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Original Article

Rate of History of Tuberculosis Among Healthcare Workers in Turkey: A Cross-Sectional Study

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Abstract

OBJECTIVES: Healthcare workers (HCWs) possess a high risk for both latent tuberculosis infection (LTBI) and active disease. This study aimed to investigate tuberculosis (TB) disease history in hospital staff working in healthcare institutions in the Eastern Black Sea Region of Turkey.

MATERIAL AND METHODS: This study included 460 HCWs employed in 5 hospitals in the Eastern Black Sea Region of Turkey. Between May 01 and July 31, 2016, the participants were asked to answer a questionnaire, including data about TB history. The data about family TB history, Bacilli Calmette–Guerin (BCG) vaccination, or tuberculin skin test (TST) application before starting work were also evaluated.

RESULTS: Of the 460 participants, 69.3% were women (n=319) and 30.7% (n=141) were men. The mean age was 32 (17–63) years. A total of 8 participants (1.7 %) had TB history. There was no statistically significant relationship between TB history and age, sex, body mass index (BMI), smoking habits, or presence of comorbidities ($p>0.05$ for all variables); family history of TB ($p<0.001$) and TST positivity ($p<0.001$) were significantly higher in participants with a TB history. Each participant was checked for the presence of both BCG scar and TST positivity. No difference was noted between positive TB history and negative HCWs ($p>0.05$). The duration of work (years) was higher in participants with a TB history. The p value was very close but did not reach the limits of significance ($p=0.059$).

CONCLUSION: In this study, the rate of TB among HCWs was 1.7% (8 of 460 HCWs). Family history of TB and TST positivity are strong predictors of TB in HCWs.

KEYWORDS: Health care workers, tuberculin skin test, tuberculosis

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INTRODUCTION

Tuberculosis (TB) is a serious infectious disease, and the incidence of both latent TB infection (LTBI) and active disease is 3–10 times higher in healthcare workers (HCWs) than in the normal population [1, 2]. Therefore, it is important to effectively screen hospital staff for the presence of TB infection or active disease. Tuberculin skin test (TST) and interferon-γ release assays (IGRAs) represent the gold standard to identify LTBI. They both demonstrate host/pathogen interactions between the immune system and *Mycobacterium tuberculosis*; therefore, they can be positive in both cases (LTBI and TB) [3]. IGRAs are *in vitro* tests for TB infection. They are gradually being preferred to TSTs to screen HCWs. TST has been used for initial screening of TB among HCWs. However, its low specificity among Bacilli Calmette–Guerin (BCG) vaccinated HCWs may provide false positive results, with a potential negative consequence of unnecessary chest X-rays and/or isoniazid prophylaxis. IGRAs are accurate and useful, especially in BCG-vaccinated HCWs in low prevalence countries. The latest TB prevention guidelines for HCWs indicate TSTs as the primary level screening, and positive cases are tested with IGRAs in most countries [4]. All health staff must be screened either by using TST or IGRA to establish baseline measurements before starting work in a hospital. In addition, an annual screening, wherein the results are compared with the baseline results, should be performed [5].

This study aimed to investigate the rate of TB history in hospital staff during their work in a healthcare setting, treatment administered after a TB diagnosis, rate of TST application before starting work, and other related variables in HCWs employed in institutions in the Eastern Black Sea Region of Turkey.

MATERIAL AND METHODS

A total of 460 HCWs employed in 5 hospitals in the Eastern Black Sea Region of Turkey, who agreed to participate, completed a questionnaire created by the authors. Demographic data including age, sex, smoking history, comorbidities, type

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of occupation, and work duration were collected. Data about self or family TB history, BCG vaccination, and TST application before starting work were also evaluated. All TSTs were applied using the Mantoux technique when the employees started working at the hospital, and the results were recorded as positive if the diameter was larger than 15 mm. The participants with a TB history were noted and evaluated with a detailed history, including the time of diagnosis, department where they were working, and the regimen and duration of TB treatment. It was also queried if they were treated as outpatients and if they had resistant TB. A total of 460 of 2056 HCWs (22.3%) who were employed in these 5 local hospitals completed the questionnaire.

The data collection took 3 months, between May 01 and July 31, 2016.

Statistical Analysis

The data were analyzed using the Statistical Package for the Social Sciences version 22.0 (IBM SPSS Corp.; Armonk, NY, USA) program. Categorical variables were expressed in terms of frequency (n) and percentage (%), and continuous variables were expressed as mean, median, min–max values, and standard deviation. The compatibility of continuous variables with normal distribution was tested using the Kolmogorov–Simirnov method. Chi-squared, Fisher's exact test, *t*-test, and Mann–Whitney U tests were used for bilateral comparisons, and p values <0.05 were considered statistically significant.

This study was approved by Ordu University clinical research ethics committee (approval number: 2016/29).

RESULTS

Of the 460 HCWs, 8 (1.7%) had TB history. The distribution of health institutions and occupational groups of the participants was examined; 58% were auxiliary health personnel (that is, HCWs other than nurses and doctors) (Table 1).

Of the participants, 69.3% were women (n=319) and 30.7% (n=141) were men; the median age was 32 (17–63) years (Table 2). No significant relationship between TB history and sex, smoking habits, or presence of comorbid diseases was demonstrated (p>0.05 for all variables). The participants were similar in terms of BCG vaccination or TST application before starting work (p>0.05). However, family history of TB ($\chi^2[1]=38.220$, p<0.001; Fisher's exact test) and TST positivity ($\chi^2[1]=78.540$, p<0.001; Fisher's exact test) were significantly higher in the TB group (Table 3).

MAIN POINTS

- Eight out of 460 study participants had active tuberculosis disease while working as HCWs.
- Having a family member who had TB at home environment and a positive TST before starting to work were risk factors for having TB.
- Health care workers with a positive family history and TST are candidates for TB prophylasis or close follow-up for the development of active disease.

Analysis of continuous variables revealed that patients with a TB history were similar to those with a negative TB history in terms of age, BMI (kg/m^2), and duration of smoking history (packs per year) (p>0.05). However, the median duration of work (years) of the participants with TB was higher than those without a TB history (15 years versus 5 years, z=-1.891, p=.059). The difference was not significant, although it was at the limit of significance (Table 2).

At the time of diagnosis, 87.5% (n=7) of the participants with TB continued working as HCWs, and 37.5% (n=3) were employed in the internal medicine department. The site of infection was the pleura in 12.5% (n=1), whereas pulmonary TB was reported in 87.5% (n=7).

The median treatment period was 180 (180–283) days; 75% of the patients were followed up as outpatients, and 25% were hospitalized. None of the patients had resistant TB (Table 4).

DISCUSSION

The incidence and prevalence of both LTBI and active disease in HCWs differ in the literature. According to estimates, 1% to 10% of HCWs may be annually infected at hospitals with more than 200 TB admissions per year [6]. In our study, the total number of TB cases diagnosed and/or followed up in these 5 hospitals in 2016 was 55, which accounts for approximately 0 to 3 HCWs who might have been infected annually. These are local hospitals catering to general health problems. As they are not branch hospitals, the number of TB cases followed up by these hospitals is relatively low. In larger or branch hospitals specifically dealing with TB, the estimated number of infected health staff is expected to be higher. Factors such as the annual incidence of TB in the general population, economic status of the country, work location/department in the healthcare

Table 1. Distribution of the Institutions and Occupations of the Participants

	Negative Total (n=460)	Positive (n=452) 98.3%	(n=8) 1.7%	
TB history	**n (%)**	**n (%)**	**n (%)**	**p**
Hospitals				
Hospital #1	216 (47.0)	214 (47.3)	2 (25.0)	
Hospital #2	113 (24.6)	110 (24.3)	3 (37.5)	0.358
Hospital #3	75 (16.3)	72 (15.9)	3 (37.5)	
Hospital #4	35 (7.6)	35 (7.7)	0	
Hospital #5	21 (4.6)	21 (4.6)	0	
Total	460	452	8	0.323
Occupation				
Auxiliary HCWs	267 (58.0)	260 (57.5)	7 (87.5)	
Nurses	151 (32.8)	150 (33.2)	1 (12.5)	
Doctors	42 (9.1)	42 (9.3)	0	
Total	460		8	

TB: tuberculosis; HCW: healthcare workers

facility, occupational categories, infection control measures of the country, and institution might play a role in this diversity.

In our study, the rate of TB among HCWs was 1.7% (8 of 460 HCWs), which is higher than the prevalence reported by He et al. [7]. (6.7/1000 among medical staff and 2.5/1000 among administrative/logistic staff). The discrepancy in the rates of TB cases in HCWs reported in these studies can be explained by the geographical features and difference in the degree of occupational exposure to active TB cases. Another explanation is that LTBI diagnosed by TST positivity is defined as a TST induration ≥10 mm in China, which is ≥15 mm in Turkey. This may mean that more HCWs with LTBI receive prophylaxis, which may in turn prevent the development of active disease. In a study examining TST diameters in young nursing trainees, 219 of 436 students (50.2%) were positive based on the 10 mm or greater cut-off, and 82 (18.8%) were positive based on the 15 mm or greater cut-off values [8].

In an article published by Arseven et al. [9] in 1983, 300 physicians and staff working in a tertiary center in Turkey were evaluated, primarily with chest X-ray, and suspected cases were examined with sputum smears for acid fast bacilli (AFB) and further evaluated if needed. Inactive TB lesions were detected in 14 patients (11 had TB in the last 1–1.5 years), 4 (1.3%) patients were accepted as active TB clinically, and 2 of them were AFB positive.[9] In another study, 945 HCWs

Table 2. Comparison of the Presence of TB in Terms of Continuous Variables

		Total (n=460)	TB negative (n=452) 98.3%	TB positive (n=8) 1.7%	
	N	M (min–max)	M (min–max)	M (min–max)	p value
Age (years)	460	31 (17–63)	32 (17–63)	25 (18–47)	0.903
BMI (kg/m^2)	443	24.4 (14.8–45.7)	24.4 (14.8–45.7)	26.3 (20.3–35.2)	0.689
Smoking (packs/year)	74	10 (0.25–35)	10 (0.25–35)	7.5 (5–10)	0.410
Work duration (years)	274	5 (0.2–40)	5 (0.2–40)	15 (10–23)	0.059

N: number, M: median, min–max: minimum–maximum

Table 3. Comparison of the Presence of TB in Terms of Demographic Variables

	Total (n=460)	TB negative (n=452) 98.3%	TB positive (n=8) 1.7%		Statistics
	n (%)	n (%)	n (%)	χ^2	p value
Sex				3.885*	0.062
Female	319 (69.3)	316 (69.9)	3 (37.5)		
Male	141 (30.7)	136 (30.1)	5 (62.5)		
Smoking history				1.074*	0.529
Positive	121 (26.3)	118 (26.1)	3 (37.5)		
Negative	339 (73.7)	334 (73.9)	5 (62.5)		
Never smoked	330 (71.7)	325 (71.9)	5 (62.5)		
Quit	9 (2.0)	9 (2.0)	0		
Comorbidities				0.539*	0.364
Present	72 (15.7)	70 (15.5)	2 (25.0)		
Absent	388 (84.3)	382 (84.5)	6 (75.0)		
BCG vaccination				0.759*	0.686
Present	341 (74.1)	334 (73.9)	7 (87.5)		
Absent	119 (25.9)	118 (26.1)	1 (12.5)		
TST (work onset)				3.166*	0.095
Present	109 (23.7)	105 (23.2)	4 (50.0)		
Absent	351 (76.3)	347 (76.8)	4 (50.0)		
Family history of TB				38.220*	<0.001
Positive	46 (10.0)	40 (8.8)	6 (75.0)		
Negative	414 (90.0)	412 (91.2)	2 (25.0)		
TST result				78.540*	<0.001
Positive	5 (1.1)	0	5 (62.5)		
Negative	455 (98.9)	452 (100.0)	3 (37.5)		

n: number, TST: tuberculin skin test

Table 4. Demographic and Clinical Characteristics of Patients with TB History (n=8)

	N	%
Continued working at the time of diagnosis		
Yes	7	87.5
No	1	12.5
Work department at the time of diagnosis		
Internal medicine	3	37.5
Emergency	2	25.0
Surgery	1	12.5
No data	1	12.5
Does not work at the hospital	1	12.5
Site of infection		
Pulmonary	7	87.5
Pleural	1	12.5
	Median	**Min–Max**
Treatment duration (days)	180	180–285
	N	**%**
Treatment modality		
Outpatient	6	75.0
Inpatient	2	25.0
Resistant TB		
No	8	100.0
Yes	0	0

N: number; Min–Max: minimum–maximum; TB: tuberculosis

employed at a university hospital and a city hospital were screened in 1994; 17 of them had TB history, and 4 (0.42%) received a diagnosis of definitive TB [10]. The percentage of HCWs with TB infection in our study is higher than that of the above two studies, although the presence of active TB has not been investigated in our study (total number of cases: 0.06 and 0.02 vs 1.7). This might be associated with local factors such as regional differences in TB incidence between cities and regions of the same country. In a study from the same area, the percentage of HCWs who had TB history was 1.5%, which was comparable with the results of our study [11]. Between 1986 and 1998, 6,156 HCWs from 4 major tertiary institutions were retrospectively evaluated to determine if they had a TB history. It was reported that 59 HCWs had TB in the past. Although the risk of TB was higher for HCWs than that for the normal population, it has been found that those working in the chest diseases clinics have 6.37 times higher risk than those working in other clinics. The risk of having TB was higher in medical staff working in the internal medicine and emergency departments (62.5%). In addition, the risk of nurses having TB was 2.63 times higher than that of doctors [12]. In our study, the history of TB was higher among HCWs other than nurses and doctors. This might be owing to low socioeconomic status or less adherence to healthcare measures among auxiliary health personnel.

In a study by Joshi et al., 674 HCWs with positive baseline TST or IGRA results were followed up for 6 years. Of them, 14 participants had developed active TB (incidence rate 3.5%) [13]. In some publications, it is indicated that this rate can go up to 10% [14]. Of these, 4 (28.6%) patients were men and 10 (71.4%) women; 4 (28.6%) HCWs had pulmonary TB, whereas the remaining 10 had extrapulmonary TB (4 pleural, 4 lymph node, 1 abdominal, and 1 bone/joint TB). A total of 6 (43%) of 14 HCWs had evidence of smear and/or positive TB culture, and almost all of them were <30 years of age. The incidence of TB was high in young trainees, nurses, and those who had worked for <5 years as an HCW at the time of baseline survey; however, none of the incidence rate ratios reached significance [13]. In our study, the mean age of TB positive cases was 25 years, which was similar to that in the aforementioned study. Of these, 3 were women (37.5%) and 5 (62.5%) were men. Only 1 (12.5%) of 8 patients developed extrapulmonary TB. The median work duration of HCWs in our study was 15 (10–23) years. This was inconsistent with the results of the former study in which 11 of 14 positive patients had worked for 1 to 5 years in the healthcare setting. This might be associated with the poor awareness of the protection methods for TB in HCWs who were inexperienced and relatively new at work. Prado et al. found a high prevalence of LTBI among older HCWs than younger HCWs. They reported that this association could be either because of a longer time of exposure to risks or the decreasing immunity that comes with age [15].

TB is an airborne infection transmitted through close contact with a contagious TB patient. Practically, the infection can be transmitted to HCWs either nosocomially or by bacilli from a non-hospital source. In some cases, it was assumed that close contact occurred among the household members, and the contact outside the house did not play a major role in the transmission of TB infection [16]. In our study, HCWs with a TB history had higher rates of in-house contact than those who did not. This finding underlines the possibility that the index patient was present at home. In some publications, gene polymorphism analysis methods have been used to determine the source of infection. Contradictory results are present, pointing out that the source is either a hospital or home environment [17]. In a study conducted in South Africa, Cape Town, where the incidence of TB is high, the households of TB cases were examined. In 18 of 33 households, isolates of different DNA strains were obtained from 2 patients in the same household. Furthermore, at least 1 patient had a strain that was not shared by another household member, suggesting that the infection was transmitted either out of home or occurred owing to reactivation of a latent infection [16]. In high incidence countries, repeated exposures of index patients and TB-naive subjects (that is, HCWs) may play a role in disease emergence. In countries where there is a great difficulty in tracing the transmission of TB, control and prevention strategies are still of great importance for both HCWs and the community. In our study, the percentage of TB history among HCWs other than doctors and nurses was 87.5% (7 of 8 HCWs). We have attributed this to the lower socioeconomic status of the auxiliary HCWs than that of others. In developing countries, community exposure likely accounts for most of the infectious diseases, including TB, owing to socioeconomic status differences.

As this was a study based on HCWs' self-reporting of their TST results and TB history by using a questionnaire, all the participants reported that they had negative (<15 mm) TST results. However, in a meta-analysis from Brazil, the prevalence of LTBI among primary HCWs was reported to be 27%. The following factors were positively associated with LTBI in primary HCWs: age >50 years; absence of a BCG scar; being an ex-smoker, nurse, nurse technician, or community HCW; and the irregular use of N95 masks [15]. The percentage of LTBI in HCWs has been reported to be different in different parts of the world. Studies using TST to detect LTBI reported high prevalence (38%–78%), whereas studies using IGRAs reported a lower prevalence of LTBI (8.9%–20.6%) in HCWs. The prevalence of LTBI in Turkey was reported to be 20.6% by Bozkanat et al. [18]. The diversity in the rates reported could be because of false positive TST results as a consequence of previous BCG vaccination, previous infection with non-TB mycobacteria, or differences in TB prevalence between study populations [19]. In our study, some of the HCWs seemed to have concealed their positive TST results. In addition, some of the workers who had TB history might not have been willing to complete the survey or may have hidden their disease history. The possible reasons for this may be the disinformation about TST positivity, which may be perceived as a contagious condition among HCWs. Moreover, stigma and preconceived notions of job loss may play a role in this situation. HCWs' perception of TB may change or improve with the help of in-service training, which should take place among other infection control measures.

All TSTs were performed using the Mantoux method, and the results were recorded as positive if the diameter was >15 mm. The results were grouped as positive or negative, but neither the longitudinal nor the transverse diameters were documented in detail. This reflects the insufficiency in HCWs' occupational health registries and a lack of a national medical archive system for HCWs. The records of infectious diseases such as TB or other disorders' may be used for large studies or statistical implications, which may in turn lead to a better understanding of disease spread and improvement in treatment modalities. Systematic education, annual examination, and standard recording system should be organized for better control of occupational diseases by health authorities. In a study investigating early tuberculin conversion among medical intern trainees in Tunisia, 4% of all trainees experienced TST conversion after they started working in the hospital. This study concluded that TST conversion rates were twice as high in hospitals without TB infection control measures than in those with precise infection control measures [20]. Potentially effective measures taken for the prevention of occupational TB transmission are managerial activities, administrative controls, practical usage of N-95 respirators, and engineering controls. The implementation of a sound TB infection control package on the basis of facility assessment is hampered by constraints in poor resource settings; nevertheless, administrative controls alone have been proven to be effective in reducing the risk of TB among HCWs [21]. An updated meta-analysis by Uden et al. [22] highlights the continuing need for improvements in infection control and HCWs' screening programs. Despite increasing efforts worldwide, occupational TB control still has not reached the desired level [23].

The limitations of our study are the retrospective design and self-reporting questionnaire methodology.

In conclusion, this study underlines the fact that the rate of TB is higher among HCWs than in the normal population. Effective infection control measures should be implemented to prevent the transmission of infection in a healthcare setting. The precautions include the use of masks by employees, negative pressure rooms, ultraviolet germicidal irradiation, regular TST scans, and treatment of LTBI in HCWs working in high-risk departments. In addition, HCWs should have chest X-rays before starting work at healthcare institutions, and chest X-ray and TST results should be recorded regularly for later comparisons.

Ethics Committee Approval: Ethics Committee approval for the study was obtained from the Clinical Research Ethic Committee of Ordu University (Approval Number: 2016/29).

Informed Consent: Written informed consent was obtained from the patients who agreed to take part in the study.

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