Original Article

Pulmonary Tuberculosis in Healthcare Workers at a University Hospital: A Significant Burden of Subclinical Disease

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Abstract

OBJECTIVES: This research intends to determine the incidence of subclinical and active pulmonary tuberculosis (TB) among healthcare workers at a university hospital in Bangkok, Thailand.

MATERIALS AND METHODS: A retrospective cohort study included data from full-time employees aged 18 and over from January 1st, 2018, to December 31st, 2022. Data from the hospital's employee database and extracted cases of subclinical and active pulmonary TB were collected to calculate their annual incidences. The study also compared jobs with different levels of patient exposure risk and sputum culture positivity rates between both groups.

RESULTS: During the five-year period, 65 cases of pulmonary TB were diagnosed. Of these, 45 (69.2%) were subclinical, and 20 (30.8%) were active pulmonary TB. The annual incidence of subclinical pulmonary TB per 100,000 persons was 98.12, 47.85, 46.93, 53.70, and 23.24 between 2018 and 2022, respectively. Meanwhile, the incidence of active pulmonary TB for the same period was 18.40, 29.90, 35.20, 23.87, and 11.62 per 100,000 persons, respectively. Compared to Thailand's overall TB incidence of 155 per 100,000 persons in 2022, our lower incidence was likely due to early detection and treatment of TB among healthcare workers, raising concerns about the transmissibility of subclinical pulmonary TB. Notably, a significant proportion of healthcare workers with pulmonary TB were nurses (41.5%), and 22.2% of subclinical pulmonary TB cases were culture-positive.

CONCLUSION: The study revealed that subclinical pulmonary TB constitutes a considerable proportion of pulmonary TB among healthcare workers. It also highlights the contagious potential of subclinical pulmonary TB, contributing to the TB burden in both healthcare workers and society. Given the asymptomatic nature of subclinical pulmonary TB, which complicates detection through passive case finding, implementing active case finding using routine chest radiographs is essential for preventing TB transmission.

Keywords: Mycobacterium infections; Tuberculosis; Asymptomatic diseases; Subclinical diseases; Healthcare workers.

Tuberculosis (TB), caused by *Mycobacterium tuberculosis* (MTB), is one of the leading infectious diseases worldwide, including in Thailand. It poses significant risks of morbidity, mortality, and societal burden. The World Health Organization (WHO) Global Tuberculosis Report estimated the global incidence of TB at 133 per 100,000 persons in 2022. According to the same report, TB mortality rates were 14 per 100,000 persons for those without HIV and 2.1 per 100,000 persons for people living with HIV.[1] The WHO's current strategy for TB eradication also aims for an 80% reduction in TB incidence and a 90% reduction in TB deaths by 2030.[2] For the situation in Thailand, TB incidence in Thailand was 155 per 100,000 persons. Currently, the second phase of Thailand's Operation Plan to End Tuberculosis also aims to reduce the incidence of TB to 89 per 100,000 persons by 2027.[3]

According to the emerging concept proposed by Drain et al., TB is not a binary condition, comprising solely latent TB infection (LTBI) and active TB disease, as previously acknowledged. Instead, TB exists on a spectrum, including LTBI, incipient TB, subclinical TB, and active TB. Notably, subclinical pulmonary TB (PTB) represents a state where viable MTB is present without clinical TB symptoms, yet it can be detected through imaging studies.[4]

Healthcare workers (HCWs) are at risk for developing TB due to their frequent exposure to various infectious diseases in the workplace.[5] A study by Mingchay et al. [6] showed that the incidence of TB among HCWs at a university hospital in Bangkok between 2013 and 2020 was 164 per 100,000. A study at another university hospital in Northeastern Thailand found the average TB incidence rate among staff members of 305 per 100,000 from 2013 to 2015.[7] Moreover, a study at a university hospital in Northern Thailand from 2003 to 2016 revealed the TB incidence of 240 per 100,000 among HCWs.[8] These findings underscore the significance of occupational health risks for TB in HCWs.

Therefore, the study primarily aimed to determine the incidences of subclinical and active PTB among HCWs at a university hospital in Bangkok, Thailand. Additionally, the study aimed to assess the positivity rate of sputum culture to estimate the risk of transmission within the hospital setting.

Materials and Methods

This retrospective chart review included information on all employees at Siriraj Hospital, Bangkok, Thailand, between 2018 and 2022. The data consisted of an annual check-up, medical histories, chest radiographs, and sputum MTB culture results. Chest radiographs were evaluated using the hospital's picture archiving and communication system (PACS). A pulmonologist and two doctors with Fundamental Occupational Medicine Certificates reviewed both the medical history and chest radiographs to confirm the diagnosis.

Full-time employees aged 18 or older who had worked in any department at the hospital for a minimum of one year before enrollment were included. All PTB cases were characterized by a chest radiograph showing findings consistent with TB. A computerized tomography (CT) of the chest was performed to ensure the diagnosis when chest radiograph findings were ambiguous. Furthermore, a significant improvement in relevant chest radiograph abnormalities following treatment with anti-TB medication was required. Of note, sputum MTB cultures may yield either positive or negative results. Extrapulmonary and miliary TB were excluded.

PTB was classified into subclinical and active PTB. Subclinical PTB was defined as pulmonary TB without typical chest symptoms associated with TB, which are cough, dyspnea, hemoptysis, or chest pain, as well as constitutional symptoms such as fever, night sweats, or weight loss. On the other hand, active PTB was characterized by the presence of any of the aforementioned symptoms.

HCWs comprised doctors, nurses, allied health professionals (AHP) such as medical technologists and personnel in Thai traditional medicine, as well as care support workers such as pharmacist assistants and nurse assistants. Administrative, including clerks, and those in ancillary and domestic care roles such as patient transport and maintenance, were also parts of the HCWs population.[9]

Moreover, the present study categorized them into jobs with direct patient contact (i.e., doctors, nurses, medical technologists, Thai medicine personnel, care support workers, and those providing ancillary care and patient transport) and jobs without direct patient contact (i.e., clerks and maintenance staff).

Statistical analysis

The annual incidences of subclinical and active PTB per 100,000 persons were calculated using the mid-year population numbers as a denominator. Descriptive data, which are job categorization and sputum MTB culture results, were shown in numbers and percentages. The study also examined the relationship between culture positivity among subclinical and active PTB. Fisher's exact test was used for data analysis of categorical data. A p-value less than 0.05 was considered statistically significant. All analyses were performed using IBM SPSS statistics (version 18, IBM Corp, Armonk, NY, USA).

Human research ethic

This study was conducted after receiving approval from the Institutional Review Board of Siriraj Hospital, Mahidol University (069/2567). Due to the retrospective design of the study, informed consent was waived.

Results

A total of 65 PTB cases were recorded, 45 (69.2%) of which were subclinical and 20 (30.8%) active cases. Table 1 and Figure 1 depict the incidence of subclinical and active PTB. The characteristics of the participants, shown in Table 2. Table 3 compares between jobs with direct patient contact and without direct patient contact. The sputum culture positivity of subclinical PTB and active PTB is demonstrated in Table 4.

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Table 1: Incidences of subclinical and active PTB by year from 2018-2022.

Year	PTB cases (n)	Incidence of subclinical PTB per 100,000 / n	Incidence of subclinical PTB per 100,000 / n
2018	19	98.12 / 16	18.40 / 3
2019	13	47.85 / 8	29.90 / 5
2020	14	46.93 / 8	35.20 / 6
2021	13	53.70 / 9	23.87 / 4
2022	6	23.24 / 4	11.62 / 2

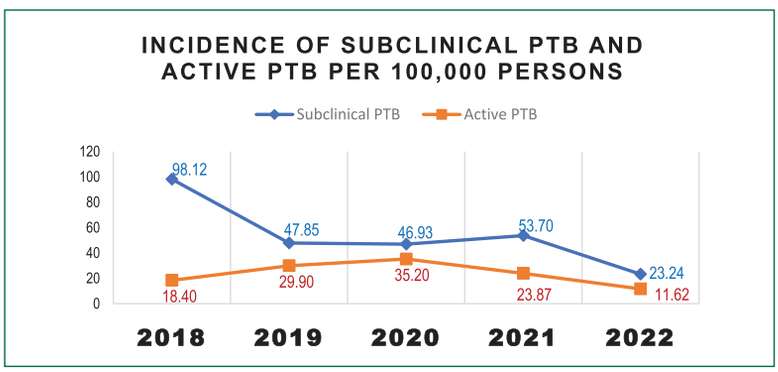

Figure 1: Incidences of subclinical PTB and active PTB by year from 2018-2022

Table 2: Incidences of subclinical and active PTB by year from 2018-2022.

Characteristic	Subclinical PTB (n = 45)	Active PTB (n= 20)
Age, median (Q1, Q3), years	35.00 (28.00, 38.50)	35.00 (25.00, 43.00)
Gender, n (%)		
Female	33 (73.3)	14 (70.0)
Male	12 (26.7)	6 (30.0)
BMI, n (%)		
≥18.5 kg/m2	41 (91.1)	12 (60.0)
<18.5 kg/m2	4 (8.9)	8 (40.0)
Smoking status, n (%)		
Never	40 (88.9)	18 (90.0)
Ever	5 (11.1)	2 (10.0)
Diabetes Mellitus, n (%)		
No	43 (95.6)	17 (85.0)
Yes	2 (4.4)	3 (15.0)
HIV infection, n (%)		
No	45 (100.0)	19 (95.0)
Yes	0(0.0)	1 (5.0)
Old TB, n (%)		
No	42 (93.3)	18 (90.0)
Yes	3 (6.7)	2 (10.0)
Employment duration, median (Q1, Q3), years	6 (2.00, 11.00)	5 (2.25, 16.25)

Table 3: Job categorization (n = 65)

	Subclinical PTB, n (%)	Active PTB, n (%)	*p*
Jobs with direct patient contact	25 (55.6)	13 (65.0)	0.589
Jobs without direct patient contact	20 (44.4)	7 (35.0)	

Table 4: Sputum TB culture (n = 65)

	Subclinical PTB, n (%)	Active PTB, n (%)	p
Negative & no sputum collected	35 (77.8)	9 (45.0)	0.020
Positive	10 (22.2)	11 (55.0)	

Discussion

This study highlights the incidences of both subclinical and active PTB among HCWs. Interestingly, the majority of PTB cases identified were subclinical PTB, comprising 69.2% of the total cases. A similar trend was observed in a study conducted at another university hospital in Bangkok, where the percentage of subclinical PTB cases among HCWs from 2013 to 2020 was 43.5%.[6] These studies' cases were detected by active case finding, which may lead to higher detection of subclinical PTB. In the general population, most cases are typically detected through passive case finding, which may lead to lower detection of subclinical PTB. For example, a study in South Korea demonstrated that 19.3% of PTB cases were diagnosed with subclinical PTB.[10] Similarly, research conducted in China revealed that 18.2% of PTB cases were classified as subclinical PTB.[11] These findings imply that a considerable number of subclinical PTB cases would likely be underdiagnosed without active case-finding efforts.

Comparisons between job categories with and without direct patient contact did not reveal significant differences. One possible explanation is that the study did not directly compare between PTB and non-PTB cases. According to theoretical assumptions, all active PTB cases would have progressed from subclinical disease.[4] Thus, both subclinical and active PTB likely share similar risk factors, resulting in the nonsignificant result observed. Additionally, the classification of job risks may have influenced the outcome. In this study, jobs were divided into only two groups based on assumed patient contact risks. This approach was chosen to avoid having insufficient cases in each group for meaningful analysis. Also, even with the larger number of cases, categorization based on job descriptions might present challenges. For instance, a case report from a tertiary hospital in Northeastern Thailand found that among sixteen HCWs with PTB, only nine could be confirmed as work-related despite all having clinical-related roles.[12] Further studies with extended study periods and alternative classification methods might yield different findings.

Transmission of MTB is indeed associated with sputum positivity, as it signifies the potential for disease spread. In this study, 22.2% of subclinical PTB cases were found to be culture-positive, indicating a risk of transmission. Monklang et al.[13] conducted a study among the general population who visited the hospital's check-up clinic at a university hospital in Bangkok, revealing 33 PTB cases over a 6-year period. Among these, approximately 85% were subclinical, with 27.3% presenting positive culture results. However, other studies have reported varying rates of culture positivity among subclinical PTB cases. For example, a study conducted by Tang et al.[11] in China found the percentage of culture-positive subclinical cases at 23.2%, while Min et al.[10] reported that of 46.2% in South Korea. In a large cohort study with 4,636 PTB patients by Jeong et al.[14] in South Korea, 1,720 were subclinical PTB patients. The culture positivity proportion in this subclinical PTB group accounted for as high as 50.2%. In addition, similar to our study, this interesting study also demonstrated that the percentage of culture positivity in the active PTB group was significantly greater than in the subclinical PTB group. Altogether, these findings emphasize the importance of an active case-finding strategy. Without such efforts, a vast proportion of subclinical PTB cases would remain undetected, constantly contributing to TB transmission. Specifically, active case finding through chest radiography is a crucial tool for reducing subclinical TB cases and subsequent TB transmission, especially in high-risk populations such as HCWs.

Conclusion

This study provides insight into the significant burden of TB in HCWs, especially subclinical PTB, within a large university hospital. Importantly, our findings underscore the critical importance of the active case-finding approach of subclinical PTB by utilizing chest radiographs to enhance the prevention of TB transmission within healthcare settings.

Conflicts of interest

No conflict of interest

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