

Positive Tuberculin Skin Test Among Health Care Workers: Prevalence and Risk Factors in Teaching Hospitals of a Highly Endemic Region for Tuberculosis, Zahedan, Iran

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Abstract

Background: Tuberculosis (TB) is not only considered as a community acquired disease, but also as an occupational infection. Health care workers (HCWs) in several countries show an increasing pattern for TB.

Objectives: The current study aimed to determine the prevalence of positive tuberculin skin test (TST) among HCWs in a highly endemic area for TB in Iran, namely Zahedan, the capital of Sistan and Baluchestan province, located in Southeast of Iran, near the border of Afghanistan.

Patients and Methods: In a cross sectional study in 2009, 328 HCWs from all five teaching hospitals in Zahedan were recruited. Inclusion criteria were lack of history of TB in family, receiving BCG vaccination within the first six month after the birth without later booster dose. Age, gender, job, working experience, history of exposure to a known patient with TB and TB vaccine scar were registered. The outcome was positive results during two TSTs (induration > 10 mm). A logistic regression was implemented to determine the predictors of positive TST result.

Results: TST was positive in 198 (60.4%) health care workers out of 328. Likelihood of positive TST among HCWs increased in nurses (OR = 4.617, 95% CI = 1.181-18.054, P = 0.028), increasing working experience (OR = 1.178, 95% CI = 1.131 - 1.226, P < 0.001), and history of exposure to patients with TB (OR = 9.035, 95% CI = 4.018 - 20.315, P < 0.001). Age, gender and BCG vaccination scar were not associated with TST results (P > 0.05).

Conclusions: The prevalence of positive TST in HCWs in teaching hospitals in Zahedan is so high. Tuberculosis prevention programs should be implemented for HCWs and personnel of hospitals in Zahedan.

Keywords: Tuberculosis, Tuberculin Skin Test, Occupational Infection, Health Care Workers, Iran

1. Background

Tuberculosis (TB) is currently one of the greatest problems with a profound and increasing global burden. More than 80% of those infected with *Mycobacterium tuberculosis* live in the developing countries (1). In fact, two third of all annual deaths attributable to TB occur only in 22 countries (2). In the national level, in Iran, the prevalence of TB was 142 per 100,000 in 1963; then showed a decline of about ten times to a prevalence of 13.9 per 100,000. In 2005 according to a world health organization (WHO) report, 12 Iranians per 100,000 had TB. Main challenges of TB control in Iran include under-diagnosis (50%). In addition to inaccurate diagnosis and lack of obligatory TB reporting system in Iran, a challenge is bordering with Afghanistan in South-east and newly established countries in the North (3). The incidence of TB is totally different in various parts of Iran. This difference is highly related to the geographical location (1). The highest prevalence of TB in Iran belongs to

Sistan and Baluchestan province up to 44 per 100,000 (4). In some parts of this province, the TB notification rate was up to 135 per 100,000 people in 2002 (5). The high prevalence of TB in this province is explained as the neighborhood to Afghanistan (6) with a notification rate of TB of about 202 per 100,000 people, two times higher than the average of Iran (5). Tuberculosis is not only considered as a community acquired disease, it is also an occupational infection. Indeed, TB is showing an increasing trend in health care workers (HCWs) even in some countries with the decreasing pattern of TB in the general population. In a review of surveillance reports from New York state, the total number of notifications of TB declined from 3636 in 1994 to 1434 in 2002, but the proportion amongst HCWs increased from 2.5% to 4%, as indicated by skin testing and other assessments (7). According to the estimation of the occupation safety and health administration in 1997, only in the US, more than 5 million workers were exposed to TB in the course of their work, and on the top of list, are the

HCWs. Comparing the general population with HCWs, the risk of TB is reported up to three times higher in Estonia, six times higher in Serbia, 4.8 times higher in Peru (8, 9) and 2.3 times higher in nurses in Japan (10). Unfortunately, the prevalence of positive tuberculin skin testing (TST) among HCWs in Iran is not internationally available, even though Iran is endemic for TB. This is also the case of Zahedan, capital of Sistan and Baluchistan province, which is a highly endemic region for TB.

2. Objectives

The current study aimed to determine the prevalence of positive tuberculin skin test (TST) among HCWs in a highly endemic area for TB in Iran, namely Zahedan, the capital of Sistan and Baluchistan province.

3. Patients and Methods

3.1. Design and Setting

This cross sectional study was conducted in all 5 teaching hospitals in Zahedan, Iran in 2009 by infection research center, Zahedan University of Medical Sciences, Zahedan, Iran.

3.2. Participants and Sampling

All hospital HCWs (n = 449) working fulltime in teaching hospitals of Zahedan who agreed to take a tuberculin skin test were included in this study, subjects with no experience of familial exposure to TB, those who had received BCG vaccine at birth and not received any booster dose for BCG were enrolled. Sampling strategy was census. Totally 328 HCWs were recruited. The HCWs were working in different hospital departments, such as outpatient clinic, intensive care unit, departments of internal medicine. Subjects with pregnancy, breast-feeding or allergy to tuberculin or working in laboratory and administration office were excluded. In most similar studies, HCWs who had received BCG vaccination within the previous six months were excluded (11), and BCG was usually given in childhood.

3.3. Measures and Measurements

Demographic information (age, gender), history of BCG vaccination (vaccination history) and factors potentially associated with TB exposure (history of exposure to patients with TB) were collected by an interview using a structured questionnaire. The job related factors included job category, working experience and professional or household exposure to patients with TB. Participants were assessed for TB vaccine scar.

3.4. Main Outcome

The main outcome included the results of a two-step TST defined as induration > 10 mm, recommending previously (12, 13). Screening was conducted using the Mantoux test (intracutaneous tuberculin units manufactured by Aventis Pasteur, France). Purified protein derivative supplies were provided by pharmacy department at KAUH in Saudi Arabia. A nurse sterilized the forearm skin of the candidate with propyl alcohol and, using a 26 gauge needle, introduced 0.1 mL of a commercially available purified protein derivative tuberculin intracutaneously (equivalent to five tuberculin units), raising a wheal 6 - 10 mm in diameter. The delayed skin test reactions were measured by a physician after 48 - 72 hours, as convenient for the participants. The diameter of the erythematous induration was measured in millimeters and recorded. The tuberculin test was diagnosed positive if the wheal reaction was 10 mm or over. The conduct and interpretation of tuberculin skin tests were based on the current guidelines of the centers for disease control and prevention (CDC) statement committee on latent tuberculosis infection (14, 15). In countries with universal immunization at childhood, and lack of boosters in adulthood, such as Iran, against TB, TST is used as a valuable tool to monitor the acquisition of TB by HCWs (16).

3.5. Codes of Ethics

A written informed consent was obtained from each participant. The study was approved by ethical committees of the Zahedan University of Medical Sciences.

3.6. Statistical Analysis

The data were analyzed by SPSS version 21. The frequency of data was determined, and the association between the gender and age with site, and other data were analyzed using the Chi-square test. A logistic regression was implemented to determine the predictors of positive TST results. A P value less than 0.05 was considered significant.

4. Results

Out of the 449 hospital personnel who agreed to take a tuberculin skin test, 328 ones (73.0%) were HCWs without an experience of familial exposure to TB, all had received TB vaccine at birth, and had not received any booster. Out of the 328 subjects, 182 (55.5%) were male, TB test was negative in 130 (39.6%) subjects and positive in 198 ones (60.4%). The prevalence of positive TST was high among nurses (OR = 4.617), longer working experience (OR = 1.178), and history of exposure to patients with TB (OR = 9.035). Age, gender and BCG vaccination scar were not associated with TST results. All results are shown in Tables 1 and 2.

Table 1. Demographic and Tuberculosis Related Data of Participants (n = 328)

Variable	No. (%)
Job	
Nurse	223 (68.0)
Paramedics	86 (26.2)
Physician	19 (5.8)
Gender	
Female	146 (44.5)
Male	182 (55.5)
Exposure to known case of TB	
Negative	254 (77.4)
Positive	74 (22.6)
BCG scar	259 (79.0)
TST	
Negative	130 (39.6)
Positive in total	198 (60.4)
Positive in 1st test	186 (56.7)
Positive in the 2nd test	12 (3.7)

5. Discussion

In about 60% of HCWs in Zahedan hospitals, TST was positive which was very high and alarming. The prevalence of positive TST was increased among nurses; it also increased with working experience and history of exposure to patients with TB. The only international report in this regard from Iran was published regarding Hamedan, in West of Iran, which is less endemic than Sistan and Baluchistan province regarding TB infection. In that study, among 245 HCWs in the two teaching hospitals, 92 (38%) had positive TST, and TST positivity was associated with old age, length of employment, and working in wards. Fifty-six subjects showed tuberculin reaction of more than 15 mm, 4 (7.1%) of them had calcification on radiograph. No cases of active pulmonary tuberculosis were found in the subjects (17). The 60% prevalence of positive TST among the current study HCWs was much higher than those of the most previous international reports. The results of a systematic review can partly explain the high prevalence in general population in the current study region. TST prevalence is linked to the prevalence of TB in the general population of each country (11). This HCWs TB risk will be greater when larger numbers of patients infected (smear-positive) with TB are managed at a health care facility (18,19). They explain that the highest prevalence of TB in Iran is known in Sistan and Baluchistan.

The prevalence of TB is up to 44 per 100,000 (4) in Iran,

which even in some regions increases to 135 per 100,000 (5). As mentioned earlier, this is because of the high prevalent regions are near the border of Afghanistan (6) with a prevalence of about two times higher than that of Iran (5). According to a review, the overall prevalence of positive TST in medical/nursing students was 12% (95% CI: 10 - 13), which varied widely from 2% in Iran to 40% in Uganda. The prevalence estimates highly correlated (correlation coefficient [R] = 0.91, P = 0.01) with TB prevalence in the general population (e.g. ranging from 28 per 100,000 in Iran to 403 per 100,000 in Uganda) (11). Other factors which may also partly explain this high rate of positive TST include lack of personal-protection measures and also poor knowledge and attitudes of the HCWs. Literature clearly shows the association between the risk of TB infection in HCWs and their lack of personal-protection measures (20, 21), the knowledge and attitudes regarding TB infection-control (22). In the current study, BCG scar was not linked to TST results, which was in line with those of most studies reviewed systematically (11). Unfortunately, although the risk of TB infection for HCWs can be reduced by implementation of effective infection-control measures (18, 19) and some of the evidence is derived from the developing countries (23-25), in most developing countries there is no TB infection-control programs for HCWs. Efficacious control measures to control and prevent TB in HCWs is best achieved by three approaches: administrative, engineering and personal respiratory protection (26). The one which seems affordable in the developing countries is the administrative control which includes the early and aggressive investigation, diagnosis and effective treatment of patients with TB in hospitals. For such an approach, hospitals and health care facilities should provide ready access to laboratory diagnosis, including emergency out-of-hours microscopy for acid-fast bacilli, and a heightened awareness of the diagnosis amongst doctors and other HCWs. Other approaches such as engineering control needs highly complex physical facilities and might be less appropriate for the developing world. These facilities provide care for patients with diagnosed or suspected TB and include from a naturally ventilated isolation room to airborne isolation or respiratory isolation, negative pressure rooms, or high-efficiency particulate air filtration. Personal respiratory protection refers to filtered masks/face sealing with standards, are mostly expensive (26). It seems that expensive guidelines published by the developed world (27, 28) cannot be easily used in the developing countries world. When such preventive measures are implemented, the number of TB exposure episodes and tuberculin skin test conversion rates decrease among HCWs. In a few years, the US increased the number of hospitals with tuberculin skin test programs to monitor the

Table 2. Regressors of Positive Tuberculosis Skin Test Among Health Care Workers (n = 328)

Variable	P	OR ^a	95% CI OR	
			Lower	Upper
Working experience	< 0.001	1.178	1.131	1.226
Exposure to TB patient	< 0.001	9.035	4.018	20.315
Job, nurse	0.028	4.617	1.181	18.054

^aOR, odd ratios.

acquisition of TB among HCWs about 30% (29). In Finland, a 30-year study showed a lower risk of TB among HCWs than the general population. These results are related to a good TB control program (30, 31). Although the current study found no relationship between the wards and TST results, resource can be allocated according to the results of a systematic review, that is paying the highest attention to HCWs who work in TB inpatient facilities, laboratories, general medicine wards and emergency rooms; paying intermediate attention to HCWs in outpatient medical facilities and less attention to the workers in the surgery, obstetrics and gynecology, administration and operating theaters (11). All in all, although the incidence of TB may be declining in many countries, there remains a risk of transmission in hospitals due to delayed diagnosis, inadequate facilities and also, in some countries, an increasing proportion of HCWs (16). Unfortunately, in Iran, there is no TB infection control program for HCWs. Previously, there was a need for more emphasis on tuberculosis control measures and regular staff screening (17) and here the current study results are another alarm for the need of such an intervention.

The current study did not assess participants for active/passive TB, conducting chest X-ray and clinical evaluation such as productive cough, history of symptoms and sputum test.

According to the results of the current study, the prevalence of positive TST in HCWs in teaching hospitals in Zahedan, Iran was so high which reminds the need of TB prevention programs for HCWs in teaching hospitals, especially for nurses. A screening for latent TB should be done for those HCWs who report a history of exposure to a known case of a patient with TB, and also the ones who retire soon.

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Footnote

Authors' Contribution: All authors had an equal role in the writing of paper.

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