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Screening for latent TB among HCWs newly hired in a major hospital in Riyadh, Saudi Arabia

Mostafa Kofi [1], Abdulaziz Bin Rsheed[2], Saad AlBattal[3], Abood AlAbood[4], Azzam AlOtaibi[5], Abdulaziz AlQahtani[6], Tarek ElSaid[7], Yasser Yousef [8], Safa AlSedrah[9], Ahmed AlKhashman[10]

[1-10] Department of Family and Community Medicine, PSMMC, Riyadh, Saudi Arabia

[1, 8] Department of Occupational Medicine and Public Health, Faculty of Medicine, Suez Canal University, Egypt

[7] Department of Family Medicine, Faculty of Medicine, Suez Canal University, Egypt

Abstract

Introduction: Identification of LTB status is mandatory as pre-employment by PSMMC bylaws and MOH in Saudi Arabia, for the objective of follow up of negative LTB yearly, for possible conversion to positive LTB. Research work in Saudi Arabia and internationally indicating increased risk of TB as re-emerging disease.

Health Care workers (HCWs) are at High risk of exposure to Tuberculosis infection or even LTB. The aim of this study is to identify prevalence of LTB infection among New HCWs Hires and their socio-demographic and work characteristics.

Methods: A cross sectional survey of 6404 HCWs new hires for the 2017-2019 for PSMMC and PSCC, Riyadh KSA, for their status regarding Latent TB. Review of pre -employment records was conducted for results of PPD testing. Data regarding results of PPD, socio-demographic characteristics, also work characteristics were gathered using a data collection form. Presentation for the pattern of LTB findings in relation to socio-demographic groups and work characteristics was concluded.

Results: screening for LTB as part of pre-employment health examination and annual screening for high risk groups is mandatory in health care setting. In this study we reviewed TST for LTB using PPD testing using the criteria of 10mm or more are positive, we screened 6404 HCWs out of which 314 (4.9%) were positive PPD (>=10mm induration). Furthermore, the highest frequency of positive PPD were from African Countries 14/101 HCWs (12.2 %), and from East Asia 187/2793 (6.3%) were positive PPD. Also, among physicians 67/743 (8.3%) were positive PPD, and the least were Administrators 16/866 (1.8%). Female HCWs having positive PPD 212/3707 (5.4%) were more than male HCWs having positive PPD 102/2383 (4.1%). Positive PPD was much higher among international contract HCWs (6.7%) than among local contract HCWs (3.1%). HCWs newly hired in PSMMC having higher percentage of positive PPD (5.2%) than HCWs hired in PSCC (2.5%).

Conclusion: Health Care Workers are at high risk of contracting TB infection, PPD testing for HCWs is mandatory as a screening tool for establishing a base line detection of LTB, and improve TB control and care in Health care settings. Periodic screening is crucial for early detection of LTB and monitoring the progression to active TB among HCWs.

Keywords: latent TB, screening, HCWs

Introduction

Around one third of the world's population is estimated to be infected with M. tuberculosis; around 5–10% of those infected will develop active TB disease in the first 5 years after initial infection. Latent tuberculosis infection (LTBI) is a state of persistent immune response to stimulation by Mycobacterium tuberculosis antigens with no evidence of clinically manifest active TB [1].

Identification of (LTB) status is mandatory as pre-employment by Prince Sultan Military Medical City (PSMMC), Prince Sultan Cardiac Center (PSCC) and Ministry of Health (MOH) in Saudi Arabia. The objective of pre-employment TB screening is treating LTB cases and following up the negative LTB candidates yearly, for possible conversion to positive LTB.

Tuberculin Skin Test (TST) is a delayed-type hypersensitivity response to the purified protein derivative (PPD) of Mycobacterium Tuberculosis (MTB); mainly used to identify and treat infected persons by MTB who are at high risk of conversion to active TB [2]. There is no strong evidence support the use of Interferon-Gamma Release Assay (IGRA) rather than TST for the diagnosing of LTB [1].

Research work in Saudi Arabia and internationally indicating increased risk of Tuberculosis (TB) as re-emerging disease **(3)**. Particularly, health care workers (HCWs) are at high risk of exposure to Tuberculosis infection or even LTB. Uden L. *et al*., 2017 [4] estimated the prevalence of LTBi among HCWs as 37%. Parks JS in 2018 [5] reported that the risk of tuberculosis to be higher among health workers compared to general population in South Korea. The prevalence of LTB among HCWs to be 15.8% using whole-blood interferon (IFN)-γ release assay (IGRA) method for detection. On another work reported by Yeon JH [6] *et al*., in 2018 who screened all HCWs using IGRA from July 2015 to December 2016 in the National Health Insurance Service Ilsan Hospital in Goyang, South Korea. The estimated prevalence of LTBI was 16%. Chen B *et al*, in 2018 [7] screened HCWs at thirty-one TB hospitals in northern provinces of China from January to June 2015 and estimated LTBi rate of 33.9% using IGRA. Keshavarz Valian S *et al*., in 2018 [8] reported LTB prevalence among HCWs in Children Care hospital in IRAN to be 27.13% based on TST. Additionally, Sabri A. *et al*. **(9)** conducted a study in two Moroccan cities, Rabat and Meknes from March 2012 to September 2016. LTBi prevalence among HCWs was 52.1% based on TST. Similarly, Al-Sokkary RH *et al*. 2015 **(10)** carried a cross sectional study on HCWs in a chest hospital in Zagazig city, from August 2012 until January 2013. The estimated prevalence of LTBi

diagnosed by TST was 59.1%. Alele FO *et al*. in 2019 [11] systematically reviewed twenty-one studies in occupational tuberculosis among health care workers conducted in Sub-Saharan Africa between 1997 and 2015. The median prevalence of LTBI among HCWs was 62%.

The above-mentioned review demonstrates that the risk of acquiring TB among HCWs is high and would impact the recruitment, longevity and retention of HCWs. The aim of this study is to identify prevalence of LTB infection among new HCWs hires and their socio-demographic and work characteristics in PSMMC and PSCC.

The primary aims of this study are to

1. Provide an estimate LTB prevalence among newly hired HCWS in PSMMC and PSCC
2. Describe socio-demographic and work characteristics of Positive LTB HCWs
3. Compare the prevalence of LTB according to gender, job type and area of origin
4. Review the risk factors of LTB among newly hired HCWs in PSMMC and PSCC

Methods

Project Summary: A cross sectional survey of the new hires for the 2017-2019 of the PSMMC, Riyadh KSA, for their status regarding Latent TB. Review of pre -employment records was conducted for results of PPD testing. Data regarding results of PPD, socio-demographic characteristics, also work characteristics were gathered using a data collection form. Presentation for the pattern of LTB findings in relation to socio-demographic groups and work characteristics was concluded.

Study design

Cross sectional survey by Records review for the 2017-2019 records for pre-employment at PSMMC, Riyadh Saudi Arabia using a specially formed data collection form.

Sampling plan:

Comprehensive non probability sample to cover all new hires as HCWs from January 2017 to October 2019.

Statistical Methods

The study screened 6404 HCWs for their PPD reaction and results were tabulated using Excel software, also these data were double checked for quality. SPSS software was used to produce descriptive statistics and p values when needed.

Descriptive statistics is produced using measures of central tendency and measures of dispersion, also representation of results using tables.

Ethics considerations

IRB approval: PSMMC-IRB Research Ethics Committee HP-01-R079 approval letter number 1153 dated 7 January 2019.

Records review is be anonymous

Data collected is be used for this research only

Data collected will be destroyed after research publication

All identified LTB candidates were afforded appropriate preventive treatment within PSMMC

Results

From table (1); 6404 newly hired HCWs screened for PPD, two thirds of study population were females 3919 (61.2%). Most of the study subjected were from the Middle East 3235 HCWs (50.5%) followed by the East Asia 2980 HCWs (46.5%). Nursing staff represented most of the study population 2838 (44.3%) and least were physicians 810 (12.6%). Most of the HCWs tested were for recruitment to PSMMC 5758 (89.9%), whereas 646 (10.1%) for PSCC.

Table (2), shows nationality of HCWs distributed by gender where 2497 (83.8%) of East Asia were females. However, around (60%) of Middle East newly employed were males. Table (3) shows distribution of post by gender, females were the highest frequency among nursing staff 2612 (92%), whereas males were higher frequency 508 (62.7%) among physicians. Table (4), shows that the mean age for males and females recruited were close; since mean age and SD were 29.21±8.25 vs 29.6±8.15 years for males and females.

Table (5), shows that among 6404 HCWs tested 6090 (95.1%) had negative PPD (<10mm Induration), while 314 (4.9%) had positive PPD (>=10mm induration). Additionally, from table (6) the highest frequency of positive PPD were from African Countries 14/101 HCWs (12.2 %), and from East Asia 187/2793 (6.3%) were positive PPD.

Table (7) shows that the highest frequency of positive PPD were among physicians 67/743 (8.3%), followed by Nursing Staff 179/2659 (6.3%) then technicians 41/944 (4.2%). The least positive PPD frequency were among Administrators 16/866 (1.8%). Furthermore, from table (8) as overall females were 212/3707 (5.4%) who had positive PPD compared to males 102/2383 (4.1%); its noticed that there is increasing trend in Positive PPD HCWs over the years 2017, 2018 and 2019 when it increased from 2.3% to 10.8%.

Table (10) shows that among international recruitment 215/2982 (6.7%) positive PPD compared to only 99/3108 (3.1%) were positive PPD among Local recruitment. In addition, from table 11; among HCWs recruited to PSMMC 298/5460 (5.2%) were positive PPD compared to only 16/630 (2.5%) were positive PPD among HCWs recruited for PSCC.

Table 1: Socio-demographic Characteristics for the study population.

Year	Frequency	Percent
2017	2428	37.9
2018	2457	38.4
2019	1519	23.7
SEX	Frequency	Percent
F	3919	61.2
M	2485	38.8
Nationality	Frequency	Percent
Middle East	3235	50.5
East Asia	2980	46.5
Africa	115	1.8
Western Pacific	74	1.2
Post	Frequency	Percent
Nursing	2838	44.3
Technician	985	15.4
Laborers	889	13.9
Administrative	882	13.8
Physician	810	12.6
	Frequency	Percent
PSMMC	5758	89.9
PSCC	646	10.1
Contract type	Frequency	Percent
Local Recruit	3207	50.1
Int'l Recruit	3197	49.9
Total	6404	100.0%

Table 2: Nationality by gender of HCWs tested

			SEX		Total
			F	M	
Nationality	Middle East	Count	1298	1937	3235
		%	40.1%	59.9%	100.0%
	East Asia	Count	2497	483	2980
		%	83.8%	16.2%	100.0%
	Africa	Count	67	48	115
		%	58.3%	41.7%	100.0%
	Western Pacific	Count	57	17	74
		%	77.0%	23.0%	100.0%
Total		Count	3919	2485	6404
		%	61.2%	38.8%	100.0%

Table 3: Post by Gender of HCWs tested.

			SEX		Total
			F	M	
	Nursing	Count	2612	226	2838
		%	92.0%	8.0%	100.0%
	Technician	Count	505	480	985
		%	51.3%	48.7%	100.0%
Post	Laborer	Count	158	731	889
		%	17.8%	82.2%	100.0%
	Administrative	Count	342	540	882
		%	38.8%	61.2%	100.0%
	Physician	Count	302	508	810
		%	37.3%	62.7%	100.0%
Total		Count	3919	2485	6404
		%	61.2%	38.8%	100.0%

Table 4: Mean Age by Gender for the study population.

	SEX	N	Mean	Std. Deviation
Age	Females	3919	29.60	8.157
	Males	2485	29.21	8.251

Table 5: Frequency distribution of Positive PPD among all HCWs tested.

	Frequency	Percent
Negative PPD	6090	95.1
Positive PPD	314	4.9
Total	6404	100.0

Table 6: Frequency distribution of Positive PPD according to nationality among all HCWs tested.

			PPD		Total
			Negative	Positive	
Nationality	Middle East	Count	3126	109	3235
		% within Nationality	96.6%	3.4%	100.0%
	East Asia	Count	2793	187	2980
		% within Nationality	93.7%	6.3%	100.0%
	Africa	Count	101	14	115
		% within Nationality	87.8%	12.2%	100.0%
	Western Pacific	Count	70	4	74
		% within Nationality	94.6%	5.4%	100.0%
Total		Count	6090	314	6404
		% within Nationality	95.1%	4.9%	100.0%

P<0.0001

Table 7: Frequency distribution of Positive PPD according to Post among all HCWs tested.

			PPD		Total
			Negative	Positive	
	Nursing	Count	2659	179	2838
		%	93.7%	6.3%	100.0%
	Technician	Count	944	41	985
		%	95.8%	4.2%	100.0%
Post	Laborer	Count	878	11	889
		%	98.8%	1.2%	100.0%
	Administrative	Count	866	16	882
		%	98.2%	1.8%	100.0%
	Physician	Count	743	67	810
		%	91.7%	8.3%	100.0%
Total		Count	6090	314	6404
		%	95.1%	4.9%	100.0%

P<0.001

Table 8: Frequency distribution of Positive PPD according to gender among all HCWs tested.

			PPD		Total
			Negative	Positive	
SEX	Females	Count	3707	212	3919
		%	94.6%	5.4%	100.0%
	Males	Count	2383	102	2485
		%	95.9%	4.1%	100.0%
Total		Count	6090	314	6404
		%	95.1%	4.9%	100.0%

P<0.02

Table 9: Frequency distribution of Positive PPD according to nationality among all HCWs tested.

			PPD		Total
			Negative	Positive	
Year	2017	Count	2371	57	2428
		% within Year	97.7%	2.3%	100.0%
	2018	Count	2364	93	2457
		% within Year	96.2%	3.8%	100.0%
	2019	Count	1355	164	1519
		% within Year	89.2%	10.8%	100.0%
Total		Count	6090	314	6404
		% within Year	95.1%	4.9%	100.0%

P<0.001

Table 10: Frequency distribution of Positive PPD according to Local vs Int'l recruitment among all HCWs tested.

			PPD		Total
			Negative	Positive	
Contract type	Local	Count	3108	99	3207
		%	96.9%	3.1%	100.0%
	International	Count	2982	215	3197
		%	93.3%	6.7%	100.0%
Total		Count	6090	314	6404
		%	95.1%	4.9%	100.0%

P<0.001

Table 11: Frequency distribution of Positive PPD according to PSMMC vs PSCC among all HCWs tested.

		PPD		Total
		Negative	Positive	
PSMMC	Count	5460	298	5758
	%	94.8%	5.2%	100.0%
PSCC	Count	630	16	646
	%	97.5%	2.5%	100.0%
	Count	6090	314	6404

P<0.001

Discussion

This study reviewed the PPD test finding of 6404 new hired HCWs in a tertiary care center, positive PPD HCWs were 314/6404 (4.9%); which is much less than those reported by Chen B *et al*., 2018 [7] in which he reported a 33.9% among HCWs, the difference might be due to that Chen B *et al*, screened HCWs in TB hospitals, which has a reasonably higher exposures to TB bacilli; and it's for HCWs who have been in chest hospital, not a new HCWs. On the same context, Kumar MG *et al*., 2019 (12) studied 598 HCWs at a tertiary care hospital in Bengaluru city in India from March 2016 until June 2017, about 120 (20.1%) of the study subjects had a positive TST reaction. Kumar MG *et al*. reported higher positive PPD rate 20.1% than current study rate 4.9%, could be due to the high incidence of TB in India, which have been ranked by WHO as one of the top eight countries, accounted for 27% of global TB burden [13]. Similarly, Janagond AB *et al*., 2017 [14] in a tertiary care hospital in India; A total of 206 eligible HCWs screened between January 2014 and December 2015. PPD results suggested that 36.8% (76/206) were infected with TB using a PPD induration ≥10 mm as a cut-off point; this rate of positive PPD is many folds more than our findings; but we have to notice that this study is from high incidence country which might affect the rate of PPD positive among HCWs.

In a work by Hsieh MJ *et al*., 2018 [15] in a major hospital in Taiwan; among a total of 274 HCWs were enrolled, including 43 Respiratory therapists (RTs), 163 Nurses, and 68 other HCWs. The positive rates of QuantiFERON-TB Gold (QFTG) were 14.0% in RTs, 6.1% in nurses, and 8.8% in other HCWs. Furthermore, Park JS, 2018 [5]; conducted a study in a 700-bed tertiary referral hospital in South Korea from June 2017 to December 2017. A total of 499 HCWs (54 doctors, 365 nurses and 80 paramedical personnel) were enrolled in the study. Park JS *et al*. [5] reported prevalence of LTB as 15.8% based on the QFTG. Both studies reported LTBI prevalence more than the overall findings of our study population, it might be due to the use of different diagnostic method such as QFTG.

On the other hand, in countries with low incidence of TB, the work by Li M. *et al*., 2018 (16) reviewed UK occupational TB HCWs screening database from 2010 until 2017; reported a rate of 21/482 (4%) positive PPD among new HCWs. A retrospective study by Olivieri R *et al*., 2016 [17] under a LTBI screening program among HCWs at the Siena University Hospital (Italy). Among the 2136 HCWs screened, 144 (6.7 %) were PPD positive. Which is comparable to our findings. Also, from Italy another work on same context by Lamberti M *et al*., 2016 (18) in major hospital in Italy, around 533 were administered PPD as the baseline examination. Positive PPD were found in 73 (13.2%) individuals; although Italy is a low-incidence country regarding TB, the finding is about three-fold of our study; made the authors to suggest that the prevalence of LTBI in HCWs may be relatively high.

Nationally, in a work conducted by Bukhary ZA *et al*., 2018 (19) LTBI rate was 10.8% among HCWs during the pilgrim season by QFTG; which is higher than the findings of our study. The differences may be due to different diagnostic methods. On the other hand, Hajoj *et al*., 2016 [20] screened all new HCWs in a tertiary hospital in Riyadh, Saudi Arabia from February 2012 until January 2015. Positive PPD was noticed in 31.5% of the enrolled HCWs; the elevated rate of positive PPD may largely depend on the origin of the HCWs, that particularly from TB endemic regions. El-Helaly *et al*., 2014 [21] reviewed the health records of 3156 new HCWs from August 2009 until May 2011. PPD was positive in 421/1412 (29.8%); since more than 60% of study population have a work duration in healthcare of ten to twenty years raising the risk of TB exposure.

Majority of the HCWs with positive PPD in our study were from Africa (12.2%), East Asia (6.3%) and the least positive PPD were from Middle East (3.4%); Since the HCWs with positive PPD in our study were from the thirty high TB burden countries according to World Health Organization TB report 2019 (1). Furthermore, females had higher frequency of positive PPD (5.4%) than males (4.1%) in current study. Researches documented LTB risk factors as being African and Asian in origin, female gender and younger in age. (22-23) Occupational exposure is known risk factor of LTB among HCWs; physicians usually have the highest rate of LTB, followed by nursing staff and laboratory technicians which is documented by several studies [7, 24, 25]. Similarly, among HCWs in present study physicians have the highest frequency 67/810 (8.3%) of positive PPD, followed by nursing staff 179/2838 (6.3%); however least PPD positive frequency was among Manual laborers 11/889 (1.2%).

In other studies in which HCWs were screened for LTB there were reports of prevalence of Positive LTB to be12%; 15.8%; 10.8%; and 16%; respectively in different studies from other LMIC countries [26, 29]; also; Lika Apriani *et al*., in 2019 [30] searched multiple databases such as Embase, Medline and Web of Science for publications on LTB among HCWs from 2015 to 2017, and concluded that from 26 LMICs. Prevalence of positive tuberculin skin test (TST) was 14–98% (mean 49%); which are comparable rates to our findings.

So, TB is highly infectious and continue to poses an increased risk among HCWs due to occupational exposure. These indicates that HCWs are at risk of having LTB at different levels in primary health care, so it's advisable for screening to be done for new hires and periodically, in family medicine practice and primary care centers.

Study indicates to prioritize the training of HCWs on TB infection control and prevention and ensure the implementation of TB preventive measures in all health facilities. As well as emphasizing on the importance of annual TB screening of negative PPD healthcare workers for early detection and treatment of LTBI.

Conclusion

Health Care Workers are at risk of contracting TB infection. PPD testing of HCWs is mandatory as a screening tool for establishing a base line detection and treatment of LTB that will improve TB control in Health care settings.

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