Prevalence and Annual risk of Tuberculous infection among inmates (0-17 years) residing in orphanages of Bangaluru city

R Srivastav[1], S Singh[1],VK Chadha[2], R Jitendra[3], J Gupta[1], J Ahmed[1], G Umadevi[1], P Suganthi[4], Laksminarayana[4], V Magesh[4].

Summary

A tuberculin survey was carried out during 2006 among 1267 inmates (0-17 years of age) residing in 19 selected orphanages in Bangaluru city. Using an anti-mode at 14 mm identified on the frequency distribution of reaction sizes, prevalence of infection was estimated at 15.3%. Using mirror-image technique with the mode at 20mm, the prevalence of infection was estimated at 11.8%. The results suggest the need to undertake measures to reduce transmission of infection in the orphanages.

Keywords: Tuberculosis, Infection, Prevalence, Annual Risk

Introduction

Tuberculosis (TB) continues to be a major public health problem in India with an estimated 1.9 million new cases and 280 000 deaths every year[1]. About 40% of the population in the country is estimated to be already infected with *Mycobacterium tuberculosis (M. tuberculosis)*. The community based zonal level tuberculin surveys during 2000-2003 revealed that on an average about 1500 children per 100 000 children in the country get newly infected with *M. tuberculosis* each year[2]. The lifetime risk of developing TB among such infected children is about 10%[3].

In India, a large number of children get orphaned each year due to the loss of parents. It is estimated that there were about 25.7 million orphans living in the country in the year 2005[4]. A proportion of these orphans get rehabilitated in about 700 orphanages spread across the country providing care and shelter to varying numbers of children and adolescents[5]. It is likely that a high proportion of children living in such institutions get infected with *M. tuberculosis*, due to poorer living conditions and over-crowding. However, there is no information available on this aspect. Therefore, a survey was carried out during the year 2006 among orphans residing in a sample of orphanages in Bangalore city to find out the prevalence of tuberculous infection among them.

MATERIAL AND METHODS

The study was carried out among children and adolescents, 0-17 years of age in 19 orphanages coming under the jurisdiction of Bangaluru Mahanagar palika (BMP). There are about 100

[1]Field Investigator, [2]Senior Epidemiologist, [3]Statiscal assistant, [4]Investigator
Address for correspondences: VK Chadha, Sr. Epidemiologist, National Tuberculosis Institute, No.8 Bellary Road, Bangaluru-560003, Karnataka, India. Phone: 080-23441192, E-mail: vineet2.chadha@gmail.com

orphanages located in the city[6]. The orphanages for this study were purposively selected on the basis of willingness of the authorities to participate.

The age at last birthday, sex and BCG scar status of each eligible individual person was recorded. Each inmate was administrated 0.1 ml of tuberculin test containing 1TU of PPD RT23 with Tween 80 on the mid volar aspect of the left forearm, using a disposable tuberculin syringe and needle. A test was recorded as satisfactory if it raised a pea-sized wheal with steep border and clear pits and as unsatisfactory if there was leakage or administered sub-cutaneously. The tuberculin vials were obtained from Statens Serum Institute (SSI), Copenhagen and cold chain was meticulously maintained. The readings of reaction were done at about 72 hours after the tuberculin test and the maximum transverse diameter of induration was recorded in millimeters using palpation method.

The inmates having reactions ≥15 mm with either a history of contact with a TB case or symptoms suggestive of TB were referred to the nearest Government health center for further investigations and treatment, if required.

The tuberculin testing and reading was performed by personnel of National Tuberculosis Institute, Bangalore having vast experience.

Statistical Methods

The frequency distribution of reaction sizes was plotted to identify the anti-mode and mode of tuberculous reactions. Prevalence of infection was estimated using (i) anti-mode method wherein all reactions equal to or more than the anti-mode are attributed to infection with *M.tuberculosis,* (ii) Mirror-image technique wherein proportion of reactions more than the mode is doubled and added to the frequency at the mode[6]. Ninety five percent confidence intervals were calculated. ARTI was derived from the estimated prevalence of infection by using the following equation[6]:

$$ARTI = 1-(1-P)^{1/a}$$

Where P is the estimated prevalence of infection and '*a*' is the mean age of the children test read. The mean age was calculated after adding 0.5 years to the age in completed years.

RESULTS

A total of 1267 eligible inmates in the selected orphanages were tuberculin tested. Of these, 1256 (99.1%) were tested satisfactorily. The reading was carried out among 1156 (92%) of the tested children, the remaining were absent on the day of reading. The mean age of the children tested was 11.3 years. About 55% of the children were found to have BCG scar.

The frequency distribution of reaction sizes among all children (with and without BCG scar) and by BCG scar status are presented in figure 1 and 2 respectively. The distribution among children without BCG scar as well as among all children revealed an anti-mode separating tuberculous

reactions from cross reactions at 14mm. The mode of tuberculous reactions could be identified at 20 mm in all the three distributions.

Using anti-mode method, prevalence of infection in the overall group of children was estimated at 15.3% (CI: 13.2 to 17.3). Using mirror-image technique, it was estimated at 11.8% (CI: 9.9 to 13.6). The ARTI computed from prevalence using these two methods was 1.5% and 1.1% respectively.

The estimates of prevalence of infection by BCG scar status are presented in table 1.

Table-1

BCG status	Prevalence (%)	
	Anti-mode method	Mirror-image technique
Without BCG scar	16.3 *(13.1 to 19.5)*	12.9 *(9.9 to 15.8)*
With BCG scar	14.3 *(11.6 to 17.0)*	10.6 *(8.2 to 13.0)*

(): 95% confidence interval; P<0.05

DISCUSSION

This study for the first time provided information on prevalence of tuberculous infection in any kind of closed institution. The study revealed that between 11-15% of orphans, 0-17 years of age residing in the selected orphanages were already infected with *M. tuberculosis*. These individuals may also be at higher risk of developing TB disease than other children in the general community, due to lower levels of nutrition and emotional stress. In a study carried out during the same year among school children using the same batch of PPD, about 10% of the children 6-8 years of age were found to be infected using the same anti-mode at 14 mm. The anti-mode and mode observed in the present study were similar to those observed in most of the tuberculin surveys carried out in the country in the recent past[9].

The ARTI using the anti-mode and the mirror-image technique was estimated at 1.5% and 1.1% respectively. This represents the average annual risk of infection experienced by the study cohort from their birth to the time of the survey. However, these estimates do not exclusively represent the risks of infection within the orphanages since the children get admitted into these institutions at different years of age.

A possible limitation of the study could be due to purposive sampling and relatively inadequate sample size due to limited availability of tuberculin as standard PPD is not freely available in the country. More such studies in different parts of the country would throw more light on the subject. The statistically significant difference in estimated prevalence by BCG Scar status was perhaps due to relatively small number of children tested in the two subgroups.

Since the children and adolescents living in orphanages are a high risk group for acquisition of tuberculous infection and developing TB, proper ventilation to reduce the transmission of infection and active screening for TB followed by treatment should be undertaken in all such closed institutions.

References

1. World Health Organization: Global tuberculosis control - A short update to the 2009 report. WHO/HTM/TB /2009.426.

2. Chadha VK, Jaganath PS, Kumar P et.al: Average annual risk of tuberculous infection in India; Int J Tuberc Lung Dis, 2005, 9, 116-118.

3. Comstock GW, Livesay VT, Woolpert SF: The prognosis of a positive tuberculin reaction in childhood and adolescence; Am J Epidemiol, 1974, 99, 131-138.

4. UNICEF. Info by country - India, basic indicators 2007. URL: http://www.unicef.org/infobycountry/india_statistics.html. Accessed on 26 February 2010.

5. Indian Orphanages Network. List of orphanages in India.URL: http://www.indianorphanages.net/orphanage/orphanages.html.   Accessed on 26 February 2010.

6. Cauthen GM, Pio A, ten Dam HG: Annual risk of tuberculous infection. Geneva; World Health Organization. 1988, WHO/TB/88.154.

7. Chadha VK, Jitendra R, Kumar P, Kirankumar R, Shashidharan AN, Suganthi P, Gupta J, Jaganath PS: Change in risk of tuberculous infection over an 8-year period among school children in Bangalore city; Int J Tuberc Lung Dis, 2008, 12 (10), 1116-1121.

8. Chadha VK, Jaganath PS., Kumar P: Can BCG vaccinated children be included for tuberculin surveys to estimate annual risk of tuberculous infection in India?; Int J Tuberc Lung Dis, 2004, 8, 1437-1442.

9. Chadha VK, Agarwal SP, Kumar P, Chauhan LS, Kollapan C, et. Al: The Annual risk of tuberculous infection in four defined zones of India - A comparative picture; Int J Tuberc Lung Dis, 2005, 9, 569-575.

Figure 1: Frequency distribution of tuberculin reaction sizes

N= 1156
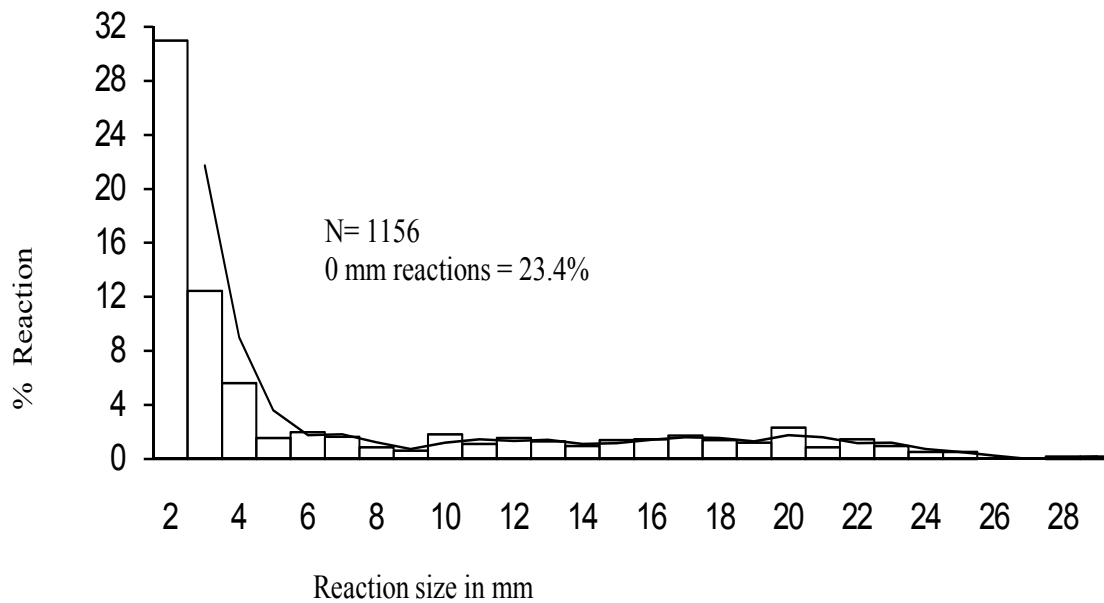0 mm reactions = 23.4%

% Reaction

Reaction size in mm

Figure 2: Frequency distribution of tuberculin reaction sizes by BCG scar status

Without BCG scar, N=516, 0 mm reactions=26.2 %

With BCG scar, N=636, 0 mm reactions = 21.2%

% Reactions

Reaction size in mm