ORIGINAL ARTICLE

Prevalence of Tuberculosis among Health Care Workers in A Tertiary Teaching Hospital in Malaysia

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ABSTRAK

Petugas kesihatan mempunyai risiko yang lebih tinggi untuk dijangkiti penyakit tuberkulosis (TB). Kajian ini bertujuan untuk menentukan prevalen TB dalam kalangan petugas kesihatan dan faktor-faktor yang berkaitan. Analisa secara retrospektif dilakukan dengan menggunakan data survelan TB di Hospital Canselor Tuanku Muhriz (HCTM) dari 2018 sehingga 2020. Kadar prevalen TB menunjukkan aliran peningkatan, dari 1.54 per 100 petugas kesihatan pada tahun 2018 kepada 5.02 per 100 petugas kesihatan pada tahun 2020. Petugas kesihatan yang berumur 31-40 tahun (p<0.001), merupakan staf sokongan (p=0.008), bekerja di Jabatan Makmal Diagnostik (p<0.001) dan petugas kesihatan yang bekerja di makmal (p<0.001) mempunyai kaitan yang signifikan untuk dijangkiti TB. Dari segi kes indeks TB dalam kalangan petugas kesihatan, 16 kes (69.5%) adalah TB pulmonari (PTB), 6 kes (26.1%) adalah TB ekstrapulmonari (EPTB) dan 1 kes (4.4%) mempunyai kedua-dua PTB dan EPTB. Pengetahuan petugas kesihatan tentang perkaitan ini sangat penting supaya langkah pencegahan dapat dilaksanakan.

Kata kunci: petugas kesihatan, prevalen, tuberkulosis

ABSTRACT

Health care workers are at increased risk of nosocomial transmission of tuberculosis (TB). This study aimed to determine the prevalence of TB among health care workers and its associated factors. A retrospective analysis was conducted using database of TB screening program at Hospital Canselor Tuanku Mukhriz (HCTM) over the

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period of three years (2018-2020). The prevalence rate of TB showed increasing trend, from 1.54 per 100 health care workers in 2018 to 5.02 per 100 health care workers in 2020. Aged group of 31-40 had higher risk for contracting TB (p<0.001), health support workers had significant association with TB acquisition (p=0.008), workers in Diagnostic Laboratory Department had the high risk of getting infected with TB (p<0.001) and the workplace with the highest prevalence was in laboratory (45.9%). In terms of TB index cases among health care workers, 16 cases (69.5%) were pulmonary tuberculosis (PTB), 6 cases (26.1%) were extrapulmonary tuberculosis (EPTB) and 1 case (4.4%) had both PTB and EPTB. It was crucial for health care workers to be aware of these significant associations and for relevant authorities to carry out protective measures.

Keywords: health care workers, prevalence, tuberculosis

INTRODUCTION

Tuberculosis (TB) remains one of the top 10 causes of death from an infectious *Mycobacterium tuberculosis* despite the availability of effective and affordable chemotherapy (WHO 2020). This problem can be due to ineffective implementation of control measures, immigration from high TB burden counties, human immunodeficiency virus epidemic and the appearance of multidrug-resistant TB (Borgdorff & van Soolingen 2013). Drug-resistant TB is a major threat worldwide. The variable and uncertain impact of TB necessitates better diagnostic tools, drugs and vaccines.

Transmission of TB in a health care setting has been recorded since more patients come to the health care facility looking for treatment which increased the exposure to health care workers (HCWs). Unrecognised or improperly treated TB may be the common source of transmission. Previous epidemiologic studies had shown that HCW in intermediate-burden countries as well as both low- and middle-income countries were at higher risk of contracting TB than the risk among the general population (Apriani et al. 2019; Baussano et al. 2011; Chu et al. 2014; Uden et al. 2017). Hence, TB has been well-recognised as an occupational hazard (Israel et al. 1994). Incidence rates of TB among HCWs had been reported by Chu et al. (2014) in China (61/100,000), Jiamjarasrangsi et al. (2005) in Thailand (188/100,000) and Gopinath et al. (2004) in India (208/100,000). While in Malaysia, the incidence rates ranged from 135 to 156/100,000 (Liew et al. 2019).

TB transmission in health care not only put HCWs' health at risk, but it also raises the risk of two-way spread between health-care settings and general populations, making the control of TB in the communities more challenging (Zhu et al. 2020). Furthermore, HCWs play a critical role in the overall TB control program, and a high burden of occupation-

related TB would have a detrimental effect on the health care workforce, hence weakening the effectiveness of TB control program (Grobler et al. 2016). Health care workers who are exposed to patients with suspected or confirmed TB disease or handled specimen for TB diagnosis are needed to go for TB screening according to the guideline by Ministry of Health Malaysia for early detection and to reduce its transmission (MOH 2012). The risk of contracting TB is higher among contacts, as most of the cases are diagnosed within three months after index case (Reichler et al. 2018).

Understanding the epidemiological characteristic of TB among HCWs are necessary for appropriate preventive and control measures as it is essential to protect them and decrease TB annual incidence. In view of this, the aim of this study was to determine the prevalence and epidemiological pattern of TB among HCWs in a tertiary teaching hospital. These findings could be a significant indicator for controlling nosocomial infections of TB, strengthening the current screening protocols and supporting public health in Malaysia.

MATERIALS AND METHODS

This study was carried out at Hospital Canselor Tuanku Muhriz (HCTM), formerly is known as Hospital Universiti Kebangsaan Malaysia, one of the five teaching university hospitals in Malaysia. It is in Bandar Tun Razak, Kuala Lumpur with a total of 3,873 staff in 2020. It was a retrospective review based on data reports of TB screening program among HCWs in HCTM from January 2018 to December 2020. Tuberculosis is a notifiable disease under Prevention and Control of Infectious Diseases Act 1988. Confirmed TB cases among HCWs in HCTM from either Respiratory Unit, Resident Clinic or Primer Clinic were notified immediately to Infection Control Unit. Following that, contact tracing would be commenced within three months by Infection Control Unit in which all suspected contacts would be screened using Mantoux test. Induration of 15 mm was considered positive for TB infection as per Malaysian guidelines (MOH 2012). HCWs who tested positive were referred to Respiratory Unit for further management, treatment and follow-up.

In this study, we were focusing on 1,045 HCWs who had been identified as close contact to index HCWs with TB and underwent screening. Demographic data and factors associated with TB infection, such as gender, age, occupation, department of employment and workplace, were collected from the Infection Control Unit database. The disease profile for 23 TB index cases among HCWs, including vaccination status, comorbidities (diabetes mellitus, HIV), behavioural data (smoking history, alcohol consumption), and clinical data (chest radiograph findings, TB location) were obtained from Infection Control Unit database as well. Exclusion criteria was HCW who was not employed under HCTM.

Health care workers were categorised into 6 groups, namely,

medical practitioners (Consultant, Specialist, Medical Officer, House Officer), paramedics (Assistant Medical Officer, Staff Nurse, Nursing Sister, Clinical Nurse, Matron), dental services (Dentist, Dental Technologist, Dental Therapist, Dental Surgical Assistant), allied health professions (Medical Laboratory Technologists, Physiotherapist, Emergency Technologist, Optometrist, Audiologist, Psychologist, Clinical Scientist, Dietitian), health support workers (Engineer, Assistant Engineer, IT Officer, Health care Assistant, Public Assistant, Driver, Security Officer, Assistant Clinical Scientist) and administrative workers (Senior Executive, Clerk, Assistant Clerk, Finance Officer, Assistant Treasurer, Assistant Accountant, Customer Service Officer).

Prevalence rate of TB among HCWs were calculated by dividing the number of positive TB (both TB index cases and positive TB among screened HCWs) by total number of HCWs for the respected year. The prevalence rates were reported per 100 HCWs. The ratio between TB index among HCWs to screened HCWs was determined for respected years. In terms of disease profile, both medical histories and clinical data of TB index cases among HCWs were described

using proportions. Chi Square test was used to compare prevalence of TB among screened HCWs between their sociodemographic and occupational characteristics which can be used as the associating factors. SPSS version 23 (SPSS Inc., Chicago, IL, USA) was used for all statistical analyses and $p<0.05$ was considered statistically significant.

RESULTS

In the present study, the prevalence rate of TB among HCWs in HCTM was shown in Table 1. It increased from the rate of 1.54 in 2018 to 5.02 in 2020. The ratio between TB index among HCWs to screened HCWs also increased from 2018 to 2020 (Table 2). In 2020, an average of 92 HCWs were screened for one index case as compared with only 24 HCWs were screened for one index case in 2018.

Table 3 showed the disease profile of 23 TB index cases among HCWs in HCTM. TB occurred more commonly among female HCWs (73.9%) and in ages between 31-40 years old (56.5%). Majority of TB index cases (95.6%) were Malaysian and had Bacillus Calmette-Geurin (BCG) scar, considered as immunised for TB. The study showed that 4.4% had diabetes mellitus and none of the HCWs was diagnosed with human immunodeficiency virus (HIV)

Table 1: Frequencies and rates of TB among HCWs in HCTM, 2018 until 2020

Year	Total HCWs	Positive TB	Prevalence rate[a]
2020	3922	197	5.02
2019	3896	80	2.05
2018	3875	60	1.54

TB: tuberculosis; HCW: Health care worker; HCTM: Hospital Canselor Tuanku Muhriz
[a]Prevalence rate calculated per 100 HCWs.

Table 2: Ratio between TB index among HCWs to screened HCWs in HCTM, 2018 until 2020

Year	Total TB index	Total screened	Ratio[a]
2020	5	459	1:92
2019	7	318	1:45
2018	11	268	1:24

TB: tuberculosis; HCW: Health care worker; HCTM: Hospital Canselor Tuanku Muhriz
[a]Ratio calculated between total TB index to total screened

prior to TB diagnosis. Almost all were non-smokers (95.6%) and none of the HCWs consumed alcohol. Only one

Table 3: Demography TB index cases among HCWs in HCTM, 2018-2020 (n=23)

Variables	n (%)
Gender	
Male	6 (26.1)
Female	17 (73.9)
Age (years)	
21-30	7 (30.4)
31-40	13 (56.5)
41-50	3 (13.1)
Nationality	
Malaysian	22 (95.6)
Non-Malaysian	1 (4.4)
BCG scar	
Present	22 (95.6)
Absent	1 (4.4)
Diabetes mellitus	
Yes	1 (4.4)
No	22 (95.6)
HIV	
Yes	0 (0.0)
No	23 (100.0)
Smoking	
Yes	1 (4.4)
No	22 (95.6)
Alcohol consumption	
Yes	0 (0.0)
No	23 (100.0)
Chest radiograph	
Far advanced	1 (4.4)
Moderately advanced	3 (13.0)
Minimal	12 (52.2)
No lesion	7 (30.4)
TB location	
Pulmonary TB	16 (69.5)
Extrapulmonary TB	6 (26.1)
Both	1 (4.4)
Mode of detection	
Active	0 (0.0)
Passive	23 (100.0)

n = number of HCWs

case had far advanced lesion in his lungs. Overall, 16 cases (69.5%) were pulmonary TB (PTB), 6 cases (26.1%) were extrapulmonary TB (EPTB) and 1 case (4.4%) had both PTB and EPTB. All index cases were detected by passive screening.

Table 4 summarised the prevalence of TB among screened HCWs in terms of sociodemographic and occupational characteristics. A total of 314 (30%) were found positive and 731 (70%) remained negative. The prevalence of TB was significantly higher among aged between 31-40 (p<0.001) and health support workers (p=0.008). In terms of department and workplace, HCWs from Diagnostic Laboratory Department and those who work in laboratory had more significantly associated with TB infection (p<0.001). Gender was found to be insignificant with TB infection.

DISCUSSION

Even though our study was using Mantoux test for latent TB screening, the prevalence of TB among HCWs in this study was relatively low compared to other previous local studies, ranging from 26.2-46% (Munisamy et al. 2017; Tan et al. 2002). Tuberculosis prevalence among HCWs was 47.2% in Sri Lanka (Ratnatunga et al. 2015).

Table 4: Prevalence of TB among screened HCWs in terms of sociodemographic and occupational characteristics, 2018-2020 (n=1,045)

Variables	Positive TB (n=314)	Negative TB (n=731)	χ^2	p
	n (%)	n (%)		
Gender				
Male	93 (29.2)	225 (70.8)	0.14	0.708
Female	221 (30.4)	506 (69.6)		
Age (years)				
21-30	37 (16.2)	191 (83.8)	30.99	<0.001*
31-40	213 (35.1)	394 (64.9)		
41-50	56 (33.1)	113 (66.9)		
51-60	8 (19.5)	33 (80.5)		
Occupational categories				
Administrative workers	49 (35.5)	89 (64.5)	15.74	0.008*
Allied health professions	34 (28.6)	85 (71.4)		
Dental services	1 (3.2)	30 (96.8)		
Health support workers	57 (35.8)	102 (64.2)		
Medical practitioners	82 (29.7)	194 (70.3)		
Paramedics	91 (28.3)	231 (71.7)		
Department				
Administration	31 (35.2)	57 (64.8)	82.34	<0.001*
Diagnostic Laboratory	26 (51.0)	25 (49.0)		
Emergency	136 (40.8)	197 (59.2)		
Family Medicine	23 (36.5)	40 (63.5)		
Medical	33 (28.2)	84 (71.8)		
Operation Theatre	8 (18.6)	35 (81.4)		
Ophthalmology	2 (7.1)	26 (92.9)		
Orthopaedic & Traumatology	9 (12.7)	62 (87.3)		
Otorhinolaryngology	24 (34.3)	46 (65.7)		
Paediatric	1 (3.7)	26 (96.3)		
Psychiatry	0 (0.0)	16 (100.0)		
Rehabilitation	8 (15.7)	43 (84.3)		
Surgery	13 (14.9)	74 (85.1)		
Workplace				
Clinic	87 (24.4)	270 (75.6)	52.99	<0.001*
Emergency Department	136 (40.8)	197 (59.2)		
Laboratory	28 (45.9)	33 (54.1)		
Office	31 (35.2)	57 (64.8)		
Ward	32 (15.5)	174 (84.5)		

TB: tuberculosis; HCW: Health care worker, n = number of HCWs
*significant p<0.05 (Pearson Chi Square)

In that study, exposed HCWs were subjected to Mantoux test as well. In comparison, a local study showed a 10.6% prevalence using an interferon-γ assay for diagnosis (Rafiza et al. 2011). Higher prevalence in previous local studies and Sri Lanka could be due to false positive Mantoux test which could be attributed to Bacille Calmette-Guérin (BCG) vaccination and non-tuberculous mycobacterial infections. Low TB prevalence in our study could be credited to HCTM Occupational and Safety Unit's updated TB control program, improved awareness and increased practice of preventive

measures among staff.

In terms of TB surveillance activity in HCTM, active TB screening was increasing as shown by increased ratio between TB index among HCWs to screened HCWs over the years. Hence, this increased the number of cases detection and led to increased TB prevalence from 2018 to 2020. Rapid contact investigations, inter-department involvement, frequent update of shared database and regular analysis of the data had been carried out by Infection Control Unit to identify TB among HCWs and thus preventing further transmission. These were among the activities which contributed to good TB surveillance system in HCTM. Apart from that, improved hazard identification and workplace risk assessment as well as presence of competent staff in conducting investigation might also be the reasons of increasing screening as part of the intervention. Besides screening, other interventions such as providing appropriate ventilation and well-maintained functioning equipment especially in laboratory, empowering all HCWs on TB prevention via adequate risk communication and health education, providing standard personal protective equipment and conducting regular medical surveillance can reduce the risk of transmission.

The prevalence of TB among aged group of 31-40 was significantly higher, followed by aged group of 41-50. This finding was comparable to other studies (Almufty et al. 2019; Belo & Naidoo 2017). It could due to longer duration of employment. Those who were employed for more than ten years, they had a three-fold higher risk of TB infection than those who worked for less than a year, as longer duration of employment was associated with increased cumulative exposure to TB patients, thus increasing the risk of contracting TB (Pai et al. 2005).

Occupational categories may denote differences in TB exposure frequency and intensity (Joshi et al. 2006). A study in Germany showed occupational category was a significant association for TB (Schablon et al. 2009). It indicated that doctors and nurses were associated with increased risk of TB. In contrast, our study found out the risk was low among doctors and paramedics as compared with health support workers. Direct comparison was difficult as occupational categories of the German report are doctor, nurse, and other professions while our occupational categories were different which might affect the analysis. However, there was potential for improvement, particularly in terms of preventive measures implemented for the support workers. Although most prevention aimed HCWs who provided direct patient care, other support workers were also exposed to TB-infected patients.

This study showed workers in Diagnostic Laboratory Department and HCWs who worked in laboratory were associated with increased risk of TB infection. A higher risk of getting TB was associated with TB lab workers (50%) as reported by Polish study (Demkow et al. 2008). Another study from China also found the highest prevalence of TB was among general

laboratory workers (Zhang et al. 2013), which was more consistent with our study. Unfortunately, we could not distinguish whether our HCWs handled TB specimen or not. Despite that, laboratory workers should apply universal precautions when handling specimens for both suspected and confirmed TB specimens.

The limitation of our study was data involvement from one tertiary teaching hospital only which is also a referral hospital, therefore the findings may not reflect the real TB prevalence and its associated factor. Hence, a multicentre study would be imperative. Another limitation was the data incompleteness for screened HCWs so we could not provide further analysis of the disease profiles. Generally, research with a more robust methodology would be required.

CONCLUSION

Tuberculosis prevalence among HCWs was considered low in HCTM. Aged group of 31-40, health support workers and workers in Diagnostic Laboratory Department were significantly associated with heightened risk of TB acquisition. The most prevalent setting for TB infection was laboratory. The prevalence of TB infection was low, but it was increasing over three years due to good surveillance system. Intervention was recommended to lower the risk of TB transmission among HCWs.

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