

# Investigating the Prevalence of Latent Tuberculosis among Healthcare Workers of Major Hospitals of Ahvaz, Iran

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**Abstract:** *Background and Objective:* Healthcare and laboratory workers in hospitals have a higher exposure to hospital-acquired infections (HAIs) than the general populations. Tuberculosis (TB) infection is a common HAI that is communicated from the patients with TB admitted or hospitalized in the healthcare centres. This study aims to determinate the incidence and prevalence of latent TB infection among healthcare workers in the major Hospitals in Ahvaz, Khuzestan province, Iran.

*Methods:* This is a case-control study conducted on healthcare workers diagnosed with TB between January 2010 to December 2017. The study population consisted of healthcare workers of the three major hospitals of Ahvaz, Khuzestan including Imam Khomeini Hospital, Golestan Hospital and Shafa Hospital. All subjects underwent Mantoux tuberculin skin test (TST) and after 48 to 72 hours the reaction was measured as the length of induration. The induration equal to or greater than 10 mm was considered as positive TB. Moreover, the subjects and controls were asked to complete a self-administered questionnaire on potential risk factors for TB.

*Results:* Among 513 subjects, male and female subjects were respectively 186 and 327. Of all subjects, 67 subjects (male: 42; female: 25) showed positive TST (10 mm  $\leq$  induration) and 275 subjects showed 5 mm  $>$ induration. There was a significant relationship between TST result and the workplace of the subjects. Gender showed no significant relationship with the TST result.

*Conclusion:* All healthcare workers who are in direct contact with TB patients must undergo regular TB screening test and the workers should be trained for self-conducting TST.

**Keywords:** Tuberculosis (TB), healthcare workers, laboratory workers, prevalence, Ahvaz.

## INTRODUCTION

Tuberculosis (TB) is a known occupational risk factor for healthcare workers, especially in developing countries with a high burden of tuberculosis [1, 2]. Hospital acquires infections (HAI) is a major health issue worldwide with significant economic and health burden. TB is a common HAI that is communicated from patients with TB to healthcare workers [3, 4]. Infection to TB and transfer to healthcare workers impose significant economic and health burden worldwide. However, no serious attention has been paid to this issue until the emergence of several epidemic TB outbreaks in the USA and European hospitals [3]. The healthcare workers of hospitals in developed and developing countries are under increased exposure to TB [1, 5]. Several studies and health reports are available on the incidence and effective managements of TB and the risk factors for

healthcare workers in the developed countries [6-8]. However, in the developing countries there is a paucity of regulations and healthcare policies for the prevention and management of HAIs and particularly TB [4, 5, 8, 9]. This is because few studies have been conducted and thus there is no reliable data on this regard. The main reasons for this issue are shortage limit of the resources, difficulty of collecting TB data in hospitals, and lack of attention to the TB as an occupation risk factor. Therefore, there is no comprehensive data on the incidence and prevalence of TB among healthcare workers in developing countries [10, 11]. Tuberculosis (tuberculin) skin test (TST) is administered to detect the presence of Mycobacterium (M.) TB, the bacterium that causes TB. Because there are no representative viable organisms in body tissues and fluids, TST is the only diagnostic method for detecting M. TB infection in an individual and is used in an individual patient and epidemiological studies [11, 12]. Mantoux TST is the standard recommended TST that is administered through injection of 0.1 mL of liquid containing 5 tuberculin units (TUs) purified protein derivative (PPD)

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into the top layers of the forearm's skin [13]. The skin test reaction is read between 48 and 72 hours after the test administration. The reaction is measured in millimetres of the induration (palpable, raised, hardened area or swelling) [10, 13]. The area with erythema (redness) is excluded from the measurement. The diameter of the indurated area is measured across the forearm, perpendicular to the long axis. Bacille Calmette-Guerin (BCG) is the only vaccine available for prevention of TB. The effectiveness of the vaccine significantly depends on the age of vaccination as in the children the effectiveness is greater than the adults. BCG vaccine is 70 to 80% effective against the most severe forms of TB in children [13-15]. However, this vaccine has low efficiency to prevent TB among adults. It's less effective in preventing respiratory disease, which is the more common form of TB in adults [10, 13, 16]. In developed countries, for those healthcare workers who do not undergo BCG vaccine, the TST is used as the standard plan for prevention of transfer of TB infection in hospitals [10]. Recent studies have shown that the incidence of TB is decreasing in Iran and the latest report of the centre for disease control in Iran estimates the incidence rate of 14 among 100 thousand individuals [1, 17]. Few studies have been conducted on the prevalence and risk factors of latent TB among healthcare workers in Iran [18]. There is no published data on the spread of latent TB among the healthcare workers in Southern Iran. This study aims to determinate the incidence and prevalence of latent TB infection among healthcare workers in the major Hospitals in Ahvaz, Khuzestan province, Iran. The study population consisted of healthcare workers of the three major hospitals of Ahvaz including Imam Khomeini Hospital, Golestan Hospital and Shafa Hospital TB who were diagnosed with TB between January 2010 to December 2017. The study intended to identify the spread of latent TB in the subjects.

## METHODS

This is a case-control study conducted on healthcare workers between January 2010 to December 2017. The study population (n= 513) consisted of healthcare workers of the three major hospitals of Ahvaz, Khuzestan including Imam Khomeini Hospital, Golestan Hospital and Shafa Hospital. The procedures of the study were approved by the local ethics committee of Ahvaz Jundishapur University of Medical Sciences, Ahvaz, Iran (AJUMS.REC.1392.215), which were in complete

accordance with the ethical standards and regulations of human studies of the Helsinki declaration (2014). The experimental procedures, objectives of the study and possible benefits and risks of the participating in the study were clearly explained to the subjects and then all patients filled and signed the written consent form. All subjects underwent Mantoux tuberculin skin test (TST) and the reaction was measured in millimetres of the induration. The Mantoux TST was administered through injection of 0.1 mL of liquid containing 5 tuberculin units (TUs) purified protein derivative (PPD) into the top layers of the forearm's skin. The skin test reaction is read between 48 and 72 hours after the test administration. The reaction is measured in millimetres of the induration, the area with palpable, raised, hardened or swelling mark. The area with erythema (redness) was excluded from the measurement. The diameter of the indurated area was measured across the forearm, perpendicular to the long axis. The positive TB was defined as the induration equal to or greater than 10 mm. The subjects and controls were asked to complete a self-administered questionnaire on potential risk factors for TB. Inclusion criteria were healthcare and laboratory workers of the Hospitals that are working in therapeutic or administrative departments. The healthcare workers from the administrative and therapeutic departments were entered into the study and underwent TST. Exclusion criteria were currently active TB, a history of TB, and having a latent TB. The collected data were analyzed with the statistical package of SPSS (WINDOWS, Version 22).

## RESULTS

Table 1 shows the demographic information and the clinical features of the participants in this study by positive and negative TST results. Five hundred thirteen subjects participated in this study in this study. Of them, 327 subjects were women and 186 subjects were men (Table 1).

Our findings show no significant difference between the positive and negative TB by gender ( $P=0.892$ ), work period ( $P=0.814$ ), contact to TB patients ( $P=0.234$ ), previous vaccination ( $P=0.430$ ), past TB, and past TST ( $P=0.621$ ). The occupational information showed 272 subjects were from Therapeutic departments and 239 subjects from other departments. Twenty-two subjects were from the Lung department, 102 subjects from intensive care unit (ICU), 57 from surgery department, 52 from ICU, 131 from the

**Table 1: Demographic and clinical data of the subjects of this study. There is no difference by gender, work period, contact to TB patients, previous vaccination between positive and negative TB subjects**

Variable		Negative TB (n=446)	Positive TB (n= 67)	P-value
Gender (N, %)	Man	161 (36.1)	25 (37.3)	0.892
	Woman	285 (63.9)	42 (62.7)	
Work Period (mean ± SD)		89.28±87.38	91.98±85.76	0.814
Contact to TB patients	Yes	259 (58.7)	34 (50.7)	0.234
	No	182 (41.3)	33 (49.3)	
BCG	Yes	430(97.5)	67(100)	0.426
	No	3(0.3)	0	
	No information	8(1.8)	0	
Past TB	Yes	3 (0.7)	1 (1.5)	0.430
	No	443 (99.3)	66 (98.5)	
Past TST	Yes	5 (1.1)	0	0.621
	No	96 (21.5)	13 (19.4)	
	No information	345 (77.4)	54 (80.6)	

**Table 2: Outcomes of the TST by the place of the work of the subjects. The internal medicine department (31.3%), other departments (29.9%), ICU department (17.9%) showed the highest incidence rates of positive TB among all departments. The Lung department (1.5%) and Administrative department (6%) showed the lowest incidence rate**

Place of work	TST outcome		
	>10	5-10	<5
Lung	1 (1.5)	0 (00)	21 (7.6)
Internal	21 (31.3)	40 (23.4)	41 (14.9)
Surgery	9 (13.4)	23 (13.5)	25 (9.1)
ICU	12 (17.9)	14 (8.2)	26 (9.5)
Other	20 (29.9)	58 (33.9)	71 (25.8)
Administrative	4(6)	36 (21.1)	91 (33.1)
<b>Total</b>	<b>67 (100)</b>	<b>171 (100)</b>	<b>275 (100)</b>

administrative department, and 149 subjects from other departments (Table 2).

The definition of positive TB was induration of equal or greater than 10 mm from TST. According to this definition, 67 subjects had latent TB, from which 25 subjects were men and 42 were women. Among the subjects with positive TB, 1 subject was from the Lung department, 21 subjects from Internal medicine department, 9 subjects from the Surgery department, and 12 subjects from ICU, 4 subjects from administrative and 20 from other departments.

## DISCUSSION

In this study among of 513 subjects who participated in the skin test, 67 subjects have latent TB

and the spread of latent TB considering our sample was 13% that was lower compared to the similar previous studies. Rahbar *et al.* studied 350 workers in Imam Khomeini Hospital, Urmia, Iran and reported 96 subjects have latent TB based on positive TST [19]. The difference between the two studies could be because of the difference in the frequencies of exposing the subjects to the M. TB as the physicians and nurses in comparison with other healthcare workers and individuals, have more interactions to the TB patients. Therefore, this group and especially the workers who work in breathing and infectious sickness departments are under greater risk of interactions with the infectious agents and thus greater risk of TB infliction.

In this study, our findings show a significant relationship between the subject's workplace in the hospital and the TST result. Similarly, Demkow *et al.* in a study conducted in Poland showed that among from 155 subjects, ninety-six subjects had direct contact with TB patients [20]. Jo *et al.* investigated the prevalence of TB among the nurse and physicians in South Korea reported that among 493 subjects, 379 worked in the main departments of the Hospital with a high rate of contacts with the TB patients [21]. In our study, there is no significant relationship between the age of the workers nor the working duration of the workers and the TST result. However, Demkow *et al.* reported a significant relationship between the age of workers and also their working duration with the TST outcomes [20]. They reported that 62% of the workers older than 40 years showed latent TB infection, whereas 22% of the workers younger than 40 years showed latent TB and the workers with 10 years of working experiences showed infection prevalence of 33% [20]. It's evident that the workers with a greater time of contacts with the TB patients had a higher risk of infections from the patients. In our study from 513 subjects, 186 subjects are men and 327 subjects were women and the men and women with positive latent TST was respectively 42 and 25 subjects. The results of our study show no significant relationship between the gender of the workers and the TST result and this finding supports the previous studies.

In our study, all of the subjects who had positive latent TB had previously received BCG vaccination. Therefore, there is no relationship between the positivity of latent TB (TST outcome) and previous BCG vaccination. This finding in our study contradicts the previous findings of other studies. Plitt *et al.* in a study conducted in Edmonton, Canada tried to determine the main factors influencing the spread of latent TB among the physicians [22]. They reported that the physicians with previous BCG vaccination showed a lower rate of positive TST compared with the peers without BCG vaccination. Previous BCG vaccination in an individual could lead to the test reaction to the TST [23]. In the Gamboa-Molina *et al.* study conducted in Mexico, the amount of reaction in the subjects with previous BCG vaccination was greater than the peers without the vaccination [24]. Other studies have shown that some factors such as BCG vaccination booster effect could result in a false-positive answer in the TST result [25]. Wang *et al.* investigated the false-positive effects of previous BCG vaccination on the TST test for 10-25 years after BCG

vaccination [26]. They reported that the time course is an important factor in this regard so that BCG vaccination could have a false-positive effect on TST result for up to 15 years after the vaccination, whereas after 15 years the BCG would not induce any effect on the TST result. In our study, from 513 subjects participated in the study, only 4 subjects had previous TB and underwent successful treatment and there is no significant relationship between BCG vaccination and the TST result [26]. In this study, 2 subjects had no previous TST and the TST result in our study is positive, but as the time of the previous test is not clear this finding might be incorrect. For these subjects, we use the induration cut-off value of 15 mm. Thirty-four subjects of 67 subjects who have contacts with TB patients in the past, but there is no significant relationship between the contact to the patients and the TST outcome. In our study, 446 subjects who did not have TB, had previous contacts with the TB patients. Chan-Yeung *et al.* confirmed this finding of our study. They reported that there is no relationship between the TST result and previous contacts with the TB patients. They reported that among 282 subjects with a low rate of contacts with TB patients, 105 subjects have positive TST, whereas 72 subjects have had normal contact with the patients. Twenty-eight persons showed positive TST and among 78 subjects who have high contacts with the patients, 30 subjects showed positive TST [27].

## CONCLUSION

Our findings show the health workers that are working in the therapeutic departments are more susceptible to TB infection than those workers in the administrative departments. This is expectable and confirms that previous findings considering that the more contacts with the communicable infection source will increase the risk of the respective disease. Moreover, among the different therapeutic departments, the internal medicine and ICU departments showed the highest incidence rates of latent TB among all departments. The Lung department showed the lowest rate of TB followed by the Administrative department. One reason attributable to the low incidence rate of TB in the Lung department could be the high degree of isolation of patients and secure communications between the health workers and the patients adopted in this department. Different strategies can be adopted to reduce or limit the communication of HAIs including TB from patients to health workers. Defining good isolation strategies and training the health workers are the two major

strategies. Participation of health workers in different training workshops is necessary to increase the knowledge of the workers towards the HAIs particularly TB and the effective methods of preventing the infections to this pathogen. Moreover, appropriate isolation of the patients infected with TB is an important approach for the prevention of HAI spread.

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