Prevalence of latent tuberculosis infection among multinational healthcare workers in Muhayil Saudi Arabia

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Objectives The aim of this work was to assess the prevalence of latent tuberculosis infection (LTBI) in multinational healthcare workers (HCWs) in Muhayil, Saudi Arabia.

Materials and methods This work was carried out in 2013 and included all hired HCWs in Muhayil National Hospital (MNH), Muhayil, south of Saudi Arabia. Data were collected from HCWs including age, sex, job category, and country of citizenship. They were examined for LTBI using the tuberculin skin test (TST) after obtaining their consent to perform the test. CXR was also carried out in all participants to (and if needed sputum stain for *Mycobacterium tuberculosis* smear) for the detection of active disease. Statistical analysis was carried out, and P values less than 0.05 were considered significant.

Results Out of the 208 HCWs tested with TST, 47 (22.5%) were positive. The prevalence of LTBI was the highest in the age group of 50 years or more [26.3% ($n = 5$)] and the lowest in the age group 20–29 years [19% ($n = 14$)]. The prevalence of LTBI was the highest in nurses [28.7% ($n = 21$)] and the lowest in physicians [16.5% ($n = 7$)]. The prevalence of LTBI was the highest in HCWs from the Philippines [27.5% ($n = 23$)] and the lowest in HCWs from the Middle East, Saudi Arabia, and Yemen [16.5% ($n = 3$)]. Signs suggestive of inactive TB were found in 10% of the participants ($N = 21$), and all of them were TST positive (44.5% of all TST-positive participants).

Conclusion LTBI is prevalent in HCWs in MNH, especially in nurses and in HCWs from countries with high rates of tuberculosis (Philippine and South Asia).

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Introduction and aim of the work

According to the WHO, one-third of the world's population is already infected with TB and every second, someone somewhere is newly infected with tuberculosis [1].

Tuberculosis can be considered both a nosocomial and an occupational infection [2]. TB in healthcare workers (HCWs) is often caused by an infection at their workplace [3]. Adequate infection control measures by the hospital authorities, high suspicion of tuberculosis by clinicians, and early identification of latent tuberculosis infection (LTBI) are necessary to prevent tuberculosis among HCWs [4]. Tuberculin skin test (TST) testing is an accepted inexpensive method for the detection of LTBI despite debates on its limitations and effectiveness in individuals recently vaccinated with BCG [5].

Most published data on LTBI in HCWs in Saudi Arabia were from hospitals of big cities such as Riyadh and Jeddah, and not much data are available for HCWs in remote areas such as Muhayil South of Saudi Arabia.

The aim of this work was to assess the prevalence of LTBI in HCWs in Muhayil, Saudi Arabia.

Materials and methods

This work was carried out in 2013 and included all hired HCWs in Muhayil National Hospital (MNH), Muhayil, south of Saudi Arabia (after obtaining the consent of the participants). Data were collected from each HCW including age, sex, job category, and country of citizenship. They were examined for LTBI using TST by an injection (using a 26-G needle) of 0.1 ml (5 U) of purified protein derivative intracutaneously (Mantoux test) into the volar aspect of the forearm. The reaction was read 48–72 h later; the size of the reaction was determined by measurement of the induration, not the erythema. A measurement equal to or more than 10 mm was considered positive [6]. The test was performed and read by the chest consultant in MNH. Plain posteroanterior Chest X Ray (CXR) was also performed for all participants (and if needed sputum stain for Mycobacterium tuberculosis smear) for the detection of active disease. The X rays were examined by the radiology consultant in Muhayil National Hospital (MNH). The study methods were approved by the Muhayil National Hospital ethical committee.

The results of the TST testing and CXR were analyzed with other variables.

Statistical analysis

Statistical analysis was carried out using the SPSS program (version 14; SPSS Inc., Chicago, Illinois,

USA). Odds ratios (ORs) were calculated. All P values less than 0.05 were considered significant in this study.

Results

Of the 208 participants in this work (Table 1), 36 were physicians (32 from the Middle East and four from Yemen), 73 were nurses (54 from Philippines, 11 from South Asia, three from Middle East and five from Yemen), 29 were technicians (10 from Philippines, nine from South Asia, one from Saudi Arabia and nine from Yemen), 39 were administrators (four from Philippines, four from South Asia, seven from the Middle East, and 23 from Saudi Arabia), and 31 were handy workers (15 from Philippines and 16 from South Asia).

The TST was performed for 208 HCWs; 91 (43.75%) of these workers were men and 117 (56.25%) were women. Seventy-three (35%) workers were in the age group 20–29 years, 89 (43%) workers were in the age group 30–39 years, 27 (13%) workers were in the age group 40–49 years, and 19 (9%) workers were in the age group of 50 years or more (Table 2).

TST was positive in 47 (22.5%) HCWs. The prevalence of positive TST was 22% (n = 20) in men and 23% (n = 23) in women [OR: 1.01; 95% confidence interval (CI): 0.52, 1.95)]. The prevalence of positive TST was 19% (n = 14) in the age group 20–29 years, 23.5% (n = 21) in the age group 30–39 years (OR: 1.3; 95%

CI: 0.6, 2.78), 26% (n = 7) in the age group 40–49 years (OR: 1.47; 95% CI: 0.52, 4.17), and 26.3% (n = 5) in the age group of 50 years or more (OR: 1.5; 95% CI: 0.46, 4.87) (Tables 2 and 3).

The prevalence of positive TST was 15% (n = 6) in administrators, 16.5% (n = 7) in physicians (OR: 1.3; 95% CI: 0.4, 4.4), 28.7% (n = 21) in nurses (OR 2; 95% CI: 0.75, 5.6), 21% (n = 5) in technicians (OR: 1.14; 95% CI: 0.31, 4.2), and 25.8% (n = 7) in workers (OR: 1.9; 95% CI: 0.58, 6.25) (Tables 3 and 4).

The prevalence of positive TST according to countries of citizenship or region of HCWs was 16.5% (n = 4) in HCWs from Saudi Arabia, 27.5% (n = 23) in HCWs from the Philippines (OR: 1.9; 95% CI: 0.6, 6.2), 24.4% (n = 10) in HCWs from South Asia (OR: 1.6; 95% CI: 0.44, 5.85), 16.5% (n = 7) in HCWs from the Middle East (OR: 1; 95% CI: 0.26, 3.84), and 16.5% (n = 3) in HCWs from Yemen (OR: 1; 95% CI: 0.19, 5.15) (Tables 3 and 5).

Chest X ray was performed for all participants in this work (N = 208) and signs suggestive of inactive TB were found in 10% (N = 21); all of them were TST positive (44.5% of all TST-positive participants). The overall percent of agreement between positive tuberculin and positive CXR was 87.5%, the positive percent agreement was 44.7%, and the negative percent agreement was 100%. None of the participants had CXR findings suggestive of active TB (thus, no sputum smear examination was performed) (Tables 6 and 7).

Table 1 Classification of participants according to country (or region) and job category

Job category	Philippines (N)	South Asia[a] (N)	Middle East[b] (N)	Saudi Arabia (N)	Yemen (N)	Total [N (%)]
Physicians	0	0	32	0	4	36 (17.3)
Nurses	54	11	3	0	5	73 (35)
Technicians	10	9	0	1	9	29 (14)
Administrators	4	5	7	23	0	39 (18.7)
Workers	15	16	0	0	0	31 (15)
Total [N (%)]	83 (40.1)	41 (19.7)	42 (20.2)	24 (11.5)	18 (8.5)	208 (100)

[a]India, Pakistan, and Bangladesh; [b]Egypt, Sudan, Jordan, Syria, and Palestine.

Table 2 Tuberculin skin test results according to age and sex of the participants

Variables	TST results			P value	Significance
	Positive TST [N (%)]	Negative TST [N (%)]	Total [N (%)]		
Age group (years)					
20–29	14 (19)	59 (81)	73 (35)	0.000000	Significant
30–39	21 (23.5)	68 (76.5)	89 (43)	0.000000	Significant
40–49	7 (26)	20 (74)	27 (13)	0.000000	Significant
≥50	5 (26.3)	14 (73.7)	19 (9)	0.000000	Significant
Total	47 (22.5)	161 (77.5)	208 (100)	0.000000	Significant
Sex					
Males	20 (22)	71 (78)	91 (43.75)	0.000000	Significant
Females	27 (23)	90 (77)	117 (56.25)	0.000000	Significant
Total	47 (22.5)	161 (77.5)	208 (100)	0.000000	Significant

TST, tuberculin skin test.

Table 3 Analysis of risk factors for latent tuberculosis infection in healthcare workers

Variables	Tuberculin test results[a]		Odds ratio (95% CI)
	Negative (n = 161) [N (%)]	Positive (n = 47) [N (%)]	
Age group (years)			
20–29	59 (81)	14 (19)	1
30–39	68 (76.5)	21 (23.5)	1.3 (0.6, 2.78)
40–49	20 (74)	7 (26)	1.47 (0.52, 4.17)
≥50	14 (73.7)	5 (26.3)	1.5 (0.46, 4.87)
Sex			
Female	93 (57.8)	27 (57.4)	1
Male	68 (42.2)	20 (42.6)	1.01 (0.52, 1.95)
Nationality			
Saudi Arabia	20 (83.5)	4 (16.6)	1
Middle East	35 (83.5)	7 (16.5)	1 (0.26, 384)
Philippine	60 (27.5)	23 (72.5)	1.9 (0.6, 6.2)
South Asia	31 (75.6)	10 (24.4)	1.6 (0.44, 5.85)
Yemen	15 (83.5)	3 (16.5)	1 (0.19, 5.15)
Occupation			
Administrator	33 (85)	6 (15)	1
Nurse	52 (71.3)	21 (28.7)	2 (0.75, 5.6)
Physician	29 (16.5)	7 (83.5)	1.3 (0.4, 4.4)
Technician	24 (21)	5 (79)	1.14 (0.31, 4.2)
Worker	23 (74.2)	8 (25.8)	1.9 (0.58, 6.25)

CI, confidence interval; [a]Tuberculin results of ≥10 are considered positive.

Discussion

According to the WHO 2014 global TB report [7], there were 9.0 million new TB cases and 1.5 million TB deaths in 2013.

The overall prevalence of LTBI (TST positive) in the participating HCWs was 22.5% (47 out of 208), which is higher than that reported by Abbas et al. [8], who found a prevalence of 11% among HCWs in four major tertiary care hospitals in Riyadh, Saudi Arabia, and higher than that that reported by Nienhaus et al. [9], who found a prevalence of 26.7% (TST, Mantoux method). The prevalence of LTBI was much higher (79%) among HCWs of King Abdulaziz University Hospital, Saudi Arabia [10]. Other studies showed a higher prevalence of LTBI in HCWs (40.8%, 79%) [11,12].

In this work, the prevalence of LTBI in HCWs was the highest in the age groups 40–49 years (26%) and at least 50 years (26.3%) and was the lowest in the age group 20–29 years (19%). Nienhaus et al. [9] reported that the prevalence of LTBI increased from 4.6% in HCW younger than 30 years to 69.2% in HCW older than 60 years. Other studies reported an increased prevalence of LTBI in HCWs with increased age [8,13–15].

Table 4 Tuberculin skin test results according to job category

Job category	TST results			P value	Significance
	Positive TST [N (%)]	Negative TST [N (%)]	Total [N (%)]		
Physicians	7 (16.5)	29 (83.5)	36 (17.3)	0.000000	Significant
Nurses	21 (28.7)	56 (71.3)	73 (35)	0.000000	Significant
Technicians	5 (21)	24 (79)	29 (14)	0.000000	Significant
Administrators	6 (15)	33 (85)	39 (18.7)	0.000000	Significant
Workers	8 (25.8)	23 (74.2)	31 (15)	0.000000	Significant
Total	47 (22.5)	161 (77.5)	208 (100)	0.000000	Significant

TST, tuberculin skin test.

Table 5 Tuberculin skin test results according to nationality

Country or region	TST results			P value	Significance
	Positive TST [N (%)]	Negative TST [N (%)]	Total [N (%)]		
Philippine	23 (27.5)	60 (72.5)	83 (40.1)	0.000000	Significant
South Asia[a]	10 (24.4)	31 (75.6)	41 (19.7)	0.000000	Significant
Middle East[b]	7 (16.5)	35 (83.5)	42 (20.2)	0.000000	Significant
Saudi Arabia	4 (16.5)	20 (83.5)	24 (11.5)	0.000000	Significant
Yemen	3 (16.5)	15 (83.5)	18 (8.5)	0.000000	Significant
Total	47 (22.5)	161 (77.5)	208 (100)	0.000000	Significant

TST, tuberculin skin test; [a]India, Pakistan, and Bangladesh; [b]Egypt, Sudan, Jordan, Syria, and Palestine.

Table 6 CXR results compared with tuberculin skin test

TST results	CXR results			P value	Significance
	Positive CXR[a] [N (%)]	Negative CXR [N (%)]	Total [N (%)]		
Positive TST	21 (44.5)	26 (55.5)	47 (100)	0.000000	Significant
Negative TST	0 (0)	161 (100)	161 (100)	0.000000	Significant
Total	21 (10)	187 (90)	208 (100)	0.000000	Significant

[a]Findings suggestive of old TB (e.g. fibronodular lesions, upper zone calcification), NB: none of the participants had signs of active TB.

Table 7 Relationship and agreement between tuberculin and CXR

Variables	Tuberculin test results		P value
	Positive (n = 47)	Negative (n = 161)	
CXR results			
Positive (n = 21) [N (%)]	21 (44.7)	0 (0.0)	<0.001[a]
Negative (n = 187) [N (%)]	26 (55.3)	161 (100)	
Spearman correlation		0.620	<0.001[b]
Weighted Cohen's kappa agreement		0.565	<0.001[b]
Overall percent agreement		87.5%	95% CI = 83.1, 91.9%
Positive percent agreement		44.7%	95% CI = 37.9, 51.5%
Negative percent agreement		100%	100%

CI, confidence interval; [a]Fisher's exact test was used to compare the difference in proportions.
[b]Based on normal approximation.

The prevalence of LTBI was 22% in men and 23% in women, without a significant difference. A similar finding (with lower results of 7.2% in men and 7.1% in women) was reported by Schablon et al. [13]. In another study [16], female HCWs had a higher prevalence of LTBI than male HCWs.

The prevalence of LTBI was the highest among nurses (28.7%) and workers (25.8%) and the lowest among administrators (15%) and physicians (16.5%). Mirtskhulava et al. [16] reported a higher prevalence among nurses and physicians (67.8 and 66.7%). Abbas et al. [8] found that the highest prevalence of LTBI among HCWs was in physicians (14.9%) and nurses (12.9%). In another study [15], the prevalence of LTBI was the highest among physicians (41.2%), followed by nurses (30.3%).

The higher prevalence of LTBI among nurses than among physicians in this work can be attributed to the differences in the burden of TB in their country of citizenship [all participating physicians were from the Middle East and Yemen and most of the participating nurses (65 out of 73) were from South and Southeast Asia (Table 1)].

The highest prevalence of LTBI, according to country or the region of origin in this work, was among HCWs from the Philippine (27.5%). HCWs from South Asia had a prevalence of 24.4%. HCWs from the Middle East, Saudi Arabia, and Yemen had the lowest prevalence (16.5%). Abbas et al. [8] found the highest prevalence among HCWs in Riyadh, Saudi Arabia, from Subsaharan countries (61.1%), followed by HCWs from Western countries (18.7%), and HCWs from East Asian countries (15%). Koshak and Tawfeeq [10] found the highest prevalence among HCWs in Jeddah, Saudi Arabia, in HCWs from Nigeria (87.5%), followed by HCWs from Philippines (83.3%), and HCWs from India and Pakistan (75 and 74.2%).

The finding (in this work and others) of a higher prevalence of LTBI among HCWs from South and Southeast (Philippines, India, Pakistan, and Bangladesh) and Africa can be explained by the higher prevalence of TB in their countries than in Saudi Arabia and the Middle East (Egypt, Jordan, Palestine, and Syria). According to the WHO Global TB report 2014, South and Southeast (Philippines, India, Pakistan, and Bangladesh) and sub-Saharan African countries are high-burden countries [7].

Although pre-employment CXR was done for all participants by the Saudi healthcare authorities as routine check before contracting (and therefore all were presumed to be free from TB), 10% (N=21, all were TST positive) had signs suggestive of inactive TB in their CXR examination (none had CXR evidence of active TB). This finding questions the efficacy of pre-employment examination (and reporting) and the need to improve the pre-employment CXR reporting.

Higher results were reported by Joshi et al. [17], who studied the 'prevalence of abnormal radiological findings in HCWs with LTBI and correlations with T-cell immune response' in India, and found that LTBI was diagnosed by TST alone in 38% of HCWs (n = 276 out of tested 726 HCW), and 63% of these HCWs had CXR findings suggestive of inactive TB (n = 174).

Kassim et al. [12] studied TST to assess the occupational risk of M. tuberculosis infection among HCWs in Abidjan, Côte D'Ivoire, and reported that out of the 512 participants, 405 (79%) had a TST reaction of at least 10 mm, eight (2%) were anergic, and five (1%) had a radiograph compatible with TB.

Conclusion and recommendation
LTBI is prevalent among HCWs in MNH, especially among nurses and HCWs from countries with high rates of tuberculosis (Philippine, India, Pakistan, and Bangladesh). Because HCWs in Saudi Arabia are

from multiple nationalities and mostly from areas with a high prevalence of TB (South and Southeast Asian countries), pre-employment and postemployment assessment of TB must be considered for better control of TB (especially among HCWs).

Acknowledgements

References

1 WHO. Tuberculosis, WHO fact sheet no. 104; 2014. Available at: *http://www.who.int/mediacentre/factsheets/fs104/en/*. [Last accessed on 2015 Feb 1].

2 Rosenman KD, Hall N. Occupational risk factors for developing tuberculosis. *Am J Ind Med* 1996; **30**:148–154.

3 Nienhaus A. Tuberculosis in healthcare workers. *Pneumologie* 2009; **63**:23–30.

4 De Vries G, Sebek MM, Lambregts-van Weezenbeek CS. Healthcare workers with tuberculosis infected during work. *Eur Respir J* 2006; **28**:1216–1221.

5 Franchi A, Diana O, Franco G. Job-related risk of latent tuberculosis infection in a homogeneous population of hospital workers in a low incidence area. *Am J Ind Med* 2009; **52**:297–303.

6 American Thoracic Society. Diagnostic standards and classification of tuberculosis in adults and children. *Am J Respir Crit Care Med* 2000; **161**:1376–1395.

7 WHO. *Global burden of TB report 2014*. Geneva: *WHO Press*; 2014.

8 Abbas MA, AlHamdan NA, Fiala LA, AlEnezy AK, AlQahtani MS. Prevalence of latent TB among health care workers in four major tertiary care hospitals in Riyadh, Saudi Arabia. *J Egypt Public Health Assoc* 2010; **85**:61–71.

9 Nienhaus A, Schablon A, Loddenkemper R, Hauer B, Wolf N, Diel R. Prevalence of latent tuberculosis infection in healthcare workers in geriatric care. *Pneumologie* 2007; **61**:613–616.

10 Koshak EA, Tawfeeq RZ. Tuberculin reactivity among health care workers at King Abdulaziz University Hospital, Saudi Arabia. *East Mediterr Health J* 2003; **9**:1034–1041.

11 Drobniewski F, Balabanova Y, Zakamova E, Nikolayevskyy V, Fedorin I. Rates of latent tuberculosis in health care staff in Russia. *PLoS Med* 2007; **4**:e55.

12 Kassim S, Zuber P, Wiktor SZ, Diomande FV, Coulibaly IM, Coulibaly D, *et al*. Tuberculin skin testing to assess the occupational risk of *Mycobacterium tuberculosis* infection among health care workers in Abidjan, Côte d'Ivoire. *Int J Tuberc Lung Dis* 2000; **4**:321–326.

13 Schablon A, Beckmann G, Harling M, Diel R, Nienhaus A. Prevalence of latent tuberculosis infection among health care workers in a hospital for pulmonary diseases. *J Occup Med Toxicol* 2009; **4**:1.

14 Whitaker JA, Mirtskhulava V, Kipiani M, Harris DA, Tabagari N, Kempker RR, Blumberg HM. Prevalence and incidence of latent tuberculosis infection in georgian healthcare workers. *PLoS One* 2013; **8**:e58202.

15 Babayigit C, Ozer B, Ozer C, Inandi T, Duran N, Gocmen O. Performance of QuantiFERON-TB Gold In-Tube test and Tuberculin Skin Test for diagnosis of latent tuberculosis infection in BCG vaccinated health care workers. *Med Sci Monit* 2014; **20**:521–529.

16 Mirtskhulava V, Kempker R, Shields KL, Leonard MK, Tsertsvadze T, del Rio C, *et al*. Prevalence and risk factors for latent tuberculosis infection among health care workers in Georgia. *Int J Tuberc Lung Dis* 2008; **12**:513–519.

17 Joshi R, Patil S, Kalantri S, Schwartzman K, Menzies D, Pai M. Prevalence of abnormal radiological findings in health care workers with latent tuberculosis infection and correlations with T cell immune response. *PLoS One* 2007; **2**:e805.