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# Tuberculin Skin Test (PPD) and Its' Conversion after One Year in School Children

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**Abstract:** The control of Tuberculosis (TB) is a major health problem in developing countries. Annual Risk of Infection (ARI) is an index used for evaluating the programs against tuberculosis. This index shows the incidence of this infection within a society during 1 year. This study carried out among primary school students during 2 successive years in order to evaluate the results of tuberculin test (PPD) in the 1st year and to determine the variation in the 2nd year. In this study from the northwest of Iran (Ardabil), 780 primary school students randomly selected from 17 primary schools. The age was 8-14 years and mean age was 9.92±1.29. All the subjects injected tuberculin skin test (Pastor Institute 5 IU) in May 2005 and May 2006. In both tests, the results recorded after 48-72 h. PPD >10 mm considered positive. Among the subjects, 55 cases (7.1%) had positive PPD in both tests, 614 cases (78.7%) had negative PPD in both tests, in 33 cases (4.2%) PPD converted from negative (1st year) to positive (2nd year) and in 78 cases, the results were unreliable. Overall, BCG had injected 98.1% of subjects on the vaccination schedule. According to the results, with the passing of time, BCG vaccination dose not affect tuberculin test of schoolchildren. On the other hand, the conversion rate in PPD from negative to positive was (4.2%), which shows the high rate of tuberculosis in this region.

**Key words:** Tuberculosis (TB), tuberculin skin test (PPD), Annual Rate of tuberculosis Infection risk (ARI), BCG

## INTRODUCTION

The history of TB is the history of humankind and its control is still a health problem in developing countries. The prevalence and incidence of tuberculosis is not uniform throughout Iran, so that according to the reports of tuberculosis and pulmonary diseases research center it has widespread mostly in the boundary such as northwestern of Iran (Reza, 1996). Tuberculosis infection prevalence and Annual Risk of Infection (ARI) are some indices used for measuring and evaluating the programs against tuberculosis. The former determines infected people percentage in the society, which is determined by positive tuberculin skin test and the following Eq:

$$\text{Tuberculosis infection prevalence} = \left(\frac{\text{The number of positive tuberculin test}}{\text{The number after eliminating previous BCG receivers}}\right) \times 100$$

ARI indicates the percentage of infected people in a society during one year and is determined by positive skin test. This index is determined among people not injected with BCG (Reza, 1996).

Tuberculin skin test is still an important technique to diagnose of tuberculosis (Almeida *et al*., 2001) and its negative results in endemic area should be interpreted cautiously (Pina *et al*., 2002). Recent studies show the influence of nutrition and micronutrient and factors, such as sex and smoking on the results of this test (Cuevas *et al*., 2002; Jentoft *et al*., 2002). Tuberculin test is highly affected by BCG vaccination in the 1st years of the life and this influence weakens with the passing of time (Wang *et al*., 2002). However, Mudido *et al*. (1999) showed this influence as a negligible factor. In a study, the influence of BCG vaccination regarded until the age of 6 year and in another one, it regarded until the age of 7 years (Bozaykut *et al*., 2002; Guseva *et al*., 2001). Therefore, in schoolchildren and adults, the positive results in tuberculin test are related to the infection by mycobacterium tuberculosis not to the effect of BCG vaccination (Kuyucu *et al*., 2001; Bugiani *et al*., 2003).

In a study of tuberculin skin test on Iranian children (2-6 years old) who had, BCG vaccination PPD was negative in 79.4% (Hamid and Reza, 1993). Generally,

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in the interpretation of tuberculin test, the indurations of >15 mm regard because of tuberculosis and the indurations <5 mm as a negative test. The indurations of 5-9 mm considered suspicious and the results between 10-14 mm are cautiously interpreted (Chadha, 2001). Hence, in schoolchildren (7-12 years old) 2-step tuberculin test in 2 subsequent years and assessing the results of 1st year and comparing it with the results of 2nd year provide valuable information about tuberculosis prevalence. On the other hand, in identifying of new infected person two- step tuberculin skin test has been as an important method (Larsen *et al*., 2002; Yano *et al*., 2002; Shigetoh *et al*., 2002; Silva *et al*., 2002). with this background, study was designed among schoolchildren (7-12 years old) of northwest of Iran (Ardabil).

## MATERIALS AND METHODS

In May 2005, 878 students from 17 schools were randomly selected and entered to this study. One year later May 2006 at the 2nd stage, 780 students of them retested again.

Ninety eight students were eliminated from the 2nd step because of changing the school, absence or vacation. A questionnaire including general information and BCG vaccination record was filled for all the subjects. The results of tests were recorded in the same questionnaire.

PPD-S 5-unit solution with moderate power provided by Pastor Institute was used in the test, which injected subcutaneously on anterior surface and at the top of left forearm in an amount of 0.1 mL. The results of the test were interpreted by pen technique method and on the base of transverse diameter of induration's about 48-72 h after the injection (Carter and Lee, 2002 ). Diameters of induration's <5, 5-9 and >10 mm were interpreted as negative, suspicious and positive, respectively.

The BCG vaccination records of the subjects were inspected according to the position of scar and vaccination history. The subjects without BCG scar and or equivocal history of vaccination were classified as suspicious of BCG vaccination record.

The data were analyzed by software EPI and Harvard Graphics. Statistical tests included $k^2$, chi square ($\chi^2$) test with Yat's and students t-test correction or fisher exact.

## RESULTS

The age of students was in the range of 8-14 with the average age of 9.92±1.29. In 55 children (7.1%) the result of PPD test in both steps was positive, in 614 children (78.7%) it was negative in both years and in 78 children (10%) it was suspicious. In 33 children (4.2%), the result of PPD test was negative in the 1st phase and converted to positive in the 2nd test. Table 1 shows the number and percentage of students in each school and the frequency and percentage of PPD Conversion (PPDC) in different ages.

Table 1: Frequency and percentage of PPD conversion (PPDC) in different ages

| | PPDC | | |
|---|---|---|---|
| Age | No. | Percentage | No. children in each age group |
| 7-8 | 5 | 3.7 | 136 |
| 8-9 | 8 | 4.8 | 167 |
| 11-10 | 10 | 5.5 | 183 |
| 10-11 | 8 | 3.7 | 218 |
| 11-12 | 1 | 1.4 | 73 |
| 12-13 | 0 | 0.0 | 0 |
| 13-14 | 1 | 33.3 | 3 |

Among all the subjects, 765 cases (98.1%) had been injected with BCG vaccine and only 5 cases (1.9%) had negative or suspicious vaccination record. Total 33 cases (4.2%) had PPDC and according to the analysis, there was not a significant relation between age and PPDV. Considering the frequency and percentage of PPDC among the schools, it was revealed that there was a strong significant relation between PPDC and the school of subjects ($p = 0.001$), so that the percentage of PPDC was reportedly about 14.9 in some schools and zero in other ones. There was not a significant relation between BCG vaccination and PPDC, so that among 33 children, who had PPDC, 31 cases (93.9%) had been injected with BCG and only 2 cases (6.1%) had suspicious or negative vaccination history. The result of PPD in 55 cases (7.1%) was negative. There was not a significant relation between positive PPD and age (Table 1). According to the Table 2 and statistical analysis, there was a significant relation between frequency and percentage of the subjects with positive PPD and the school ($p = 0.001$). The relation between positive PPD and vaccination record was seemingly significant. In other words, among the children with the record of positive BCG vaccination, only 51 cases (6.6%) had positive PPD, while among children with suspicious or negative BCG vaccination record, 4 cases (26.6%) had positive PPD ($p<0.02$). Since, the result of PPD test was negative in 416 cases (78.7%), the relation between negative PPD and vaccination history was significant ($p<0.001$). According to the analysis, it could be suggested that in none of the cases with negative or suspicious BCG vaccination record, the PPD was negative i.e., the result of PPD test was certainly positive, suspicious or converted in these children.

Table 2: Frequency and percentage of PPDC and the result of PPD test in schools

| | Subjects | | Positive PPD | | Negative PPD | | PPDC | |
|---|---|---|---|---|---|---|---|---|
| School | No. | Percentage | No. | Percentage | No. | Percentage | No. | Percentage |
| 1 | 87 | 11.1 | 16 | 18.4 | 49 | 56.3 | 13 | 14.9 |
| 2 | 50 | 6.4 | 4 | 8.0 | 36 | 72.0 | 4 | 8.0 |
| 3 | 34 | 4.3 | 1 | 2.9 | 29 | 58.2 | 1 | 2.9 |
| 4 | 43 | 5.5 | 5 | 14.7 | 29 | 67.4 | 4 | 9.3 |
| 5 | 43 | 5.5 | 1 | 2.3 | 38 | 88.4 | 1 | 2.3 |
| 6 | 46 | 5.9 | 4 | 8.7 | 39 | 84.8 | 0 | 0.0 |
| 7 | 34 | 4.3 | 4 | 11.8 | 22 | 64.7 | 0 | 0.0 |
| 8 | 39 | 5.0 | 6 | 15.4 | 28 | 71.8 | 2 | 5.1 |
| 9 | 23 | 2.9 | 2 | 8.6 | 19 | 82.6 | 1 | 4.3 |
| 10 | 32 | 4.1 | 2 | 6.2 | 18 | 56.2 | 1 | 3.1 |
| 11 | 67 | 8.6 | 1 | 1.5 | 52 | 77.6 | 1 | 1.4 |
| 12 | 48 | 6.1 | 1 | 2.1 | 44 | 91.6 | 0 | 0.0 |
| 13 | 57 | 7.3 | 6 | 10.5 | 39 | 68.4 | 4 | 7.0 |
| 14 | 37 | 4.7 | 0 | 0.0 | 35 | 94.6 | 0 | 0.0 |
| 15 | 65 | 8.3 | 1 | 1.5 | 63 | 96.9 | 1 | 1.5 |
| 16 | 49 | 6.3 | 1 | 2.0 | 48 | 97.9 | 0 | 0.0 |
| 17 | 26 | 3.3 | 0 | 0.0 | 26 | 100.0 | 0 | 0.0 |

## DISCUSSION

Tuberculosis is a major health problem in developing countries. BCG vaccine has been long known as a useful method in immunization against this infection. suggested the possibility of immunization against tuberculosis infection and used subcutaneous injection of BCG for the first time (Akbar, 1987).

Injection of BCG has been included in the vaccination schedule of Iran and according to the various reports, BCG prevents sever forms of tuberculosis (Tripathy, 1993). It is possible that BCG interfere in the results of tuberculin test. In this study, among subjects with BCG vaccination history (98.1%), the result of tuberculin test was negative in 2 steps in both tests. Therefore, tuberculin test is still a valuable test for evaluating the tuberculosis.

Contact with infected person is a major factor in altering the result of tuberculin skin test. Nutritional factors and repeat of BCG vaccine and BCG scar do not have considerable effects on this test (Lao and De Guio, 1999). On the other hand, the change in the result of tuberculin skin test from negative to positive shows the risk of tuberculosis infection (Watkins *et al*., 2000).

The high rate of PPDC in subjects during 1 year is one of the most important findings of this study. According to the results of various studies on different age groups and different region of Iran before vaccination program, ARI has been 0.5-1% (Reza, 1996). However, as shown in this study, among 780 studied cases, 33 cases (4.2%) had PPDC during 1 year. In addition, analysis shows that there is a strong significant relation between PPDC and the schools of subjects. It may be concluded that in certain regions of this area with high incidence of PPDV, there is a significant distribution of tuberculosis infection. On the other hand, the percentage of PPDC (4.2%) is considerable and has a remarkable difference with the estimated ARI in Iran. Although, this data cannot be generalized, it shows that this area has a high rate of tuberculosis distribution.

The effects of booster phenomena on the second test of PPD may interfere the results of this study. However, it has been shown that this phenomena is most effective in the first 48 h after the first test and when the period between 2 tests is short (Singh *et al*., 2001). On the other hand, the amount of this phenomena is estimated about 10-20% (Menzies, 2000). Therefore, it is not expected that booster phenomena can considerably affect the results of this study. The importance of contact investigation in children tuberculosis (Yeo *et al*., 2006), we need a source case identification program to reduce TB incidence in this area.

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