

Risk of tuberculosis among healthcare workers: can tuberculosis be considered as an occupational disease?

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Abstract This study aimed to determine the incidence of tuberculosis among hospital employees in four major urban institutions, which employ nearly 90% of all hospital workers caring for adult patients in a city of 2.5 million inhabitants. It also had the objective of finding out whether this incidence changes according to the in-hospital setting, i.e. the departments, and thus, whether tuberculosis can be considered to pose an occupational risk. The study population consisted of all healthcare workers of the four hospitals between 1986 and 1998. From these, those who developed tuberculosis within this period were determined and were considered as the case group. All the remaining employees constituted the control group. Fifty-nine healthcare workers were found to have developed the disease. The annual incidence was found to range between 0.016 and 0.139%. Tuberculosis was seen 3 times more frequently among the hospital employees than the general population. The workers in departments of chest diseases were found to have a higher risk than those of other departments (OR: 6.37, CI: 3.69–11.00). Similarly, the nurses were also at a higher risk than the doctors (OR: 2.63, CI: 1.12–6.36). These findings suggest that tuberculosis can be considered as an occupational disease. © 2002 Elsevier Science Ltd. All rights reserved

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INTRODUCTION

Hospital-acquired tuberculosis has been noted to increase in the recent years both in Turkey and in other countries (1–3). This increase in the latter has been attributed to the concurrent spread of HIV infection and of multi-drug resistant strains of *M. tuberculosis* (1).

Various studies showed 2–50 times higher risks of acquiring tuberculosis in the hospital setting than in the community (2–5). The Centers for Diseases Control and Prevention (CDC) reported a 3.2-fold higher risk (6).

There is no Turkish study conducted in this field. This study aimed to determine the incidence of tuberculosis among hospital employees in four major urban institutions (two secondary and two tertiary care centers), which employ nearly 90% of all hospital workers caring for adult patients in a city of 2.5 million inhabitants and

which serve to a population of 6 million people. It also had the objective of finding out whether this incidence changes according to the in-hospital setting, i.e. the departments, and thus, whether tuberculosis can be considered to pose an occupational risk.

METHODS

Study population

The study population consisted of all healthcare workers of four hospitals between 1986 and 1998. From this population, those who were diagnosed to have tuberculosis based on positive sputum cultures were determined, were considered as the case group and will hereafter be referred to as “patients”. All the remaining employees constituted the control group.

Methods

The data were collected by the investigators through examining various source documents (discharge letters,

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patient records, reports enabling patients for a sick leave) retrieved from each institution. The latter document is only given by a board of doctors at the departments of chest diseases, when the disease is tuberculosis and, while a copy is kept in the records of the board, another is sent to the institution of the patient in order to be filed. Using these data, standard case report forms were completed. As the number of healthcare workers varied within a year, the number in December was arbitrarily chosen as representative of that year. From these figures of the 13 years, which comprised the study period, the average number of employees per year was calculated for each of the four institutions. Similarly, the annual mean numbers of employees with different professional activities (doctors, nurses, paramedics) and of those working in pulmonary and non-pulmonary wards were separately calculated. Statistical analyses were performed using these mean numbers.

In order to determine the risk of hospital-acquired tuberculosis, the healthcare workers of the chest departments and of the Hospital of Chest Diseases were taken as the study group, whereas all others working in non-pulmonary sections formed the control group.

From the records of each patient, data on age, gender, profession, the department and institution where he or she worked, the duration of employment, past medical history, history of tuberculosis in his or her family, the organ involvement by tuberculosis, date of diagnosis, tuberculin reaction, drug resistance and the result of treatment were obtained. Risk rates for tuberculosis were calculated for each institution, department and profession group.

ANALYSIS

Statistical analysis was done with calculation of odds ratios and using chi-square analysis. SPSS 8.0 and Epiinfo version 5 software was used for this purpose.

Results

The annual mean number of employees in the study population was found to be 6156. The rate of tuberculosis among hospital admissions during the study period was found to be 26.3%.

During the study period, a total of 59 employees (26 males, 33 females) developed tuberculosis. Their mean age was 38.3 ± 11.7 years. The mean ages for male and female patients were 47.4 ± 10.1 and 31.2 ± 6.9 years, respectively. The yearly incidences are shown in Fig. 1, and their distribution to the four institutions in Table I.

Precise information regarding the duration of employment could be obtained for 44 of the 59 tuberculosis patients. Out of these, 88.6% were found to have worked for more than 24 months.

Data on past medical histories were obtained from the records of 37 of the patients. Thirty-three (89.2%) had unremarkable histories, one had developed tuberculosis previously, one had received immunosuppressive therapy and two had chronic obstructive lung disease which did not necessitate steroid treatment.

Information regarding previous exposure to tuberculosis bacilli was available for 37 patients. Of these, two

TABLE I. Distribution of cases with respect to institutions where they are employed

Institution	Number of cases	(%)
University Hospital	20	33.9
Hospital of Chest Diseases of Ministry of Health	19	32.2
Public Hospital	11	18.6
University Hospital Chest Department	9	15.3
Total	59	100.0

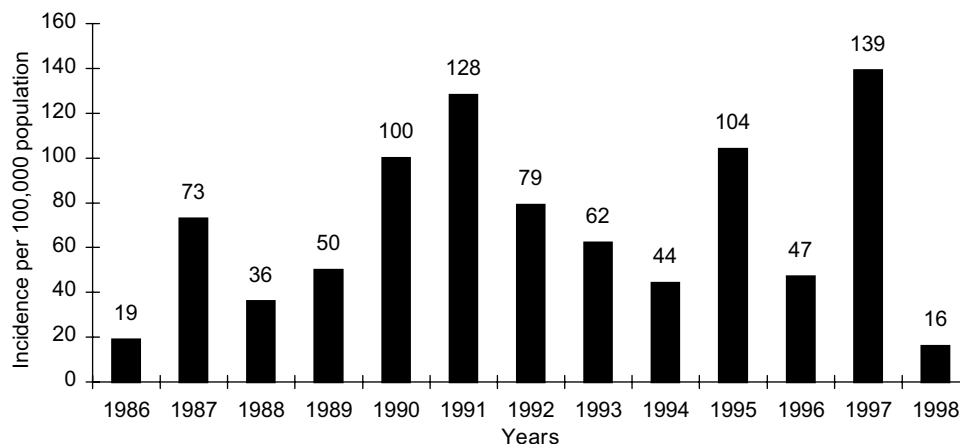


Fig 1. Yearly incidence of cases

reported contact to active tuberculosis cases within the family.

There was no difference between tuberculosis patients working in pulmonary and non-pulmonary disease departments with regard to past medical history and previous exposure to active tuberculosis cases.

The risk of developing tuberculosis was 6.37 times higher in employees of pulmonary disease departments as compared to those working in other departments (Table 2). Besides, working in the chest department of a university hospital was associated with a higher risk (8.0%) compared to working in a state hospital (3.5%) ($P=0.04$).

When the patient population was examined for occupational subgroups, the nurses were found to face a higher risk of acquiring tuberculosis than the doctors (OR: 2.63, CI: 1.12–6.36) (Table 3). There was no difference in risk between nurses and paramedics.

Doctors of pulmonary departments were at 6.97 times, the nurses 7.86 times, and the paramedics 7.70 times higher risk than those of non-pulmonary departments (OR: 6.97, CI: 1.37–31.70; OR: 7.86, CI: 2.90–21.62; OR: 7.70, CI: 2.49–24.57, respectively) (Table 4).

Tuberculin skin tests had been performed to four of the patients (6.8%) at the time they started working in

their current position, two had positive (larger than 10 mm) reactions. The test was done to 21 patients when tuberculosis was diagnosed and 18 (80.9%) had positive reactions.

Fifty (84.7%) of the patients developed pulmonary and/or pleural tuberculosis, eight had extrapulmonary involvement. No information could be obtained from one patient concerning the organ involved. Three (5.1%) of the patients were found to have *in vitro* resistance to one drug (two to isoniazid, one to streptomycin), three had multi-drug resistance. Fifty-one patients (86.4%) were successfully treated with isoniazid, rifampin, ethambutol and morphozinamide. One was a failure and progressed to chronic tuberculosis. No data on prognosis were obtained from the records of seven patients.

DISCUSSION

In this study, we aimed to determine the prevalence and epidemiologic features of tuberculosis among healthcare workers employed in secondary and tertiary care centers in a large city. As this was a retrospective review of hospital records, data on demographic characteristics and presenting features of the disease were incompletely obtained. No information was found on the treatment results in seven of the cases, even though they were hospital employees and this unfortunately reflects the insufficiency of the archiving system.

The most important finding of the study was that tuberculosis developed much more frequently in the study group compared with the general population. Although the incidence varied from year to year, the highest level it reached was 139 per 100,000. This was nearly 3-fold higher than the incidence in Turkey, 48 per 100,000 and 3.8-fold higher than the incidence in Izmir, 36 per 100,000, the city in which the investigation was conducted. This higher risk faced by the healthcare workers has previously been emphasized by the results of several studies (1,4,6,7–15).

There was no apparent risk factor in the majority of the study group patients with regard to their past medical history or history of tuberculosis within the close family. On the other hand, close to 90% had been employed for more than 2 years. Ward patients that these healthcare workers encountered and served in the working environment thus seem to be the main source of infection. The mean age of the study group, which is 38.3 years, is representative of the epidemiology of the disease in developing countries (8,9). Fifty-eight percent of tuberculosis cases in Turkey is between the ages of 20 and 44 according to the data of Turkish Health Ministry. This means that tuberculosis in Turkey is the disease of young population. Mean age in this study (38.3 ± 11.7) is also in accordance with these data. Although no data associated with sex were found among the data of Turkish Health

TABLE 2. The risk of tuberculosis in employees of pulmonary and non pulmonary sections

Groups	Tb (+)	Tb (–)	Total
Pulmonary section	28	757	785
Employees	(3.56%)	(96.44%)	(12.75%)
Non pulmonary	31	5340	5371
Section employees	(0.58%)	(99.42%)	(87.25%)
Total	59	6097	6156
	(0.96%)	(99.04%)	(100.0%)

Note: Odds Ratio: 6.37 (CI: 3.69–11.00) Tb: tuberculosis.

TABLE 3. The risk of tuberculosis in occupational subgroups

Occupation	Tb(+)	Tb(–)	Total
Nurse ^a	19	1639	1658
	(1.15%)	(98.85%)	(32.32%)
Doctor ^a	9	2003	2012
	(0.45%)	(99.55%)	(39.22%)
Paramedic	15	1445	1460
	(1.03%)	(98.97%)	(28.46%)
Total	43	5087	5130 ^b
	(0.84%)	(99.16%)	(100.0%)

Note: χ^2 : 6.22 SD: 2, P : 0.044, Tb: Tuberculosis.

^aOdds ratio: 2.63, (CI: 1.12–6.36), odds ratio done between doctors and nurses. ^bIncludes only doctors, nurses and paramedics. Other staff were excluded.

TABLE 4. The risk of tuberculosis in occupational subgroups working in different departments

	Doctors ^a		Nurses ^b		Paramedics ^c	
	Tb (+)	Tb (-)	Tb (+)	Tb (-)	Tb (+)	Tb (-)
Pulmonary	3	134	11	244	9	236
Section	(2.18%)	(97.81%)	(4.31%)	(95.69%)	(3.67%)	(96.32%)
Nonpulmonary	6	1869	8	1395	6	1209
Section	(0.32%)	(99.68%)	(0.57%)	(99.43%)	(0.49%)	(99.51%)
Total	9	2003	19	1639	15	1445
	(0.45%)	(99.55%)	(1.15%)	(98.85%)	(1.03%)	(98.97%)

^a(Fisher exact χ^2 : P: 0.019), odds ratio: 6.97 (CI: 1.37–31.70).

^b(Fisher exact χ^2 : P: 0.000), odds ratio: 7.86 (CI: 2.90–24.57).

^c(Fisher exact χ^2 : P: 0.000) odds ratio: 7.70, (CI: 2.49–24.57).

Ministry, no difference was observed between males and females in disease development in the study group. Ninety-nine percent of Turkish population and also of the study group is caucasian. Therefore, an ethnic difference related to tuberculosis has no significance and specificity in both our community and the study group.

Two factors could have a role in the high incidence of nosocomially acquired tuberculosis; delay in the diagnosis of the ward patients with active tuberculosis, particularly the smear-positive ones, and lack of appropriate protective measures, both of which would result in increased and prolonged exposure to tuberculosis bacilli in the working environment.

A review of all patient records during the study interval showed that nearly all smear-positive cases were diagnosed within the first 3 days of hospitalization, whereas the diagnosis was delayed for as long as 40 days in smear-negative ones. Although smaller than in the smear-positive cases, the risk of infection with contact with the latter group needs to be taken into consideration. A high index of suspicion and close cooperation with the microbiology laboratory might reduce the time to diagnosis.

Several protective measures can be taken in order to reduce the risk of tuberculosis infection in the hospital setting. One is the need for isolation of the infectious cases and use of ultraviolet lights in patient rooms, outpatient clinics and laboratories. These are rarely done in countries with limited resources because of economic restraints, as is the case in the institutions that participated in this study. A control program needs to be issued in hospitals of areas with a high prevalence of tuberculosis, in order to protect the healthcare workers from nosocomial infection (16–18). This would include screening with serial tuberculin testing. Only four of the 59 tuberculosis cases (6.8%) in this study had a tuberculin test at the time of employment. It must be borne in mind, on the other hand, that this approach is of limited use in countries where routine BCG vaccination is done. In Turkey, until very recently, revaccination was recommended as

part of the national tuberculosis program, to reach a total of four vaccinations. It has been shown that tuberculin reaction size significantly increases with the number of vaccines received.

When subgroup analysis was made for different occupations, nurses and paramedics were found to carry a nearly 3-fold higher risk as compared with the doctors. This is similar to the findings reported by Sepkowitz (4) and Schwartzman *et al.* (5). This possibly reflects the fact that the nurses and paramedics have longer patient contact. It can also be argued that they may be less careful in complying with protective measures.

Tuberculosis was also found to develop more frequently in employees working in the chest departments, with a risk ratio of 6.37. This is also consistent with previous reports (2,4,5,12,13). The observation that the disease is more prevalent in university hospitals is possibly related to the fact that more seriously ill patients, including the immunocompromised, are cared for in these tertiary care centers, in which more patients undergo invasive procedures and are treated in intensive care units and bronchoscopy is more frequently performed for diagnostic purposes. These have already been reported as significant risk factors (14,15).

Drug resistance rates were lower in this study group compared with the general population in Turkey (19). Out of six cases with drug-resistant tuberculosis, one had resistance to isoniazid and rifampin, but was cured with isoniazid, rifampin, ethambutol and morphozinamide. The case who went on to develop chronic tuberculosis did not have any bacteriologically documented resistance. This may thus have been due to non-compliance with treatment for which no conclusive record was found. It may alternatively be explained by the lack of reliability of susceptibility testing.

In conclusion, healthcare workers, and particularly those frequently dealing with tuberculosis patients are at an increased risk of contracting the disease. Therefore, a standard control program needs to be strictly followed and physical protective measures need to be

established including the installation of hepafilter systems or ultraviolet lights in patient rooms in the departments which are at risk. Besides, emphasis must be placed on the education of the employees and on the necessity for better record keeping.

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