Prevalence of pulmonary tuberculosis amongst the tribal population of Madhya Pradesh, central India

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Background This was a prevalence survey of pulmonary tuberculosis (PTB) disease in the tribal population of Madhya Pradesh state, central India.

Methods A community-based cross-sectional tuberculosis (TB) disease prevalence survey was undertaken among adults aged ≥15 years in the tribal population of Madhya Pradesh. A multistage stratified cluster sampling was adopted. A representative random sample of villages predominated by tribal populations was selected from 11 districts. All eligible individuals were questioned for chest symptoms relating to TB. Sputum samples were collected from all eligible individuals, transported to the laboratory, and examined by Ziehl–Neelsen (ZN) smear microscopy and solid media culture methods.

Results Of the 23,411 individuals eligible for screening, 22,270 (95.1%) were screened for symptoms. The overall proportion of symptomatic individuals was 7.9%. Overall prevalence (culture and/or smear positive) of PTB was 387 [95% confidence interval (CI): 273–502] per 100,000 population. 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).

Conclusion The findings suggest that the TB situation amongst the tribal population is not that different from the situation among the non-tribal population in the country. However, 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.

Keywords Tuberculosis, tribal, central India

Introduction Tuberculosis (TB) continues to be a major public health problem in India, with over 1.9 million new cases annually, making it the highest TB burden country in the world. It accounts for one-fifth of the world’s new TB cases, and two-thirds of the cases in the Southeast Asia region. India is a vast country inhabited by diverse groups of people, with a
wide variety of socio-cultural backgrounds. The tribal population is one such group of people who share common cultural and socio-religious beliefs, and reside in particular discrete geographic areas. Their cultural and socio-religious beliefs are quite different from the wider general population. They are an underprivileged group of society, often having poor access to the health-care delivery systems.

Prevalence of TB disease is an important epidemiological index to measure the burden of the disease in a community. Epidemiological information on TB is also vital for the planning of control strategies and service delivery systems. A nation-wide disease survey conducted by the Indian Council of Medical Research (ICMR) in 1955–58 provided, for the first time, information on the TB disease situation in the general population of the country. Information on the TB situation in the tribal populations of India is limited to a few studies carried out in small populations scattered across the country.

The tribal population accounts for ~25% of the population of the central Indian state of Madhya Pradesh (MP). Except for a study in the Saharia tribal community in a small pocket of the state, there is no information on the prevalence of TB disease amongst the state’s tribal population. Though the Revised National Tuberculosis Control Programme (RNTCP), based on the Directly Observed Treatment Short Course (DOTS) strategy, was launched in India as a national programme in 1997, it was only implemented from 2004 in the survey area. In view of these, the present study was undertaken in the tribal population of the state to estimate the prevalence of pulmonary TB (PTB) disease.

Materials and methods

Study area

The study was conducted amongst the tribal population of MP from July 2007 to February 2008. Many of the tribal areas are far in the interior jungles, with poor connectivity by road: the terrain is difficult, and many areas become inaccessible during the rainy season. A random sample of 11 districts was selected using probability proportional to the population of the districts.

Sampling

In deciding on an appropriate sample size for the survey, there is a need to strike a balance between precision of the estimate and the costs involved in the survey. The precision of the estimates made from the survey depends on the size of the sample and the amount of clustering. Adapting a cluster sampling, the costs of the survey could considerably be reduced. When cluster sampling is performed, the sample size calculated from binomial equation needs to be multiplied by a factor called clustering coefficient, or design effect. Thus, the required sample size was estimated to be about 20,000 adults aged ≥15 years for an assumed prevalence of 1270/100,000 bacteriologically (culture and/or smear) positive PTB cases, with a precision of 20% at a 95% confidence level [confidence interval (CI)], a design effect of 2 for cluster sampling and coverage for examination of ≥90%. A multi-stage cluster sampling was adopted for the survey. At the first stage, 25% of the districts in the state were selected by systematic sampling after arranging all the districts in ascending order of tribal population. In the second stage, 25% blocks (at least one block) were selected randomly from each selected district and the required number of villages (a village is considered as a sampling unit for the survey), were selected randomly from these blocks using probability proportional to the size of each block in each selected district.

Census

Planning visits were made to the villages prior to the survey to inform village leaders regarding the purpose of the survey. Group meetings were also conducted to explain the purpose of the study to the community and to seek their co-operation. A complete census of the selected villages was done by house-to-house visits, and all individuals in the household were registered. Relevant data were collected on an individual card in a pre-coded form by trained investigators who were trained in survey methodology at the Tuberculosis Research Centre (TRC), Chennai. TRC is a premier research institute of India devoted to research in various aspects of TB, and a WHO Collaborating Centre. Informed consent was obtained from all individuals included in the survey.

Symptom screening and sputum collection

All individuals aged ≥15 years were questioned for chest symptoms relating to TB, namely: persistent cough for ≥2 weeks; chest pain for ≥1 month; fever for ≥1 month; and haemoptysis. Persons with any of these symptoms (‘chest symptomatic persons’) were considered eligible for sputum collection. Persons with a previous history of anti-TB treatment were also considered eligible for sputum collection. Two sputum samples (of ≥2 ml each)—one spot and one overnight—were collected from all eligible individuals in sterilized McCartney’s bottles.

Sample storage and transportation

Portable refrigerators were carried to the field. The samples were stored in the refrigerator in the field and were transported to the laboratory maintaining a cold chain. They were kept at +4°C in the laboratory until processing was done.
Processing of sputum specimens
Direct smears were made from both sputum specimens. The smears were stained by the Ziehl–Neelsen (ZN) method and were examined for acid fast bacilli. In addition, all positive smears and 20% random sample of negatives were read once again for quality check. All the specimens were also processed for culture by modified Petroff’s method and were examined for growth of *Mycobacterium tuberculosis* once a week for 8 weeks. Niacin test and growth on para-nitrobenzoic acid was done to confirm the growth of *M. tuberculosis*.9

Case definition
A PTB case was defined as an individual whose sputum was positive for acid fast bacilli by ZN microscopy and/or growth of *M. tuberculosis* by culture examination.10

Treatment
All bacteriologically positive cases were referred to the concerned health authorities for anti-TB treatment under the RNTCP using standardized DOTS regimens.11

Estimation of prevalence of TB
If *X* is the number of eligible persons, *x* is the number screened for symptoms, *S* is the number eligible for sputum collection, *s* is the number with sputum collection and *f* is the number of positives (smear and/or culture), the total number of positives is estimated as *(f/s)/(S/x) X = p* adjusting for non-coverage, i.e. assuming that the findings in those examined would be same as in those not examined. The prevalence was estimated as the ratio *p/X* expressed per 100 000 population.

Statistical analysis
The data was computerized, edited and corrected for mistakes, if any, and analysed using SPSS package (13.0 version). Linear trend in proportions was tested for significance using trend Chi-square. The Chi-squared test of significance was applied to the difference in proportions of symptomatic individuals and cases among different classifications. The 95% CIs were estimated using the appropriate cluster sampling formula for the variance of the prevalence estimate. A *P*-value of <0.05 was considered to be statistically significant.

Results
The distribution of the 11 districts included in the survey by population, geography, number of villages selected and the population covered for the survey is presented in Table 1.

Coverage
Of the 23 411 individuals eligible for screening, 22 270 (95.1%) were screened for symptoms. Of these, 1770 (7.9%) were found to be symptomatic. Sputum was collected from 1703 (96.2%) symptomatic individuals who were eligible for sputum collection. Thus, the coverage for symptom elicitation and sputum collection were both >95%.

Distribution of symptomatic persons
The proportion of males eligible for sputum collection was higher (9.1%) than that of females (6.9%) (Table 2), and the difference was statistically significant (*P* < 0.001). The proportion of symptomatic individuals eligible for sputum collection increased from 3.7% in the 15- to 24-year age group to 14.3%
in the 55+ year age group. The increase in trend was statistically significant (P < 0.001) (Table 3).

**Prevalence of bacillary TB**

Overall prevalence (culture and/or smear) was found to be 387 (95% CI: 273–502) per 100,000. The prevalence of bacillary TB was more than double (P < 0.001) amongst males (554/100,000; 95% CI: 415–693) than females (233/100,000; 95% CI: 101–364) (Table 2). The prevalence increased with age being 174/100,000 (95% CI: 33–315) in the 15- to 24-year age group to 990/100,000 (95% CI: 589–1391) in the 55+ year age group (Table 3 and Figure 1). The increase in trend with age was statistically significant (P < 0.001). The overall prevalence of smear-positive PTB cases, irrespective of culture result, was 294 per 100,000 (95% CI: 155–433). The prevalence of culture-positive PTB cases, irrespective of smear result, was estimated as 322 per 100,000 (95% CI: 226–418).

**Discussion**

The present study is the first TB prevalence survey amongst the tribal population from across the state of MP in central India. The results provide vital information on the TB disease situation amongst this population and can serve as baseline data for future evaluation of the impact of disease control measures and epidemiological trends.

TB prevalence surveys have been carried out in different parts of the country, mostly in the general population (non-tribal)\textsuperscript{3,12–14} and in few isolated tribal
Prevalence in the general population ranged from 144 per 100,000 in Wardha district, Maharashtra State, up to 1070 per 100,000 in Raichur district, Karnataka. From the limited studies in tribal populations, again, a wide variation of prevalence rates was reported, ranging from 133 per 100,000 amongst the tribal population in Wardha district, Maharashtra, to 1270 per 100,000 amongst the Saharias, a primitive tribe of MP. However, it needs to be noted that many of these studies were conducted decades ago before the implementation of DOTS under RNTCP. In a recent study (2004–06) by TRC, Chennai, the prevalence of culture and smear-positive PTB were found to be 311 and 169 per 100,000 respectively, in Thiruvallur district in the southern Indian state of Tamil Nadu.

The results of the present study indicate that the TB situation amongst the tribal population of this central Indian state is not that different from the situation among non-tribal population as observed in other studies. The finding that the prevalence increased with age and is higher in males than females is consistent with the findings of majority of other studies. However, despite the fact that the finding suggests that the TB situation amongst the tribal population in MP is comparable with that of the non-tribal population in the country, TB remains a major health problem amongst this tribal population. This situation could change for the worse if appropriate TB control measures are not taken in a timely manner. At present, this population generally lives in inaccessible areas, with poor access to the health delivery system. This population is, however, in a transition phase from their previous primitive way of life to a more modern lifestyle resulting in drastic changes in various aspects of their life, including economic activities. If this change does not go hand-in-hand with improved health-care delivery and status, diseases such as TB could increase due to various factors such as increased exposure due to migration to crowded cities, increase in use of tobacco and alcohol, etc.

The earlier National TB Programme was implemented in 1962; however, its performance was far below expectation and requirement. This may well have had particular relevance in respect to the tribal populations considering the difficult terrain in which they live, resulting in irregular drug supply and poor supervision by programme officials. When effectively implemented over a number of years, the RNTCP has been shown to result in a significant decrease in the prevalence of TB disease, as demonstrated by the studies by the TRC in Thiruvallur district. However, the RNTCP was only implemented during 2003–04 in the majority of the study districts. In view of this recent implementation, it is unlikely that the TB prevalence in the community has as yet been affected by the RNTCP. The RNTCP 2009 report shows a high treatment success rate of 86% in the state for the 2007 new smear-positive PTB patient cohort (ranging from 69 to 93% in the districts). However, the 2008 case detection rate (54%) is far below the expected 70% of estimated expected cases (district ranges from 30 to 108%). The programme performance in the state has, however, been seen to gradually improve since implementation with an increase in the case detection rate from 42% in 2001 to 54% in 2008 and in the treatment success rate from 83% in 2001 to 86% in 2007. Continued implementation of quality services under RNTCP, using the DOTS

### Table 4 Prevalence of TB in different parts of the country

<table>
<thead>
<tr>
<th>Population</th>
<th>Author and year</th>
<th>Area/state</th>
<th>TB prevalence per 100,000</th>
<th>References</th>
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<td>Wardha district, Maharashtra</td>
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<td></td>
<td>Datta M et al., 2000</td>
<td>North Arcot District, Tamil Nadu, South India</td>
<td>800</td>
<td>14</td>
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strategy, however, raises the hope of an impact on the TB situation in this population and area after a number of years.

**Conclusion**

The study results provide vital information on the TB disease situation amongst the tribal population of central India, and can serve as baseline data for future evaluation of the impact of disease control measures and epidemiological trends. The findings suggest that the TB situation amongst the tribal population is not that different from the situation among non-tribal population in the country. However, 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.

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**Conflict of interest:** None declared.

**References**


