

TUBERCULIN SENSITIVITY IN AN URBAN POPULATION IN IRAN

ALI SADEGHI-HASSANABADI, M.D., M.P.H.,
AND IRAJ JAVIDIAN, M.D., M.P.H.

From the Department of Community Medicine, Shiraz Medical School, Shiraz, Islamic Republic of Iran.

ABSTRACT

Mantoux test using 2 IU of tuberculin prepared in Iran was performed on 6675 healthy persons randomly selected from an urban population (Shiraz) of Iran.

In 3776 persons with no evidence of previous BCG vaccination the rate of positive reaction was less than 2% up to the age of 14, slightly more than 2% among those 15-19 years of age, but strikingly higher (45.5%) in older age groups ($P < 0.001$). The rate of positive reaction was higher among females ($P < 0.025$).

At the time of the study 2899 persons (43.3%) had received BCG. In this group the rate of positive reaction, being highest in the below 4 years old age group, dropped suddenly in the 5-10 year old age group and gradually increased thereafter to reach a high level (>90%) again. The differences between different age groups as well as the two sexes were statistically significant ($P < 0.005$), though the sex difference was reversed in this group.

Keywords: Mantoux test, prevalence of tuberculin positive, age and sex differences, Iran
MJIRI, Vol. 10, No. 1, 31-35, 1996.

INTRODUCTION

The tuberculin test is one of the most commonly employed measures to estimate the prevalence of tuberculosis in different communities. This is because the test is still the cheapest and safest method with a high sensitivity.¹⁻⁴

Using this test in high-risk groups and especially children starting elementary school can be a useful indicator for estimating the risk of infection in the community.⁵

During the past decade many studies have been carried out in order to determine skin sensitivity to tuberculin among children, including the WHO study in 21 countries⁶ and a few studies in Iran.^{7,8}

In this study the tuberculin skin test was performed in a representative sample of Shiraz residents. The main objective of the study was to determine the prevalence of positive skin tests among the unvaccinated population and, if possible, the waning of reaction among those previously vaccinated.

SUBJECTS AND METHODS

The study was carried out in Shiraz, a city of about one million population in southern Iran. A total number of 6675 subjects in different age groups and both sexes were randomly selected from different parts of the city as follows:

A. Four urban health centers located in 4 different zones were used for selecting children less than four years of age.

B. Four kindergartens, four elementary, four junior-high and six high schools from each of the four educational zones of the city were chosen to select boys and girls in the 5-6, 7-10, 11-14 and 15-19 year age groups respectively.

C. Six urban neighbourhoods were used to select subjects above 20 years of age.

Selection of the study population was carried out in two stages. During the first stage the study areas were chosen on a random basis and in the second stage the subjects were selected from each area by convenient sampling while trying to reach an almost equal number of subjects in each

Tuberculin Sensitivity in an Urban Iranian Population

age-sex group (about 500 persons).

Although the total number of the study population was meant to be 6000 it was actually increased to 6675 to compensate for the differences in age and sex distribution in some centers.

Tuberculin testing was done by the standard Mantoux method using 2 IU of tuberculin provided by Pasteur Institute of Iran. 0.1 ml of PPD was injected intradermally in the skin of the left forearm midway between the elbow and the wrist using a one ml disposable syringe and a 24 or 25 gauge needle. The tests were read 72 hours later by measuring the diameter of induration in millimeters.

The test was performed irrespective of the BCG vaccination history, although both arms were carefully inspected for the presence of BCG scar and the subjects were inquired concerning their history of vaccination. Information regarding age, sex, state of previous BCG vaccination and the diameter of induration at the site of injection were recorded.

RESULTS

Out of 6675 persons studied, 3776 had no history of BCG vaccination and lacked the scar. The results of the tuberculin test in this group relative to age are presented in Table I. The highest rate of negative reaction (94%) was found in the below four years group which gradually decreased by age to reach its lowest percentage (37%) in the oldest age group (≥ 20 years). On the other hand, and as expected, the proportion and extent of positive reactions (diameter ≥ 10 mm) increased by age so that in those above 20 years of age more than 45% had a reaction of more than 10 millimeters. The difference in the diameter of reaction according to age is statistically significant ($P < 0.001$). This has been shown in Fig. 1.

The prevalence of 5-9mm reactions was not different among the two sexes but the proportion of females showing reactions of 10mm or more was more than males (Table II). This corresponds with more males having negative and less than 4mm reactions. The difference in the distribution of reaction size between the two sexes was statistically significant ($P < 0.025$) and the peak of the curve is higher for females than for males (Fig. 2).

As shown in Table III those having a history of BCG vaccination comprised a total of 2899 persons. The highest proportion (60.6%) was in the 5-10 year old age group. It should be mentioned that the BCG coverage at the time of this study (1989) was far from what is seen today ($\geq 80\%$). This is the reason why only 2.4% of the children less than four years of age were vaccinated. The highest proportion of vaccinated persons was found among elementary school children for whom an active vaccination program had been going on for a few years. The rate decreased thereafter and reached its lowest value (36.4%) in the 15-19 year old age

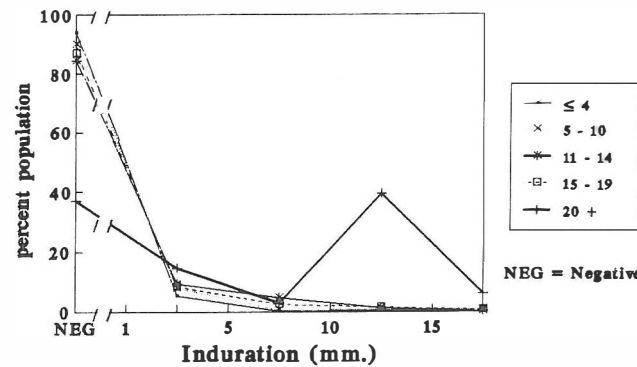


Fig. 1. Tuberculin sensitivity in the unvaccinated population relative to age.

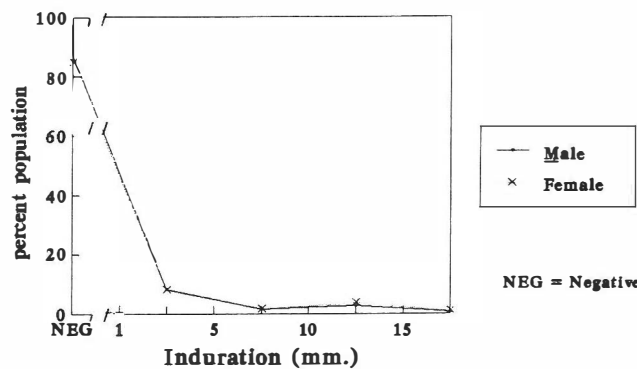


Fig. 2. Tuberculin sensitivity in the unvaccinated population relative to sex.

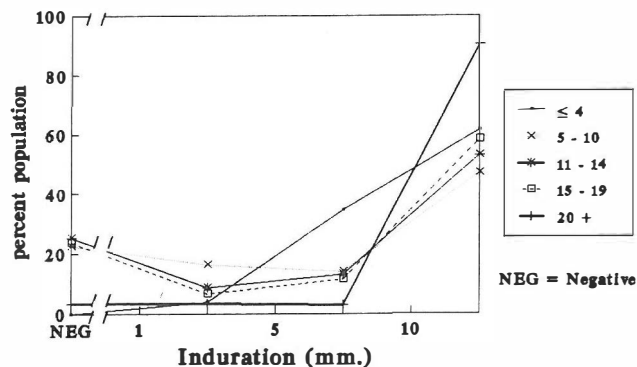


Fig. 3. Tuberculin sensitivity in the vaccinated population relative to age.

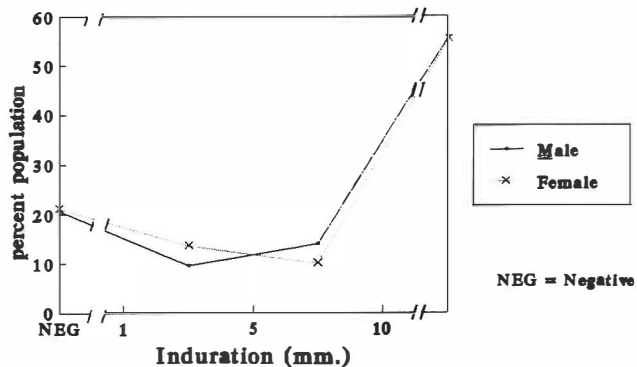


Fig. 4. Tuberculin sensitivity in the vaccinated population relative to sex.

Table I. Results of tuberculin tests among the unvaccinated population relative to age.

Age group (yrs)	No. studied	Diameter of reaction in mm*				
		Negative	1-4	5-9	10-14	>15
≤4	1048	986 (94)	56 (5.4)	1 (0.09)	4 (0.38)	1 (0.09)
5-10	933	838 (90)	74 (7.9)	6 (0.64)	8 (0.86)	7 (0.75)
11-14	472	399 (84.5)	44 (9.3)	22 (4.7)	6 (1.3)	1 (0.21)
15-19	1077	937 (87)	92 (8.5)	25 (2.35)	16 (1.5)	7 (0.65)
≥20	246	91 (37)	36 (14.6)	7 (2.8)	97 (39.5)	15 (6.1)
Total	3776	3251 (86)	302 (8)	61 (1.6)	131 (3.5)	31 (0.82)

*Figures in each box represent the number of cases and the numbers in parentheses represent the percentage having the reaction in each age group.

group. The percentage of vaccinated subjects among the adult population (≥20 years old) was comparatively high (57%), probably due to previous vaccination programs.

Interestingly, among those with a confirmed BCG scar, the prevalence of positive reactions to the tuberculin test decreased gradually from 100% among the under-four year old group till adolescence and then increased again to reach more than 96% among the oldest age group. This is true both for the total number of positive subjects and for those showing reactions of more than 10mm (Table III, Fig. 3).

The difference in the size of reaction in the vaccinated group is statistically significant among different age groups ($P<0.005$). The difference between male and female subjects is also statistically significant ($P<0.005$), such that females have a higher rate of negative or less than 5mm reactions than males (Table IV, Fig. 4).

DISCUSSION

The rate of positive tuberculin skin tests (≥10mm) among subjects under 20 years of age was relatively low and similar to the findings of other studies in the same community.⁷⁻⁹ This rate had a gradually increasing trend among the four consecutive age groups (<20) and ranged from 0.47% in the less-than-four year old group to 2.15% in the 9-15 year old group. This rate was found to be 1.51% in a group of 6 year old children during 1987⁸ and was estimated to be about 1.56% between 1981-87.⁷ Recently another study showed a positive tuberculin reaction rate of 1.72% among 1000 students in Shiraz who were 14-15 years old.

Table II. Results of tuberculin tests among the unvaccinated population relative to sex.

Sex		Total No.	Diameter of reaction in mm*				
			Negative	1-4	5-9	10-14	>15
Male	No. %	1990	1732 (87)	162 (8.1)	32 (1.6)	51 (2.6)	13 (0.65)
Female	No. %	1786	1519 (85)	140 (7.8)	29 (1.6)	80 (4.5)	18 (1.0)
Total	No. %	3776	3251 (86)	302 (8)	61 (1.6)	131 (3.5)	31 (0.8)

The mean age of our above 20 year old group was about 40 years. This was probably the reason why the rate increased remarkably from a low percentage to a high level of 45.5%.

In interpreting the results of this study, the analysis of the data presented in Table I was based on a cross-sectional study, therefore it does not show the trend of exposure to infection in a cohort. In other words, those less than 20 years old were born between 1970 and 1989 and their life experience and environmental exposure is totally different from the oldest age group (i.e., ≥20 years old) who were born during the 1950s. Thus we can conclude that the rates observed among the older population in this study are not expected to be found among the young when they get old.

Regarding the overall reaction patterns and comparing our results with those presented by the authorities in this field,^{1,2,10-13} we can say that Fig. 1 is actually showing two different patterns in the two main age groups of below and above 20 years. The sensitivity pattern of those below 20 years of age is similar to the "Georgia pattern"^{1,2,10} and is seen mainly in those populations who have a high prevalence of atypical mycobacteria and have low exposure to *Mycobacterium tuberculosis*. In contrast, the pattern in the above twenty group indicates an apparent bimodal distribution similar to that obtained in southern India and Haiti. In this situation the prevalence of infection with both *Mycobacterium tuberculosis* and atypical mycobacteria is high and even though it is quite possible to have a mixed infection, reactions less than 10mm in diameter are generally regarded as being due to atypical mycobacteria and those more than 10mm due to tuberculosis.

We conclude that there are two distinct population groups regarding tuberculosis exposure. Those less than 20 years of age present a pattern similar to a relatively developed community, with lower exposure rates and better environmental conditions leading to a lower risk of infection. The other group (middle aged) present a pattern that is characteristic of a developing country.

The higher proportion of positive tests (>10mm) among females in our study has also been found in other previous

Tuberculin Sensitivity in an Urban Iranian Population

Table III. Results of tuberculin tests among the unvaccinated population relative to age.

Age group (yrs)	Total No. Studied	No. Vaccinated (%)	Reaction (mm)				Total No. Positive		Total No. Positive ≥ 5 mm	
			Negative	1-4	5-9	≥ 10	No.	%	No.	%
≤ 4	1074	26 (2.4)	0 (0)	1 (3.8)	9 (34.6)	16 (61.6)	26	100	25	96.2
5-10	2368	1435 (60.6)	324 (22.6)	235 (16.4)	201 (14)	675 (47)	1111	77.4	876	61.0
11-14	968	496 (51.24)	125 (25.2)	43 (8.7)	65 (13.1)	263 (53)	371	74.8	328	66.1
15-19	1693	616 (36.4)	146 (23.7)	41 (6.7)	70 (11.4)	359 (58.3)	470	76.3	429	69.6
≥ 20	572	326 (57)	11 (3.4)	11 (3.4)	9 (2.8)	295 (90.5)	315	96.6	304	93.2
Total	6675	2899 (43.4)	606 (20.9)	331 (11.4)	354 (12.2)	1608 (55.5)	2293	79.0	1962	76.7

Table IV. Results of tuberculin tests among the unvaccinated population relative to sex.

Sex	Total No.	Reaction (mm)				Total No. Positive		Positive ≥ 5 mm	
		Negative	1-4	5-9	≥ 10	No.	%	No.	%
Male	1571	325 (20.7)	151 (9.6)	220 (14)	875 (55.7)	1246	79.3	1095	69.7
Female	1328	281 (21.2)	180 (13.6)	134 (10.1)	733 (55.2)	1047	78.8	867	65.3
Total	2899	606 (20.9)	331 (11.4)	354 (12.2)	1608 (55.5)	2293	79.1	1962	67.6

studies in southern Iran,^{7,8,14} while this has been different in other parts of the world.⁷ This finding requires further explanation since we also found that men with a previous history of BCG vaccination had a higher percentage of reactions above 5 mm.

ACKNOWLEDGEMENTS

This study was supported by a grant (No. 67-11) from Shiraz University of Medical Sciences. The sincere cooperation of the technical staff at the Tuberculosis Control Center of Shiraz is most appreciated.

Thanks are also due to Dr. M. Torabi, Mr. H.R. Tabatabai and Mr. A.H. Hashemian for their help in data analysis.

REFERENCES

1. Comstock GW: Epidemiology of TB. Am Rev Respir Dis 125 B(Suppl): 8-15, 1982.
2. Reichman LB: Tuberculin skin testing; the state of the art. Chest 76(Suppl): 764-770, 1979.
3. Gryzobowski S: The value and limitation of the tuberculin test. SA Med J 17: 19-21, 1982.
4. Snider DE: The tuberculin skin test. Am Rev Respir Dis 125 B(Suppl): 108-118, 1982.
5. Sutherland I, et al: The risk of TB infection in the Netherlands from 1967 to 1979. Tubercle 66: 241-253, 1983.
6. Bleiker MA: Progress report II on the cooperative international study on the demographic and geographic distribution of low, medium and high grade tuberculin sensitivity. Bull Int Un

A. Sadeghi-Hassanabadi, M.D., M.P.H., et al.

- Tuberc XLII (10): 65-78, 1969.
7. Sadeghi-Hassanabadi A, Sadeghi E: Trend of tuberculosis infection in children seven years of age in Shiraz, 1981-1986. *EMR Health Serv J* 8: 36-43, 1990.
 8. Pesaran P: Use of tuberculin test for prevalence survey of tuberculosis infection in 6-7 year old children in Shiraz. Thesis for M.S. degree in Epidemiology, Dept. of Community Medicine, Shiraz Medical School, 1987.
 9. Mossanen E: Results of PPD test in 1000 students in Shiraz. (Unpublished data in TB Control Center, Shiraz, Iran).
 10. American Thoracic Society: The tuberculin skin test. *Am Rev Respir Dis* 104: 769-774, 1971.
 11. Edwards L, Comstock G: Contribution of northern population to the understanding of tuberculin sensitivity. *Arch Environ Health* 17: 507-516, 1968.
 12. Ten Dam HH, Hitz KL: Determining the prevalence of TB in populations with non-specific tuberculin sensitivity. *Bull WHO* 58(3): 475-483, 1980.
 13. Chaparas SD: Immunity in TB. *Bull WHO* 60(4): 447-462, 1982.
 14. Daei-Parizi MH: Tuberculosis and its prevalence in Kerman, Iran. Manuscript published by the Kerman University, 1982.

