Original Article

Characteristics and Xpert MTB/RIF Assay Results of Prisoners with Pulmonary Tuberculosis, Songkhla Province, Southern Thailand

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Background: Pulmonary tuberculosis (PTB) is a communicable disease and one of the major health problems worldwide. PTB is also a major health problem in prisons. Previously chest radiography and conventional acid fast bacilli smear were used in screening PTB but with low sensitivity and specificity. Sputum culture is a gold standard for PTB diagnosis but time-consuming. Xpert MTB/RIF provided high sensitivity and specificity for detection of tuberculosis and rifampin resistance directly from sputum in less than two hours. In Thailand Xpert MTB/RIF was mostly used in high risk multi-drug resistant suspected cases. Xpert MTB/RIF was combined with mass-screening chest radiography in prisoners for PTB and early detection of multidrug resistant TB. However, factors affecting Xpert MTB/RIF results in prisoner are not well understood, and the present study was undertaken to examine the factors affecting of Xpert MTB/RIF results in prisoners.

Objective: To estimate the prevalence of PTB in four prisons in Songkhla Province, and assess the factors affecting the results of Xpert MTB/RIF assay.

Materials and Methods: A cross-sectional survey in prisoners from four prisons in Songkhla Hospital was conducted between April 2018 and September 2018.

Results: The calculated prevalence of probable PTB cases was 2,832 per 100,000 prisoners. From 10,626 prisoners, 301 cases of PTB were detected from the mass-screening. Factors associated with a positive Xpert MTB/RIF result were type of prison (adjusted OR 0.38; 95% CI 0.22 to 0.65), previous TB infection (adjusted OR 0.36; 95% CI 0.21 to 0.60), having at least one TB symptom (adjusted OR 1.9; 95% CI 1.18 to 3.05), and having reticulopatchy infiltration lesion (adjusted OR 3.35; 95% CI 1.88 to 5.97).

Conclusion: The four prisons had a high prevalence of PTB. Xpert MTB/RIF is a useful diagnostic tool for early detection of PTB in prisoners. However, patients' factors affecting Xpert MTB/RIF results should be considered before the assay is performed.

Keywords: Pulmonary tuberculosis, Prisoners, Xpert MTB/RIF assay, Chest radiography

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Pulmonary tuberculosis (PTB) is one of the major health problems worldwide. In 1993, the World Health Organization (WHO)(1) announced a global emergency on tuberculosis (TB), after that, the TB incidence rate had declined by 2% per year with the aim to reduce the TB incidence rate by 20% by the year 2020. However, rifampicin resistance (RR) or multi-drug resistance tuberculosis (MDR-TB) has begun to pose a serious new challenge. In 2017(2), of the 558,000 new cases of RR-TB reported worldwide, an estimated 82% had MDR-TB.

Thailand, a developing country, always had a high incidence of TB. Xpert MTB/RIF assay screening is helpful with the recent appearance of the drug-resistant TB strains, especially in countries with a high prevalence of TB. In 2018, the WHO reported

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that the incidence of TB was 156 cases per 100,000 people[3]. In Thailand, there were 82,008 TB cases notified in 2017 and 83% of the diagnosed cases was PTB[3]. The incidence of MDR/RR-TB was 5.7 cases per 100,000 people in Thailand[3]. Among PTB cases, there were 2,700 MDR/RR-TB cases and 24% of the resistant cases were resistant to rifampicin[3].

In 2019, the WHO reported that TB incidence rate in European prisons was 17 times higher than those in the general European population, ranging from 11 times higher in western Europe to 81 times higher in eastern Europe[4]. The TB situation in prisons was worsened by the emergence and spread of MDR and extensively drug-resistant (XDR) TB[5]. In Southern Thailand, Songkhla Hospital is a tertiary care hospital, responsible for prisoners in the four main prisons of Songkhla Province. Piriyakitkamjom and Pongpiboon reported that the prevalence of PTB in Songkhla prisons was 965 PTB confirmed cases per 100,000 people in 2017[6].

Xpert MTB/RIF assay as a TB screening tool, uses a reverse transcriptase polymerase chain reaction to detect the TB-specific *rpoB* gene[7]. The assay results can be obtained within two hours. Mutation of the *rpoB* is an indicator for rifampicin resistance. This rapid test has been endorsed by WHO since 2010 for PTB screening[8,9]. The sensitivity and specificity of Xpert MTB/RIF assay for sputum were 92% (70% to 100%) and 99% (91% to 100%), respectively[10].

Xpert MTB/RIF assay has been used at Songkhla Hospital for TB screening since April 2016, especially in sputum smear negative cases suspected to have TB disease or rifampicin resistance. Its utility for routine TB screening and detection of rifampicin-resistant TB among the prisoners was examined, but there were various limitations surrounding the analyses. In addition, factors associated with positive Xpert MTB/RIF assay result was not assessed in previous studies[11]. Therefore, the present study aimed to quantify the prevalence of PTB among prisoners in the Songkhla prisons and to assess factors affecting Xpert MTB/RIF assay.

Materials and Methods

Ethical approval

The present study was approved by the Research Ethics Committee of Songkhla Hospital, Songkhla, Thailand.

Study design

A cross-sectional survey was conducted in prisoners from the four major prisons in Songkhla Province between April 2018 and September 2018. In the present study, the authors de-identified the name of the four major prisons by using the letter A, B, C, D to protect their confidentialities. The data were collected as a part of the TB mass-screening program, conducted by Songkhla Hospital, Songkhla, Thailand. The demographic factors and clinical presentations of the prisoners with and without PTB were recorded using a case record form and a questionnaire.

Participant recruitment

Ten thousand six hundred twenty-six prisoners underwent frontal chest radiography (CXR) to screen for the evidence of PTB infection. The films were interpreted independently by radiologists who were unaware of the subjects' other TB signs or symptoms. All prisoners with abnormal CXRs compatible with PTB were interviewed using a standardized symptom questionnaire for further TB screening. Patients having one or more physical symptoms, mainly cough more than two weeks, fever for two or more weeks, hemoptysis, or significant weight loss, were suspected of having PTB infection, according to the WHO symptom criteria[12].

The inclusion criteria for cross-sectional study were 1) prisoners from one of the four prisons in Songkhla Province as mentioned above, 2) 18 years or older, and 3) an abnormal CXR compatible with PTB. The exclusion criteria were 1) prisoners diagnosed with extrapulmonary TB, and 2) those who finished their imprisonment during the mass screening.

The prisoners who were recruited into the study were classified into three groups, 1) bacteriologically confirmed TB cases (definite TB), which is clinical presentation compatible with TB with at least one spot sputum acid fast bacilli (AFB) positive or positive Xpert MTB/RIF assay or sputum culture positive for *Mycobacterium tuberculosis*, 2) clinically diagnosed TB (probable TB), which is clinical presentation and radiologic images highly suggestive of TB or those for whom anti-TB treatment was initiated by an attending clinician based on the clinical presentation but the patient did not meet the criteria for definite TB (no culture-based evidence of *M. tuberculosis*), and 3) non-TB, which is no evidence of TB infection from smear microscopy, culture, or CXR, no anti-TB treatment initiated, and the patient was cured from disease with alternative treatments. For the purposes of analysis, both definite TB and probable TB cases were classified as diagnosed TB cases.

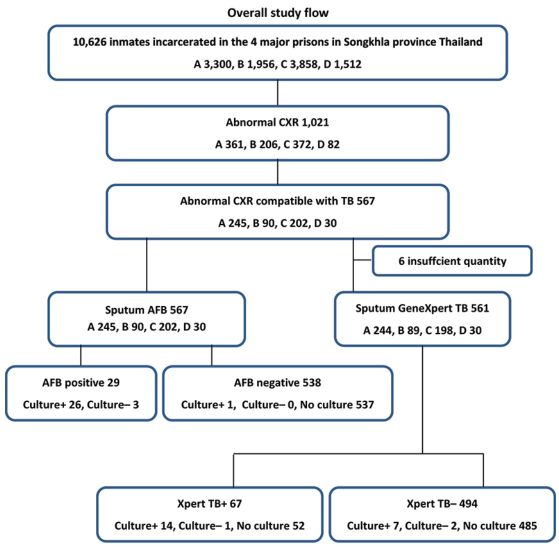

Figure 1. Flow diagram showing mass-screening program, cases diagnosed with tuberculosis and number of cases diagnosed.

Statistical analysis

The data from the TB registration book were input into an excel spreadsheet and analyzed by R software, version 3.5.1 (R Core Team, Vienna, Austria). Descriptive statistics, means, and standard deviations (SDs) were used to describe continuous variables. Numbers and percentages were used to describe categorical variables.

For the inferential statistics, multivariate logistic regression was performed to assess the factors associated with positive Xpert MTB/RIF assay results. The variables for the final regression model were selected using the backward stepwise method based on the Akike Information Criteria (AIC).

Results

Of the 10,626 prisoners who were in the mass-screening programs with frontal CXR, 567 had abnormal radiographic findings, compatible with PTB. All 567 cases were tested with sputum AFB on three consecutive days and a single time with Xpert MTB/RIF assay. No rifampicin resistance was detected by Xpert MTB/RIF assay in the present study. Only 54 (9.52%) of the cases had sputum culture data available (Figure 1).

Patients with the diagnosis of tuberculosis had a median age of 35 years (interquartile range [IQR] 30 to 43), 95% were male, 97.3% were Thai. The median body mass index was 20 kg/m^2 (IQR 18.7 to 21.9). Of these, 46.2% of cases were from Songkhla A prison, 1.7% had either diabetes mellitus (DM) or human immunodeficiency virus (HIV) as underlying diseases, 13.6% had a history of previous TB infection, and 22.9% had at least one WHO symptoms (any cough, fever, weight loss, or night sweats) as recorded in (Table 1). Prisoners from the Songkhla A prison and the Songkhla C prison had a slightly higher chance of being diagnosed with TB. Prisoners with previous history had a significantly lower probability of being diagnosed with pulmonary TB (Table 1).

Seven point six percent of the 301 prisoners with the diagnosis of tuberculosis had sputum acid fast smear positive and 22.3% of the cases had Xpert MTB/RIF result positive. *M. tuberculosis* was detected by sputum culture in 7% of the cases with 46.2% of the cases had lung lesions at the right upper lobe, observable from CXR and 35.9% of TB cases had the reticular infiltration CXR finding (Table 1).

The factors associated with higher chance of being diagnosed with pulmonary TB were having lung lesions at both upper lung, having a reiculopatchy, reticulonodular, and patchy infiltration, and having Xpert TB positive results (Table 1).

Patients with diagnosed tuberculosis and positive Xpert MTB/RIF result had a median age of 34 years (IQR 30 to 39.5), 95.5% of the cases was male, and 97.0% of cases were Thai. The median body mass index was 20.1 kg/m^2 (IQR 18.8 to 21.4). Of these, 61.2% of cases were from Songkhla A prison, 22.4% had at least one WHO TB symptoms (any cough, fever, weight loss, or night sweats) as recorded (Table 2).

Only 20.9% of the prisoners with positive Xpert MTB/RIF had a positive sputum acid fast smear, 43.3% of the positive Xpert MTB/RIF cases had right upper lung lesions found on CXR, and 38.8% of the cases had reticulopatchy infiltration on CXR finding (Table 2).

There were notable differences between Xpert-negative and Xpert-positive prisoners (Table 2) in patient and laboratory characteristics. Factors associated with having Xpert-positive were residing in the Songkhla A Prison, having positive acid fast strain, having lesions on the right upper and both lower lungs, having radiculopatchy infiltration, and having positive TB culture ($p<0.05$).

From the multivariate logistic regression (Table 3), the factors associated with positive Xpert MTB/RIF assay were type of prisons (adjusted OR 0.38; 95% CI 0.22 to 0.65), previous history of TB infection (adjusted OR 0.36; 95% CI 0.21 to 0.6), had at least one of WHO TB symptoms (adjusted OR

Table 1. Demographic and clinical factors of prisoners with tuberculosis diagnosed and non tuberculosis diagnosed from mass- screening abnormal chest X-ray (n=561)

Characteristic	Not diagnosed with TB (n=260) n (%)	Diagnosed with TB (n=301) n (%)	Total (n=561) n (%)	p-value
Age (year)				0.872
Median (IQR)	36 (30, 43)	35 (30, 43)	35 (30, 43)	
Prison				0.047
A	105 (40.4)	139 (46.2)	244 (43.5)	
B	53 (20.4)	36 (12.0)	89 (15.9)	
C	87 (33.5)	111 (36.9)	198 (35.3)	
D	15 (5.8)	15 (5.0)	30 (5.3)	
Sex				0.68
Male	245 (94.2)	286 (95.0)	531 (94.7)	
BMI				0.061
Median (IQR)	20.6 (19, 22)	20 (18.7, 21.9)	20.2 (18.8, 22)	
Nationality				0.564
Thai	255 (98.1)	293 (97.3)	548 (97.7)	
Underlying disease				0.886
No underlying	242 (93.1)	280 (93.0)	522 (93.0)	
DM/HIV	3 (1.2)	5 (1.7)	8 (1.4)	
Other	15 (5.8)	16 (5.3)	31 (5.5)	
Previous history of TB				<0.001
Yes	69 (26.5)	41 (13.6)	110 (19.6)	
WHO symptoms				0.004
≥1	35 (13.5)	69 (22.9)	104 (18.5)	
Localized lesion on CXR				0.071
Right upper lung	142 (54.6)	139 (46.2)	281 (50.1)	
Left upper lung	60 (23.1)	68 (22.6)	128 (22.8)	
Both upper lungs	45 (17.3)	79 (26.2)	124 (22.1)	
Other	13 (5.0)	15 (5.0)	28 (5.0)	
Infiltration on CXR				<0.001
Reticular	141 (54.2)	108 (35.9)	249 (44.4)	
Reticulopatchy	22 (8.5)	56 (18.6)	78 (13.9)	
Reticulonodular	25 (9.6)	48 (15.9)	73 (13.0)	
Patchy	36 (13.8)	57 (18.9)	93 (16.6)	
Old fibrosis	30 (11.5)	23 (7.6)	53 (9.4)	
Other	6 (2.3)	9 (3.0)	15 (2.7)	
AFB				<0.001
Positive	0 (0.0)	23 (7.6)	23 (4.1)	
Xpert TB				<0.001
Positive	0 (0.0)	67 (22.3)	67 (11.9)	
Culture				<0.001
Growth	0 (0.0)	21 (7.0)	21 (3.7)	
No growth	0 (0.0)	3 (1.0)	3 (0.5)	
No culture	260 (100)	277 (92.0)	537 (95.7)	

TB=tuberculosis; BMI=body mass index; DM/HIV=diabetes mellitus or human immunodeficiency virus; WHO=World Health Organization; CXR=chest X-ray; AFB=acid fast bacilli; IQR=interquartile range

* TB diagnosed=either bacteriologically confirmed or clinically diagnose

Table 2. Characteristics of prisoners with tuberculosis diagnosed and non tuberculosis diagnosed by Xpert MTB/RIF assay results from mass- screening abnormal chest X-ray (n=561)

Characteristic	TB diagnosed (n=301); n (%)				Not diagnosed TB (n=260); n (%)	
	Xpert– (n=234)	Xpert+ (n=67)	Total (n=301)	p-value	Xpert+ (n=0)	Xpert– (n=260)
Age				0.257		
Median (IQR)	35 (30, 43.8)	34 (30, 39.5)	35 (30, 43)		0 (0.0)	37 (9.6)
Prison				0.039		
A	98 (41.9)	41 (61.2)	139 (46.2)		0 (0.0)	105 (40.4)
B	29 (12.4)	7 (10.4)	36 (12.0)		0 (0.0)	53 (20.4)
C	95 (40.6)	16 (23.9)	111 (36.9)		0 (0.0)	87 (33.5)
D	12 (5.1)	3 (4.5)	15 (5.0)		0 (0.0)	15 (5.8)
Sex				1		
Male	222 (94.9)	64 (95.5)	286 (95)		0 (0.0)	245 (94.2)
BMI				0.877		
Median (IQR)	20 (18.7, 22)	20.1 (18.8, 21.4)	20 (18.7, 21.9)		0 (0.0)	20.7 (2.6)
Nationality				1		
Thai	228 (97.4)	65 (97.0)	293 (97.3)		0 (0.0)	255 (98.1)
Underlying disease				0.239		
No underlying	215 (91.9)	65 (97.0)	280 (93.0)		0 (0.0)	242 (93.1)
DM/HIV	4 (1.7)	1 (1.5)	5 (1.7)		0 (0.0)	3 (1.2)
Other	15 (6.4)	1 (1.5)	16 (5.3)		0 (0.0)	15 (5.8)
Previous history TB				0.118		
Yes	28 (12.0)	13 (19.4)	41 (13.6)		0 (0.0)	69 (26.5)
WHO symptoms				0.906		
≥1	54 (23.1)	15 (22.4)	69 (22.9)		0 (0.0)	35 (13.5)
Localized lesion on CXR				0.041		
Right upper Lung	110 (47)	29 (43.3)	139 (46.2)		0 (0.0)	142 (54.6)
Left upper lung	59 (25.2)	9 (13.4)	68 (22.6)		0 (0.0)	60 (23.1)
Both upper lungs	56 (23.9)	23 (34.3)	79 (26.2)		0 (0.0)	45 (17.3)
Other	9 (3.8)	6 (9.0)	15 (5.0)		0 (0.0)	13 (5.0)
Infiltration on CXR				<0.001		
Reticular	100 (42.7)	8 (11.9)	108 (35.9)		0 (0.0)	141 (54.2)
Reticulopatchy	30 (12.8)	26 (38.8)	56 (18.6)		0 (0.0)	22 (8.5)
Reticulonodular	36 (15.4)	12 (17.9)	48 (15.9)		0 (0.0)	25 (9.6)
Patchy	45 (19.2)	12 (17.9)	57 (18.9)		0 (0.0)	36 (13.8)
Old fibrosis	15 (6.4)	8 (11.9)	23 (7.6)		0 (0.0)	30 (11.5)
Other	8 (3.4)	1 (1.5)	9 (3.0)		0 (0.0)	6 (2.3)
AFB				<0.001		
Positive	9 (3.8)	14 (20.9)	23 (7.6)		0 (0.0)	260 (100)
Culture				<0.001		
Growth	7 (3.0)	14 (20.9)	21 (7.0)		0 (0.0)	0 (0.0)
No growth	2 (0.9)	1 (1.5)	3 (1.0)		0 (0.0)	0 (0.0)
No culture	225 (96.2)	52 (77.6)	277 (92.0)		0 (0.0)	260 (100)

TB=tuberculosis; BMI=body mass index; DM/HIV=diabetes mellitus or human immunodeficiency virus; WHO=World Health Organization; CXR=chest X-ray; AFB=acid fast bacilli; IQR=interquartile range

Table 3. Logistic regression analysis assessing associations between patient characteristics and odds of positive Xpert MTB/RIF among patients with the diagnosis of PTB (n=301)

Characteristic	Crude OR (95% CI)	Adjusted OR (95% CI)	p-value	
			Wald's test	LR-test
Age group (ref: age ≤30 years)				0.606
Age >30 years	0.94 (0.65, 1.36)	0.9 (0.6, 1.35)	0.606	
Prison (ref: A)				0.006
B	0.51 (0.31, 0.84)	0.38 (0.22, 0.65)	<0.001	
C	0.96 (0.66, 1.41)	0.73 (0.47, 1.14)	0.172	
D	0.76 (0.35, 1.61)	0.63 (0.27, 1.48)	0.287	
BMI group (ref: ≤18 kg/m^2)				0.766
18 to 25 kg/m^2	0.87 (0.54, 1.39)	0.95 (0.57, 1.59)	0.855	
>25 kg/m^2	0.62 (0.27, 1.41)	0.72 (0.29, 1.78)	0.482	
Underlying disease (ref: none)				0.322
DM/HIV	1.44 (0.34, 6.09)	3.02 (0.64, 14.19)	0.162	
Other	0.92 (0.45, 1.9)	0.86 (0.38, 1.91)	0.704	
Previous history TB (ref: no)				<0.001
Yes	0.44 (0.28, 0.67)	0.36 (0.21, 0.6)	<0.001	
WHO symptoms (ref: 0)				0.007
≥1	1.91 (1.22, 2.99)	1.9 (1.18, 3.05)	0.008	
Infiltration on CXR (ref: reticular)				<0.001
Reticulopatchy	3.32 (1.91, 5.78)	3.35 (1.88, 5.97)	<0.001	
Reticulonodular	2.51 (1.45, 4.32)	2.54 (1.44, 4.48)	0.001	
Patchy	2.07 (1.27, 3.36)	1.97 (1.19, 3.26)	0.008	
Old fibrosis	1 (0.55, 1.82)	1.35 (0.68, 2.67)	0.393	
Other	1.96 (0.68, 5.67)	2.12 (0.7, 6.44)	0.184	

TB=tuberculosis; BMI=body mass index; DM/HIV=diabetes mellitus or human immunodeficiency virus; WHO=World Health Organization; CXR=chest X-ray; OR=odds ratio; CI=confidence interval; LR=likelihood ratio

* Adjusted for all variables shown in the table

1.9; 95% CI 1.18 to 3.05), and having reticulopatchy infiltration on CXR (adjusted OR 3.35; 95% CI 1.88 to 5.97). Being held in the Songkhla A Prison, having at least one WHO TB symptom, and having either reticulopatchy, reticulonodular, and patchy infiltration were associated with higher odds of having a positive Xpert MTB/RIF assay result, while a past history of TB infection was associated with a lower risk of having a positive Xpert MTB/RIF assay result.

Discussion

The authors found that the prevalence of PTB in prisoners from the four major prisons in Songkhla was 2,833 cases (confirmed or probable TB cases) per 100,000 prisoners, and 847 bacteriogically confirmed cases per 100,000 prisoners (sputum smear or GeneXpert or culture positive cases). Meanwhile, the TB prevalence in general Thai population was 156 cases per 100,000 population[3]. Previous study of Sretrirutchai et al reported the prevalence of smear-positive PTB from four provincial prisons in Southern Thailand in 1998 was 568 per 100,000 prisoners, which was eight times higher than the prevalence in the general population at that time[13]. Similarly, a study of Jittimanee et al reported that the prevalence of sputum smear confirmed cases of PTB was 354.8 per 100,000 people from 27 of 136 prisons in Thailand in 2007[14]. The prevalence of confirm PTB cases from the four major prisons in Songkhla province was 965 per 100,000 prisoners in 2016[6]. While WHO reported the decline in the prevalence of PTB in the general population but the level of TB in prisons had been reported to be up to 100 times higher than the general population[3,15]. The present study found the increase in the prevalence of PTB in prisons. This might be due to the fact that the present study included probable

PTB cases and used the Xpert assay for screening PTB. These figures show that the number of PTB cases in the prison population has been increasing over time, which could be due to various causes such as overcrowding, limited access to health care, and poor ventilation.

Of the 19.6% of the negative AFB-smear prisoners, they had positive Xpert MTB/RIF assay results, while 60.9% of the positive AFB-smear prisoners had positive Xpert MTB/RIF results. This finding was notably higher than in the study by Manakul(16) in 2016 that reported that only 8.06% of the AFB smear negative prisoners had a positive result of Xpert MTB/RIF assay. Thus, Xpert MTB/RIF assay might be useful to reduce false negative TB screening and increase sensitivity results among prisoners with abnormal CXR findings but negative AFB-smear(17). False-positives AFB smear had to differentiate non-tuberculous mycobacteria (NTM) but lack of sputum culture to confirm in the present study(18).

The cases with negative Xpert MTB/RIF assay but positive AFB-smear (suspected false negatives) might be related to the inexperience of technicians, since Xpert MTB/RIF assay had only been implemented in prisons in Songkhla since 2016 (two years before that study), and thus, there was at that time a limited number of laboratory personnel properly trained in collecting sputum and performing the assay. Meyer et al found sputum quality may impact test yield and sensitivity of Xpert MTB/RIF(19). A previous study by Agonafir et al reported that less experience laboratory technicians had a higher rate of false negative(11). Future studies should examine the laboratory factors including techniques, volume of sputum, and duration of the sputum collection to laboratory to reduce the false negative rate(19).

In the present study, the factors associated with positive Xpert MTB/RIF assay results were type of prison, past history of TB infection, positive WHO symptoms, and infiltrations found on CXR. Other factors including diabetes mellitus, HIV, gender, body mass index, and age of prisoners were not significantly associated with Xpert MTB/RIF assay results. This information on underlying disease was obtained from using a questionnaire filled by the prisoners themselves. Further laboratory to investigated HIV or blood sugar would be helpful to confirm the results.

The highest rate of positive Xpert MTB/RIF assay results was found in prison A. This is consistent with the study of Sretrirutchai et al(13) that reported that prison A was overcrowded and lacked proper ventilation.

In the present study, previous pulmonary TB infection was associated with lower odds of having positive Xpert MTB/RIF assay (OR 0.36; 95% CI 0.21 to 0.60). This is opposite to other studies. For example, the study by Reechaipichitkul et al found that patients with a previous history of TB infection had 3.2 times the risk of being diagnosed with TB(20). The lower odds found in the present study might be due to the misclassification of prisoners' reports. The previous history PTB should be classified as cured or incomplete treatment, which will affect the analysis results.

Prisoners with at least one of the WHO symptoms had 1.9 times higher odds of having positive Xpert MTB/RIF assay results. Lawn et al also reported that patients with one or more WHO symptoms had 1.38 times higher odds of having a positive Xpert MTB/RIF assay result(21). The probability of having a positive Xpert MTB/RIF assay result might be higher in prisoners with symptoms or having active PTB because of a high accumulation of *M. tuberculosis*(20).

Prisoners with a positive Xpert MTB/RIF assay result had a higher proportion of reticulopatchy infiltration, while those with a negative Xpert MTB/RIF assay result had a higher proportion of reticular infiltration. The study of Wekesa et al found that the most common CXR abnormality was consolidation in PTB diagnosed cases(22). Prisoners with reticulopatchy infiltration on CXR were found to have 3.35 times higher odds of having a positive Xpert MTB/RIF assay result than those with reticular infiltration. This is consistent with the study of Lawn et al(21) that found a higher prevalence of parenchymal abnormalities on CXR in patients with a positive Xpert MTB/RIF assay result than in those with a negative Xpert MTB/RIF assay result(21). A study by Lawn et al also found that minimal fibropatchy and cavity lesions on CXRs were significantly associated with positive Xpert MTB/RIF assay results(21). These findings implied that infiltration morphology noticed on a CXR might predict or affect Xpert MTB/RIF assay results. Reticulopatchy infiltration on CXR was correlated with positive Xpert MTB/RIF assay results.

The present study had several limitations. First, 65.44% of the diagnosed TB cases were clinically diagnosed, and therefore, misclassification of TB cases were possible due to the uses of the clinically probable criteria. Of all the diagnosed TB cases, 92%, had no TB culture results. The TB cases confirmed by AFB staining were not sent for TB culture, resulting in the present study being unable to use the TB culture as the gold standard to assess the performance of Xpert MTB/RIF assay. Importantly, no samples in the present study showed resistance to RIF either by Xpert MTB/RIF assay or culture. However, the authors could not evaluate the accuracy of Xpert MTB/RIF assay in the detection of RIF resistance in the present study due to the lack of TB culture data. Other factors affecting Xpert MTB/RIF assay and the incidence of TB infection such as length of incarceration and skill of the technicians performing Xpert MTB/RIF assay were not assessed, and therefore, not taken into account in the present study.

Conclusion

The prevalence of PTB in prisoners in the four major prisons in Songkla Province was higher than in the general Thai population. Xpert MTB/RIF did not help diagnose tuberculosis in prisons in this study. Screening for PTB in prisoners using CXR, AFB smear, and Xpert MTB/RIF assay might be useful, but further studies were needed in the cases with abnormal CXR but negative AFB smear, especially for large prisons. The main factors associated with positive Xpert MTB/RIF assay results were the presence of at least one TB symptom and reticulopathy infiltration on the CXR. However, the factors affecting of Xpert MTB/RIF assay such as technician skills in collecting and processing sputum have to be improved to maximize the usefulness of Xpert MTB/RIF assay in mitigating the spread of PTB in Thailand's prisons.

What is already known on this topic?

Previous studies in Thai prisoners have quantified prevalence of PTB. None of those reports studied the uses of Xpert MTB/RIF assay in prisons. Various studies from other countries assess the usefulness and factors affecting Xpert MTB/RIF assay. However, Thai prisoners are a special population whose factors might differed from those in other countries.

What this study adds?

This study assessed factors affecting MTB/RIF assay including the findings on CXR, patient demographic, past medical history, and type of prisons. The results from this study suggest that those factors should be considered when clinicians interprete the MTB/RIF assay results, especially in prisoners. Other potential factors affecting Xpert MTB/RIF assay such as imprison time and skill of technician on the Xpert MTB/RIF assay should be evaluated by further studies.

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Conflicts of interest

The authors declare no conflict of interest.

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