge of TB prevention and control among HCWs should be improved by regular infection control training. |
| 7 | Jesudas, C. D. | 2014 | India | NA | NA | Environment | Commentry | Tuberculosis risk in health care workers | Risk to health care workers (HCW) is of paramount importance in the global fight against tuberculosis (TB). There is mounting evidence that they are at increased risk of contracting TB infection as well as developing the disease. This occupational risk is at alarming proportions in the low- and middle-income countries (LMIC), because of increased exposure and lack of preventive measures. Although tuberculin skin test has been used for a long time to detect latent TB infection (LTBI), it has significant drawbacks. Interferon-gamma release assays arrived with a lot of promise, but the expected benefit of more specific diagnosis has not yet been proved. | Effective environmental and personal protective measures along with education to the patients and the HCW needs to be carried out expeditiously, to reduce the occupational risk of TB. |
| 8 | Joshi, R. | 2007 | India | Maharastra | Sevagram | Environment | Cohort | Prevalence of abnormal radiological findings in health care workers with latent tuberculosis infection and correlations with T cell immune response | A total of 330 HCWs with positive TST or QFT underwent standard chest radiography. Of these 330, 113 radiographs (34.2%) were finally classified as normal, 206 (62.4%) had lesions suggestive of inactive TB, and 11 (3.4%) had features suggestive of active TB. The mean TST indurations and interferon-gamma levels in the HCWs in these three categories were not significantly different. None of the demographic or occupational covariates was associated with prevalence of inactive TB lesions on chest radiography. | In a high TB incidence setting, nearly two-thirds of HCWs with latent TB infection had abnormal radiographic findings, and these findings had no clear correlation with T cell immune responses. Further studies are needed to verify these findings and to identify the causes and prognosis of radiologic abnormalities in health care workers. |

| S.No | Author | Year | Country | State | Area | Subject | Methods | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|---|
| 9 | Khayyam, K. U. | 2010 | India | Delhi | NITRD | Environment | Retrospective study | To find out the risk of tuberculosis disease among health care workers (HCWs) of LRS Institute | A total of 40 cases of tuberculosis were reported by the health care workers between March 1999 to March 2008 yielding an overall risk of 727 per 1,00,000 population per year which is four times higher than the reported national average. Among these 40 cases, 25 (62.5%) were pulmonary and 15 (37.5%) were extra-pulmonary tuberculosis. | This institute's health care workers have to deal with a large number of tuberculosis patients, the risk of exposure is more in them and thus having the disease. Multi-centric studies are needed to evaluate the true prevalence of tuberculosis among HCWs and effective intervention strategies are required to reduce nosocomial transmission. |
| 10 | Mathew, A | 2012 | India | South India | NA | Environment | Case control | The risk factors for acquiring TB among HCWs in India | The cases and controls were of similar age. Logistic regression analysis showed that body mass index (BMI) <19 kg/m(2) (odds ratio [OR]: 2.96, 95% confidence interval [CI]: 1.49-5.87), having frequent contact with patients (OR: 2.83, 95% CI: 1.47-5.45) and being employed in medical wards (OR: 12.37, 95% CI: 1.38-110.17) or microbiology laboratories (OR: 5.65, 95% CI: 1.74-18.36) were independently associated with increased risk of acquiring TB | HCWs with frequent patient contact and those with BMI <19 kg/m(2) were at high risk of acquiring active TB. Nosocomial transmission of TB was pronounced in locations, such as medical wards and microbiology laboratories. Surveillance of high-risk HCWs and appropriate infrastructure modifications may be important to prevent interpersonal TB transmission in health care facilities. |
| 11 | Nair, V. | 2001 | India | Kerala | NA | Environment | Cross sectional | Role and participation in Implementing different national health programmes | MPWs consistently 'over-reported' their Performance when self-reported information was compared with that obtained from household surveys. Male MPWs concentrated on the National Malaria Eradication Programme and health education while female workers focused on the family welfare and immunization programmes. Key national health programmes (such as for tuberculosis and acute respiratory infection) were neglected by all MPWS: MPWs were aware of health problems of the elderly, but were not adequately trained nor officially expected to deliver any services in these fields | Grass-root level workers apportion more time to select national health programmes to the detriment of other health programmes, thereby negating their multipurpose role. Our study emphasizes the need for interventions to derive 'multipurpose benefits' from the MPWS: |
| 12 | Pai, M. | 2005 | India | NA | NA | Environment | Cohort | To estimate latent tuberculosis infection prevalence in health care workers using the tuberculin skin test (TST) and a whole-blood interferon gamma (IFN-gamma) assay; to determine agreement between the tests; and to compare their correlation with risk factors | A large proportion of the health care workers were latently infected; 360 (50%) were positive by either TST or IFN-gamma assay, and 226 (31%) were positive by both tests. The prevalence estimates of TST and IFN-gamma assay positivity were comparable (41%; 95% confidence interval [CI], 38%-45% and 40%; 95% CI, 37%-43%, respectively). Agreement between the tests was high (81.4%; kappa = 0.61; 95% CI, 0.56-0.67). Increasing age and years in the health profession were significant risk factors for both IFN-gamma assay and TST positivity. BCG vaccination had little impact on TST and IFN-gamma assay results | Our study showed high latent tuberculosis infection prevalence in Indian health care workers, high agreement between TST and IFN-gamma assay, and similar association between positive test results and risk factors. Although TST and IFN-gamma assay appear comparable in this population, they have different performance and operational characteristics; therefore, the decision to select one test over the other will depend on the population, purpose of testing, and resource availability. |

| S.No | Author | Year | Country | State | Area | Subject | Methods | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|---|
| 13 | Pai, M | 2006 | India | NA | NA | Environment | Observational | To compare TST and IFN-gamma conversions and reversions in healthcare workers | Of the 216 participants, 48 (22%) were TST-positive, and 38 (18%) were QFT-positive at baseline. Among 147 participants with concordant baseline negative results, TST conversions occurred in 14 (9.5%; 95% confidence interval [CI] = 5.3-15.5) using the 6 mm increment definition, and 6 (4.1%; 95% CI = 1.5-8.7) using the 10 mm increment definition. QFT conversions occurred in 17/147 participants (11.6%; 95% CI = 6.9-17.9) using the definition of IFN-gamma greater than or equal to 0.35 IU/ml, and 11/147 participants (7.5%; 95% CI = 3.8-13.0) using IFN-gamma greater than or equal to 0.70 IU/ml. Agreement between TST (10 mm increment) and QFT conversions (>or= 0.70 IU/ml) was 96% (kappa = 0.70). QFT reversions occurred in 2/28 participants (7%) with baseline concordant positive results, as compared with 7/10 participants (70%) with baseline discordant result | IFN-gamma assay shows promise for serial testing, but repeat results need to be interpreted carefully. To meaningfully interpret serial results, the optimal thresholds to distinguish new infections from nonspecific variations must be determined. |
| 14 | Zwerling, A | 2013 | India | NA | NA | Environment | Cohort | To assess whether QuantiFERON-TB Gold In-Tube (QFT) responses are associated with occupational TB exposure | Among 270 medical and nursing trainees, high rates of conversions (6.3-20.9%) and reversions (20.0-26.2%) were found depending on the definitions used. Stable converters were more likely to have had TB exposure in hospital pre-study. Recent occupational exposures were not consistently associated with QFT responses over time | IFN-gamma responses and rates of change could not be explained by occupational exposure investigated. High conversion and subsequent reversion rates suggest many health care workers (HCWs) would revert in the absence of treatment, either by clearing the infection naturally or due to fluctuations in the underlying immunological response and/or poor assay reproducibility. QFT may not be an ideal diagnostic test for repeated screening of HCWs in a high TB incidence setting. |
| 15 | Rekha, B. | 2013 | India | NA | NA | Human rights | Cohort | To evaluate the effectiveness of an isoniazid preventive therapy (IPT) register and card in improving the adherence of health care workers (HCWs) to programmatic guidelines. | Of 87 children identified aged <6 years, 71 (82%) were traced by HCWs; 53 were screened for TB and initiated on IPT, and 39 completed treatment. HCWs expressed satisfaction with the use of the IPT card and register, saying that it helped them to remember to complete required tasks. | In a programme setting, with HCW training and introduction of specific documentation (IPT card and register), implementation of contact tracing and chemoprophylaxis for child contacts improved from 19% to 61%. |
| 16 | Gopinath, K G | 2004 | India | Tamilnadu | Vellore | Incidence | Hospital records | To document the incidence of TB among HCWs in the Christian Medical College | The overall incidence of sputum positive cases was similar to that observed in the general population, during most years. | The chance of developing extra-pulmonary tuberculosis was higher in HCWs compared with the general population. |

| S.No | Author | Year | Country | State | Area | Subject | Methods | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|---|
| 17 | Banerjee, A. | 2004 | India | Andra Pradesh | Viz-ianaga-ram | Legal/ Economic | Indepth inter-view, FGDs | Acceptability of traditional healers as DOT provider | There were 18 THs per 1000 population. Of the 120 THs interviewed, 15 (13%) claimed to be TB special-ists. Of the 72 healers aware of TB, 65 (90%) consid-ered prolonged cough an important symptom and 53 (74%) believed that TB could be cured with allopathic drugs. THs felt collaboration was possible by directly observed treatment (DOT) providers (49, 68%), refer-ring symptomatic individuals (54, 75%) and offering treatment for side effects (18, 25%). | Involvement of THs in the TB Control Pro-gramme may improve services as they are a major health service provider in tribal areas and are acceptable as DOT providers to patients, public health pro-viders and NGO workers. |
| 18 | McArthur, E | 2016 | India | Madya Pradesh | Bhopal | Legal/ Economic | Qualitative | Characterize socio-cultural & knowledge-based barriers that af-fected TB diagnosis | Women, especially younger women, faced socio-cul-tural barriers & stigma, causing many to hide their symptoms. Older women had little awareness about TB. Women often sought treatment from private practitioners, resulting in delayed diagnosis | Understanding these diagnostic & help-seeking behaviors barriers for wom-en is critical for development of a gen-der-sensitive TB control program. |

# 10. Illegal Migrants & TB

| S. No. | Author | Year | State | Area | Population | Methods | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Yamamura, J. | 2000 | NA | NA | Illegal migrant | Observational | TB cases among over-staying foreigners | The ratio of male to female was four to one. By ethnic origin, the proportion was highest among Filipinos (30%), followed by Koreans (23%), Pakistanis (13%) and Indians (7%). The proportion of extrapulmonary TB among all types of TB was 35% overall. Compared with pulmonary TB cases, patient's as well as doctor's delay was more marked among extrapulmonary TB cases. The default rate including repatriation was as high as 41%, reasons for this high defaulting rate were as follows: 1. Language barrier, 2. Worry for loosing work during treatment, 3. Worry for high medical costs because of no coverage by a health insurance scheme, 4. Lack of information on medical systems and TB, 5. Worry for forced repatriation by the immigration office. In addition, some cases were not followed up due to unkind behaviour of attending physicians | a) To provide free medical check-ups b) To provide easy access to medical facilities c) To utilize the tuberculosis prevention law d) To follow up patient thoroughly and strictly e) To explain TB in their mother languages f) To change the immigration law and its system g) To make liaison with other organizations such as medical facilities and NGOs, including foreign ones, and exchange informations h) To build good human relations with patients. |

# 11. Immunosuppressive Therapy & TB

| S.No | Author | Year | State | Area | Population | Methods | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Parchand, S. | 2011 | Chandigarh | PGIME | Intermediate uveitis (IU) | Descriptive | Intermediate uveitis in Indian population | Tuberculosis was the most common underlying etiology seen in 57 (46.7%), | Tuberculosis is an important etiologic cause of IU in developing countries like India where the disease is endemic. It is important to investigate these patients as specific therapy with ATT helped in reducing the recurrences significantly. |
| 2 | Kshatriya, R. | 2016 | Gujarat | Anand | Diabetes Mellitus | Case report | Cannon ball appearance on radiology in a middle-aged diabetic female | A case of middle year female with diabetes mellitus presented with atypical symptoms with cannon ball appearance on radiology and found to be of tuberculosis in origin. | Thus any patients with immunocompromised condition can present with atypical manifestation of tuberculosis either clinically or radiologicaly in high endemic countries for tuberculosis |
| 3 | Padhi, S. | 2015 | Pondicherry | NA | Hemophagocytic lymphohistiocytosis | Review | Hemophagocytic lymphohistiocytosis: An unusual complication in disseminated Mycobacterium tuberculosis | The literature review (January 1975-March 2014) found that HLH complicated the clinical course of 63 tuberculosis patients (41 males, 22 females, mean age = 45 +/- 23.5 years) with a high mortality rate of 49% (31/63 died). The mean serum ferritin level (n = 44/63) was 5963 ng/mL (range 500-38,539 ng/mL); and a higher proportion (54.2%) of patients had pancytopenia at presentation. On univariate analysis (n = 53/63), age >30 years [hazard ratio (HR): 2.79, 95% confidence interval (CI):1.03-7.56, P = 0.03], presence of comorbidities (HR 4.59, CI: 1.08-19.52, P = 0.04), marked hemophagocytosis in bone marrow (HR: 2.65, CI: 1.16-6.05, P = 0.02), and nonusage/delayed usage of antitubercular therapy (ATT) (HR: 3.44, CI: 1.51-7.87, P = 0.003) were associated with decreased survival, though none of these parameters attained statistical significance (P > 0.05) in multivariate analysis. | Hemophagocytic lymphohistiocytosis (HLH) should be considered as a differential diagnosis in patients with tuberculosis who present with cytopenias, organomegaly, and coagulopathy. Strong clinical suspicion and early usage of ATT might be useful in reducing the morbidity and mortality. The utility of immunosuppressive/immunomodulator therapy lacks general concensus among treating physicians, and warrants further studies. |
| 4 | Padhi, S. | 2013 | Pondicherry | NA | Hemophagocytic lymphohistiocytosis | Descriptive | Hemophagocytic lymphohistiocytosis: critical reappraisal of a potentially under-recognized condition | Definite evidence of hemophagocytosis was noted in 4 patients on initial bone marrow examination. The underlying etiologies were as follows: Rickettsia tsutsugamushi (case 1), autoimmune disorder (case 2), systemic onset juvenile idiopathic arthritis (sJIA) (case 3), unknown bite (possibly a venomous snake) (case 4), Plasmodium vivax (case 5), Cytomegalo virus (case 6), and Mycobacterium tuberculosis (case 7). In one patient, hemophagocytosis was presumed to have been exacerbated by administration of granulocyte monocyte colony stimulating factor (GMCSF) for severe neutropenia. Two patients died with disseminated intravascular coagulation (DIC) and multi organ failure within few days of HLH diagnosis. | Due to lack of specificity of diagnostic criteria, diagnosing and differentiating HLH from its closest mimickers like sepsis/septic shock may be quite challenging in critically ill patients. Therefore, increasing awareness among physicians is essential for early diagnosis and effective therapy to reduce the mortality |

| S.No | Author | Year | State | Area | Population | Methods | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|
| 5 | Qureshi, S. | 2014 | Uttar Pradesh | NA | Immunocompromised | Case report | Mixed pulmonary infection in an immunocompromised patient | A 49-year-old man who was a known case of chronic obstructive pulmonary disease, on prolonged corticosteroid use with diabetes mellitus. Chronic use of corticosteroids is a predisposing factor for opportunistic infections, such as nocardiosis or tuberculosis. | A combined approach to therapy early in the course of disease would be effective in such cases. |
| 6 | Gupta, P. P. | 2007 | Haryana | Rohtak | Immunosuppresive | Case report | Primary tuberculous glossitis in an immunocompetent patient | A 25-year-old male with no known immunosuppressive disorder presented with a tuberculoma at the base of his tongue. | This highlights the importance of considering tuberculosis in the differential diagnosis of chronic tongue lesions, even in the absence of pulmonary tuberculosis. |
| 7 | Bavikatte, A. P. | 2017 | Kochin | Amrita Institute of Medical Sciences | Live donor liver transplantation | Cohort | Live donor liver transplantation for antitubercular drug-induced acute liver failure | A total of seven (7.7%) patients with ATT-induced ALF who had underwent live donor liver transplantation were included in the study. Out of seven patients, three (42.8%) had established diagnosis of tuberculosis and the remaining (58.2%) patients were started on ATT empirically. | Restarting of ATT post liver transplant is feasible and should be individualized along with frequent monitoring of immunosuppressant levels; however, if the primary diagnosis of tuberculosis was empirical, reintroduction of ATT can be omitted. |
| 8 | Olithselvan, A. | 2014 | Pondicherry | NA | Liver transplant recipient | Review | Tuberculosis in liver transplant recipients | TB (52.9%) remained the most common cause; however, in almost half (47.1%), other attributable causes were found. Patients were treated with a standard daily regimen for a median of 12 months (IQR = 7.5 months). Posttransplant TB was associated with a high mortality rate (2/5 or 40% | In conclusion, we observed a low prevalence of TB in LTRs from a high-prevalence region. The presence of granulomas suggestive of TB in liver explants warrants isoniazid prophylaxis in the absence of disease. Post-liver transplant TB is associated with a high mortality rate. The roles of routine IGRA testing and isoniazid prophylaxis in a high-prevalence setting urgently need to be studied. |
| 9 | Haas, C. | 2006 | NA | NA | Organ transplantation | Review | Mycobacterium tuberculosis infection following organ transplantation | 7.0-11.8% in India. The incidence of tuberculosis among transplant recipients is much higher than in the general population. Diabetes mellitus, renal impairment, systemic lupus erythematosus, chronic liver disease and AIDS all increase the risk of post-transplant tuberculosis. Extrapulmonary and disseminated forms are frequent in this setting. The diagnosis of tuberculosis in transplant recipients is often difficult, and treatment is frequently delayed. Tuberculosis can be life-threatening in such cases. Treatment is difficult because rifampicin is a cytochrome P450 inducer (leading to reduced levels of cyclosporine), and because the hepatotoxicity of isoniazid, rifampin and pyrazinamide is frequently increased in transplant recipients. | Treatment of latent tuberculosis before transplantation markedly reduces the risk of developing active tuberculosis after transplantation. |

| S.No | Author | Year | State | Area | Population | Methods | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|
| 10 | Sinha, A. | 2010 | Delhi | NA | Pediatric renal transplantation | Descriptive | Long-term outcome of pediatric renal transplantation at a referral center in New Delhi | Urinary infections (n = 13), septicemia (4), tuberculosis (4), CMV disease (7), viral hepatitis (7), and pneumonia (3) were important causes of morbidity. | The respective patient survivals were 95.3%, 87.9%, and 76.9% at one-, five- and 10 yr. Our results affirm that despite scarcity of resources and frequent infections, long-term outcomes of pediatric renal transplantation are highly satisfactory. |
| 11 | Vachharajani, T | 2000 | Maharastra | NA | Renal Transplant | Sample | The incidence of Mycobacterium tuberculosis in hemodialysis (HD) and renal transplant (RT) patients | Tuberculous peritonitis was seen only in HD patients (33.3%) | Tuberculosis should be included in the differential diagnosis of fever in HD and RT patients, especially if fever is of unknown origin in the RT patient. |
| 12 | Rathi, M. | 2014 | Chandigarh | NA | Renal transplant recipient | Case report | Scedosporium apiospermum and Mycobacterium tuberculosis in a renal transplant recipient | A 50-year-old female, a renal allograft recipient who presented with left hemiplegia, esophageal ulcers and fever 3 months after her transplant. Esophageal biopsy revealed Cytomegalovirus (CMV) inclusions and the whole blood quantitative CMV polymerase chain reaction (PCR) was positive. Neuroimaging showed a brain abscess, stereotactic biopsy from which revealed Scedosporium apiospermum on fungal culture. Her tacrolimus and mycophenolate were stopped and she was managed with intravenous ganciclovir and voriconazole. With these measures, she showed marked improvement in her general and neurological condition. Two months later, she developed recurrence of fever with dry cough. Radiological investigation revealed a cavitating lung lesion, a needle aspiration from which demonstrated acid-fast bacilli. She was started on antituberculous treatment. | Although CMV disease is not uncommon in the first three months post transplant, Scedosporium is a rare cause of brain abscess. On the other hand, tuberculosis is common in transplant recipients, especially in developing countries, like India |
| 13 | John, G. T. | 2002 | Tamil Nadu | Vellore | Renal transplant recipients | Cohort | Nocardiosis in tropical renal transplant recipients | Among renal transplant recipients of the tropics nocardiosis is a marker of a high susceptibility to tuberculosis and other infections, the association with tuberculosis is stronger in those developing early nocardiosis (<2 yr). | Chronic liver disease is a risk factor for death in patients with nocardiosis especially when associated with tuberculosis. This report constitutes the largest single centre experience among renal transplant recipients. |
| 14 | Sun, H. Y NA | 2014 | NA | NA | Solid-organ transplant Recipients | Cohort | Tuberculosis in solid-organ Transplant recipients: disease characteristics and outcomes in the current era | Patients from the later versus earlier era had Tuberculosis develop later after transplant (odds ratio, 1.01; 95% CI, 1.00-1.02; P= .05), were more likely to be liver transplant recipients (odds ratio, 4.52; 95% CI, 1.32-15.53; P= .02), and were more likely to receive tacrolimus-based immunosuppression (odds ratio, 3.24; 95% CI, 1.14-9.19; P= .03). Mortality rate was 10% in the later cohort and 21% in the earlier cohor | Notable changes have occurred in the Epidemiological characteristics of tuberculosis in transplant recipients. Overall mortality rate has improved, with about 90% of the patients now surviving after tuberculosis. |

| S.No | Author | Year | State | Area | Population | Methods | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|
| 15 | Sakhuja, V. | 1996 | Chandigarh | NA | Renal transplant recipient | Cohort | Incidence of tuberculosis among renal transplant recipients in India | 36 cases of tuberculosis were encountered in 305 renal transplant recipients (11.8%) with grafts functioning for more than 3 months followed up at our center. The infection was limited to the thoracic cavity in 41.7% and a single extrapulmonary site in 11.1%, and it was disseminated in 27.8% cases. In 19.4% of cases, the disease appeared as pyrexia of unknown etiology and the diagnosis was confirmed by a good therapeutic response to antitubercular therapy. Tuberculosis was diagnosed within 1 year of transplantation in 58.3% of cases. There was no significant difference in the incidence of tuberculosis in patients on different immunosuppressive regimens. | The incidence of tuberculosis in renal allograft recipients in third world countries is much higher than that seen in the western world. Most of the cases are encountered in the first posttransplant year. Tuberculosis must be considered seriously in all patients who have prolonged fever of undetermined etiology |

# 12. Injecting Drug users & TB

| S. No | Author | Year | State | Area | Population | Methods | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Singh, S. | 1999 | Delhi | NA | Jail | Active screening | Prevalence of sexually transmitted and blood-borne infections amongst the inmates of a district jail in Northern India | 44 for smack/charas and 8 had a history of intravenous drug abuse. 25 (10.4%) active pulmonary tuberculosis (TB). Out of the 3 HIV-positive persons, one was an intravenous drug user (IVDU), second was a drug addict and frequent CSW visitor while the third was a homosexual | This pilot study gives an indication that sexually transmitted and blood-borne infections are highly prevalent in jail premises and pose a threat of rapid spread of these infections through IVDU and homosexuality. |

# 13. Migrant Workers & TB

| S. No. | Author | Year | State | Area | Population | Methods | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Chakravarty, J | 2006 | Eastern India | NA | HIV | Observational | Clinico-epidemiological profile of HIV patients | The most common opportunistic infection was tuberculosis (38.8%) followed by oropharyngeal candidiasis (20.3%) and diarrhea (12.7%) | CD4 counts of the patients were significantly inversely correlated with the number of symptoms and the number of opportunistic infections |
| 2 | Pais, P. | 1996 | NA | NA | HIV | Cohort | Descriptive | Pulmonary tuberculosis has been the most common clinical presentation. So far AIDS associated tuberculosis has responded to standard therapy but the development of multi-drug resistant mycobacteria and their spread to the large tuberculous population in the country is a potential threat. | NA |
| 3 | Thomas, B. E. | 2014 | Tamil Nadu | Tiruvallur | Migrant workers | Cross sectional | Prevalence of chest symptoms amongst brick kiln migrant workers and care seeking behaviour | Three hundred and seventy-seven (9.4%) chest symptomatics were identified. The most significant variables associated with chest symptoms were illiteracy, alcohol abuse and heavy smoking. Of the chest symptomatics identified, 50.4% took action to get relief from their symptoms. The duration of over 6-month stay in the chamber was significantly associated with taking action (OR, 5.5 | The TB control programme needs to further explore how to extend its services to such 'hard to reach' groups. Active case finding to ensure early diagnosis and treatment initiation amongst such groups needs consideration. |

# 14. Miners & TB

| S.No | First Author | Year | State | Area | Subject | Methods | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Haraprasad Mohapatra | 2010 | Odisha | Jharsuguda | Rate of TB Infection | Prospective Analysis | The dust concentration and dust dose associated with the rate of tuberculosis | Rate of TB infections icreased from 59% to 65.9% from 2005-2007 | The study clearly revealed that the tuberculosis patients have been increased significantly in the successive years of investigation |

# 15. Nutrition & TB

| S No | Author | Year | Country | State | Area | Methods | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Areeshi, M. Y. | 2017 | NA | NA | NA | Meta analysis | Vitamin D Receptor ApaI (rs7975232) Polymorphism Confers Decreased Risk of Pulmonary Tuberculosis in Overall and African Population, but not in Asians | We observed decreased risk of PTB in allelic (a vs. A: p=0.003; OR=0.873, 95% CI=0.798 to 0.955), homozygous (aa vs. AA: p=0.006; OR=0.761, 95% CI=0.626 to 0.924), dominant (aa+Aa vs. AA: p=0.039; OR=0.874, 95% CI=0.769 to 0.993) and recessive (aa vs. AA+Aa: p=0.025; OR=0.819, 95% CI=0.688 to 0.975) genetic models. During subgroup analysis, allele (a vs. A: p=0.005; OR=0.846, 95% CI=0.753 to 0.951), homozygous (aa vs. AA: p=0.002; OR=0.662, 95% CI=0.513 to 0.854) and recessive genetic models (aa vs. AA+Aa: p=0.003; OR=0.709, 95% CI=0.566 to 0.889) demonstrated decreased PTB risk in African population. However, no significant association was observed in Asian population | VDR ApaI polymorphism is significantly associated with decreased risk of PTB for in overall and African population, but not in Asians. |
| 2 | Bhargava, A | 2013 | India | Uttarakhand | NA | Cohort | Nutritional status of adult patients with pulmonary tuberculosis in rural central India and its association with mortality | At the time of diagnosis, median BMI and body weights were 16.0 kg/m(2)and 42.1 kg in men, and 15.0 kg/m(2)and 34.1 kg in women, indicating that 80% of women and 67% of men had moderate to severe under-nutrition (BMI<17.0 kg/m(2)). Fifty two percent of the patients (57% of men and 48% of women) had stunting indicating chronic under-nutrition. Half of women and one third of men remained moderately to severely underweight at the end of treatment. 60 deaths occurred in 1179 patients (5%) in whom treatment was initiated. Severe under-nutrition at diagnosis was associated with a 2 fold higher risk of death. Overall, a majority of patients had evidence of chronic severe under-nutrition at diagnosis, which persisted even after successful treatment in a significant proportion of them | These findings suggest the need for nutritional support during treatment of pulmonary TB in this rural population. |
| 3 | Bhaskaram, P. | 1992 | India | NA | NA | Observational | BCG vaccination in malnourished child population | Vaccinated children showed a significantly greater tendency to localise the tubercular lesions while most of the unvaccinated children suffered from progressive forms of the infection. Vaccination had similar effects even when there was associated malnutrition. Age did not seem to influence the severity of the disease in unvaccinated children while older children (greater than 3 yrs) had a greater tendency to localise the lesion in the vaccinated group. | NA |

| S No | Author | Year | Country | State | Area | Methods | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|
| 4 | Bhaskaram, P. | 1990 | India | Andra Pradesh | Hyder-abad | Case control | Peripheral blood monocyte (MO) function in malnourished subjects with pulmonary tuberculosis | The MO functions, however, were comparable among the three groups indicating lack of in vivo activation of the MO in patients harbouring tubercular infection/disease. With the evidence available from the literature on the effects of malnutrition on cellular immune functions, it was speculated that the observed MO dysfunction could be due to lack of appropriate lymphokine elaboration due to associated malnutrition. | Immunological defect might increase the risk of overt infection among the malnourished contacts. |
| 5 | Bhat, J. | 2017 | India | Madya Pradesh | Gwalior | Case control | Investigation of the risk factors for pulmonary tuberculosis | Malnutrition and history of asthma were associated with an increased risk of PTB. More than 56 per cent cases were attributed to malnutrition and 12 per cent attributed to asthma. Low family income, alcohol consumption and smoking were the other contributors. The risk was higher in males as compared to females. | Nutrition supplementation, especially in tuberculosis (TB) patients and integrated approach to improve their living conditions are needed to control TB in this community. |
| 6 | Bhat, P. G. | 2013 | India | Karnataka | NA | Cross sectional | Intensified tuberculosis case finding among malnourished children in nutritional rehabilitation centres | Of them, 1173 (72%) were evaluated for TB and 19(2%) were diagnosed as TB. Of 1173, diagnostic algorithm was followed in 460 (37%). Among remaining 763 not evaluated as per algorithm, tuberculin skin test alone was conducted in 307 (41%), chest radiography alone in 99 (13%) and no investigations in 337 (45%). The yield of TB was higher among children evaluated as per algorithm (4%) as compared to those who were not (0.3%) (OR: 15.3 [95%CI: 3.5-66.3]). Several operational challenges including non-availability of a full-time paediatrician, non-functioning X-ray machine due to frequent power cuts, use of tuberculin with suboptimal strength and difficulties in adhering to a complex diagnostic algorithm were observed | This study pointed to a number of operational issues that need to be addressed if this collaborative strategy is to identify more TB cases amongst malnourished children in India. |

| S No | Author | Year | Country | State | Area | Methods | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|
| 7 | Bose, K., Jr. | 2007 | India | West Bengal | NA | Case control | The nutritional status of tuberculosis patients (TBP | TBP had significantly lower means for all variables (except for height in men) compared to CT in both sexes. In men, the highest percent differences between the two groups were observed for fat mass (FM: 60.1%), fat mass index (FMI: 59.2%) and suprailiac skinfold (SUPSF: 58.8%). In women, the highest percent differences between the two groups were observed for SUPSF (59.7), mid-upper arm fat area (MUAFA: 58.1), triceps skinfold (TSF: 51.4), biceps skinfold (BSF: 51.2), FM (51.2) and FMI (49.0). Regression analyses confirmed that tuberculosis status had significant impact ($p < 0.0001$) on all anthropometric and body composition characteristics compared (except for height in men) in both sexes. Among men, tuberculosis status explained the highest percent variation in percent body fat (PBF: 57.2%), FMI (56.0%) and FM (55.6%). In women, tuberculosis status explained the highest amount of variation in PBF (67.9), TSF (63.5%), BSF (62.8), FMI (61.0) and FM(60.7). Results of contingency chi-square tests revealed that there were significant differences in the frequency of undernutrition between TBP and CT in men (chi2 = 73.13361) and women (chi2 = 59.0000). The frequencies of undernutrition were significantly more common among TBP, in both men (56.5%) as well as women (51.6%). | There was significant differential amount of loss in fat and muscle measures in tuberculosis patients. |
| 8 | Chadha, V. K. | 2009 | India | Karnataka | Bangaloe | Cross sectional | To estimate the prevalence of under-nutrition among school children and to find out the relationship between nutritional status and tuberculin sensitivity. | The prevalence of under-nutrition (including mild and severe under-nutrition) varied between 14.9-29.8%. The prevalence of severe under-nutrition varied from 2.9-6.7%. The frequency distributions of reaction sizes were found to be similar among children classified by nutritional status. The differences in proportions of significant reactions (=10 mm) and mean tuberculin reaction sizes between children classified by nutritional status were not found to be statistically significant | Tuberculin sensitivity was not influenced by nutritional status among apparently healthy school children. |
| 9 | Chandrasekaran, P | 2017 | India | NA | NA | Review | Malnutrition: Modulator of Immune Responses in Tuberculosis | There is very little evidence in the literature that any specific food on its own or a specific quantity can alter the course of TB disease or be effective in the treatment of malnutrition. | Clinical trials or studies will be needed to recommend and to better understand the link between malnutrition, tuberculosis, and impaired immunity. |

| S No | Author | Year | Country | State | Area | Methods | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|
| 10 | Das, B. S. | 2003 | India | NA | NA | Case control | Effect of iron supplementation on mild to moderate anaemia in pulmonary tuberculosis | Blood haemoglobin concentration, total erythrocyte count (TEC), packed cell volume (PCV), mean corpuscular volume (MCV), mean corpuscular haemoglobin and serum Fe, total Fe-binding capacity and ferritin were estimated before treatment and 1, 2 and 6 months after treatment. The patients were divided randomly into three groups and during the initial 2 months of treatment were provided with one of three supplementary regimens consisting of placebo, Fe alone or Fe with other haematinics. Significant improvements in haematological indices and Fe status were noticed in all three groups. Blood haemoglobin concentration, MCV and PCV were significantly higher at 1 month in both Fe-supplemented groups than the placebo group. This difference, however, disappeared at 2 and 6 months with similar values in all three groups. The increase of other haematological indices was similar in all groups. Serum Fe and Fe saturation of transferrin were significantly higher in both Fe-supplemented groups than the placebo group up to 2 months; this effect, however, disappeared at 6 months. There was a consistent increase in TEC and decrease in ferritin values up to 6 months in all groups. | Radiological and clinical improvement was similar in all three groups. These observations suggest that Fe supplementation in mild to moderate anaemia associated with pulmonary tuberculosis accelerated the normal resumption of haematopoiesis in the initial phases by increasing Fe saturation of transferrin. However, consistent improvement of haematological status was dependent only on the improvement of the disease process. |
| 11 | Dye, C. | 2011 | India | NA | NA | Ssecondary data | Nutrition, diabetes and tuberculosis in the epidemiological transition | TB incidence cases would have increased (28% from 1.7 m to 2.1 m) faster than population size (22%) because of adverse effects of aging, urbanization, changing BMI and rising diabetes prevalence, generating an increase in TB incidence per capita of 5.5% in 10 years. In India, general nutritional improvements were offset by a fall in BMI among the majority of men who live in rural areas. The growing prevalence of diabetes in India increased the annual number of TB cases in people with diabetes by 46% between 1998 and 2008. | Nutritional and demographic changes had stronger adverse effects on TB in high-incidence India than in lower-incidence Korea. The unfavourable effects in both countries can be overcome by early drug treatment but, if left unchecked, could lead to an accelerating rise in TB incidence. The prevention and management of risk factors for TB would reinforce TB control by chemotherapy. |

| S No | Author | Year | Country | State | Area | Methods | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|
| 12 | Gupta, K. B | 2009 | India | NA | NA | Descriptive | Tuberculosis and nutrition | In patients with tuberculosis, it leads to reduction in appetite, nutrient malabsorption, micronutrient malabsorption, and altered metabolism leading to wasting. Both, protein-energy malnutrition and micronutrients deficiencies increase the risk of tuberculosis. It has been found that malnourished tuberculosis patients have delayed recovery and higher mortality rates than well-nourished patients. Nutritional status of patients improves during tuberculosis chemotherapy. High prevalence of human immunodeficiency (HIV) infection in the underdeveloped countries further aggravates the problem of malnutrition and tuberculosis. Effect of malnutrition on childhood tuberculosis and tuberculin skin test are other important considerations | Nutritional supplementation may represent a novel approach for fast recovery in tuberculosis patients. In addition, raising nutritional status of population may prove to be an effective measure to control tuberculosis in underdeveloped areas of world. |
| 13 | Gupta, S | 2013 | India | West Bengal | Kolkatta | Observational | Socio-economic profile | Most of them (73.3%) were malnourished (BMI < 18.5); 62.2% of patients belonged to 'below poverty line' (BPL) category and 82.2% patients lived in overcrowded room. Majority of them (82.3%) either had past history of tuberculosis or history of contact or both | Apart from the biological reasons of drug resistance, the sociodemographic and economic factors are no less important for the spread of drug resistant tuberculosis. |
| 14 | Hemanth Kumar, A. K. | 2009 | India | Tamilnadu | Chennai | Observational | To determine the influence of immunological status, sex and body mass index on the steady state pharmacokinetics of lamivudine (3TC) and stavudine (d4T) in HIV-infected adults, who were undergoing treatment with generic fixed dose combinations (FDC) of these drugs in India. | The patients' immune status, sex or body mass index had no impact on the pharmacokinetics of 3TC | Blood levels of 3TC and d4T drugs that are part of generic FDCs commonly used by HIV-infected individuals in India were within the therapeutic range and not influenced by nutritional or immune status. |
| 15 | Jain, Y. | 2015 | India | Chattisgarh and Madhya Pradesh | NA | Programme data | Burden & pattern of illnesses among the tribal communities in central India | The tribals had significantly higher proportion of all tuberculosis, sputum positive tuberculosis, severe hypertension, illnesses that require major surgery as a primary therapeutic intervention and cancers than non tribals. The proportions of people with rheumatic heart disease, sickle cell disease and epilepsy were not significantly different between different social groups. Nutritional levels of tribals were poor. | There is a need for universal health coverage with preferential care for the tribals, especially those belonging to the PVTG. Further, the high level of undernutrition demands a more augmented and universal Public Distribution System. |

| S No | Author | Year | Country | State | Area | Methods | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|
| 16 | Jenum, S. | 2014 | India | South India | NA | Observational | Influence of age and nutritional status on the performance of the tuberculin skin test and QuantiFERON-TB gold in-tube in young children | TST and QFT had a susceptibility for clinical TB of 31% and 23%, respectively, in this group. Children <2 years were more likely to test QFT indeterminate. A height-for-age Z score within the lowest quartile increased the odds ratio (OR) for a positive or indeterminate QFT result [OR 2.46 (1.19-5.06), OR 3.08 (1.10-8.58)], whereas the OR for a positive TST was reduced with a weight-for-height Z score within the lowest quartile [OR 0.17 (0.06-0.47)] | Stunted children were more susceptible to Mycobacterium tuberculosis infection and more prone to indeterminate QFT results. TST was less reliable in children with wasting. |
| 17 | Kant, S. | 2014 | India | NA | NA | Descriptive | Significance of nutrition in pulmonary tuberculosis | Poor nutrition leads to protein-energy malnutrition and micronutrients deficiencies which lead to immunodeficiency. This secondary immunodeficiency increases the host's susceptibility to infection and hence increase the risk for developing tuberculosis. Tuberculosis itself leads to reduction in appetite, nutrient malabsorption, micronutrient malabsorption, and altered metabolism leading to wasting and poor nutritional status. | Nutritional status and dietary intake and hence nutritional status of patients get improved during antituberculosis treatment. |
| 18 | Kashyap, R. S | 2016 | India | Maharastra | Melghat | Cohort | To study socioeconomic status (SES) and living conditions (LC) as risk factors for latent tuberculosis infection (LTBI) and their impact on QuantiFERON-TB gold (QFT-G) and tuberculin skin test (TST) outcome for determining a better diagnostic test for LTBI in the malnourished tribal population | In concordant set, the two tests revealed that LTBI was significantly associated with smoking (adjusted odds ratio [aOR]: 2.64 [95% confidence interval [CI]: 1.03-6.79]), tobacco usage (aOR: 2.74 [95% CI: 1.50-4.99]), and malnourishment (aOR: 1.97 [95% CI: 1.12-3.48]) after basic adjustment. Inclusion of latent variable SES and LC in the model has mediating effect on the association of above factors with LTBI. Further, the association of SES and LC with LTBI in concordant set was unaltered in presence of other cofactors. From discordant set, results of QFT-G corroborated with that of concordant set. | Poor SES and LC can be considered as strong risk factors linked with LTBI as compared to malnourishment, which is often targeted in such communities. Further, our study showed QFT-G test as a reliable tool in screening of LTBI in the tribal population of Melghat, India |
| 19 | Krishnaswamy, K. | 1991 | India | Andra Pradesh | Hyderabad | Observational | Adult undernourished tuberculous patients receiving isoniazid, rifampicin and ethambutol were evaluated clinically and biochemically for hepatic dysfunction | While only 11% of the patients developed jaundice, the majority of the patients had a significant elevation of the serum hepatic enzymes suggesting subclinical hepatotoxicity. A significant downward trend during the 3-6 months period was seen in patients with multiple estimations of SGOT and SGPT indicating a self-limiting toxic process. However, the continued elevation of GGT suggests enzyme induction by rifampicin. Undernutrition contributes to drug toxicity by various mechanisms. | It is important to evaluate the nutritional status of the tuberculous patients receiving drugs, which are potentially hepatotoxic. |

| S No | Author | Year | Country | State | Area | Methods | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|
| 20 | Lodha, R. | 2014 | India | Delhi | NA | RCT | The effect of micronutrient supplementation in children treated with antituberculosis therapy (ATT). | An improvement in CXR was observed in 285 children, but there was no difference between those receiving zinc and no zinc or between those receiving micronutrients and no micronutrients after 6 mo of ATT. However, children who received micronutrients had a faster gain in height over 6 mo than did those who did not receive micronutrients (height-for-age z score Delta = 0.08; P = 0.014) | Micronutrient supplementation did not modify the weight gain or clearance of lesions on CXR in children with intrathoracic tuberculosis. However, micronutrient supplementation during treatment may improve height gain in children with intrathoracic tuberculosis |
| 21 | Mahadevan, B | 2005 | India | Pondicherry | NA | Observational | To study tuberculin reactivity in childhood tuberculous meningitis both in clinical and histopathological (HP) contex | Of the 50 children studied, 68% of them were malnourished and 42% had BCG scar. Tuberculin test was positive in 22 (44%) cases. Spearman analysis showed negative correlation between stage of TBM and the size of tuberculin reaction. BCG status did not affect the size of tuberculin reaction. Histopathological grade of the tuberculin reaction was found to be directly proportional to the size of the tuberculin reaction and it was not affected by the stage of TBM. C | Tuberculin positivity is low in TBM irrespective of the nutritional status. |
| 22 | Mandal, A. | 2012 | India | West Bengal | Kolkatta | Cohort | To define the most suggestive clinical features of abdominal tuberculosis, to evaluate the usefulness of the normally available investigations, and the response of anti-tuberculous drugs | Anemia and under- nutrition, abdominal tenderness, ascites, and hepato / splenomegaly were the most common findings. Chest radiography showed active or healed tuberculous focus in 16. Ultrasonography revealed abdominal lymphadenopathy, ascites, and mass lesions in 26, 12, and four patients, respectively. Barium examination showed abnormality in eight patients out of 18, among whom it was performed. An ascitic fluid study done in 12 patients showed high adenosine deaminase in all, and positive acid fast bacilli in one. Laparoscopic peritoneal biopsy was done in18 patients, and 13 showed tuberculous granuloma. Treatment success was achieved in 38 patients with anti-tuberculous drugs. Most patients tolerated the anti-tuberculous drugs well. | With good clinical examination and appropriate investigations definitive diagnosis of abdominal tuberculosis can be reached in a significant number of patients. Strongly suggestive clinical and laboratory data are also indications for anti-tuberculous therapy in an endemic country like India. Anti-tuberculous drugs are well tolerated and highly effective. |
| 23 | Medhi, G. K. | 2006 | India | Assam | 2006 | Cross sectional | Health problems and nutritional status of tea garden population of Assam | Prevalence of underweight among children was 59.9% (357 of 596) and thinness among adults was 69.9% (1,213 of 1,735). Anemia was widespread. Worm infection (65.4%, 217 of 332); skin problems; respiratory infections, including tuberculosis; filariasis were present in a significant way. Children suffered more in various diseases. Major noncommunicable diseases like hypertension, stroke were emerging in the community and were associated with modifiable risk factors like alcohol and tobacco use | Health status of the population can be ameliorated through better hygienic practices, environmental sanitation, creating health awareness, nutritional intervention and overall improvement of socioeconomic conditions of the population |

| S No | Author | Year | Country | State | Area | Methods | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|
| 24 | Naik, A. L. | 2017 | India | Karnataka | Manga-lore | RCT | To estimate and compare serum Vit D status in newly diagnosed PTB patients before and after DOTS to validate the supplementation of Vit D in PTB patients. | Mean Vit D levels of the study population aged 43+/-13 years was 20.74 ng/ml (normal >30 ng/ml) at the time of diagnosis. After completion of six months of therapy mean Vit D reduced to 17.49 ng/ml (p-value=0.041). On individual observations, 70% of the participants showed a decrease in Vit D levels from their baseline, whereas 30% showed an increase. Comparison between the two groups indicated the possible role of younger age in the improved status. | VDD was seen in PTB patients, which worsened in majority of the study population after treatment; hence it would be advisable to recommend Vit D supplementation in PTB patients for a better outcome. |
| 25 | Oxlade, O. | 2017 | India | Eastern states | NA | Modelling | Estimating the Impact of Reducing Under-Nutrition on the Tuberculosis Epidemic in the Central Eastern States of India | The modeled nutrition intervention scenarios brought about reductions in TB incidence and TB related mortality in the Central Eastern Indian states ranging from 43% to 71% and 40% to 68% respectively, relative to the scenario of no nutritional intervention. Modest reductions in under-nutrition averted 4.8 (95% UR 0.5, 17.1) million TB cases and 1.6 (95% UR 0.5, 5.2) million TB related deaths over a period of 20 years of intervention, relative to the scenario of no nutritional intervention. Complete elimination of under-nutrition in the Central Eastern states averted 9.4 (95% UR 1.5, 30.6) million TB cases and 3.2 (95% UR 0.7-, 10.1) million TB related deaths, relative to the scenario of no nutritional intervention. | Our study suggests that intervening on under-nutrition could have a substantial impact on TB incidence and mortality in areas with high prevalence of under-nutrition, even if only small gains in under-nutrition can be achieved. Focusing on under-nutrition may be an effective way to reduce both rates of TB and other diseases associated with under-nutrition. |
| 26 | Padmapriyadarsini, C. | 2016 | India | Tamilnadu | NA | Commentry | Undernutrition & tuberculosis in India: Situation analysis & the way forward | Nutritional supplementation in patients with TB is associated with faster sputum conversion, higher cure and treatment completion rates, significant gain in body weight and body composition as well as better performance status. | Reduction of TB burden in India and its elimination will require improving the nutritional status of the community as a whole. |
| 27 | Pathak, R. R. | 2016 | India | Bihar | Seven district | Cohort | To assess whether intensified case finding (ICF) strategies at NRCs can lead to pediatric case detection among SAM children and link them to TB treatment under RNTCP | Among 440 SAM children screened, 39 (8.8%) were diagnosed with TB. Among these, 34 (87%) initiated TB treatment and 18 (53%) were registered with the RNTCP. Of 16 children not registered under the RNTCP, nine (56%) weighed below six kilograms-the current weight requirement for receiving drugs under RNTCP. | More effort is needed to link this vulnerable population to TB services in addition to introducing child-friendly drug formulations for covering children weighing less than six kilograms |

| S No | Author | Year | Country | State | Area | Methods | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|
| 28 | Pednekar, M. S. | 2008 | India | Maharastra | Mumbai | Cohort | Association of body mass index with all-cause and cause-specific mortality: findings from a prospective cohort study | During 774 129 person-years of follow-up, 13 261 deaths were observed. After adjusting for the potential confounders, increased mortality was observed in all under-weight categories [relative risk (RR) = 1.94 for BMI < 16.0 kg/m(2), 1.38 for BMI 16.0 to <17.0 and 1.24 for BMI 17.0 to <18.5 among women; the corresponding values for men were 2.24, 1.45 and 1.27, respectively] when compared with the rate in the normal weight category (BMI 18.5 to <25.0). Extremely thin (BMI < 16.0 kg/m(2)) cohort members were at highest risk for death due to tuberculosis (TB) (RR = 7.20 and 14.94 in women and men, respectively), cancer (RR = 1.87 and 2.44, respectively) and respiratory diseases (RR = 3.46 and 4.35, respectively) | Under-weight was associated with an increased risk of pre-mature death. Despite the growing concerns regarding the gradual transition toward increasing rates of obesity, under-nutrition remains a major health problem in India. This study suggests the need for public health policies focusing on reducing under-nutrition |
| 29 | Prince, L. | 2016 | India | NA | NA | NFHS | Risk of self-reported symptoms or diagnosis of active tuberculosis in relationship to low body mass index, diabetes and their co-occurrence | Population-level analysis found that diabetes/low BMI co-occurrence may be associated with elevated tuberculosis risk, although its predicted effect on tuberculosis incidence/prevalence was generally </=0.2 percentage points and not robustly statistically significant. | Concerns about the additional elevation of tuberculosis risk from diabetes/low BMI co-occurrence and hence the need to coordinate tuberculosis control efforts around the nexus of co-occurring diabetes and low BMI may be premature. However, study findings robustly support the importance of individually targeting low BMI and diabetes as part of ongoing tuberculosis control efforts. |
| 30 | Ramachandran, G. | 2013 | India | Tamilnadu | Chennai | Sample survey | Age, nutritional status and INH acetylator status affect pharmacokinetics of anti-tuberculosis drugs in children | Age, nutritional status and INH acetylator status influenced drug levels. Peak RMP and INH concentrations were important determinants of treatment outcome. | Recommendations for anti-tuberculosis treatment in children should take these factors into consideration. |
| 31 | Ramachandran, G. | 2004 | India | Tamilnadu | Chennai | Sample survey | To estimate serum vitamin A in pulmonary tuberculosis (PTB) patients at the start and end of anti-tuberculosis treatment | Mean serum vitamin A in patients at the start of treatment was 21.2 microg/dl, which was significantly lower than in household contacts (42.2 microg/dl) and healthy 'normals' (48.1 microg/dl). The vitamin A levels in patients increased following treatment | The low vitamin A levels observed in patients returned to normal at the end of anti-tuberculosis treatment without vitamin A supplementation. |

| S No | Author | Year | Country | State | Area | Methods | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|
| 32 | Ray, M | 1998 | India | Punjab | Chandigarh, | Case control | Plasma zinc status in Indian childhood tuberculosis: impact of antituberculosis therapy | The mean plasma zinc concentration in children with pulmonary tuberculosis (n = 20) was 68.65+/-2.50 microg/dl, central nervous system (CNS) tuberculosis (n = 10) was 64.20+/-3.82 microg/dl, tuberculous lymphadenitis (n = 10) was 63.2+/-3.77 microg/dl and disseminated tuberculosis (n = 10) was 59.0+/-2.75 microg/dl at 0 months. The mean plasma zinc level of healthy children was 129.10+/-3.01 microg/dl and in malnourished non-tuberculous children it was 108.40+/-3.16 microg/dl. Thus children with tuberculosis had significantly lower plasma zinc level than those without tuberculosis, irrespective of their nutritional status (P < 0.001). There was a significant rise in zinc level at the end of 6 months of antituberculosis therapy (P < 0.001). | Plasma zinc status may prove to be a good objective marker for monitoring the severity of the disease and the response to therapy. |
| 33 | Roy, V | 2010 | India | Delhi | Medical college | Sample survey | Pharmacokinetics of isoniazid in moderately malnourished children with tuberculosis | The serum INH concentrations were higher in the undernourished group but the pharmacokinetic parameters were comparable with those in the normal nutrition group. Weight gain was significantly more in the undernourished group after 1 month of treatment. | The study suggests that INH pharmacokinetics may not be significantly altered in children with moderate malnutrition. |
| 34 | Samuel, B. | 2017 | India | West Bengal | Rural | Cohort | whether providing nutritional support (monthly supply of rice and lentil beans) to TB patients who live below the poverty line was associated with TB treatment outcome. | Of 173 TB patients provided nutritional support, 15 (9%) had unsuccessful treatment outcomes, while 84 (21%) of the 400 not provided nutrition support had unsuccessful treatment outcomes (p < 0.001). After adjusting for age, sex and previous treatment, those who received nutritional support had a 50% reduced risk of unsuccessful treatment outcome than those who did not receive nutritional support (Relative Risk: 0.51; 95% Confidence Intervals: 0.30 - 0.86 | Samuel, B., et al. "Relationship between Nutritional Support and Tuberculosis Treatment Outcomes in West Bengal, India." J Tuberc Res 4(4): 213-219. |
| 35 | Shetty, N. | 2006 | India | Karnataka | Bangalore | Case control | To evaluate potential socio-demographic risk factors for TB | Significant risk factors were low education level (OR 0.30; 95%CI 0.11-0.82), not having a separate kitchen (OR 3.26; 95%CI 1.25-8.46) and chronic disease, mainly diabetes (OR 2.44; 95%CI 1.17-5.09). High income, cooking with biomass fuels, history of smoking and alcohol consumption were not significant on multivariate analysis. Patients were respectively 11 and seven times more likely to have a BMI <18.5 (95%CI 5.62-21.98) and mid-arm circumference <24 cm (95%CI 3.87-11.89). | TB was associated with low education level, kitchen type and diabetes, reflecting the complex interaction between non-communicable disease, urbanisation and a changing economic climate in Bangalore. The relationship between TB, the use of biomass cooking fuels and gender differentials related to fuel exposure merit further exploration. The study underscores the poor nutritional status of patients. |

| S No | Author | Year | Country | State | Area | Methods | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|
| 36 | Singla, R. | 2010 | India | Delhi | NA | Sample survey | To assess the role of these putative risk factors in the development of DIH in patients receiving anti-TB treatment | Risk of developing DIH was greater in older patients. Significantly greater percentage of cases had extrapulmonary tuberculosis (TB) (P<0.01). Also, a significantly higher percentage of cases had moderate to far advanced disease severity on chest radiograph (P<0.01). On multivariate logistic regression, the adjusted odds were significant (P<0.01) for age>35 yr, MAC<20 cm and hypoalbuminaemia (albumin<3.5 g/dl) | Older age, poor nutritional status including baseline hypoalbuminaemia were independent predictors of occurrence of anti-TB DIH. Clinicians should be vigilant for occurrence of hepatotoxicity in this high risk group. |
| 37 | Sudarsanam, T. D. | 2011 | India | Tamilnadu | Vellore | RCT | To investigate the effects of nutritional supplementation on the outcome and nutritional status of south Indian patients with tuberculosis (TB) with and without human immunodeficiency virus (HIV) coinfection on anti-tuberculous therapy | There was no significant difference in TB outcomes at the end of treatment, but HIV-TB coinfected individuals had four times greater odds of poor outcome than those with TB alone. Among patients with TB, 1/35 (2.9%) supplemented and 5/42(12%) of those not supplemented had poor outcomes, while among TB-HIV-coinfected individuals, 4/13 (31%) supplemented and 3/7 (42.8%) non-supplemented patients had poor outcomes at the end of treatment, and the differences were more marked after 1 year of follow-up. Although there was some trend of benefit for both TB alone and TB-HIV coinfection, the results were not statistically significant at the end of TB treatment, possibly because of limited sample size. | Nutritional supplements in patients are a potentially feasible, low-cost intervention, which could impact patients with TB and TB-HIV. The public health importance of these diseases in resource-limited settings suggests the need for large, multi-centre randomized control trials on nutritional supplementation. |
| 38 | Udani, P. M. | 1994 | India | Eastern states | NA | Descriptive | BCG vaccination in India and tuberculosis in children: newer facets | BCG vaccinated, well-nourished children manifest modified patterns of tuberculous disease, following infection. The most important manifestation is the increased incidence of intrathoracic tuberculosis, specially enlargement of the various groups of mediastinal nodes and their local complications. Localisation of the disease by T cell immunity, due to BCG vaccination is responsible for this and the much lower incidence of haemotological complications such as neurotuberculosis and disseminated disease. In these children, the clinical picture of neurotuberculosis is also modified, with a tendency for more localised involvement of the brain and meninges. Similarly, vaccinated children may present with hepatomegaly, splenomegaly or isolated organ disease. It is important to relearn the new patterns of tuberculosis disease seen in vaccinated, non-malnourished children, and to a lesser extent in children with grade 1 to 2 protein energy malnutrition (PEM) | With these limitations of BCG vaccination, other strategies like chemoprophylaxis need multicentric trials in high risk children, in different parts of the country. |

| S No | Author | Year | Country | State | Area | Methods | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|
| 39 | Vijayakumar, M. | 1990 | India | Andra Pradesh | Hyder-abad | Case control | Malnutrition and childhood tuber-culosis | Data on CMI showed immunosuppressive effect of tuberculosis per se in all children. Well nour-ished children had similar CMI status irrespective of the severity of the disease while malnourished children with severe forms of disease showed low-est CMI response. These data suggest not only the synergistic interactions of malnutrition and tuber-culosis, but the contributory role of malnutrition in causing more severe immuno suppression. | The results point out the importance of better nutritional status of the child in preventing the severe forms of the disease. |
| 40 | Brinda, E. M. | 2012 | India | Tamil Nadu | Vellore | Sample survey | Investigated various socioeconomic and health factors associated with out-of-pocket and catastrophic health expenditures among rural older people | Male gender, poor sanitation, diabetes, tubercu-losis, malaria, respiratory ailments, gastrointesti-nal diseases, dementia, depression, and disability were associated with higher out-of-pocket expen-ditures. Illiteracy, tuberculosis, diabetes, and de-mentia increased the risk for catastrophic health expenditures, while pension schemes protected against it. Income inequalities were associated with inequities on education, disease prevalence, and access to safe water, sanitation, and nutrition. | Interactions between determinants of out-of-pocket health expenditure, economic inequality, and inequities on essential health care delivery to older people are complex. We highlight the need for equitable health services and policies, focusing on both medical and social determinants. |
| 41 | Prasad, B. M. | 2017 | India | NA | NA | Cohort | This study examined the availability of TB services in prisons of India | iagnostic and treatment services for TB were avail-able in 18% and 54% of the prisons respectively. Only half of the prisons screened inmates for TB on entry, while nearly 60% practised periodic screen-ing of inmates. District level prisons (OR, 6.0; 95% CI, 1.6-22.1), prisons with more than 500 inmates (OR, 52; 95% CI, 1.4-19.2), and prisons practising periodic screening of inmates (OR, 2.7; 95% CI, 1.0-7.2) were more likely to diagnose TB cases. 19% of the inmates screened had symptoms of TB (cough >/=2 weeks) and 8% of the PTBP were diagnosed with TB on smear microscopy. | The TB screening, diagnostic and treat-ment services are sub-optimal in prisons in India and need to be strengthened urgently. |

# 16. Prisoners & TB

| S.No | Author | Year | State | Area | Theme | Subject | Methods | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Mallick, G | 2017 | Chhattisgarh | NA | Others | Programme evaluation | Observational study | The advocacy & sensitisation activities in prisons & the effect on TB case notification | Patients with presumptive TB who were examined by sputum microscopy increased by 39% per 100000 prisoners, & TB case notification rates increased by 38%, in 2014 relative to 2013 | Sustained enhanced case finding with improved access to diagnostic services in prisons has value in improving TB case detection. |
| 2 | Prasad, B. M | 2017 | NA | NA | Accesss | Utilistion of TB diagnostic & treatment services | Cohort | Examined the availability of TB services in prisons of India | Diagnostic & treatment services for TB were available in 18% & 54% of the prisons. Half of the prisons screened for TB on entry; district level prisons (OR 6.0); prisons with >500 inmates (OR 52). 19% had symptoms of TB & 8% of the PTBP were diagnosed with TB on smear microscopy. | The TB screening, diagnostic & treatment services are sub-optimal in prisons in India & need to be strengthened urgently |
| 3 | Dhuria, M., N | 2016 | Delhi | Urban | Others | Programme evaluation | Observational study | To assess the TB control activities in prisons | Mean number of patients initiated on TB treatment was 120.6 annually between 2008 & 2012. Coordination between prison authorities & RNTCP authorities in relation to initial screening & discharge process appeared to be weak | TB control activities in the prison require restructuring. Initial screening for early diagnosis & treatment & "Discharge planning" needs to be devised so that there is sufficient time before release or transfer of individuals from prison. This needs strong commitment from the prison health authorities & RNTCP staff. |
| 4 | Singh, S | 1999 | Delhi | Urban | Burden | Prevalence | Observational study | Prevalence of infections amongst the inmates of a district jail | 10.4% active pulmonary tuberculosis (25/240) | NA |

# 17. Refugees & TB

| S.No | Author | Year | State | Area | Methods | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|
| 1 | Bhatia, S | 2002 | Himachal Pradesh | Dharamsala | Cohort | To determine the incidence of and risk factors for TB among Tibetan refugees | TB incidence was extraordinarily high in the settlement population, 10.9/ 1,000 in 1994. but decreased to 7.7/1,000 in 1996. Incidence rates varied between regions, age groups, and occupational groups, being highest in the Doon Valley (14.8/1,000). in sweater sellers (16.7/1,000), and in the unemployed (23/1,000). Among monastery monks, incidence rates were even higher than in the settlements, averaging 17.2/1,000 over the 3-year period. The proportion of patients without sputum results and variation in the proportion of smear positive cases indicated inadequate use and poor quality of laboratory services | RNTCP should be adopted promptly by the health care system serving Tibetan refugees and vigorously implemented among the refugee population. |
| 2 | Dierberg, K. L. | 2016 | NA | NA | Community survey | The incidence of tuberculosis (TB) among Tibetan refugees in India | The incidence of tuberculosis (TB) among Tibetan refugees in India is 431 cases/100,000 persons, compared with 181 cases/100,000 persons overall in India | The burden of TB in the Tibetan exile population in India is extremely high and requires urgent attention. |
| 3 | King, K. | 2011 | NA | NA | Community survey | To determine whether premigration screening for tuberculosis | Prevalence, 137 per 100,000 in examined population. The top source countries for people with tuberculosis were the Philippines (21.8%), India (16.8%), Vietnam (16.2%) and China (8.3%) | Premigration health screening of intending migrants is identifying substantial numbers of people who would have required treatment for tuberculosis |
| 4 | Nelson, L. J. | 2005 | NA | NA | Community survey | To determine tuberculosis (TB) incidence, independent risk factors for TB, and predictors of adverse outcomes | Incidence 835/ 100,000. Independent predictors of death for Tibet-born refugees included age >50 years, extra-pulmonary TB, and second-line therapy, while for India-born refugees they included second-line therapy and no improvement at the end of treatment. | TB incidence in Tibetan refugee settlements exceeds the highest national TB rates, and country of birth determines risk factors. TB control efforts in India should include this population. |
| 5 | Rodger, A. J. | 2002 | Manipur | Churachandpur District | Cohort | To pilot the WHO guidelines on DOTS for tuberculosis | Successful outcomes were recorded in 91% of all patients and in 86% of smear-positive cases of pulmonary TB. The default rate and the mortality rate were low at 3% each. HIV positive serostatus was the only factor associated with a poor treatment outcome. | TB treatment and control were possible in a conflict setting and WHO targets for cure were attainable. The factors associated with the success of the programme were strong local community support, the selection of outreach workers from each ethnic group to allow access to all areas and patients, the use of directly observed therapy three times a week instead of daily in the interest of increased safety, and the limiting of distances travelled by both outreach |
| 6 | Salvo, F. | 2014 | NA | NA | Cohort | To determine the proportion of drug-resistant cases among new and previously treated Tibetan TB patients | Among new TB cases, 14.5% had MDR-TB and 5.7% were isoniazid (INH) monoresistant. Among previously treated cases, 31.4% had MDR-TB and 12.7% were INH-monoresistant. Of the MDR-TB isolates, 28.6% of new and 26.1% of previously treated cases were OFX-resistant, while 7.1% of new cases and 8.7% of previously treated cases were KM-resistant. Three patients had extensively drug-resistant | MDR-TB is common in new and previously treated Tibetans in India, who also show additional complex resistance patterns. Of particular concern is the high percentage of MDR-TB strains resistant to OFX, KM or both. |

# 18. Sex Workers & TB

| S.No | Author | Year | State | Area | Theme | Subject | Methods | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Joshi, R. | 2006 | Andra Pradesh | NA | Burden | Mortality | Cohort | Chronic diseases now a leading cause of death in rural India | The crude death rate was 7.5/1000 (95% confidence interval, 7.1-7.9). Diseases of the circulatory system were the leading causes of mortality (32%), with similar proportions of deaths attributable to ischaemic heart disease and stroke. Second was injury and external causes of mortality (13%) with one-third of these deaths attributable to deliberate self harm. Third were infectious and parasitic diseases (12%). Tuberculosis and intestinal conditions each caused one-third of deaths within this category. HIV was assigned as the cause for 2% of all deaths. The fourth and fifth leading causes of death were neoplasms (7%) and diseases of the respiratory system (5%). | Non-communicable and chronic diseases are the leading causes of death in this part of rural India. The observed pattern of death is unlikely to be unique to these villages and provides new insight into the rapid progression of epidemiological transition in rural India. |
| 2 | Kanungo, S | 2010 | West Bengal | Kolkata | Burden | Mortality | Dynamic cohort | To define mortality patterns in an urban slum | Overall mortality rate of 6.2 per 1000 person-years. We assigned a cause to 89% (482/544) of the deaths. The leading causes of death, in descending order, were cardiovascular diseases (especially among adults aged over 40 years), cancer, respiratory ailments and digestive disorders. Most deaths in children under 5 years of age were caused by tuberculosis, respiratory infections and diarrhoeal diseases. | Although the most common causes of death in children were infectious, non-communicable diseases were predominant among adults. There is a need for continuing interventions against infectious diseases in addition to new and innovative strategies to combat non-infectious conditions. |
| 3 | Kolappan, C | 2016 | Andhra Pradesh (AP) &Orissa | NA | Burden | Mortality | Cohort | To estimate general mortality rate (GMR) and the tuberculosis mortality rate (TMR) | The GMR for AP and Orissa was 636 (95% CI: 610-662) and 616 (95% CI: 588-643) per 100,000 person years (p-ys) respectively. The TMR for AP and Orissa was 76 (95% CI: 67-85) and 41 (95% CI: 34-48) per 100,000 p-ys respectively. The difference in TMR between the states was statistically significant (P<0.0001). | The GMRs are similar in AP and Orissa states. Tuberculosis accounted for 12% and 7% of deaths in AP and Orissa respectively. Focused strategies are needed to reduce mortality due to tuberculosis. |

| S.No | Author | Year | State | Area | Theme | Subject | Methods | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|---|
| 4 | Gupta, S. | 2010 | Manipal | NA | Risk | Biological | Cohort | Risk factors and the socio-economic impact based on occupation in the development of tuberculosis | Diabetes mellitus (DM) (30.9%) was the most prevalent condition and significantly more common than other risk factors like smoking (16.9%), alcoholism (12.6%), HIV (10.6%), malignancy (5.8%), chronic liver diseases (3.9%), history of contact with TB (3.4%), chronic corticosteroid therapy (2.9%), chronic kidney diseases and malnourishment (1.5%). There were 82 patients (39.6%) with no underlying risk factor. Men (M:F = 3.7:1) and patients older than 40 years had a higher incidence of co-existing conditions. PTB was significantly more common in blue-collar (44%) and white-collar (27.1%) workers than household workers (12.1%), students (10.6%) and retired/unemployed people (6.3%). | Pulmonary tuberculosis had a significant impact and predominated in male patients co-existing with DM. Patients with DM and suggestive pulmonary symptoms should be screened for tuberculosis. More stringent health education and awareness programme should be implemented at the grass root level. |
| 5 | Kataria, V K | 2000 | NA | NA | Risk | Biological | Cohort | HIV and Tuberculosis Co-Infection in a Referral Chest Hospital | Sixty (1.06%) of tuberculosis patients were found to be HIV positive. Initial test was done by spot kits and subsequently confirmed by ELISA on two different samples. Majority of the cases were in sexually active age group 48 (80%). Alcohol and smoking was associated in 80% cases. Thirty six (60%) were sputum smear positive for AFB. Twenty eight (46.7%) gave history of exposure to sex workers. | Family members were not available for study. Sero prevalence of HIV in association with tuberculosis is less in Armed Forces compared to civil population |
| 6 | Mandal, A. K. | 2000 | Uttar Pradesh | Varanasi | Risk | Biological | Active screening | Prevalence of HIV and TB | M. tuberculosis was the commonest co-infection amongst HIV positive (29.5%) | Recommened routine HIV screening of all patients of tuberculosis, especially if the persons frequent the cities, visit foreign countries where sex tourism is encouraged or stay away from their spouses for long periods as true history of sexual contact with commercial sex workers was difficult to obtain from them. |
| 7 | Pais, P. | 1996 | NA | NA | Risk | Biological | Review | Common clinical presentation for HIV | Pulmonary tuberculosis has been the most common clinical presentation. So far AIDS associated tuberculosis has responded to standard therapy but the development of multidrug resistant mycobacteria and their spread to the large tuberculous population in the country is a potential threat. | Key factors of AIDS/HIV prevention are public education and counselling about the infection and safe sex practices, especially in high risk groups; STD control; promotion of voluntary blood donation and adequate screening of blood products and general and equitable progress in the economic development of the country and its people-much high risk behaviour is driven by poverty |

| S.No | Author | Year | State | Area | Theme | Subject | Methods | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|---|
| 8 | Rathi, P. M. | 1997 | Maharastra | Mumbai | Risk | Biological | Cohort | To study the spectrum of liver diseases in HIV-infected individuals | Thirty four patients (45%) were chronic alcoholics. Mean (SD) absolute lymphocyte count was 2521 (1271)/mm3; count < 2000/ mm3 was present in 20 patients. Serum bilirubin, transaminases and alkaline phosphatase levels were elevated in 13%, 13% and 24% of patients, respectively. Ultrasonography detected an abscess in two patients (tuberculous-1, amebic-1). Evidence of exposure to HBV was present in 81% (HBsAg-12, hepatitis B core and/or surface antibody-48); anti-HCV antibody was positive in 29.7%. Five patients with liver tuberculosis (granuloma-4, abscess-1) had AFB either in liver tissue or lymph nodes. | Chronic alcoholism, HBV and HCV infection, hepatic tuberculosis, and evidence of other liver disease were common in patients with HIV infection. |
| 9 | Singh, A | 1995 | Haryana | Rural | Risk | Biological | Indepth Interviews | Prevalence of TB | Tuberculosis, diabetes, hypertension and asthma were significantly more prevalent in higher age group while poliomyelitis was reported more in children. | Consultation rate was high in tuberculosis, asthma, hypertension and diabetes. |
| 10 | Sircar, A. R. | 1998 | Maharastra | NA | Risk | Biological | Descriptive | Clinical profile of AIDS at a referral hospital | Tuberculosis 54.8%; 22.5% had generalised lymphadenopathy. | The clinical manifestations of AIDS patients are strikingly different from that in the Western countries. It, thus, necessitates setting up of different guidelines for the clinical diagnosis and management of AIDS in India. |

# 19. Silicosis & TB

| S.No | Author | Year | State | Area | Theme | Subject | Methods | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Bhagia, L. J. | 2008 | Gujarat | Khambha | Risk | Environmental | Cost-benefit | Cost-benefit analysis of installing dust control devices in the agate industr | To reduce their dust exposure, dust control devices were developed. There are approximately 500 grinding machines located in Khambhat. A cost-benefit analysis of installing dust control devices on all agate-grinding machines was carried out by adding all positive factors and benefits and subtracting the negatives and costs. | By installing dust control devices not only could the prevalence of silicosis and TB be reduced but also, in the long run, there could be financial benefits. |
| 2 | **Chaudhury**, N | 2012 | Gujarat | Khambhat | Risk | Environmental | Cohort | The present study describes few co-morbidities and their influence in mortality in cases of silicosis that were followed for 30 months at Shakarpur | Out of 53 participants (35 men), with an average duration of exposure to free silica of 16.8 years, more than half of the male workers were underweight (BMI<18.5 kg/m(2)) at enrollment. Thirteen participants died in less than 3 years of follow up. While 11 of them were silicosis positive out of which 10 had tuberculosis. The odds ratio for association between silicosis and tuberculosis was 2.75. A majority (81.1%) of the 37 silicosis positive cases showed a mixed pattern in spirometry suggesting co-existence of restrictive and obstructive pathology. On regression analysis, TB and nutritional status were found to have strong influence on mortality. | Screening for early diagnosis of silicosis as well as co-morbid conditions and managing them would go a long way in prolonging the lives of the agate stone workers who are prone to die early due to silicosis. |
| 3 | Gupta, K. B. | 2006 | NA | NA | Risk | Environmental | Case report | Bilateral spontaneous pneumothorax in silicosis | The rarity of its clinical presentation in the form of bilateral simultaneous spontaneous pneumothorax combined with the typical clinical and radiological features of accelerated silicosis with tuberculosis make us to report this case | NA |

| S.No | Author | Year | State | Area | Theme | Subject | Methods | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|---|
| 4 | Jindal, S. K. | 2012 | NA | NA | Risk | Environmental | Review | Review focusses on the burden of the problem of silicosis and its clinical manifestations reported from India | Tuberculosis is a common complication reported in Indian studies. Occasionally, silico-mycosis, lung cancer and connective tissue disorders in association with silicosis are also reported. | National Human Rights Commission (NHRC) in response to the direction from the Supreme Court of India has made several recommendations on preventive, remedial and rehabilitative measures. The NHRC has been asked to work with various stakeholders such as individual organizations, state and central governments and other agencies to implement the measures. The problem has been highlighted on the national level as a major human-rights concern in India. |
| 5 | Jindal, S. K., | 2001 | NA | NA | Risk | Environmental | Opinion | Inhalation of dusts is an important cause of interstitial lung disease in the tropical countries | Pulmonary tuberculosis is an important complication seen in up to 50% of patients of silicosis in some reports from India. The presentation is generally chronic, although acute and accelerated forms of silicosis are known when the exposures are heavy. Breathlessness, dry cough, and general constitutional symptoms are commonly seen. Patients with silicotuberculosis or other forms of infection may also have significant expectoration, hemoptysis, fever, and rapid progression. Respiratory failure and chronic cor pulmonale occur in the later stages. | Dense nodular opacities on chest roentgenograms, which may be large in patients with massive pulmonary fibrosis, are characteristic. Emphysematous changes generally appear in advanced stages or in patients who smoke. Bronchoalveolar lavage and/or lung biopsy may occasionally be required to establish or exclude other causes of interstitial lung disease. Treatment is largely palliative, although a variety of drugs including corticosteroids and procedures such as whole lung lavage have been tried. None of these methods has yet been found successful in the treatment. Preventive safety steps, including removal of the patient from the site of exposure, are the only effective strategies to control disease progression. |

| S.No | Author | Year | State | Area | Theme | Subject | Methods | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|---|
| 6 | Sivanmani, K. | 2013 | Tamilnadu | Coimbatore | Risk | Environmental | Descriptive | To describe the level of preventive measures and level of awareness among the patients diagnosed with silicosis during a one-year period | The average duration of exposure was 22 years. A protective mask was used by 29% of the patients and one patient had awareness about the risks of exposure to silica. Active tuberculosis was found in 12% and old tuberculosis in 47% of patients; 59% of the patients were smokers. Spirometry showed a restrictive pattern in 59% of the patients. Radiologically nodular opacities with upper-zone predominance was found in majority of the cases | Most patients are exposed to silica in unorganized industries. Majority of the patients lack awareness about the disease and there is a low implementation of preventive and control measures. As this study was a passive surveillance, it represents only the tip of iceberg and an active field-level surveillance could reveal the true prevalence of this disease. |
| 7 | Tiwari, R. R. | 2011 | Gujarat | Ahemadabad | Risk | Environmental | Cross sectional | To compare the respiratory morbidities among the present quartz stone workers | The study revealed silicosis in 24 (17.9%), radiological suspected tuberculosis in 17 (12.7%) and silico-tuberculosis in 33 (24.7%) ex-workers while in present workers, radiological suspected tuberculosis in 10 (5.5%) subjects and silicosis grade 1/1 in one subject were found. Among the ex-workers, 14 (10.4%) had a combined type of pulmonary function impairment while 8 (6.0%) and 28 (20.9%) were having restrictive and obstructive type of pulmonary impairments, respectively. Among the present workers, pulmonary function testing revealed the combined type of functional impairment in 1 (0.5%), restrictive type in 13 (7.1%), and obstructive type of functional impairment in 17 (9.2%) subjects | The high prevalence of respiratory morbidity in ex-workers as compared to current workers can be attributed to the out-of-the-job healthy workers' effect. |
| 8 | Tiwari, R. R. | 2007 | Gujarat | Ahemadabad | Risk | Environmental | Cross sectional | Tuberculosis among workers exposed to free silica dust | The pulmonary functions of the subjects were measured using Spirovit SP- 10. Statistical analysis was carried out using statistical software package Epi Info 3.3.2. Among stone crushers the prevalence of TB was found to be 10.7% while among slate pencil workers it was as high as 22.5%. Among the quartz stone-crushers the workers aged >/=35 years, those exposed for >/=3 years and those who were smokers had higher risk TB while among the slate pencil workers, only those exposed for >/=10 years had higher risk. | Those working in mines, construction work, stone-crushing and in other similar occupations where there is a greater level of exposure to silica dust are specially vulnerable |

# 20. Slum Dwellers & TB

| SNo | Author | Year | Country | State | Area | Subject | Methods | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Bhagyalaxmi, A. | 2003 | India | Gujarat | Ahmedabad | Prevalence | Cohort | Prevalence of infection in children | Prevalence of infection in children was 30.4% as 64/210 (had induration > or = 10mm in size). Average ARI in 0-14 yrs 5.4%. | Tuberculosis is still one of the commonest problems in the urban slum |
| 2 | Chandra, S. | 2014 | India | Delhi | Delhi | Social infrastructure as a determinant of urban TB control | Secondnary data analysis | Social infrastructure as a determinant of urban TB control | 46% increment in lives saved among all types of TB cases; 7% reduction in new TB case notifications from the year 2001 to 2011; decline of 5.4 new TB cases per 100,000 population. Except per capita income, literacy, and net migration rates, other social determinants showed significant correlation with decline in new TB cases per 100,000 population. | Social infrastructure development leads to social capital generation which engenders positive growth in TB program outcomes. |
| 3 | Chinnakali, P. | 2013 | India | Puducherry | Puducherry | KAP | Cross-sectional | Level of awareness about TB in urban slums | 94% had heard about TB; 82% aware that cough is a symptom of TB; 40% sputum examination as a method of diagnosis; 84% aware of the free treatment available for TB under National program | Level of awareness about TB among urban poor in a slum area is good. |
| 4 | Yatin Dholakia | 2016 | India | Mumbai | Mumbai | Prevalence | Household survey | To estimate the hidden load of TB in adults & children in slum | Prevalence of chest symptomatics (315/1798) 17%; Crude prevalence was around 9%; hideden case was 2/7 | Active case finding should be carried out in such locations as a general health screen involving local 'champions' as intermediaries |
| 5 | Ghosh, S. | 2010 | India | West Bengal | Bankura | Access | Cross-sectional | Prevalence of chest symptomatics, their health care seeking Behavior & its correlates | Prevalence of chest symptomatics 5.5%, 70.8% did so within 2 weeks, median being 7 days. The major reason for choosing facilities was advice by family & friends (43.8%). Most of the chest symptomatics (75%) were retained in the same facility. Shift from private to government facility for subsequent visits (33.3%) was higher than from government to private facility (16.7%). The main reason (50%) for changing health facility was expectation for better service. | Literacy & lower monthly income affected their care seeking behavior, age and sex had no significant association. |
| 6 | Gopi, P G | 2008 | India | Tamilnadu | Chennai | Prevalence of infection | Cluster sampling methodology | Prevalence of infection and ARTI | The prevalence of infection was higher among children in slum areas (11.1%; ARTI 2.1%) compared to non-slum areas (8.9%; ARTI 1.7%); | TB situation was higher in the city than rural areas in terms of prevalence of infection & ARTI |

| SNo | Author | Year | Country | State | Area | Subject | Methods | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|---|
| 7 | Isaakidis, P. | 2011 | India | Maharastra | Mumbai | MDR-TB | Cohort | MDR-TB treatment outcomes | 58/71 HIV suspected MDR-TB; MDR-TB 45 (78%); 18 (40%) were resistant to ofloxacin; 11 (48%) were successfully treated; 4 (17%) died; 6 (26%) defaulted, and 2 (9%) failed treatment. Overall, among 58 patients on treatment, 13 (22%) were successfully treated, 13 (22%) died, 7 (12%) defaulted, two (3%) failed treatment, and 23 (40%) were alive and still on treatment. | Encouraging results are being achieved in an ambulatory MDR-Tb- program in a slum setting in India |
| 8 | Khan, K. B. | 2012 | India | Delhi | Delhi | Others | Qualitative study | Treatment outcomes & stigmatizes | Understanding the gender aspects of tuberculosis | Nil |
| 9 | Malhotra, B. | 2017 | India | Rajasthan | Jaipur | MDR-TB | Cohort | To determine the drug susceptibility profiles and genetic diversity using the random amplified polymorphic DNA (RAPD) and mycobacterial interspersed repetitive units-variable number of tandem repeats (MIRU VNTR) of MTB isolates from sputum samples of pulmonary TB patients | About 62.7 per cent isolates from the sputum samples from slum areas were sensitive to four drugs; six per cent of isolates were MDR. Poly-resistance other than MDR was high (16%). A | About one-fourth isolates were clustered by either method. RAPD was rapid, less expensive but had low reproducibility. |
| 10 | Marimuthu, P. | 2016 | India | Delhi, Maharastra, West bengal, Tamilnadu | Delhi, Mumbai, Kolkata and Chennai | Prevalence | Sample survey | Prevalence among the slum dwellers of metropolitan cities of Indi | Prevalence of TB is significantly (P=0.001) higher in the slums than non-slums of Mumbai, Chennai and Kolkata cities. As the living standard increases, TB prevalence decreases. Logistic regression analysis uncovers that lower standard of living is highly associated with TB followed by place of residence (slum or non-slum). | Mumbai has the highest prevalence among the four cities studied |
| 11 | Prasad B M | 2016 | India | Uttrapradesh | Agra | Prevalence | Household survey | Active tuberculosis case finding | 40% reached health facilities for sputum examination on their own, 60% had to be accompanied by the community volunteers to the health facility for sputum smear examination by Ziehl-Neelsen staining method. Eventually, seven persons were found to be sputum smear positive. | This study highlighted important aspects for implementing ACF |
| 12 | Samal J | 2017 | India | Chattisgarh | NA | KAP | Intervention | To assess the impact of a structured Tuberculosis (TB) awareness strategy on the knowledge and behaviour of slum dwellers | The knowledge components the improvement was incurred above 90% among the study participants in all components except in two components such as; modes of TB transmission and availability of free treatment facilities. | Health education activities should be directed to improve the knowledge of slum dwellers regarding the modes of TB transmission and availability of free treatment at public health facilities. |

| SNo | Author | Year | Country | State | Area | Subject | Methods | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|---|
| 13 | Shrivastava S R | 2012 | India | Maharastra | Mumbai | Prevalence of TB | Survey | Prevalence of TB | A total of 278 TB suspects were identified on enquiring on the presence of symptoms suggestive of TB. Out of them 221(79.5%) patients got tested for sputum examination. Sputum positive TB was diagnosed in 29 suspects and the sputum positivity rate was 13.1%, which was slightly higher than the passive case finding norms of 10% as prescribed under RNTCP | ACF should be incorporated in populations wherever tuberculosis incidence / prevalence is high as there was a definite improvement in the case detection rate |
| 14 | Singh M M | 2002 | India | Delhi | Lok Nayak Colony | KAP | Cross-sectional | The knowledge and attitude towards tuberculosis | 83.6% heard of TB from neighbours (64.9%) & friends (62.1%). Only 2.3% knew that TB was caused by a germ. Literates were more aware than illiterates regarding some signs and symptoms of TB i.e breathlessness (p=0.002), low grade fever (p=0.02), loss of appetite (p<0.001) and factors favouring TB e.g. overcrowding (56.4%) and poor diet (45.4%). Only 12.6% knew about the duration of treatment for 6-8 months and 1.7% knew about preventive role of BCG. Tendency to discriminate TB patients was evident from the findings e.g 71% respondents agreed upon isolating TB patients from the family, 74.1% on avoiding the patient in food sharing, on quitting job by the patient (33%), prohibiting marriage of the patient (27.6%), shunning him from attending social functions (18%). | Extensive health education directing towards attitudinal change by community involvement is needed to create awareness and remove myths about TB in such colonies |
| 15 | Suganthi P | 2008 | India | Karnataka | Bangalore | KAP | Cohort | To as certain 1) health-seeking behaviour patterns in persons with pulmonary symptoms; 2) pathways followed by pulmonary tuberculosis (PTB) cases until diagnosis and treatment; and 3) their knowledge about TB-symptoms, cause, mode of transmission, diagnosis and treatment. | Of 47 PTB ; 72% first approached private health facilities; about 50% visited two health facilities before diagnosis; 87% visited two or more facilities before initiating treatment; 42 initiated treatment at government health facilities & five who initiated treatment at private health facilities were later referred to government health facilities. The majority of persons with pulmonary symptoms and PTB cases had poor knowledge about TB, and most of those with pulmonary symptoms were not aware of the availability of free anti-tuberculosis services at government health facilities. | Educational interventions targeted at slum dwellers and their health providers are needed |

# 21. Tobacco users & TB

| S.No | Author | Year | State | Area | Subject | Methods | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Deepak, K. G. | 2012 | Karnataka | NA | Behaviour | Cross sectional | Smokeless tobacco use among patients with tuberculosis | 44% prevalence of smokeless tobacco use 6 months before diagnosis was reduced to just 8% during the intensive phase of treatment and climbed to 27% 6 months after treatment. The tobacco use relapse rate 6 months after completion of treatment was higher for smokeless tobacco use (52%) than for smoking (36%,). | Patients with tuberculosis are advised by their doctors, at the time of diagnosis, to quit smoking. Several patients shift from smoking to smokeless tobacco use, which needs to be addressed while providing tobacco cessation services. |
| 2 | D'Souza, G. | 2012 | Karnataka | Bangalore | Behaviour | Descriptive | To describe the clinico-epidemiological profile of attendees of a tobacco cessation clinic in a teaching hospital | Two-thirds of smokers reported high levels of nicotine dependence (Fagerstrom score >5/10). About 43% of patients had attempted quitting earlier. Four-fifths (79%) of tobacco-users reported a family member using tobacco. Commonly documented comorbidities included: Chronic respiratory disease (44%), hypertension (23%), diabetes (12%), tuberculosis (9%), myocardial infarction (2%), stroke (1%), sexual dysfunction (1%) and cancer (0.5%). About 52% reported concomitant alcohol use. | This is the first study of the baseline profile of patients attending a tobacco cessation clinic located within a chest medicine department in India. Important determinants of outcome have been captured for follow-up and prospective documentation of outcomes. |
| 3 | Gupta, P. C. | 2005 | Maharastra | Mumbai | Burden | Cohort | Tobacco associated mortality | The risk of deaths from respiratory diseases (RR 2.12, 95% CI 1.57-2.87), tuberculosis (RR 2.30, 95% CI 1.68-3.15), and neoplasms (RR 2.60, 95% CI 1.78-3.80) were significantly high in male smokers than never tobacco users. | Bidi is no less hazardous than cigarette smoking, and smokeless tobacco use may also result in significantly increased mortality. |
| 4 | Kanakia, K. P. | 2016 | South India | NA | Behaviour | Cross sectional | Tobacco use among presumptive TB patients attending a tertiary hospital and their willingness to attend tobacco cessation services | Tobacco use in the past 1 month was reported by 176 (41.5%, 9) presumptive TB patients. In total, 78 (18%) presumptive TB patients were eventually diagnosed with smear-positive pulmonary TB, of them 63 (80%) were tobacco users. Presumptive TB patients aged >/= 30 years, male sex, and < 10 years of education were significantly associated with tobacco use. Of 176, a majority of 132 (75%) used some form of smoking. Of a total of 132 smokers, 70 (53%) were willing to avail of tobacco cessation services. | Tobacco use among presumptive TB patients was high. Considering the high willingness to quit among smokers, proven brief interventions to help quit smoking can be tried. |
| 5 | Kaur, J. | 2013 | Gujarat | Vadodara | Behaviour | Intervention | To promote tobacco cessation by integrating 'brief advice' for tobacco cessation in TB patients who were tobacco users and registered for treatment under TB control programme | A total of 46.3% of TB patients, predominantly males (89.6% males and 10.3% females) were current users of tobacco; 39.1% used smokeless tobacco, 35.9% were smokers and 25% were dual users, that is, smoked as well as used smokeless tobacco. At the end of treatment, of the 67.3% patients who were offered brief advice, quit tobacco use, 18.2% re-lapsed while 14.5% were lost to follow-up. | It is feasible to introduce 'brief advice' strategy as a cost effective intervention for tobacco cessation among TB patients with careful monitoring |

| S.No | Author | Year | State | Area | Subject | Methods | Research question | Findings | Recommendations |
|---|---|---|---|---|---|---|---|---|---|
| 6 | Mariappan, V. A. | | Puducherry | NA | Behaviour | | Smoked and smokeless tobacco use among pulmonary tuberculosis patients under RNTCP in urban | Prevalence of smoking among the PTB patients at the time of TB diagnosis was 35.3%, whereas the same during the continuation phase (CP) was 23.4%. Among 83 smokers at the time of diagnosis, 52 modified and 31 did not modify their smoking after TB diagnosis. Similarly, prevalence of smokeless tobacco use both at the time of TB diagnosis and during CP was 9.8%. Male and lower education level was associated with current smoking. Similarly, female and lower education level was associated with current smokeless tobacco use | Health programme needs to concentrate on PTB patients who continue to use smoked or smokeless tobacco during their treatment; necessary interventions need to be planned. |
| 7 | Mehra, D | 2013 | Uttarakhand | NA | Behaviour | Cohort | To determine the magnitude of and the causative factors for initial default among sputum-positive pulmonary TB (PTB) patients | Initial default was seen in 120 (21.6%) patients comprising 22 (18.3%) defaulters during diagnosis and 98 (81.6%) defaulters after referral for DOTS. The initial default rate was significantly higher among patients from rural areas than urban areas, illiterate patients than literate patients and smokeless tobacco-users than non-users ($p<0.05$ for all). The main reasons for initial default among patients referred for DOTS were limited trust in DOTS (n = 44, 44.8%), adverse effects of previous ATT (n = 41, 41.8%), dissatisfaction with health services (n = 38, 38.7%), local deaths while taking DOTS (n = 28, 28.5%), advice by others against DOTS (n = 25, 25.5%), disbelief in the diagnosis (n = 18, 18.3%) and patient death before starting treatment (n = 4, 4.0%). | A high initial default rate was seen among patients with PTB. There is an urgent need to promote public awareness to lower the initial default rate. |
| 8 | Panda, R. | 2015 | Gujarat & Andhra Pradesh | NA | Behaviour | Exploratory | Explores whether auxiliary nurse midwives (ANMs) adhere to the 3As from the recommended 5As model for tobacco cessation | Majority of ANMs reported that they were aware of respiratory illnesses, tuberculosis, lung and oral cancer as conditions caused due to tobacco consumption | A majority of ANMs ask patients about tobacco use but provide advice only to patients suffering from specific diseases. A context-specific capacity building package needs to be designed to equip ANMs in recommended 5As approach in tobacco cessation. |

# 21. Tribals & TB

| S.No | Author | Year | State | Area | Subject | Methods | Research question | Findings |
|---|---|---|---|---|---|---|---|---|
| 1 | Vikas Rao | 2011 | MP | Sheopur | Prevalence | Cross-sectional | Smoking and Alcohol with PTB | 15-44 years 984/100000 >45 years 2745/100000, Males-2113/100000, Females 741/100000, Smokers-1958/100000, Alcohol-2202/100000 |
| 2 | Magna Manjareeka | 2016 | Odisha | Malkangiri | Prevalence | Cross-sectional | DM and Glucose Tolerance in Tribal TB patient | DM in TB-13.9%, IFG in TB-8.9% |
| 3 | J Bhat | 2014 | Madhya Pradesh | Gwalior and Shivpuri | Prevalence | Cross-sectional | Drug resistance in Tribal TB patients | New Patient-MDR 2.2%, 8.2% in previously treated cases |
| 4 | Ravi Prakash | 2015 | Madhya Pradesh | Gwalior and Shivpuri | Prevalence | Cross-sectional | Drug resistance in Tribal TB patients | 1.95 times increase risk for MDR in tribals |
| 5 | Beena Thomas | 2015 | | | Prevalence | Systematic review | Estimate TB Prevalence in Tribal Population | 703 per 100000 |
| 6 | M Datta | 2001 | Tamil Nadu | Arcot | Prevalence | Cross-sectional | Prevalence of TB infection and disease in tribal | Iinfection-5%, Disease- 0.008%, Isoniazid resistance-12% |
| 7 | Vikas Rao | 2015 | Madhya Pradesh | Jabalpur | Prevalence | Cross-sectional | Prevalence of TB in Tribals | Prevalence-255/100000 |
| 8 | Yadav | 2010 | Madhya Pradesh | Baiga | Prevalence | Cross-sectional | | Prevalence-146/100000 |
| 9 | Vikas Rao | 2010 | Madhya Pradesh | Chindwara | Prevalence | Cross-sectional | | Prevalence-432/100000 |
| 10 | Sharma | 2010 | Madhya Pradesh | | Prevalence | Cross-sectional | | Prevalence-454/100000 |
| 11 | Kaulagekar | 2007 | | | Social Status for TB | Secondary Data | | ST Male- 1.07% ST Female-2.63% |
| 12 | Achanta | 2013 | Andhra Pradesh | Vizianagaram | Biological | Cross-sectional | | DM in TB-5% |

# References


1. Chakravarty, J., et al. (2006). "Study on clinico-epidemiological profile of HIV patients in eastern India." J Assoc Physicians India 54: 854-857.
2. Pais, P. (1996). "HIV and India: looking into the abyss." Trop Med Int Health 1(3): 295-304.
3. Thomas, B. E., et al. "Prevalence of chest symptoms amongst brick kiln migrant workers and care seeking behaviour: a study from South India." J Public Health (Oxf) 37(4): 590-596.
4. Mehra, R. and M. Juneja (2005). "Hair as an indicator for assessing adverse effect of cadmium on human health." J Environ Sci Eng 47(1): 59-64.
5. Das, D. and B. Dwibedi "Delay in diagnosis among pulmonary tuberculosis patients of Rayagada District, Odisha, India." Int J Mycobacteriol 5 Suppl 1: S172-S173.
6. Das, D., et al. "Transportation of sputum samples in cetylpyridinium chloride for drug resistance studies from remote areas of Odisha, India." J Infect Dev Ctries 8(8): 1059-1062.
7. Das, M., et al. "Self-administered tuberculosis treatment outcomes in a tribal population on the indo-myanmar border, Nagaland, India." PLoS One 9(9): e108186.
8. Gupta, D. and L. S. Chauhan (2006). "Case detection rate targets under DOTS: the Indian experience." Natl Med J India 19(6): 330-333.
9. Muniyandi, M., et al. "Performance of Revised National Tuberculosis Control Programme (RNTCP) in tribal areas in India." Indian J Med Res 141(5): 624-629.
10. Thomas, B. E., et al. "Prevalence of chest symptoms amongst brick kiln migrant workers and care seeking behaviour: a study from South India." J Public Health (Oxf) 37(4): 590-596.
11. Deepak, K. G., et al. "Smokeless tobacco use among patients with tuberculosis in Karnataka: the need for cessation services." Natl Med J India 25(3): 142-145.
12. D'Souza, G., et al. "Clinico-epidemiological profile of tobacco users attending a tobacco cessation clinic in a teaching hospital in Bangalore city." Lung India 29(2): 137-142.
13. Gupta, P. C., et al. (2005). "Tobacco associated mortality in Mumbai (Bombay) India. Results of the Bombay Cohort Study." Int J Epidemiol 34(6): 1395-1402.

14. Kanakia, K. P., et al. “High Tobacco Use among Presumptive Tuberculosis Patients, South India: Time to Integrate Control of Two Epidemics.” Osong Public Health Res Perspect 7(4): 228-232.

15. Kaur, J., et al. “Promoting tobacco cessation by integrating ‘brief advice’ in tuberculosis control programme.” WHO South East Asia J Public Health 2(1): 28-33.

16. Mariappan, V. A., et al. “Smoked and smokeless tobacco use among pulmonary tuberculosis patients under RNTCP in urban Puducherry, India.” Indian J Tuberc 63(3): 158-166.

17. Mehra, D., et al. “Initial default among sputum-positive pulmonary TB patients at a referral hospital in Uttarakhand, India.” Trans R Soc Trop Med Hyg 107(9): 558-565.

18. Panda, R., et al. “Preparedness of frontline health workers for tobacco cessation: An exploratory study from two states of India.” J Family Med Prim Care 4(3): 298-304.

19. Anand, A. C., et al. (2006). “Risk Factors of Hepatotoxicity During Anti-tuberculosis Treatment.” Med J Armed Forces India 62(1): 45-49.

20. Bhushan, B., et al. “Profile of adverse drug reactions in drug resistant tuberculosis from Punjab.” Indian J Tuberc 61(4): 318-324.

21. Davies, P. D., et al. (2006). “Smoking and tuberculosis: the epidemiological association and immunopathogenesis.” Trans R Soc Trop Med Hyg 100(4): 291-298.

22. Dhanaraj, B., et al. “Prevalence and risk factors for adult pulmonary tuberculosis in a metropolitan city of South India.” PLoS One 10(4): e0124260.

23. Dolma, K. G., et al. “Determinants for the retreatment groups of pulmonary tuberculosis patients treated in a DOTS programme in Sikkim, India.” Indian J Tuberc 58(4): 178-188.

24. Gajalakshmi, V. and R. Peto (2009). “Smoking, drinking and incident tuberculosis in rural India: population-based case-control study.” Int J Epidemiol 38(4): 1018-1025.

25. Gaude, G. S., et al. “Drug-induced hepatitis and the risk factors for liver injury in pulmonary tuberculosis patients.” J Family Med Prim Care 4(2): 238-243.

26. Hiregoudar, V., et al. “Proportion and determinants of tuberculosis among human immunodeficiency virus-positive patients attending the antiretroviral therapy center attached to a Medical College in South India.” J Family Community Med 23(2): 88-93.

27. Jaggarajamma, K., et al. (2007). “Reasons for non-compliance among patients treated under Revised National Tuberculosis Control Programme (RNTCP), Tiruvallur district, south India.” Indian J Tuberc 54(3): 130-135.

28. Jain, K., et al. “Treatment outcome of standardized regimen in patients with multidrug resistant tuberculosis.” J Pharmacol Pharmacother 5(2): 145-149.

29. Kolappan, C., et al. (2007). “Selected biological and behavioural risk factors associated with pulmonary tuberculosis.” Int J Tuberc Lung Dis 11(9): 999-1003.

30. Kumpatla, S., et al. “Characteristics of patients with diabetes screened for tuberculosis in a tertiary care hospital in South India.” Public Health Action 3(Suppl 1): S23-28.

31. Marak, B., et al. “Non-communicable disease comorbidities and risk factors among tuberculosis patients, Meghalaya, India.” Indian J Tuberc 63(2): 123-125.

32. Pande, J. N., et al. (1996). “Risk factors for hepatotoxicity from antituberculosis drugs: a case-control study.” Thorax 51(2): 132-136.

33. Pednekar, M. S., et al. “Association of alcohol, alcohol and tobacco with mortality: findings from a prospective cohort study in Mumbai (Bombay), India.” Alcohol 46(2): 139-146.

34. Prabhakar, H. and R. Manoharan (2005). “The Tribal Health Initiative model for healthcare delivery: a clinical and epidemiological approach.” Natl Med J India 18(4): 197-204.

35. Rao, V. G., et al. “Selected risk factors associated with pulmonary tuberculosis among Saharia tribe of Madhya Pradesh, central India.” Eur J Public Health 22(2): 271-273.

36. Shamanna, S. B., et al. “Causes of liver disease and its outcome in HIV-infected individuals.” Indian J Gastroenterol 35(4): 310-314.

37. Sharma, S. K., et al. (2002). “Evaluation of clinical and immunogenetic risk factors for the development of hepatotoxicity during antituberculosis treatment.” Am J Respir Crit Care Med 166(7): 916-919.

38. Shetty, N., et al. (2006). “An epidemiological evaluation of risk factors for tuberculosis in South India: a matched case control study.” Int J Tuberc Lung Dis 10(1): 80-86.

39. Suhadev, M., et al. “Alcohol use disorders (AUD) among tuberculosis patients: a study from Chennai, South India.” PLoS One 6(5): e19485.

40. Thapa, P., et al. “Prevalence and Associated Factors of Alcoholism among Tuberculosis Patients in Udupi Taluk, Karnataka, India: A Cross Sectional Study.” J Nepal Health Res Counc 12(28): 177-181.

41. Thomas, B., et al. “Feasibility of an alcohol intervention programme for TB patients with alcohol use disorder (AUD)--a qualitative study from Chennai, South India.” PLoS One 6(11): e27752.

42. Thomas, B., et al. “Alcohol intervention strategy among tuberculosis patients: a pilot study from South India.” Int J Tuberc Lung Dis 21(8): 947-952.

43. Veerakumar, A. M., et al. “Alcohol use disorders among pulmonary tuberculosis patients under RNTCP in urban Pondicherry, India.” Indian J Tuberc 62(3): 171-177.

44. Weiss, M. G., et al. (2008). “Cultural epidemiology of TB with reference to gender in Bangladesh, India and Malawi.” Int J Tuberc Lung Dis 12(7): 837-847.

45. Bhatia, S., et al. (2002). “Tuberculosis among Tibetan refugees in India.” Soc Sci Med 54(3): 423-432.

46. Dierberg, K. L., et al. “Improved Detection of Tuberculosis and Multidrug-Resistant Tuberculosis among Tibetan Refugees, India.” Emerg Infect Dis 22(3): 463-468.

47. King, K., et al. “Is premigration health screening for tuberculosis worthwhile?” Med J Aust 195(9): 534-537.

48. Nelson, L. J., et al. (2005). “Population-based risk factors for tuberculosis and adverse outcomes among Tibetan refugees in India, 1994-1996.” Int J Tuberc Lung Dis 9(9): 1018-1026.

49. Rodger, A. J., et al. (2002). “DOTS-based tuberculosis treatment and control during civil conflict and an HIV epidemic, Churachandpur District, India.” Bull World Health Organ 80(6): 451-456.

50. Salvo, F., et al. “Survey of tuberculosis drug resistance among Tibetan refugees in India.” Int J Tuberc Lung Dis 18(6): 655-662.

51. Singh, S., et al. (1999). “High prevalence of sexually transmitted and blood-borne infections amongst the inmates of a district jail in Northern India.” Int J STD AIDS 10(7): 475-478.

52. Gupta, S., et al. “Role of risk factors and socio-economic status in pulmonary tuberculosis: a search for the root cause in patients in a tertiary care hospital, South India.” Trop Med Int Health 16(1): 74-78.

53. Joshi, R., et al. (2006). “Chronic diseases now a leading cause of death in rural India--mortality data from the Andhra Pradesh Rural Health Initiative.” Int J Epidemiol 35(6): 1522-1529.

54. Kanungo, S., et al. “Use of verbal autopsy to determine mortality patterns in an urban slum in Kolkata, India.” Bull World Health Organ 88(9): 667-674.

55. Kataria, V. K., et al. (2000). “Hiv and Tuberculosis Co-Infection in a Referral Chest Hospital.” Med J Armed Forces India 56(4): 298-300.

56. Kolappan, C., et al. “General and tuberculosis mortality in two states of India: A population-based survey.” Indian J Tuberc 63(1): 28-33.

57. Mandal, A. K., et al. (2000). “Prevalence of human immunodeficiency virus infection in and around Varanasi, Uttar Pradesh, India.” J Assoc Physicians India 48(3): 288-289.

58. Pais, P. (1996). “HIV and India: looking into the abyss.” Trop Med Int Health 1(3): 295-304.

59. Rathi, P. M., et al. (1997). “Spectrum of liver diseases in HIV infection.” Indian J Gastroenterol 16(3): 94-95.

60. Singh, A. (1995). “Estimation of chronic disease load in a rural area of Haryana.” J Indian Med Assoc 93(7): 268-270.

61. Sircar, A. R., et al. (1998). “Clinical profile of AIDS: a study at a referral hospital.” J Assoc Physicians India 46(9): 775-778.

62. Jindal, S. K. (2013). “Silicosis in India: past and present.” Curr Opin Pulm Med 19(2): 163-168.

63. Tiwari, R. R., et al. (2007). “Tuberculosis among workers exposed to free silica dust.” Indian J Occup Environ Med 11(2): 61-64.

64. Gupta, P., et al. (1999). “Ventilatory functions in stone quarry workers of Rajasthan.” Indian J Physiol Pharmacol 43(4): 496-500.

65. Yamamura, J. and T. Sawada (2000). “[A study on tuberculosis cases among over-staying foreigners].” Kekkaku 75(2): 79-88.

66. Agarwal, A., et al. “Vitamin D levels among pediatric tuberculosis patients - Does it alter following antitubercular treatment? A prospective study in 19 children.” J Clin Orthop Trauma 8(1): 31-33.

67. Aggarwal, A. N., et al. “Assessment of health-related quality of life in patients with pulmonary tuberculosis under programme conditions.” Int J Tuberc Lung Dis 17(7): 947-953.

68. Ahmed, J., et al. (2009). “Utilization of RNTCP services in rural areas of Bellary District, Karnataka, by gender, age and distance from health centre.” Indian J Tuberc 56(2): 62-68.

69. Alvarez-Uria, G., et al. “Incidence and mortality of tuberculosis before and after initiation of antiretroviral therapy: an HIV cohort study in India.” J Int AIDS Soc 17: 19251.

70. Anand, A. C., et al. (2006). “Risk Factors of Hepatotoxicity During Anti-tuberculosis Treatment.” Med J Armed Forces India 62(1): 45-49.

71. Anand, T., et al. “Decadal impact of Directly Observed Treatment Short course program on age and gender among New Infectious Tuberculosis cases in Delhi.” Indian J Tuberc 64(4): 291-295.

72. Andrade, N. N. and T. S. Mhatre “Orofacial tuberculosis--a 16-year experience with 46 cases.” J Oral Maxillofac Surg 70(1): e12-22.

73. Andries, A., et al. “High rate of hypothyroidism in multidrug-resistant tuberculosis patients co-infected with HIV in Mumbai, India.” PLoS One 8(10): e78313.

74. Anupriya, A., et al. “Tuberculous optochiasmatic arachnoiditis.” Neurol India 58(5): 732-735.

75. Arora, N., et al. “Low tuberculosis knowledge among HIV-infected patients in a high HIV prevalence region within southeast India.” J Int Assoc Provid AIDS Care 12(2): 84-89.

76. Arora, V. K., et al. (2003). “Profile of geriatric patients under DOTS in Revised National Tuberculosis Control Programme.” Indian J Chest Dis Allied Sci 45(4): 231-235.

77. Arvind, C., et al. (1993). “A retrospective study of 1247 cases of intracranial tuberculomata diagnosed by computerized tomography.” J Assoc Physicians India 41(9): 559-561.

78. Atre, S., et al. “Gender and community views of stigma and tuberculosis in rural Maharashtra, India.” Glob Public Health 6(1): 56-71.

79. Atre, S. R., et al. “Risk factors associated with MDR-TB at the onset of therapy among new cases registered with the RNTCP in Mumbai, India.” Indian J Public Health 55(1): 14-21.

80. Atre, S. R., et al. (2004). “Cultural concepts of tuberculosis and gender among the general population without tuberculosis in rural Maharashtra, India.” Trop Med Int Health 9(11): 1228-1238.

81. Balaji, G., et al. “Isolated Tubercular Osteomyelitis of Scapula - A Report of Two Cases and Review of Literature.” J Orthop Case Rep 3(4): 7-11.

82. Balasubramanian, R., et al. (2004). “Gender disparities in tuberculosis: report from a rural DOTS programme in south India.” Int J Tuberc Lung Dis 8(3): 323-332.

83. Basa, S. and S. Venkatesh “Patient and Healthcare System Delays in the Start of Pulmonary Tuberculosis Treatment Among Tribal Patients Registered Under DOTS, Odisha.” J Clin Diagn Res 10(9): LC21-LC24.

84. Batra, S., et al. “Pattern and predictors of paradoxical response in patients with peripheral lymph node tuberculosis.” Tuberk Toraks 65(3): 180-185.

85. Bhargava, A., et al. “Undernutrition and the incidence of tuberculosis in India: national and subnational estimates of the population-attributable fraction related to undernutrition.” Natl Med J India 27(3): 128-133.

86. Bhat, J., et al. (2009). “Prevalence of pulmonary tuberculosis amongst the tribal population of Madhya Pradesh, central India.” Int J Epidemiol 38(4): 1026-1032.

87. Dandona, R., et al. (2004). “Utilization of and barriers to public sector tuberculosis services in India.” Natl Med J India 17(6): 292-299.

88. Das, D. and B. Dwibedi “Delay in diagnosis among pulmonary tuberculosis patients of Rayagada District, Odisha, India.” Int J Mycobacteriol 5 Suppl 1: S172-S173.

89. Das, M., et al. “Self-administered tuberculosis treatment outcomes in a tribal population on the indo-myanmar border, Nagaland, India.” PLoS One 9(9): e108186.

90. Dhanaraj, B., et al. “Prevalence and risk factors for adult pulmonary tuberculosis in a metropolitan city of South India.” PLoS One 10(4): e0124260.

91. Dhingra, V. K. and S. Khan “A sociological study on stigma among TB patients in Delhi.” Indian J Tuberc 57(1): 12-18.

92. Dhingra, V. K., et al. (2002). “Health care seeking pattern of tuberculosis patients attending an urban TB clinic in Delhi.” J Commun Dis 34(3): 185-192.

93. Dholakia, Y. N., et al. “Chest X-rays and associated clinical parameters in pulmonary tuberculosis cases from the National Tuberculosis Programme, Mumbai.” Infect Dis Rep 4(1): e10.

94. Ferri, C. P., et al. “Socioeconomic factors and all cause and cause-specific mortality among older people in Latin America, India, and China: a population-based cohort study.” PLoS Med 9(2): e1001179.

95. Finch, P. J., et al. (1991). “Risk of tuberculosis in immigrant Asians: culturally acquired immunodeficiency?” Thorax 46(1): 1-5.

96. Gajalakshmi, V., et al. (2003). “Smoking and mortality from tuberculosis and other diseases in India: retrospective study of 43000 adult male deaths and 35000 controls.” Lancet 362(9383): 507-515.

97. Ganapathy, S., et al. (2008). “Perceptions of gender and tuberculosis in a south Indian urban community.” Indian J Tuberc 55(1): 9-14.

98. Gaude, G. S., et al. “Drug-induced hepatitis and the risk factors for liver injury in pulmonary tuberculosis patients.” J Family Med Prim Care 4(2): 238-243.

99. Gopi, P. G., et al. (2003). “A baseline survey of the prevalence of tuberculosis in a community in south India at the commencement of a DOTS programme.” Int J Tuberc Lung Dis 7(12): 1154-1162.

100. Gorityala, S. B., et al. “Assessment of treatment interruption among pulmonary tuberculosis patients: A cross-sectional study.” J Pharm Bioallied Sci 7(3): 226-229.

101. Gosoniu, G. D., et al. (2008). “Gender and socio-cultural determinants of delay to diagnosis of TB in Bangladesh, India and Malawi.” Int J Tuberc Lung Dis 12(7): 848-855.

102. Gupta, A., et al. (2001). “PCR-positive tubercular retinal vasculitis: clinical characteristics and management.” Retina 21(5): 435-444.

103. Gupta, A., et al. (2007). “Postpartum tuberculosis incidence and mortality among HIV-infected women and their infants in Pune, India, 2002-2005.” Clin Infect Dis 45(2): 241-249.

104. Gupta, S., et al. “A sociodemographic study of multidrug resistant tuberculosis cases from DOTS clinics of Kolkata.” J Indian Med Assoc 110(10): 723-725.

105. Gupta, S., et al. “Role of risk factors and socio-economic status in pulmonary tuberculosis: a search for the root cause in patients in a tertiary care hospital, South India.” Trop Med Int Health 16(1): 74-78.

106. Gupta, S. N., et al. “Surveillance data analysis of Revised National Tuberculosis Control Program of Kangra, Himachal Pradesh.” J Family Med Prim Care 2(3): 250-255.

107. Jadhav, R. N. and D. A. Palande (1999). “Calvarial tuberculosis.” Neurosurgery 45(6): 1345-1349; discussion 1349-1350.

108. Jagannathan, L., et al. “HLA-B57 and gender influence the occurrence of tuberculosis in HIV infected people of south India.” Clin Dev Immunol 2011: 549023.

109. Janagond, A. B., et al. “Screening of health-care workers for latent tuberculosis infection in a Tertiary Care Hospital.” Int J Mycobacteriol 6(3): 253-257.

110. Jain, R., et al. “Predictors of Microbiologically Confirmed Intrathoracic Tuberculosis.” Indian J Pediatr 84(11): 843-847.

111. Jain, K., et al. “Treatment outcome of standardized regimen in patients with multidrug resistant tuberculosis.” J Pharmacol Pharmacother 5(2): 145-149.

112. Kalita, J., et al. “Predictors of paradoxical tuberculoma in tuberculous meningitis.” Int J Tuberc Lung Dis 18(4): 486-491.

113. Joseph, N., et al. “Treatment outcomes among new smear positive and retreatment cases of tuberculosis in Mangalore, South India - a descriptive study.” Australas Med J 4(4): 162-167.

114. Hussain, T., et al. (2007). “Seroprevalence of HIV infection among paediatric tuberculosis patients in Agra, India: a hospital-based study.” Tuberculosis (Edinb) 87(1): 7-11.

115. Kaulagekar, A. and A. Radkar (2007). “Social status makes a difference: tuberculosis scenario during National Family Health Survey-2.” Indian J Tuberc 54(1): 17-23.

116. Khan, K. B. “Understanding the gender aspects of tuberculosis: a narrative analysis of the lived experiences of women with TB in slums of Delhi, India.” Health Care Women Int 33(1): 3-18.

117. Kolappan, C., et al. (2007). “Selected biological and behavioural risk factors associated with pulmonary tuberculosis.” Int J Tuberc Lung Dis 11(9): 999-1003.

118. Kolappan, C. and R. Subramani (2009). “Association between biomass fuel and pulmonary tuberculosis: a nested case-control study.” Thorax 64(8): 705-708.

119. Kolappan, C., et al. (2006). “Mortality of tuberculosis patients in Chennai, India.” Bull World Health Organ 84(7): 555-560.

120. Kolappan, C., et al. “Tuberculosis mortality in a rural population from South India.” Indian J Tuberc 63(2): 100-105.

121. Kolappan, C., et al. “General and tuberculosis mortality in two states of India: A population-based survey.” Indian J Tuberc 63(1): 28-33.

122. Kulkarni, P., et al. “Non-adherence of new pulmonary tuberculosis patients to anti-tuberculosis treatment.” Ann Med Health Sci Res 3(1): 67-74.

123. Kulkarni, P., et al. “Tuberculosis knowledge and awareness in tribal-dominant districts of Jharkhand, India: implications for ACSM.” Public Health Action 4(3): 189-194.

124. Latief, M., et al. “Novel risk factors and early detection of anti tubercular treatment induced liver injury-Looking beyond American Thoracic Society Guidelines.” Indian J Tuberc 64(1): 26-32.

125. Lavigne, M., et al. (2006). “The impact of smoking on adherence to treatment for latent tuberculosis infection.” BMC Public Health 6: 66.

126. Manjareeka, M., et al. “Diabetes Mellitus among Newly Diagnosed Tuberculosis Patients in Tribal Odisha: An Exploratory Study.” J Clin Diagn Res 10(10): LC06-LC08.

127. McArthur, E., et al. “Socio-cultural and Knowledge-Based Barriers to Tuberculosis Diagnosis for Women in Bhopal, India.” Indian J Community Med 41(1): 62-64.

128. Mishra, V. K., et al. (1999). “Biomass cooking fuels and prevalence of tuberculosis in India.” Int J Infect Dis 3(3): 119-129.

129. Mistry, N., et al. “Durations and Delays in Care Seeking, Diagnosis and Treatment Initiation in Uncomplicated Pulmonary Tuberculosis Patients in Mumbai, India.” PLoS One 11(3): e0152287.

130. Mukherjee, A., et al. “Gender differences in notification rates, clinical forms and treatment outcome of tuberculosis patients under the RNTCP.” Lung India 29(2): 120-122.

131. Muniyandi, M., et al. (2007). “Evaluation of post-treatment health-related quality of life (HRQoL) among tuberculosis patients.” Int J Tuberc Lung Dis 11(8): 887-892.

132. Nair, D., et al. “Household Contact Screening and Yield of Tuberculosis Cases-A Clinic Based Study in Chennai, South India.” PLoS One 11(9): e0162090.

133. Nair, D., et al. “Predictors of unfavourable treatment outcome in patients with multidrug-resistant tuberculosis in India.” Public Health Action 7(1): 32-38.

134. Narang, P., et al. (1999). “Prevalence of sputum-positive pulmonary tuberculosis in tribal and non-tribal populations of the Ashti and Karanja tahsils in Wardha district, Maharashtra State, India.” Int J Tuberc Lung Dis 3(6): 478-482.

135. Narasimhan, P., et al. “High rates of latent TB infection in contacts and the wider community in South India.” Trans R Soc Trop Med Hyg 111(2): 55-61.

136. Narayanan, P. R. (2006). “Influence of sex, age & nontuberculous infection at intake on the efficacy of BCG: re-analysis of 15-year data from a double-blind randomized control trial in South India.” Indian J Med Res 123(2): 119-124.

137. Pande, J. N., et al. (1996). “Risk factors for hepatotoxicity from antituberculosis drugs: a case-control study.” Thorax 51(2): 132-136.

138. Pardeshi, G. (2009). “Survival analysis and risk factors for death in tuberculosis patients on directly observed treatment-short course.” Indian J Med Sci 63(5): 180-186.

139. Patra, S., et al. “Profile and treatment outcomes of elderly patients with tuberculosis in Delhi, India: implications for their management.” Trans R Soc Trop Med Hyg 107(12): 763-768.

140. Purohit, M. R., et al. (2009). “Gender differences in the clinical diagnosis of tuberculous lymphadenitis--a hospital-based study from Central India.” Int J Infect Dis 13(5): 600-605.

141. Radhakrishna, S., et al. (2003). “Association of initial tuberculin sensitivity, age and sex with the incidence of tuberculosis in south India: a 15-year follow-up.” Int J Tuberc Lung Dis 7(11): 1083-1091.

142. Radhakrishna, S., et al. (2001). “Trends in the prevalence and incidence of tuberculosis in south India.” Int J Tuberc Lung Dis 5(2): 142-157.

143. Raj, P., et al. “Prevalence of smear-positive pulmonary tuberculosis in different ethnic groups in India: evaluation of public health.” Public Health 126(4): 295-299.

144. Rajasekaran, S., et al. (2009). “Post-HAART tuberculosis in adults and adolescents with HIV in India: incidence, clinical and immunological profile.” Indian J Tuberc 56(2): 69-76.

145. Rajeswari, R., et al. (1999). “Socio-economic impact of tuberculosis on patients and family in India.” Int J Tuberc Lung Dis 3(10): 869-877.

146. Ramachandran, G., et al. “Factors Influencing Tuberculosis Treatment Outcome in Adult Patients Treated with Thrice-Weekly Regimens in India.” Antimicrob Agents Chemother 61(5).

147. Rao, S. (2009). “Tuberculosis and patient gender: An analysis and its implications in tuberculosis control.” Lung India 26(2): 46-47.

148. Rao, V. G., et al. “Pulmonary tuberculosis: a public health problem amongst the Saharia, a primitive tribe of Madhya Pradesh, Central India.” Int J Infect Dis 14(8): e713-716.

149. Rao, V. G., et al. “Selected risk factors associated with pulmonary tuberculosis among Saharia tribe of Madhya Pradesh, central India.” Eur J Public Health 22(2): 271-273.

150. Reddy Satti, S. B. and N. Kondagunta “Risk Factors for DOTS Treatment Default Among New HIV-TB Coinfected Patients in Nalgonda (Dist.) Telangana (State): A Case Control Study.” Indian J Community Med 41(2): 120-125.

151. Sadacharam, K., et al. (2007). “Status of smear-positive TB patients at 2-3 years after initiation of treatment under a DOTS programme.” Indian J Tuberc 54(4): 199-203.

152. Samal, J. “Health Seeking Behaviour among Tuberculosis Patients in India: A Systematic Review.” J Clin Diagn Res 10(10): LE01-LE06.

153. Samuel, B., et al. “Relationship between Nutritional Support and Tuberculosis Treatment Outcomes in West Bengal, India.” J Tuberc Res 4(4): 213-219.

154. Santha, T., et al. (2002). “Risk factors associated with default, failure and death among tuberculosis patients treated in a DOTS programme in Tiruvallur District, South India, 2000.” Int J Tuberc Lung Dis 6(9): 780-788.

155. Sarangi, S. S. and D. Dutt “Risk factors associated with default among retreatment tuberculosis patients on DOTS in Paschim Medinipur district (West Bengal).” Indian J Tuberc 61(3): 213-223.

156. Sarpal, S. S., et al. “Gender disparities in retreatment patients of tuberculosis: A north Indian study.” J Nat Sci Biol Med 6(1): 63-66.

157. Sawant, S. S., et al. “Human immunodeficiency virus infection among tuberculosis patients in mumbai.” J Lab Physicians 3(1): 12-14.

158. Sharma, P., et al. “Increased prevalence of pulmonary tuberculosis in male adults of sahariya tribe of India: a revised survey.” Indian J Community Med 35(2): 267-271.

159. Sharma, P. P., et al. “A study of gender differentials in the prevalence of tuberculosis based on NFHS-2 and NFHS-3 data.” Indian J Community Med 35(2): 230-237.

160. Shashidhara, A. N., et al. (2004). “The annual risk of tuberculous infection in Orissa State, India.” Int J Tuberc Lung Dis 8(5): 545-551.

161. Shetty, N., et al. (2006). “An epidemiological evaluation of risk factors for tuberculosis in South India: a matched case control study.” Int J Tuberc Lung Dis 10(1): 80-86.

162. Shiotani, R. and M. Hennink “Socio-cultural influences on adherence to tuberculosis treatment in rural India.” Glob Public Health 9(10): 1239-1251.

163. Shivapujimath, R., et al. “A cross-sectional study to assess the stigma associated with tuberculosis among tuberculosis patients in Udupi district, Karnataka.” Indian J Tuberc 64(4): 323-326.

164. Singla, R., et al. “Evaluation of risk factors for antituberculosis treatment induced hepatotoxicity.” Indian J Med Res 132: 81-86.

165. Somma, D., et al. (2008). “Gender and socio-cultural determinants of TB-related stigma in Bangladesh, India, Malawi and Colombia.” Int J Tuberc Lung Dis 12(7): 856-866.

166. Stevenson, C. R., et al. (2007). “Diabetes and tuberculosis: the impact of the diabetes epidemic on tuberculosis incidence.” BMC Public Health 7: 234.

167. Sudha, G., et al. (2003). “Factors influencing the care-seeking behaviour of chest symptomatics: a community-based study involving rural and urban population in Tamil Nadu, South India.” Trop Med Int Health 8(4): 336-341.

168. Thapa, P., et al. “Prevalence and Associated Factors of Alcoholism among Tuberculosis Patients in Udupi Taluk, Karnataka, India: A Cross Sectional Study.” J Nepal Health Res Counc 12(28): 177-181.

169. Vijay, S., et al. “Risk factors associated with default among new smear positive TB patients treated under DOTS in India.” PLoS One 5(4): e10043.

170. Vivekanand, K., et al. “Study of the structure and functioning of referral mechanism of patients receiving treatment and records linkage under Revised National Tuberculosis Control Programme (RNTCP) of Government of India.” Indian J Tuberc 64(2): 77-82.

171. Weiss, M. G., et al. (2008). “Cultural epidemiology of TB with reference to gender in Bangladesh, India and Malawi.” Int J Tuberc Lung Dis 12(7): 837-847.

172. Yang, W. T., et al. “Barriers and delays in tuberculosis diagnosis and treatment services: does gender matter?” Tuberc Res Treat 2014: 461935.

173. Zodpey, S. P., et al. (1998). “Effectiveness of Bacillus Calmette Guerin (BCG) vaccination in the prevention of childhood pulmonary tuberculosis: a case control study in Nagpur, India.” Southeast Asian J Trop Med Public Health 29(2): 285-288.

174. Bhagia, L. J. and H. G. Sadhu (2008). “Cost-benefit analysis of installing dust control devices in the agate industry, Khambhat (Gujarat).” Indian J Occup Environ Med 12(3): 128-131.

175. Chaudhury, N., et al. “Co-morbidities among silicotics at Shakarpur: A follow up study.” Lung India 29(1): 6-10.

176. Gupta, K. B., et al. (2006). “Bilateral spontaneous pneumothorax in silicosis.” Indian J Chest Dis Allied Sci 48(3): 201-203.

177. Jindal, S. K. “Silicosis in India: past and present.” Curr Opin Pulm Med 19(2): 163-168.

178. Jindal, S. K., et al. (2001). “Dust-induced interstitial lung disease in the tropics.” Curr Opin Pulm Med 7(5): 272-277.

179. Sivanmani, K. and V. Rajathinakar “Silicosis in Coimbatore district of Tamil Nadu: A passive surveillance study.” Indian J Occup Environ Med 17(1): 25-28.

180. Tiwari, R. R., et al. “Comparison of respiratory morbidity between present and ex-workers of quartz crushing units: Healthy workers’ effect.” Indian J Occup Environ Med 14(3): 87-90.

181. Tiwari, R. R., et al. (2007). “Tuberculosis among workers exposed to free silica dust.” Indian J Occup Environ Med 11(2): 61-64.

182. Bavikatte, A. P., S. Sudhindran, et al. “Live donor liver transplantation for antitubercular drug-induced acute liver failure.” Indian J Gastroenterol 36(1): 56-61.

183. Gupta, P. P., S. Fotedar, et al. (2007). “Primary tuberculous glossitis in an immunocompetent patient.” Hong Kong Med J 13(4): 330-1.

184. Haas, C. and C. Le Jeunne (2006). “[Mycobacterium tuberculosis infection following organ transplantation].” Bull Acad Natl Med 190(8): 1711-21; discussion 1721.

185. John, G. T., V. Shankar, et al. (2002). “Nocardiosis in tropical renal transplant recipients.” Clin Transplant 16(4): 285-9.

186. Kshatriya, R., V. Patel, et al. “Cannon ball appearance on radiology in a middle-aged diabetic female.” Lung India 33(5): 562-8.

187. Olithselvan, A., S. Rajagopala, et al. “Tuberculosis in liver transplant recipients: experience of a South Indian liver transplant center.” Liver Transpl 20(8): 960-6.

188. Padhi, S., K. Ravichandran, et al. “Hemophagocytic lymphohistiocytosis: An unusual complication in disseminated Mycobacterium tuberculosis.” Lung India 32(6): 593-601.

189. Padhi, S., R. G. Varghese, et al. “Hemophagocytic lymphohistiocytosis: critical reappraisal of a potentially under-recognized condition.” Front Med 7(4): 492-8.

190. Parchand, S., M. Tandan, et al. “Intermediate uveitis in Indian population.” J Ophthalmic Inflamm Infect 1(2): 65-70.

191. Qureshi, S., A. Pandey, et al. “Mixed pulmonary infection in an immunocompromised patient: a rare case report.” Indian J Med Microbiol 32(1): 79-81.

Patients who are immunocompromised are predisposed to a variety of common and uncommon pulmonary infections. We report a case of mixed pulmonary infection by drug resistant tuberculosis with a nocardiosis in a 49-year-old man who was a known case of chronic obstructive pulmonary disease, on prolonged corticosteroid use with diabetes mellitus. Chronic use of corticosteroids is a predisposing factor for opportunistic infections, such as nocardiosis or tuberculosis. Since such a mixed infection is rare, maybe a combined approach to therapy early in the course of disease would be effective in such cases.

192. Rathi, M., S. Gundlapalli, et al. “A rare case of Cytomegalovirus, Scedosporium apiospermum and Mycobacterium tuberculosis in a renal transplant recipient.” BMC Infect Dis 14: 259..

193. Sakhuja, V., V. Jha, et al. (1996). “The high incidence of tuberculosis among renal transplant recipients in India.” Transplantation 61(2): 211-5.

194. Sinha, A., P. Hari, et al. “Outcome of pediatric renal transplantation in north India.” Pediatr Transplant 14(7): 836-43.

195. Sun, H. Y., P. Munoz, et al. “Tuberculosis in solid-organ transplant recipients: disease characteristics and outcomes in the current era.” Prog Transplant 24(1): 37-43.

196. Vachharajani, T., K. Abreo, et al. (2000). “Diagnosis and treatment of tuberculosis in hemodialysis and renal transplant patients.” Am J Nephrol 20(4): 273-7.

197. Ludam, R & Mania, R.N. & Sahoo, G & Sahu, Mahesh. (2015). Incidence of elderly tuberculosis in a tertiary care Indian teaching hospital. International Journal of Pharmaceutical Sciences Review and Research. 34. 87-89.

198. Moharana S, Lipika M, Moharana DN, Pattnaik SS, Padhy S, Sahoo TK. Pulmonary Tuberculosis in elderly Peculiarities and Dissimilarities: A Geriatic Clinic Experience. Int J Sci Stud 2017;5(4):50-53

199. Gupta HL, Yadav M, Sundarka MK, Talwar V, Saini M, Garg P. A study of prevalence of health problems in asymptomatic elderly individuals in Delhi. J Assoc Physicians India. 2002 Jun;50:792-5.

200. Velayutham BRV, Nair D, Chandrasekaran V, Raman B, Sekar G, et al. (2014) Profile and Response to Anti-Tuberculosis Treatment among Elderly Tuberculosis Patients Treated under the TB Control Programme in South India. PLoS ONE 9(3): e88045

201. Shivam S, Saha I, Mondal TK, Dasgupta S,

Bhattacharyya KD, Roy RN. Comparative analysis of tuberculosis in geriatric

and younger age group: An experience from rural West Bengal, India. Sahel

Med J 2014;17:71-4.

202. Arora VK, Singla N, Sarin R. Profile of geriatric patients under DOTS in Revised National Tuberculosis Control Programme. Indian J Chest Dis Allied Sci.

2003 Oct-Dec;45(4):231-5.

203. Shaik KU, Sunil Dattu M, Krishnamurthy S, Suresh R, Revanasiddappa HG, Reddy YJV. A prospective study of pulmonary tuberculosis in rural geriatric population of South India. J Clin Sci Res 2016;5:28-32

204. Mohapatra H, Goswami S, Dey D. Coalmine dust concentration and rate of tuberculosis infection around Ib Valley Coalfield, Orissa, India. J Environ Biol.

2010 Nov;31(6):953-6.

205. Bhagyalaxmi, A., A. M. Kadri, et al. (2003). “Prevalence of tuberculosis infection among children in slums of Ahmedabad.” Indian Pediatr 40(3): 239-43.

206. Chandra, S., N. Sharma, et al. “Resurrecting social infrastructure as a determinant of urban tuberculosis control in Delhi, India.” Health Res Policy Syst 2014; 12: 3

207. Chinnakali, P., J. Ramakrishnan, et al. “Level of awareness about tuberculosis in urban slums: Implications for advocacy and communication strategy planning in the National program.” Lung India 2013; 30(2): 139-42

208. Dholakia, Y. and N. Mistry “Active tuberculosis case finding in a migrant slum community, Mumbai, India.” Int J Tuberc Lung Dis 2016; 20(11): 1562.

209. Ghosh, S., A. Sinhababu, et al. “A study on care seeking behavior of chest symptomatics in a slum of Bankura, West Bengal.” Indian J Public Health 2010; 54(1): 42-4.

210. Gopi, P. G., V. V. Prasad, et al. (2008). “Annual risk of tuberculosis infection in Chennai city.” Indian J Tuberc 2008; 55(3): 157-61.

211. Isaakidis, P., H. S. Cox, et al. “Ambulatory multi-drug resistant tuberculosis treatment outcomes in a cohort of HIV-infected patients in a slum setting in Mumbai, India.” PLoS One 2011; 6(12): e28066

212. Khan, K. B. “Understanding the gender aspects of tuberculosis: a narrative analysis of the lived experiences of women with TB in slums of Delhi, India.” Health Care Women Int 2012; 33(1): 3-18.

213. Malhotra, B., D. Dashora, et al. “Genetic diversity & drug sensitivity profiles of Mycobacterium tuberculosis isolates from two slums of Jaipur city, Rajasthan, India.” Indian J Med Res 145(1): 74-83.

214. Marimuthu, P. “Tuberculosis prevalence and socio-economic differentials in the slums of four metropolitan cities of India.” Indian J Tuberc 201763(3): 167-170.

215. Prasad, B. M., S. Satyanarayana, et al. “Lessons learnt from active tuberculosis case finding in an urban slum setting of Agra city, India.” Indian J Tuberc 63(3): 199-202.

216. Samal, J. and R. K. Dehury “Impact of a Structured Tuberculosis Awareness Strategy on the Knowledge and Behaviour of the Families in a Slum Area in Chhattisgarh, India.” J Clin Diagn Res 11(3): LC11-LC15.

217. Shrivastava, S. R. and P. S. Shrivastava “Tuberculosis: active case finding survey in an urban area of India, in 2012.” J Res Health Sci 13(1): 19-23.

218. Singh, M. M., T. Bano, et al. (2002). “Knowledge and attitude towards tuberculosis in a slum community of Delhi.” J Commun Dis 2012; 34(3): 203-14.

219. Suganthi, P., V. K. Chadha, et al. (2008). “Health seeking and knowledge about tuberculosis among persons with pulmonary symptoms and tuberculosis cases in Bangalore slums.” Int J Tuberc Lung Dis 12(11): 1268-73.

220. Mallick, G., H. D. Shewade, et al. “Enhanced tuberculosis case finding through advocacy and sensitisation meetings in prisons of Central India.” Public Health Action 7(1): 67-70.

221. Prasad, B. M., B. Thapa, et al. “Status of Tuberculosis services in Indian Prisons.” Int J Infect Dis 2017; 56: 117-121.

222. Dhuria, M., N. Sharma, et al. “Universal access to DOTS in Delhi Prisons: Where do we stand?” Indian J Tuberc 63(1): 39-43.

223. Singh, S., R. Prasad, et al. (1999). “High prevalence of sexually transmitted and blood-borne infections amongst the inmates of a district jail in Northern India.” Int J STD AIDS 10(7): 475-8.

224. Rao VG, Gopi PG, Bhat J, Yadav R, Selvakumar N, Wares DF. Selected risk

factors associated with pulmonary tuberculosis among Saharia tribe of Madhya Pradesh, central India. Eur J Public Health. 2012 Apr;22(2):271-3.

225. anjareeka M, Palo SK, Swain S, Pati S, Pati S. Diabetes Mellitus among Newly Diagnosed Tuberculosis Patients in Tribal Odisha: An Exploratory Study. J Clin Diagn Res. 2016 Oct;10(10)

226. Bhat J, Rao VG, Yadav R, Muniyandi M, Sharma R, Karfarma C, Luke C. Situation of drug resistant tuberculosis in Saharia tribe of central India. Indian J Med

Res. 2015 May;141(5):636-9

227. Prakash R, Kumar D, Gupta VK, Jain S, Chauhan DS, Tiwari PK, Katoch VM. Status

of multidrug resistant tuberculosis (MDR-TB) among the Sahariya tribe of North Central India. J Infect Public Health. 2016 May-Jun;9(3):289-97

228. Thomas BE, Adinarayanan S, Manogaran C, Swaminathan S. Pulmonary tuberculosis among tribals in India: A systematic review & meta-analysis. Indian J Med Res. 2015 May;141(5):614-23

229. Datta M, Radhamani M P, Sadacharam K, et al. Survey for tuberculosis in a tribal population in North Arcot District. Int J Tuberc Lung Dis 2001; 5: 240–249

230. Rao VG, Bhat J, Yadav R, Muniyandi M, Bhondeley MK, Wares DF. Yield of pulmonary tuberculosis cases by symptoms: Findings from a community survey in Madhya Pradesh, central India. Indian J Tuberc. 2015 Apr;62(2):121-3

231. Yadav R, Rao VG, Bhat J, Gopi PG, Selvakumar N, Wares DF. Prevalence of

pulmonary tuberculosis amongst the Baigas--a primitive tribe of Madhya Pradesh, Central India. Indian J Tuberc. 2010 Apr;57(2):114-6

232. Rao VG, Bhat J, Yadav R, Gopi PG, Selvakumar N, Wares DF. Prevalence of

pulmonary tuberculosis among the Bharia, a primitive tribe of Madhya Pradesh, central India. Int J Tuberc Lung Dis. 2010 Mar;14(3):368-70.

233. Sharma P, Jain S, Bamezai R, Tiwari P. Increased prevalence of pulmonary tuberculosis in male adults of sahariya tribe of India: a revised survey. Indian

J Community Med. 2010 Apr;35(2):267-71.

234. Kaulagekar A, Radkar A. Social status makes a difference: tuberculosis

scenario during National Family Health Survey-2. Indian J Tuberc. 2007 Jan;54(1):17-23

235. Achanta S, Tekumalla RR, Jaju J, Purad C, Chepuri R, Samyukta R, Malhotra S, Nagaraja SB, Kumar AM, Harries AD. Screening tuberculosis patients for diabetes in a tribal area in South India. Public Health Action. 2013 Nov 4;3(Suppl

1):S43-7.

236. Screening of patients with tuberculosis for diabetes mellitus in India. Trop Med Int Health 18(5): 636-645.

237. Screening of patients with diabetes mellitus for tuberculosis in India. Trop Med Int Health 18(5): 646-654.

238. Achanta, S., et al. “Screening tuberculosis patients for diabetes in a tribal area in South India.” Public Health Action 3(Suppl 1): S43-47.

239. Agarwal, A. K., et al. “A Study of the Patients Suffering from Tuberculosis and Tuberculosis-diabetes Comorbidity in Revised National Tuberculosis Control Program Centers of Northern Madhya Pradesh, India.” Indian J Endocrinol Metab 21(4): 570-576.

240. Aravindalochanan, V., et al. “Association of diabetes and tuberculosis--a major public health challenge.” J Indian Med Assoc 110(9): 646-648.

241. Aravindhan, V., et al. “Chronic Endotoxemia in Subjects with Type-1 Diabetes Is Seen Much before the Onset of Microvascular Complications.” PLoS One 10(9): e0137618.

242. Balakrishnan, S., et al. “High diabetes prevalence among tuberculosis cases in Kerala, India.” PLoS One 7(10): e46502.

243. Banerjee, D. and R. Bhattacharyya “Statin therapy may prevent development of tuberculosis in diabetic state.” Med Hypotheses 83(1): 88-91.

244. Banurekha, V., et al. “Sputum Conversion and Treatment Success among Tuberculosis Patients with Diabetes Treated under the Tuberculosis Control Programme in an Urban Setting in South India.” Indian J Community Med 42(3): 180-182.

245. Chachra, V. and V. K. Arora “Study on prevalance of diabetes mellitus in patients with T.B. under DOTS strategy.” Indian J Tuberc 61(1): 65-71.

246. Chakraborty, P. P., et al. “Poncet’s disease: An unusual presentation of tuberculosis in a diabetic lady.” World J Clin Cases 3(4): 385-388.

247. Chaudhary, S., et al. “Vitamin D status of patients with type 2 diabetes and sputum positive pulmonary tuberculosis.” Indian J Endocrinol Metab 17(Suppl 3): S670-673.

248. Dayal, D., et al. “Acute Hypercalcaemia and Hypervitaminosis D in an Infant with Extra Pulmonary Tuberculosis.” J Clin Diagn Res 9(10): SD03-04.

249. Dhanwal, D. K., et al. “Hypothalamic pituitary abnormalities in tubercular meningitis at the time of diagnosis.” Pituitary 13(4): 304-310.

250. Ezung, T., et al. (2002). “Pulmonary tuberculosis and diabetes mellitus--a study.” J Indian Med Assoc 100(6): 376, 378-379.

251. Goldhaber-Fiebert, J. D., et al. “Diabetes mellitus and tuberculosis in countries with high tuberculosis burdens: individual risks and social determinants.” Int J Epidemiol 40(2): 417-428.

252. Goyal, R. and M. Singhai “Tuberculosis and non-diabetic hyperglycemia: a challenge to public health management.” Med Hypotheses 81(6): 1170-1171.

253. Gupta, S., et al. “Diabetes mellitus and HIV as co-morbidities in tuberculosis patients of rural south India.” J Infect Public Health 4(3): 140-144.

254. Gupta, S., et al. “Role of risk factors and socio-economic status in pulmonary tuberculosis: a search for the root cause in patients in a tertiary care hospital, South India.” Trop Med Int Health 16(1): 74-78.

255. Harries, A. D., et al. “Addressing diabetes mellitus as part of the strategy for ending TB.” Trans R Soc Trop Med Hyg 110(3): 173-179.

256. Harries, A. D., et al. “Diabetes mellitus and tuberculosis: programmatic management issues.” Int J Tuberc Lung Dis 19(8): 879-886.

257. Harries, A. D., et al. “The looming epidemic of diabetes-associated tuberculosis: learning lessons from HIV-associated tuberculosis.” Int J Tuberc Lung Dis 15(11): 1436-1444, i.

258. Harries, A. D., et al. “Epidemiology and interaction of diabetes mellitus and tuberculosis and challenges for care: a review.” Public Health Action 3(Suppl 1): S3-9.

259. Hemanth Kumar, A. K., et al. “Pharmacokinetics of thrice-weekly rifampicin, isoniazid and pyrazinamide in adult tuberculosis patients in India.” Int J Tuberc Lung Dis 20(9): 1236-1241.

260. Indira, P., et al. “Opportunistic Infections among People Living with HIV (PLHIV) with Diabetes Mellitus (DM) Attending a Tertiary Care Hospital in Coastal City of South India.” PLoS One 10(8): e0136280.

261. Jali, M. V., et al. “Bidirectional screening of tuberculosis patients for diabetes mellitus and diabetes patients for tuberculosis.” Diabetes Metab J 37(4): 291-295.

262. Jali, M. V., et al. “Diabetes mellitus and smoking among tuberculosis patients in a tertiary care centre in Karnataka, India.” Public Health Action 3(Suppl 1): S51-53.

263. Jonnalagada, S., et al. “The timing of death in patients with tuberculosis who die during anti-tuberculosis treatment in Andhra Pradesh, South India.” BMC Public Health 11: 921.

264. K V, Nandakumar., et al. “Outcome of tuberculosis treatment in patients with diabetes mellitus treated in the revised national tuberculosis control programme in Malappuram District, Kerala, India.” PLoS One 8(10): e76275.

265. Khanna, A., et al. “Characteristics and treatment response in patients with tuberculosis and diabetes mellitus in New Delhi, India.” Public Health Action 3(Suppl 1): S48-50.

266. Kornfeld, H., et al. “High Prevalence and Heterogeneity of Diabetes in Patients With TB in South India: A Report from the Effects of Diabetes on Tuberculosis Severity (EDOTS) Study.” Chest 149(6): 1501-1508.

267. Kota, S. K., et al. “Effect of vitamin D supplementation in type 2 diabetes patients with pulmonary tuberculosis.” Diabetes Metab Syndr 5(2): 85-89.

268. Kumar, A. K., et al. “Anti-tuberculosis drug concentrations in tuberculosis patients with and without diabetes mellitus.” Eur J Clin Pharmacol 73(1): 65-70.

269. Kumar, N. P., et al. “Modulation of dendritic cell and monocyte subsets in tuberculosis-diabetes co-morbidity upon standard tuberculosis treatment.” Tuberculosis (Edinb) 101: 191-200.

270. Kumar, N. P., et al. “Tuberculosis-diabetes co-morbidity is characterized by heightened systemic levels of circulating angiogenic factors.” J Infect 74(1): 10-21.

271. Kumar, N. P., et al. “Type 2 diabetes mellitus is associated with altered CD8(+) T and natural killer cell function in pulmonary tuberculosis.” Immunology 144(4): 677-686.

272. Kumari, P. and L. S. Meena “Factors affecting susceptibility to Mycobacterium tuberculosis: a close view of immunological defence mechanism.” Appl Biochem Biotechnol 174(8): 2663-2673.

273. Kumpatla, S., et al. “Evaluation of performance of A1c and FPG tests for screening newly diagnosed diabetes defined by an OGTT among tuberculosis patients-a study from India.” Diabetes Res Clin Pract 102(1): 60-64.

274. Kumpatla, S., et al. “Characteristics of patients with diabetes screened for tuberculosis in a tertiary care hospital in South India.” Public Health Action 3(Suppl 1): S23-28.

275. Mahishale, V., et al. “Effect of Poor Glycemic Control in Newly Diagnosed Patients with Smear-Positive Pulmonary Tuberculosis and Type-2 Diabetes Mellitus.” Iran J Med Sci 42(2): 144-151.

276. Manjareeka, M., et al. “Diabetes Mellitus among Newly Diagnosed Tuberculosis Patients in Tribal Odisha: An Exploratory Study.” J Clin Diagn Res 10(10): LC06-LC08.

277. Marak, B., et al. “Non-communicable disease comorbidities and risk factors among tuberculosis patients, Meghalaya, India.” Indian J Tuberc 63(2): 123-125.

278. Marupuru, S., et al. “Protective effect of metformin against tuberculosis infections in diabetic patients: an observational study of south Indian tertiary healthcare facility.” Braz J Infect Dis 21(3): 312-316.

279. Mathur, M., et al. “Radiological Manifestations of Pulmonary Tuberculosis - A Comparative Study between Immunocompromised and Immunocompetent Patients.” J Clin Diagn Res 11(9): TC06-TC09.

280. Mave, V., et al. “Prevalence of dysglycemia and clinical presentation of pulmonary tuberculosis in Western India.” Int J Tuberc Lung Dis 21(12): 1280-1287.

281. Mave, V., et al. “Tuberculosis screening among persons with diabetes mellitus in Pune, India.” BMC Infect Dis 17(1): 388.

282. Meenakshi, P., et al. “Effect of IFN-gamma, IL-12 and IL-10 cytokine production and mRNA expression in tuberculosis patients with diabetes mellitus and their household contacts.” Cytokine 81: 127-136.

283. Mehta, S., et al. “Rifampin resistance and diabetes mellitus in a cross-sectional study of adult patients in rural South India.” BMC Infect Dis 15: 451.

284. Naik, B., et al. “Is screening for diabetes among tuberculosis patients feasible at the field level?” Public Health Action 3(Suppl 1): S34-37.

285. Nair, A., et al. “Prevalence of pulmonary tuberculosis in young adult patients with Type 1 diabetes mellitus in India.” Multidiscip Respir Med 11: 22.

286. Nair, S., et al. “High prevalence of undiagnosed diabetes among tuberculosis patients in peripheral health facilities in Kerala.” Public Health Action 3(Suppl 1): S38-42.

287. Pavan Kumar, N., et al. “Type 2 diabetes mellitus coincident with pulmonary or latent tuberculosis results in modulation of adipocytokines.” Cytokine 79: 74-81.

288. Pednekar, M. S., et al. “Tobacco use or body mass--do they predict tuberculosis mortality in Mumbai, India? Results from a population-based cohort study.” PLoS One 7(7): e39443.

289. Ponnana, M., et al. “IL-6 and IL-18 cytokine gene variants of pulmonary tuberculosis patients with co-morbid diabetes mellitus and their household contacts in Hyderabad.” Gene 627: 298-306.

290. Prada-Medina, C. A., et al. “Systems Immunology of Diabetes-Tuberculosis Comorbidity Reveals Signatures of Disease Complications.” Sci Rep 7(1): 1999.

291. Prakash, B. C., et al. “Tuberculosis-diabetes mellitus bidirectional screening at a tertiary care centre, South India.” Public Health Action 3(Suppl 1): S18-22.

292. Prince, L., et al. “Risk of self-reported symptoms or diagnosis of active tuberculosis in relationship to low body mass index, diabetes and their co-occurrence.” Trop Med Int Health 21(10): 1272-1281.

293. Raghuraman, S., et al. “Prevalence of Diabetes Mellitus among Tuberculosis Patients in Urban Puducherry.” N Am J Med Sci 6(1): 30-34.

294. Rawat, J., et al. “Effect of age on presentation with diabetes: Comparison of nondiabetic patients with new smear-positive pulmonary tuberculosis patients.” Lung India 28(3): 187-190.

295. Shewade, H. D., et al. “Effect of glycemic control and type of diabetes treatment on unsuccessful TB treatment outcomes among people with TB-Diabetes: A systematic review.” PLoS One 12(10): e0186697.

296. Siddiqui, A. N., et al. “Effect of Diabetes Mellitus on Tuberculosis Treatment Outcome and Adverse Reactions in Patients Receiving Directly Observed Treatment Strategy in India: A Prospective Study.” Biomed Res Int 2016: 7273935.

297. Siddiqui, A. N., et al. “Diabetes prevalence and its impact on health-related quality of life in tuberculosis patients.” Trop Med Int Health 22(11): 1394-1404.

298. Singh, S. P., et al. “Association of tuberculosis and diabetes Mellitus: an analysis of 1000 consecutively admitted cases in a tertiary care hospital of North India.” Pan Afr Med J 24: 4.

299. Stevenson, C. R., et al. (2007). “Diabetes and tuberculosis: the impact of the diabetes epidemic on tuberculosis incidence.” BMC Public Health 7: 234.

300. Subhash, H. S., et al. (2003). “Drug resistant tuberculosis in diabetes mellitus: a retrospective study from south India.” Trop Doct 33(3): 154-156.

301. Vaz, M. and S. M. Travasso “Perceptions of stigma among medical and nursing students and tuberculosis and diabetes patients at a teaching hospital in southern India.” Indian J Med Ethics 1(1): 8-16.

302. Viswanathan, A. A. and N. C. Gawde “Effect of type II diabetes mellitus on treatment outcomes of tuberculosis.” Lung India 31(3): 244-248.

303. Viswanathan, V., et al. “Prevalence of diabetes and pre-diabetes and associated risk factors among tuberculosis patients in India.” PLoS One 7(7): e41367.

304. Viswanathan, V., et al. “Effect of diabetes on treatment outcome of smear-positive pulmonary tuberculosis--a report from South India.” J Diabetes Complications 28(2): 162-165.

305. Zheng, C., et al. “Diabetes and pulmonary tuberculosis: a global overview with special focus on the situation in Asian countries with high TB-DM burden.” Glob Health Action 10(1): 1-11.

306. Dandona, R., et al. (2004). “Utilization of and barriers to public sector tuberculosis services in India.” Natl Med J India 17(6): 292-299.

307. Fathima, F. N., et al. “Assessment of ‘accredited social health activists’-a national community health volunteer scheme in Karnataka State, India.” J Health Popul Nutr 33(1): 137-145.

308. Kamineni, V. V., et al. “A rapid assessment and response approach to review and enhance advocacy, communication and social mobilisation for tuberculosis control in Odisha state, India.” BMC Public Health 11: 463.

309. Kapoor, S. K., et al. (1996). “Time utilisation pattern of staff of two primary health centres in Ballavgarh, Haryana.” Indian J Public Health 40(4): 112-119.

310. Kulkarni, P., et al. “Non-adherence of new pulmonary tuberculosis patients to anti-tuberculosis treatment.” Ann Med Health Sci Res 3(1): 67-74.

311. Singh, A. (1995). “Estimation of chronic disease load in a rural area of Haryana.” J Indian Med Assoc 93(7): 268-270.

312. Singh, V., et al. (2002). “TB control, poverty, and vulnerability in Delhi, India.” Trop Med Int Health 7(8): 693-700.

313. Banerjee, A., et al. (2004). “Acceptability of traditional healers as directly observed treatment providers in tuberculosis control in a tribal area of Andhra Pradesh, India.” Int J Tuberc Lung Dis 8(10): 1260-1265.

314. Banu Rekha, V. V., et al. (2009). “Contact screening and chemoprophylaxis in India’s Revised Tuberculosis Control Programme: a situational analysis.” Int J Tuberc Lung Dis 13(12): 1507-1512.

315. Christopher, D. J., et al. “Safety of the two-step tuberculin skin test in Indian health care workers.” Int J Mycobacteriol 3(4): 247-251.

316. Fochsen, G., et al. (2009). “Conflicting accountabilities: Doctor’s dilemma in TB control in rural India.” Health Policy 89(2): 160-167.

317. Gopinath, K. G., et al. (2004). “Tuberculosis among healthcare workers in a tertiary-care hospital in South India.” J Hosp Infect 57(4): 339-342.

318. Gupta, S., et al. “Role of risk factors and socio-economic status in pulmonary tuberculosis: a search for the root cause in patients in a tertiary care hospital, South India.” Trop Med Int Health 16(1): 74-78.

319. Janagond, A. B., et al. “Screening of health-care workers for latent tuberculosis infection in a Tertiary Care Hospital.” Int J Mycobacteriol 6(3): 253-257.

320. Jesudas, C. D. and B. Thangakunam "Tuberculosis risk in health care workers." Indian J Chest Dis Allied Sci 55(3): 149-154.

321. Joshi, R., et al. (2007). "Prevalence of abnormal radiological findings in health care workers with latent tuberculosis infection and correlations with T cell immune response." PLoS One 2(8): e805.

322. Khayyam, K. U., et al. "Tuberculosis among health care workers in a tertiary care institute for respiratory diseases in New Delhi." Indian J Tuberc 57(4): 192-198.

323. Kumar, B. A. "Rehabilitation of treated TB patients: Social, psychological and economic aspects." Int J Mycobacteriol 5 Suppl 1: S129-S130.

324. Mathew, A., et al. "Risk factors for tuberculosis among health care workers in South India: a nested case-control study." J Clin Epidemiol 66(1): 67-74.

325. McArthur, E., et al. "Socio-cultural and Knowledge-Based Barriers to Tuberculosis Diagnosis for Women in Bhopal, India." Indian J Community Med 41(1): 62-64.

326. Mhimbira, F. A., et al. "Interventions to increase tuberculosis case detection at primary healthcare or community-level services." Cochrane Database Syst Rev 11: CD011432.

327. Nair, V., et al. (2001). "Changing roles of grass-root level health workers in Kerala, India." Health Policy Plan 16(2): 171-179.

328. Pai, M., et al. (2005). "Mycobacterium tuberculosis infection in health care workers in rural India: comparison of a whole-blood interferon gamma assay with tuberculin skin testing." JAMA 293(22): 2746-2755.

329. Pai, M., et al. (2006). "Serial testing of health care workers for tuberculosis using interferon-gamma assay." Am J Respir Crit Care Med 174(3): 349-355.

330. Panda, R., et al. "Preparedness of frontline health workers for tobacco cessation: An exploratory study from two states of India." J Family Med Prim Care 4(3): 298-304.

331. Porter, J. D., et al. (2002). "Lessons in integration--operations research in an Indian leprosy NGO." Lepr Rev 73(2): 147-159.

332. Rakesh, P. S., et al. "Patients' perception towards directly observed treatment - A qualitative study from Kollam district, Kerala, southern India." Indian J Tuberc 64(2): 93-98.

333. Rekha, B., et al. "Improving screening and chemoprophylaxis among child contacts in India's RNTCP: a pilot study." Int J Tuberc Lung Dis 17(2): 163-168.

334. Thomas, B. E., et al. "Prevalence of chest symptoms amongst brick kiln migrant workers and care seeking behaviour: a study from South India." J Public Health (Oxf) 37(4): 590-596.

335. Zwerling, A., et al. “Trajectories of tuberculosis-specific interferon-gamma release assay responses among medical and nursing students in rural India.” J Epidemiol Glob Health 3(2): 105-117.

336. Areeshi, M. Y., et al. “Vitamin D Receptor ApaI (rs7975232) Polymorphism Confers Decreased Risk of Pulmonary Tuberculosis in Overall and African Population, but not in Asians: Evidence from a Meta-analysis.” Ann Clin Lab Sci 47(5): 628-637.

337. Bhargava, A., et al. “Nutritional status of adult patients with pulmonary tuberculosis in rural central India and its association with mortality.” PLoS One 8(10): e77979.

338. Bhaskaram, P., et al. (1992). “BCG vaccination in malnourished child population.” Indian Pediatr 29(1): 39-44.

339. Bhaskaram, P. and M. N. Sundaramma (1990). “Peripheral blood monocyte function in malnourished subjects with pulmonary tuberculosis.” Eur J Clin Nutr 44(3): 245-248.

340. Bhat, J., et al. “Investigation of the risk factors for pulmonary tuberculosis: A case-control study among Saharia tribe in Gwalior district, Madhya Pradesh, India.” Indian J Med Res 146(1): 97-104.

341. Bhat, P. G., et al. “Intensified tuberculosis case finding among malnourished children in nutritional rehabilitation centres of Karnataka, India: missed opportunities.” PLoS One 8(12): e84255.

342. Bose, K., Jr., et al. (2007). “Comparison of nutritional status between tuberculosis patients and controls: a study from north 24 parganas district in west bengal, India.” Malays J Nutr 13(2): 131-139.

343. Brinda, E. M., et al. “Nature and determinants of out-of-pocket health expenditure among older people in a rural Indian community.” Int Psychogeriatr 24(10): 1664-1673.

344. Chadha, V. K., et al. (2009). “Relationship of nutritional status with tuberculin sensitivity.” Indian J Pediatr 76(6): 605-607.

345. Chandrasekaran, P., et al. “Malnutrition: Modulator of Immune Responses in Tuberculosis.” Front Immunol 8: 1316.

346. Das, B. S., et al. (2003). “Effect of iron supplementation on mild to moderate anaemia in pulmonary tuberculosis.” Br J Nutr 90(3): 541-550.

347. Dye, C., et al. “Nutrition, diabetes and tuberculosis in the epidemiological transition.” PLoS One 6(6): e21161.

348. Gupta, K. B., et al. (2009). “Tuberculosis and nutrition.” Lung India 26(1): 9-16.

349. Gupta, S., et al. “A sociodemographic study of multidrug resistant tuberculosis cases from DOTS clinics of Kolkata.” J Indian Med Assoc 110(10): 723-725.

350. Hemanth Kumar, A. K., et al. (2009). “Pharmacokinetics of lamivudine & stavudine in generic fixed-dose combinations in HIV-1 infected adults in India.” Indian J Med Res 130(4): 451-457.

351. Jain, Y., et al. “Burden & pattern of illnesses among the tribal communities in central India : A report from a community health programme.” Indian J Med Res 141(5): 663-672.

352. Jenum, S., et al. “Influence of age and nutritional status on the performance of the tuberculin skin test and QuantiFERON-TB gold in-tube in young children evaluated for tuberculosis in Southern India.” Pediatr Infect Dis J 33(10): e260-269.

353. Kant, S., et al. “Significance of nutrition in pulmonary tuberculosis.” Crit Rev Food Sci Nutr 55(7): 955-963.

354. Kashyap, R. S., et al. “Impact of socioeconomic status and living condition on latent tuberculosis diagnosis among the tribal population of Melghat: A cohort study.” Lung India 33(4): 372-380.

356. Lodha, R., et al. “Effect of micronutrient supplementation on treatment outcomes in children with intrathoracic tuberculosis: a randomized controlled trial.” Am J Clin Nutr 100(5): 1287-1297.

357. Mahadevan, B., et al. (2005). “Tuberculin reactivity in tuberculous meningitis.” Indian J Pediatr 72(3): 213-215.

358. Mandal, A., et al. “Presenting experience of managing abdominal tuberculosis at a tertiary care hospital in India.” J Glob Infect Dis 3(4): 344-347.

359. Medhi, G. K., et al. (2006). “Study of health problems and nutritional status of tea garden population of Assam.” Indian J Med Sci 60(12): 496-505.

360. Naik, A. L., et al. “Effect of DOTS Treatment on Vitamin D Levels in Pulmonary Tuberculosis.” J Clin Diagn Res 11(4): BC18-BC22.

361. Oxlade, O., et al. “Estimating the Impact of Reducing Under-Nutrition on the Tuberculosis Epidemic in the Central Eastern States of India: A Dynamic Modeling Study.” PLoS One 10(6): e0128187.

362. Padmapriyadarsini, C., et al. “Undernutrition & tuberculosis in India: Situation analysis & the way forward.” Indian J Med Res 144(1): 11-20.

363. Pathak, R. R., et al. “Can Intensified Tuberculosis Case Finding Efforts at Nutrition Rehabilitation Centers Lead to Pediatric Case Detection in Bihar, India?” J Tuberc Res 4(1): 46-54.

364. Pednekar, M. S., et al. (2008). “Association of body mass index with all-cause and cause-specific mortality: findings from a prospective cohort study in Mumbai (Bombay), India.” Int J Epidemiol 37(3): 524-535.

365. Prasad, B. M., et al. “Status of Tuberculosis services in Indian Prisons.” Int J Infect Dis 56: 117-121.

366. Prince, L., et al. “Risk of self-reported symptoms or diagnosis of active tuberculosis in relationship to low body mass index, diabetes and their co-occurrence.” Trop Med Int Health 21(10): 1272-1281.

367. Ramachandran, G., et al. “Age, nutritional status and INH acetylator status affect pharmacokinetics of anti-tuberculosis drugs in children.” Int J Tuberc Lung Dis 17(6): 800-806.

368. Ramachandran, G., et al. (2004). “Vitamin A levels in sputum-positive pulmonary tuberculosis patients in comparison with household contacts and healthy ‘normals’.” Int J Tuberc Lung Dis 8(9): 1130-1133.

369. Ray, M., et al. (1998). “Plasma zinc status in Indian childhood tuberculosis: impact of antituberculosis therapy.” Int J Tuberc Lung Dis 2(9): 719-725.

370. Roy, V., et al. “Pharmacokinetics of isoniazid in moderately malnourished children with tuberculosis.” Int J Tuberc Lung Dis 14(3): 374-376.

371.

372. Shetty, N., et al. (2006). “An epidemiological evaluation of risk factors for tuberculosis in South India: a matched case control study.” Int J Tuberc Lung Dis 10(1): 80-86.

373. Singla, R., et al. “Evaluation of risk factors for antituberculosis treatment induced hepatotoxicity.” Indian J Med Res 132: 81-86.

374. Sudarsanam, T. D., et al. “Pilot randomized trial of nutritional supplementation in patients with tuberculosis and HIV-tuberculosis coinfection receiving directly observed short-course chemotherapy for tuberculosis.” Trop Med Int Health 16(6): 699-706.

375. Udani, P. M. (1994). “BCG vaccination in India and tuberculosis in children: newer facets.” Indian J Pediatr 61(5): 451-462.

376. Vijayakumar, M., et al. (1990). “Malnutrition and childhood tuberculosis.” J Trop Pediatr 36(6): 294-298.

The Data for Action Framework for Tuberculosis Key and Vulnerable Populations is one of three tools that forms part of the Communities, Rights and Gender Assessments. This report presents the findings of a rapid assessment conducted in India in 2018, with a focus on five key populations and their access to TB care services. The report brings together available information about TB among key populations in India through a rigorous review of literature and interviews with stakeholders. The report summarizes the perspectives of both service providers and key populations and identifies the challenges in ensuring their equitable access to TB services.

**RESOURCE GROUP FOR EDUCATION AND ADVOCACY FOR COMMUNITY HEALTH**
194, First Floor, Avvai Shanmugam Salai Lane, Off Lloyds Road, Royapettah, Chennai 600014, India
Phone: 044-65211047 / 28132099 | Email: reach4tb@gmail.com
Website: www.reachtbnetwork.org | Facebook: @speakTB | Twitter: @speakTB

compuprint.in