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Annual Risk of Tuberculous Infection in Rural Areas of Junagadh District

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ABSTRACT

Paucity of epidemiological data on tuberculosis in India prompted the National Tuberculosis Institute, Bangalore to embark upon a nation-wide survey to estimate the Annual Risk of Tuberculosis Infection in different parts of the country. The survey in Junagadh district, one of the 26 districts drafted under the nation-wide survey is reported here.

The prevalence of infection from the analysis of 3164 children not displaying scars of the BCG vaccination was 4.16 % (CI : 3.17-5.14) and from this data the ARI was computed as 0.73% (CI: 0.55-0.91). The inclusion of vaccinated children into the study group yielded similar results. The estimate of the ARI in Junagadh district is lesser than that in several other parts of India which is probably in consonance with its better socio-economic development.

INTRODUCTION

Accounting for about a death every minute, tuberculosis (TB) continues to ravage India, which shoulders about a third of the global burden of the disease.[1] Epidemiological indicators for tuberculosis are necessary in developing countries like India, which lack an efficient health information system. The knowledge of the magnitude of the burden of TB in the community will help public health planners in drafting appropriate control measures. As TB disease surveys are prohibitively expensive and TB infection far more prevalent than the disease, prevalence of infection and Annual Risk of Infection (ARI) are the preferred epidemiological indicators for assessing the situation of TB in the community.[2] These parameters are computed from the data obtained from tuberculin surveys in a representative sample of young children because infection with environmental mycobacteria is less common in them and the infection in children is a good indicator of recent levels of transmission of infection. The ARI indicates the average probability of an uninfected person getting infected or re-infected with *Mycobacterium tuberculosis* during the course of one year. It is the earliest epidemiological parameter to be affected

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following any alteration in the TB situation in the community induced by changes in the load of infectious cases and the efficacy of TB control measures.

However, there is a dearth of epidemiological data on tuberculosis in our country. Also, most of the community surveys in TB have been restricted to pockets in southern parts of India. Paucity of epidemiological data on TB prompted the National Tuberculosis Institute, Bangalore to initiate upon a nation-wide survey to estimate the Annual Risk of Tuberculosis Infection in different parts of the country. The survey is unique as it is the first time that the prevalence and Annual Risk of TB Infection would be estimated on a national scale, though the survey on the prevalence of TB disease conducted by Indian Council of Medical Research (ICMR) between 1955 and 58[3] did provide an insight into the enormity of suffering caused by TB.

The nation-wide survey to estimate the annual risk of tuberculosis infection would provide baseline data on the epidemiological status of the prevalence of infection and ARI on a nationwide basis. This paper reports on the survey conducted in rural areas of Junagadh district, one of the 26 districts selected for the National Sample Survey. No noteworthy tuberculin survey in the community had been carried out in Junagadh district earlier.

MATERIALS AND METHODS

Study area: From an operational perspective, India was divided into four geographical zones - North, East, South and West having roughly equitable populations as per 1991 census data. From each zone, 6 districts were selected for the survey by systematic random sampling. Junagadh, a dry and and arid district situated in the Saurashtra region of Gujarat was one of the six districts selected for the survey in west zone (Map 1). The field work in the rural areas of Junagadh district was conducted in 80 clusters selected by the Probability Proportion to Size (PPS) method. A cluster in a rural area constituted a village. The rural clusters selected for the survey were situated in the tehsils of Bhesan, Goladhar, Manavadhar, Mendarda, Visavadhar, Vanthali, Keshod, Malia, Mangrol, Veraval, Kutiyana, Porbander, Ranavav, Talala and Una (Map 2).

Study population and field procedures: The field work was carried out between 1st February, 2000 and 6th June, 2000. In each cluster, 85 children, 19 years of ages were registered for tuberculin testing and reading by a team of health staff who had undergone exhaustive training in conducting tuberculin surveys. The first step in the field work was to solicit community participation. To achieve this, the services of the local health authorities, including grassroots level health workers, were enlisted.

The survey team registered children for the study from the first house located in the lane selected randomly from a rough sketch of the village being surveyed. The age of the children eligible for the study was ascertained by asking the parents about the age of their child and in the event of doubt, substantiated by their birth certificate or immunization card. The tuberculin belonged to a single batch of 1 TU PPD-RT23 with Tween 80 procured from BCG Laboratory, Guindy. A written consent was obtained from the parents or guardians of the children before subjecting them to the tuberculin testing.

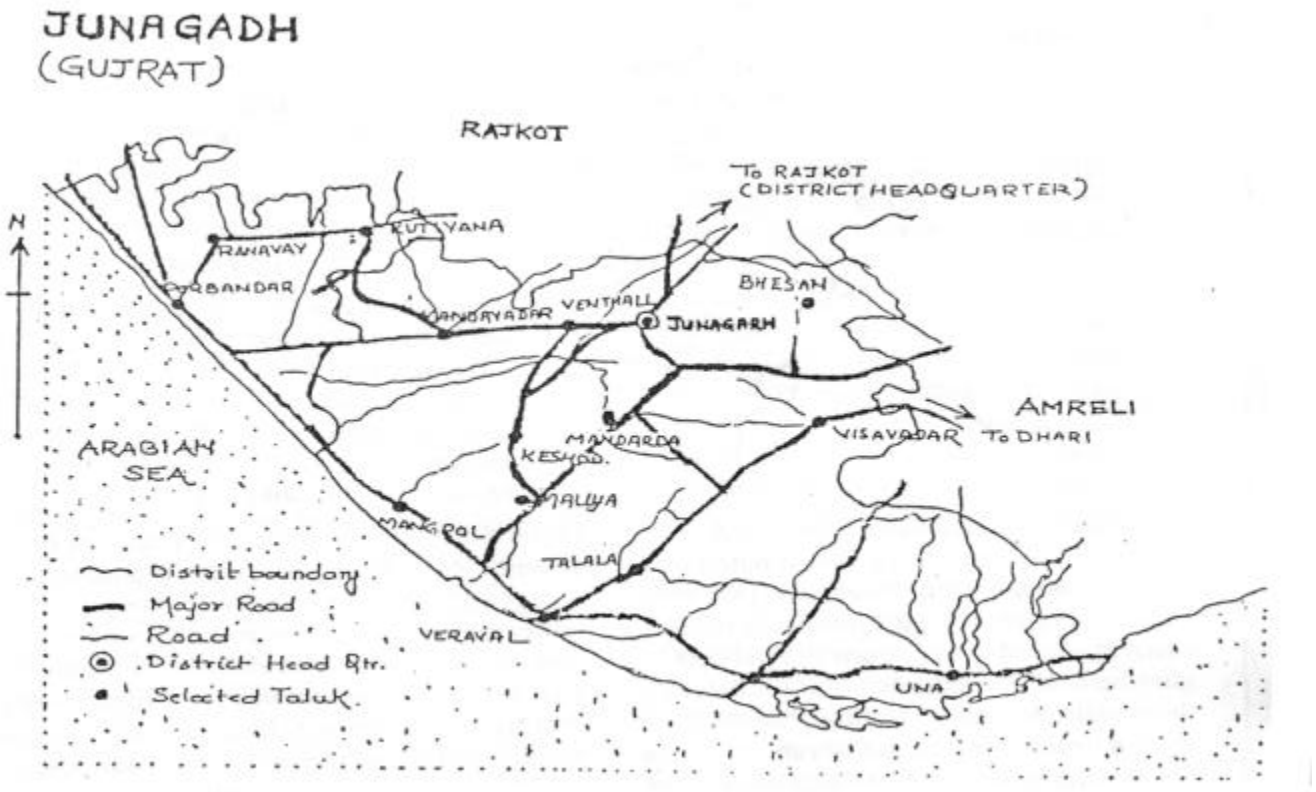
Map 1 : Showing the location of study area in Gujarat

The children were administered 0. 1 ml of tuberculin on the volar aspect of the left forearm. The tuberculin tester was assisted by a secretary who recorded the BCG vaccination status of the children based upon the presence or absence of a scar with hypo pigmented glossy appearance on the deltoid region of either of the arms. The reader, however, was unaware of the scar status to eliminate any bias. The tuberculin reading was uniformly performed 72 hours after the administration of the tuberculin test. The reader recorded the maximum transverse diameter of the indurations. As a community service, children having large or unpleasant reactions were referred

to the neighboring Primary Health Institutions (PHI) for screening for TB disease and all facilities for treatment were made available to the study subjects.

Statistical methods : The prevalence of infection is denoted by the proportion of children infected with the tubercle bacillus. The proportion of the infected children was estimated from the histogram of tuberculin reaction sizes on the premise that the anti-mode differentiates reactions due to true infection with tubercle bacilli from those attributable to non-specific sensitivity or insignificant reaction.[4] Children having reaction sizes equal to or more than the anti-mode were considered to be infected. The prevalence of infection was calculated from the average proportion of the infected children in the 80 clusters selected for the survey in the district and can mathematically be expressed as

Map 2 : Study area of Junagadh in Gujarat State.



p = Ópi/C where p denotes the prevalence of infection, pi the prevalence of infection in the cluster and c the total number of clusters.

The ARI was derived from the estimated prevalence of infection from the equation,[5] $ARI=I-(I-p)^{1/2}$, where the prevalence of infection is denoted by 'P', and the mean age of the cohort by 'a', which was 5.6 years for this study group.

Chi-square ($\div^2$) test with continuity correction was used to test the significance of differences between proportions and P-values of <0.05 were considered significant. The Confidence Intervals (C.I) of 95% were calculated in accordance to the sample design. The data were analysed using SPSS software.

RESULTS

Registered population and BCG scar status: A total of 8,127 children, 1-9 years of age were registered for the study from 7,150 households located in 80 villages drafted for the survey. Among these 6,250 (77%) children were test-read successfully. The BCG scar was perceived in 2994 (47.9%) of children while 3164 (50.60%) had no scar and 92 (1.5%) had doubtful scars as depicted in the chart (Fig 1).

Analysis for the unvaccinated group: The primary analysis was confined to data from 3,164 unvaccinated children after excluding those in whom the test was not performed satisfactorily, the absentees during reading and those having doubtful BCG scars. The frequency distribution of the reaction sizes was bimodal with an antimode at 16 mm (Fig 2). Children having reaction sizes of 16 mm or more were considered to be infected. The prevalence of infection was estimated to be 4.16 (CI:3.17-5.14) and the ARI was computed as 0.73 (CI:0.55-0.9-1).

Analysis for the vaccinated group: The data pertaining to 2994 vaccinated children was also analysed separately. The frequency distribution obtained from tuberculin reaction sizes of the vaccinated children did not reveal an anti-mode. However, the definition of infection of 16 mm, as observed for the unvaccinated group was applied to the vaccinated group. Subsequently the prevalence of infection and the ARI for the vaccinated group was estimated. There was no significant difference (p at 5% level) in the prevalence of infection and the ARI between the vaccinated and unvaccinated groups (Table 2).

Analysis for all children irrespective of vaccination status: As there was no statistical difference in the prevalence of infection and ARI among the unvaccinated and vaccinated groups, the data from all the 6250 test read children irrespective of their BCG scar status were analysed. The frequency distribution of reaction sizes, irrespective of the BCG scar status, revealed the bimodal distribution with the anti-mode at 16 mm (fig 3). The prevalence of infection was estimated to be 4.76 (CI: 3.70-5.83) and the ARI 0.87 (CI:0. 67-1.07)

DISCUSSION

The ARI in the rural areas of Junagadh district obtained from the primary analysis among the

Fig 1 : STUDY POPULATION

Rural Junagadh

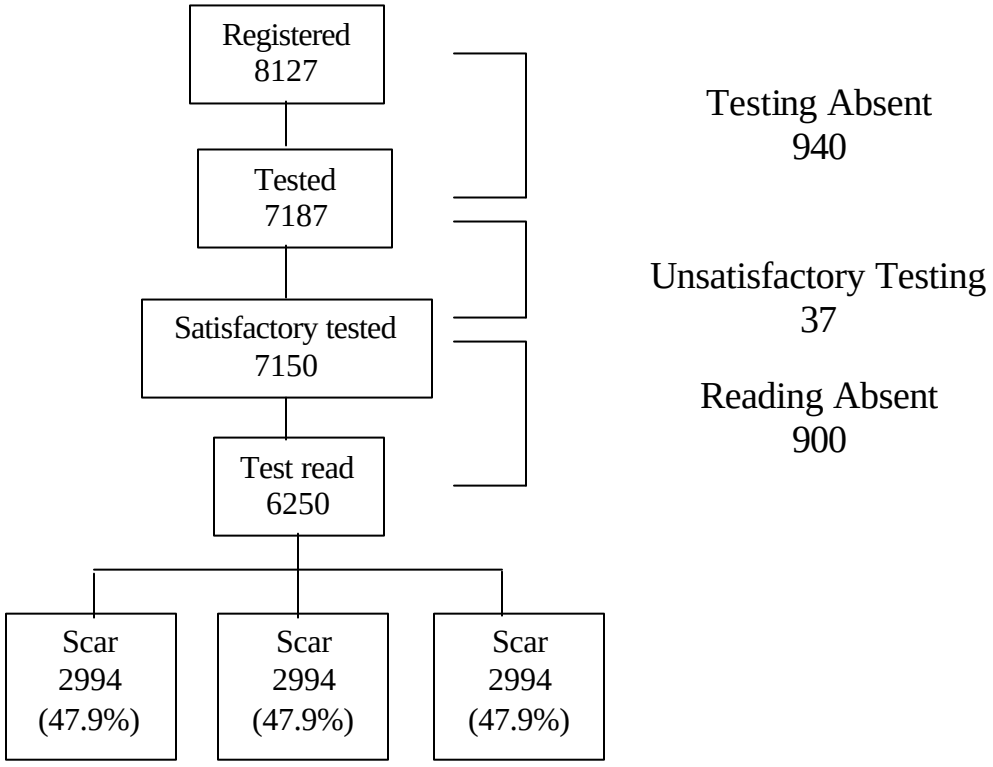


Table 1 : Comparison of Prevalence of Infection between unvaccinated and Vaccinated children and computed ARI

	*** BCG -**	****BCG +**
No. Examined	3164	2994
No. Infected	144	149
Prevalence	4.16	5.42
ARI	0.73	0.87

P=0.433 (P>0.05)

* Without BCG Scar

** With BCG Scar

vaccinated children was 0.7%, which is lesser than the national average, which is expected to be between 1.5% and 2.0%.[6-11] Junagadh district has a population of 2.9 million, with a population growth rate of 1.7% in the last decade as compared to the national average of 2.13%.[12] The literacy rate of the district is 70%[13] and the population density of the district is 277 persons per square kilometre[12] compared to the national average of 65%[14] and 324[12] respectively. The infant mortality rate in Gujarat was 62/1000[15] live births while the national average was 71.11 The survey team observed that the family sizes in the district were smaller, the houses more spacious, and the children appeared to be better nourished compared to those in several other districts drafted for the survey. The low ARI of Junagadh district is probably in consonance with its better socioeconomic development lending credence to the fact that the problem of TB diminishes with improved socioeconomic conditions.

With the increase in vaccination coverage, studies in the future that exclude vaccinated children from epidemiological surveys may not reflect a representative sample. The necessity and feasibility of including vaccinated children for estimation of the ARI has been elucidated in earlier studies conducted by the National Tuberculosis Institute, Bangalore.[11,17,18] The results from this study also establish the feasibility of including BCG vaccinated children for the estimation of the ARI. The ARI in unvaccinated children is not different from the combined group consisting of vaccinated and unvaccinated children.

An important aspect of this survey has been the maintenance of high levels of quality assurance of the field work despite hostile weather conditions. There was strict adherence to the work instructions, storage of tuberculin between 4- 8 ^{O}C, uniform reading of reaction sizes after 72 hours and the constant supervision of the testing and reading of reactions by experienced team leaders. To ensure precision, only a single reader was assigned to read the reaction sizes in all the clusters. The data for analysis were verified at the headquarters by double entry. As the east-west span of the district was vast, the survey team had to change camp on three occasions to facilitate travel. It is worthwhile to mention that Junagadh was reeling under severe drought at that point of time and the availability of water for the survey team members also dictated the choice of camp sites.

After the completion of the nationwide survey to estimate the annual risk of tuberculosis infection, we would have a better knowledge of the magnitude of the TB problem in the country as a whole. The extent of the scourge wrought by TB depends upon the efficacy of the interventional strategies to control it. The effective implementation of the Revised National Tuberculosis Control Programme (RNTCP) in Junagadh district is expected to further reduce the burden of tuberculosis there in the course of time.

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Fig 2: Frequency of tuberculin reaction sizes among unvaccinated children in the age group 1-9 years (N=3164)

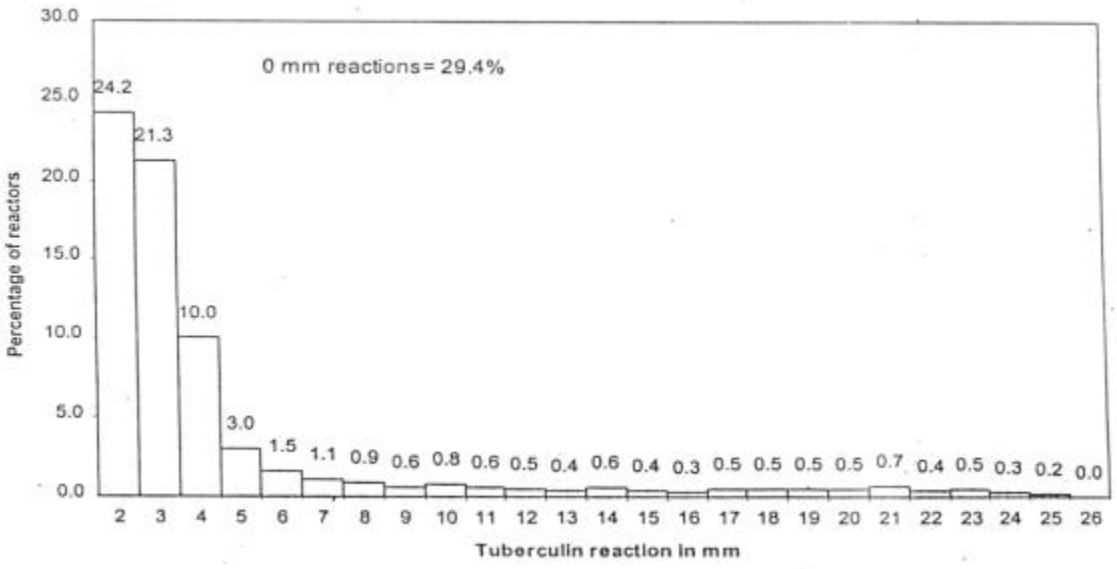
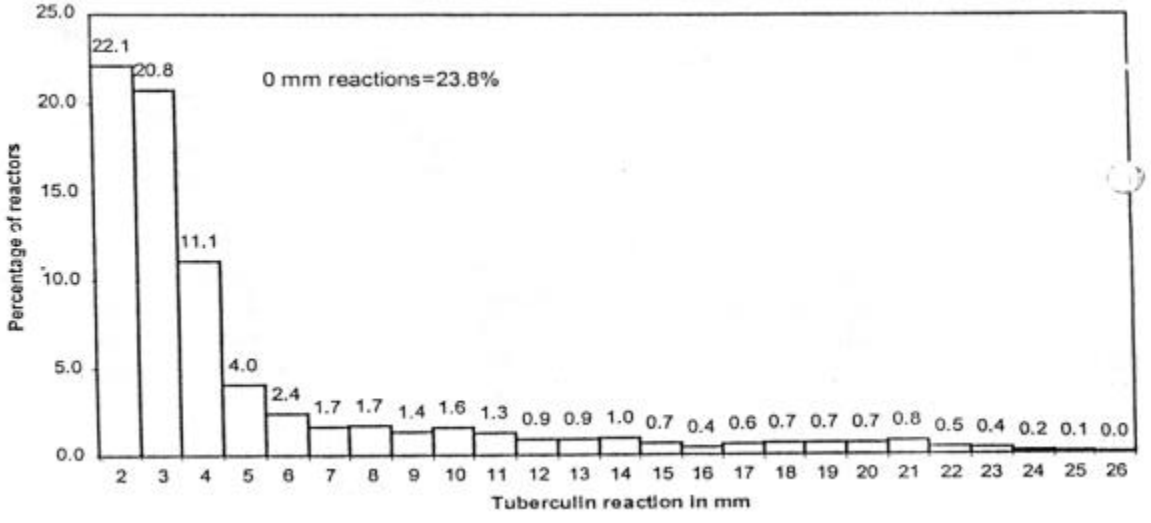


Fig 3: Frequency distribution of tuberculin reaction sizes in 1-9 years age group irrespective of BCG scar status (N=6250)



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