

Incidence of latent tuberculosis infection among health science students during clinical training

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Abstract:

BACKGROUND: The prevalence of latent tuberculosis infection (LTBI) has been found to be high among students undergoing clinical training. The aim of this study is to determine the incidence of LTBI among undergraduate health science students after their clinical training and to compare the risk between different college specialties.

METHODS: This is a retrospective cohort study of students who completed their clinical training from 2010 to 2017. The risk of LTBI was defined based on the conversion of tuberculin skin test (TST) results from negative at the start of training to positive after the completion of training.

RESULTS: A total of 2000 students were evaluated, of whom 1997 were included in this analysis. Six percent tested positive in the first TST of the initial screening. Ten percent of students with a normal baseline TST converted to positive on the follow-up TST. Clinical training in the college of medicine increased the risk of LTBI by 76% (odds ratio: 1.76; 95% confidence interval: 1.04– 2.96; $P = 0.03$) compared to clinical training in other medical colleges.

CONCLUSIONS: The risk of acquiring LTBI during clinical training in health science colleges is 10%. Students in the college of medicine are at significantly higher risk of LTBI than students of other health science specialties.

Keywords:

Latent tuberculosis infection, medical students, tuberculin skin test

Latent tuberculosis infection (LTBI) is defined by the World Health Organization as “a state of persistent immune response to stimulation by *Mycobacterium tuberculosis* (MTB) antigens without evidence of clinically manifested active tuberculosis (TB).”^[1] It is estimated that 23% of the world’s population is infected with MTB and at risk of developing active TB.^[2] Despite being an old disease, TB continues to be a major public health concern, especially in low- and middle-income settings such as the middle east and other developing countries. Saudi Arabia reports a high number of incident TB cases annually.^[3] Based on the World Health Organization

report, the estimated TB incidence rate in Saudi Arabia was 18/100,000 people in 2012, and Saudi Arabia remains a country of moderate TB burden.^[1,3,4] The estimated prevalence of LTBI in Saudi Arabia was 9.3%.^[4]

Several studies were conducted to determine the populations who are at increased risk of acquiring TB; of those populations, medical students and health-care workers were determined to have a higher prevalence of LTBI.^[5-17] A meta-analysis was conducted to estimate the prevalence of TB among high-risk groups and showed an increased prevalence of TB among medical students, interns, and health-care workers.^[4-9,18-20]

Undergraduate medical students are exposed to TB patients as health-care

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workers during their clinical training period. This risk might increase if the students lack sufficient knowledge about the disease and its mode of transmission, especially if they do not strictly adhere to the use of personal protective equipment and measures of infection control when dealing with TB or TB suspect patients. The aim of this study is to determine and compare the incidence of LTBI among undergraduate students of different health science colleges after their clinical training.

Methods

The study population consists of all undergraduate students who completed the clinical training in the following colleges from 2010 to 2017: college of medicine, college of dentistry, college of nursing, college of pharmacy, and college of applied medical sciences (including physiotherapy, laboratory science, and nutrition). We included students who were screened for TB with a tuberculin skin test (TST) before and after their clinical training as undergraduates. We excluded students with active TB.

The data were collected using a standardized form that includes age; gender; nationality; college or specialty; date of first, second, and additional TSTs; duration between the TSTs; results of TSTs; follow-up chest X-rays and sputum cultures; comorbid illnesses; and the prescription of isoniazid (INH).^[21] The TST was performed by injecting five units of protein-purified derivative intradermally, and the results were reviewed 48–72 h later. A 10 mm or more skin induration was considered a positive result, and for those with a negative result, a second step screening was performed 2 weeks later. An additional TST was performed after the last year of in-hospital training before graduation.^[22-24]

The study was conducted after ethical approval from the Institutional Review Board at King Abdulaziz University Hospital. Permission for access to participants' data was also obtained from the King Abdulaziz University Hospital. No participant identifiers were used during data collection.

Data analysis

The proportions for dichotomous variables and means for continuous variables were calculated to describe the patients' characteristics. The risk of TB infection among the students of each college was compared using a Chi-square test and logistic regression analysis. To control for potential confounding factors (age, immigration status, comorbidity, a history of contact with TB patients, and the duration of training between TSTs), multivariate logistic regression analysis was performed. The selection of confounding factors (covariates) that were included in the regression model was based on *a priori* theoretical assumption using directed acyclic graphs. The result of

the regression model was presented as odds ratio (OR) with 95% confidence interval. Statistical significance was determined using the 95% CI and $P = 0.05$. All analyses were performed using STATA (Version 12, Software StataCorp. 2011. Stata Statistical Software: Release 12. College Station, TX, USA: StataCorp LP).

Results

A total of 2000 students were evaluated, of whom 1997 were included in the analysis. The demographic characteristics and the students' distribution among the different colleges are summarized in Table 1.

Among the 1997 students, 6% tested positive on the first TST of the initial screening; 88% of them underwent chest radiograph, which showed no abnormalities suggestive of pulmonary TB. On the other hand, 10% of students with normal baseline TST tested positive on the follow-up TST after an average duration of 25 months of hospital exposure. INH prophylaxis was prescribed to 48% of the students with positive TST results, as shown in Table 2.

There was a significant difference in the risk of LTBI between students in different colleges during their clinical training [Figure 1]. This difference was not influenced by the duration of the training, as shown in Figure 2. Clinical training in the college of medicine increased the risk of TB infection by 76% compared to clinical training in other medical colleges (adjusted OR: 1.76, 95% CI: 1.04–2.96, $P = 0.03$; adjusted for age, immigration status, comorbidity, a history of contact with TB patients, and the duration of clinical training).

Discussion

Our study showed that the incidence of LTBI acquired during clinical training is 10%. Across all different health science colleges, medical students were at the highest

Table 1: General characteristics of included patients

Characteristics	n/Total	Estimate	95% CI
Age (years), mean (SD)	-	23.8 (2.2)	23.7-23.9
Male sex, (%)	693/1996	34.7	32.6-36.9
Saudi nationality, (%)	1931/1997	96.7	95.8-97.4
Chronic illness, (%)	29/1966	1.5	1.0-2.1
College, (%)			
Nutrition	150/1997	7.5	6.4-8.8
Laboratory	205/1997	10.3	9.0-11.7
Nursing	394/1997	19.7	18.0-21.5
Pharmacy	98/1997	4.9	4.0-5.9
Dentistry	372/1997	18.6	16.9-20.4
Radiology	104/1997	5.2	4.3-6.3
Physiotherapy	200/1997	10.0	8.7-11.4
Medicine	474/1997	23.7	21.9-25.6

SD=Standard deviation

Table 2: Medical screening among included individuals

Characteristics	n/total	Estimate	95% CI
Positive screening (initial) TST (%)	108/1822	5.9	4.9-7.1
Performed CXR* (%)	96/108	88.9	81.4-94.1
Abnormal CXR* (%)	0/90	0	0-4.0
Performed MTB culture* (%)	0/108	0	0-3.4
Positive follow-up (additional) TST** (%)	134/1345	9.9	8.4-11.6
Average follow-up duration [§] (mean, months)	-	24.6 (11.6)	23.9-25.2
INH treatment (%)			
Among individuals with initial positive TST	47/108	43.5	34.0-53.4
Among all individuals with positive TST ^{§§}	117/242	48.3	41.9-54.8

*Among patients with positive TST results, **Among patients with baseline-negative TST results (TST conversion), §Between screening and follow-up TSTs, §§Among patients with positive screening or follow-up TST results. TSTs=Tuberculin skin tests, CXR=Chest X-ray, MTB=*Mycobacterium tuberculosis*, INH=Isoniazid, CI=Confidence interval

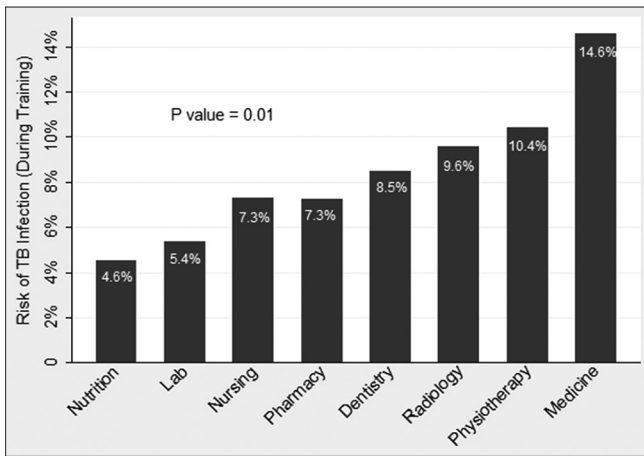


Figure 1: Risk of tuberculosis infection during clinical training in different medical colleges. TB = Tuberculosis

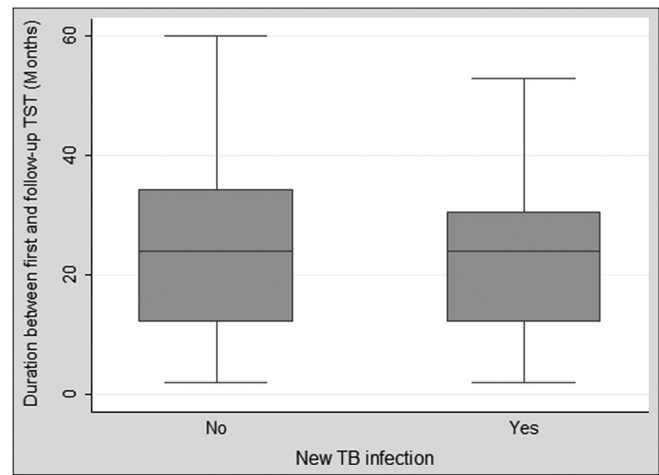


Figure 2: Duration of training between screening and follow-up tuberculin skin test, comparing trainees who developed and those who did not develop a new TB infection. TST = Tuberculin skin test, TB = Tuberculosis

risk of LTBI. These findings are alarming, considering that Saudi Arabia is a moderate TB-burden country.^[25,26]

Our findings are supported by observations from other studies that evaluated the prevalence of LTBI and identified a higher prevalence of LTBI among medical students as well as health-care workers.^[5-17] For instance, a study conducted in Tunisia showed that the prevalence of LTBI was 26.6% among medical interns, which is much higher than what we observed among undergraduate clinical trainees. Based on a recent meta-analysis that included studies of different Iranian populations, the prevalence of LTBI varied across different TB exposure risks, with a prevalence of 25% in the general population and 39% among health-care workers.^[5] Local studies within Saudi Arabia showed that the prevalence of LTBI ranged from 5% to 12% among health science colleges, (namely dental assistance, physiotherapy, midwifery, nursing, and radiology) and was approximately 11% among health-care workers.^[6,7]

Comparing different health science specialties in our study population, the risk of LTBI was significantly higher in specialties with closer contact with patients,

such as medicine, and lower in specialties with less contact with patients, such as laboratory science and nutrition.

It is notable that INH was prescribed for less than half of our study population, which is considered a high-risk group. Although we cannot explain the reasons for such a low treatment rate, proper management of latent TB infection in this specific population group (health-care personnel) is crucial to achieve public TB control.

The main limitations of this study include the lack of follow-up data regarding the development of active TB disease among LTBI patients and the single-center study design. Despite these limitations, the study had a large sample size that provided enough power to compare different health science colleges. In addition, we measured the incidence of LTBI using initial and follow-up TST results, unlike most published studies that compared the existing LTBI prevalence.

Our findings have important clinical implications for determining the risk of LTBI in a vulnerable group of

students who will be practicing medicine and providing care for the general population. These findings underscore the importance of prioritizing TB preventive programs across different health-care specialties, especially for the most vulnerable health science students who are still in training and have little experience with self-care preventive practices. Published studies have shown that less than half of health science students (46.7%) have knowledge about TB and its transmission.^[27]

Conclusions

In our study population, the risk of LTBI acquired during clinical training among health science students is 10%. Compared to students of other colleges, medical students are at significantly higher risk of LTBI. These observations underscore the importance of applying additional infection control measures to protect undergraduate health science students who are considered a vulnerable population group.

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Conflicts of interest

There are no conflicts of interest.

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