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Prevalence and risk factors of tuberculosis disease in South African correctional facilities in 2015

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SUMMARY

SETTING: Sixteen South African correctional facilities.

OBJECTIVE: To determine the prevalence of and risk factors for tuberculosis (TB) in South African correctional facilities using data collected during a TB screening program in South African correctional facilities in 2015.

DESIGN: Inmates in 16 South African correctional facilities were screened for TB from January to December 2015. Inmates reporting ≥1 TB symptom or having an abnormal computer-assisted digital chest X-ray (CXR) provided sputum. Abnormal CXRs were interpreted by a radiologist. Sputum was tested for *Mycobacterium tuberculosis* using Xpert® MTB/RIF. Data from 16 South African correctional facilities were used in regression analysis, and prevalence estimates calculated for 12 South African correctional facilities with >30% screening coverage.

RESULTS: In 12 South African correctional facilities included in the prevalence estimates, 837 inmates had TB disease (2653/100000) as indicated by current TB treatment or screening-identified TB by radiologist or Xpert. Previous TB was associated with increased odds of screening-identified TB in HIV-positive inmates (OR 4.3, 95%CI 2.5–7.3). For HIV-negative inmates, previous TB (adjusted OR [aOR] 4.9, 95%CI 1.7–14.1) and self-reported symptoms vs. none (1 symptom, aOR 8.8, 95%CI 1.2–67.7; >2 symptoms, aOR 21.7, 95%CI 3.0–158.8) were independently associated with increased odds of screening-identified TB.

CONCLUSIONS: Routine TB screening, including CXR, is needed in South African correctional facilities to identify and refer inmates with active TB.

RÉSUMÉ

Seize structures de détention d'Afrique du Sud.

Déterminer la prévalence et les facteurs de risque de tuberculose (TB) dans les structures de détention d'Afrique du Sud grâce à des données recueillies pendant un programme de dépistage de la TB dans les structures de détention d'Afrique du Sud en 2015.

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Conflicts of interest: none declared.

Les détenus de 16 structures de détention d'Afrique du Sud ont été dépistés à la recherche de TB entre janvier et décembre 2015. Les détenus ayant au moins un symptôme de TB ou ayant une anomalie à la radiographie pulmonaire (CXR) basée sur une radio numérisée assistée par ordinateur (CAD) ont fourni des crachats. Les CXR anormales ont été interprétées par un radiologue. Les frottis ont été examinés à la recherche de *Mycobacterium tuberculosis* par Xpert® MTB/RIF. Les données des 16 structures de détention ont été utilisées en analyse de régression et les estimations de prévalence ont été calculées pour 12 structures de détention avec plus de 30% de couverture du dépistage.

Dans les 12 structures de détention inclus dans les estimations de prévalence, 837 détenus avaient une TB maladie (2653/100000) comme en attestait le traitement de TB en cours ou une TB identifiée lors du dépistage par un radiologue ou par Xpert. Une TB préalable a été associée avec un risque accru de TB identifiée par dépistage chez les détenus positifs au virus de l'immunodéficience humaine (OR 4,3; IC 95% 2,5–7,3). Pour les détenus VIH négatifs, une TB préalable (OR ajusté [ORa] 4,9; IC 95% 1,7–14,1), et des symptômes rapportés par les patients (contre aucun symptôme : ORa 1 symptôme 8,8; IC 95% 1,2–67,7; ORa ≥2 symptômes 21,7; IC 95% 3,0–158,8) ont été indépendamment associés à un risque accru de TB identifiée par le dépistage.

Un dépistage de routine de la TB, incluant une CXR, est nécessaire dans les structures de détention d'Afrique du Sud afin d'identifier et de référer les détenus atteints de TB active.

RESUMEN

Dieciséis centros penitenciarios en Suráfrica.

Determinar la prevalencia de tuberculosis (TB) y los factores de riesgo de contraerla en los centros penitenciarios de Suráfrica, a partir de los datos recogidos durante un programa de detección sistemática de la TB en estos establecimientos en el 2015.

Se practicó el tamizaje de la TB en los reclusos de 16 centros penitenciarios de enero a diciembre del 2015. Los reclusos que referían uno o más síntomas indicativos de TB o que presentaban imágenes anormales en la radiografía de tórax (CXR), según un programa de análisis de las CXR digitales asistido por computador, aportaron muestras de esputo. Un radiólogo interpretó las CXR anormales. Se investigó la presencia de *Mycobacterium tuberculosis* en el esputo mediante la prueba Xpert® MTB/RIF. Los datos de los 16 centros penitenciarios se incluyeron en un análisis de regresión y se calculó la prevalencia en 12 de ellos, donde la cobertura del tamizaje fue superior a 30%.

En los 12 centros incluidos en las estimaciones de prevalencia, 837 reclusos presentaban enfermedad tuberculosa (2653/100000), según lo indicaba un tratamiento antituberculoso en curso o la detección positiva mediante el informe del radiólogo o la prueba Xpert. El antecedente de TB se asoció con una mayor posibilidad de detectar la TB mediante tamizaje, en los reclusos positivos frente al virus de la inmunodeficiencia humana (VIH) (OR 4,3; IC 95% 2,5–7,3). En los reclusos negativos frente al VIH, el antecedente de TB (OR ajustado [ORa] 4,9; IC 95% 1,7–14,1) y los síntomas autorreferidos (comparado con la ausencia de síntomas; aOR 8,8; IC 95% 1,2–67,7 para un síntoma y aOR 21,7; IC 95% 3,0–158,8 para más de dos síntomas) se asociaron de manera independiente con una mayor posibilidad de detectar la TB mediante tamizaje.

En los centros penitenciarios de Suráfrica es necesario practicar la detección sistemática de la TB, incluida la CXR, con el fin de reconocer a los reclusos con enfermedad tuberculosa activa y remitirlos.

Keywords

TB; prisons; correctional facilities; sub-Saharan Africa; risk factors

AROUND 1.5 MILLION people die annually from tuberculosis (TB) disease, and TB has now surpassed human immunodeficiency virus (HIV) infection and acquired immunodeficiency syndrome (AIDS) as the top infectious-disease killer worldwide.[1] Correctional facilities can function as reservoirs and amplifiers of TB because they congregate individuals from sub-populations at a high risk of infection and disease due to an increased likelihood of underlying comorbidities for extended periods of time, are often poorly ventilated and overcrowded, and can introduce TB risk to the surrounding community through turnover of incarcerated individuals and facility employees.[2] Evidence suggests an epidemic of TB in correctional facilities that far exceeds that of the general population.[3] The threat of TB in correctional facilities is particularly worrisome in South Africa, a nation with high incidence rates of TB and HIV/AIDS combined with the largest incarcerated population in Africa.[4]

We aimed to determine the overall and facility-specific TB prevalence rates, as well as the demographic and clinical factors associated with TB disease in 16 Department of Correctional Service (DCS) correctional facilities in South Africa.

STUDY POPULATION AND METHODS

A secondary analysis was conducted using data from a systematic TB-HIV screening program at 16 South African correctional facilities in Gauteng, Limpopo, Mpumalanga and North West Provinces from January to December 2015. This program is an expansion of a pilot project, with the addition of digital chest X-rays (dCXRs).[5] During this program, inmates were administered a questionnaire to elicit self-reported demographic and clinical variables, including past and current TB diagnoses and presence of TB symptoms (cough, fever, night sweats, or weight loss). If available, dCXR was performed on consenting inmates, and was read using computer-assisted digital (CAD) X-ray software (CAD4TB; Delft Imaging Systems, Veenendaal, The Netherlands). Inmates presenting with ≥1 TB symptom or dCXR abnormalities (CAD score ≥50) were asked to provide a morning spot sputum sample for TB testing with Xpert® MTB/RIF (Cepheid, Sunnyvale, CA, USA); testing was completed within 48 h. All dCXRs with a CAD score ≥50 were read by a radiologist, who then categorized each radiograph under ‘no TB’, ‘probable TB’, or ‘definite TB’. Inmates positive for *Mycobacterium tuberculosis* on Xpert or with a dCXR designated ‘definite TB’ were considered to have screening-identified TB disease for this analysis. All patients identified using dCXR would have been referred for further clinical assessment and further culture confirmation before starting TB treatment.

All inmates were offered HIV counseling and testing (HCT); those who consented were tested using a point-of-care HIV rapid test kit (UniGold™; Trinity Biotech, Bray, Ireland). Positive rapid tests were confirmed using the Abon™ HIV 1/2/O (Abon Biopharm, Hangzhou, China) point-of-care rapid test. If the screening test was reactive and the confirmatory test was non-reactive, venous blood was collected for enzyme-linked immunosorbent assay (ELISA); the ELISA result was used to determine the final HIV status.

Ethics

Secondary analysis was conducted on routine data from the TB-HIV screening program. Ethical approval for the data analysis was obtained from the South African DCS Research Review Board, Pretoria, and the University of Witwatersrand Human Research Ethics Committee, Johannesburg, South Africa.

Sources, handling, and management of data

Data were abstracted from three sources: 1) TB screening questionnaire (demographic, TB history, TB symptoms and HCT data), 2) dCXR results based on the radiographer's reading of abnormal CAD images, and 3) the National Health Laboratory Service (NHLS) Xpert test results. TB screening data were linked to laboratory results via a unique NHLS barcode assigned at the time of screening. Data were de-identified, de-duplicated, and analyzed using SAS v9.4 (SAS Institute, Cary, NC, USA).

Data analysis

The proportion of inmates screened was calculated by dividing the total number of screened inmates by the 2015 estimates for the incarcerated population (obtained from the DCS). The proportion of inmates with TB was calculated by dividing the number of TB cases by the number of inmates screened, and a prevalence rate was expressed per 100000 persons. As CAD scores were not routinely recorded, inmates were presumed to have a CAD score ≥50 (indicative of possible TB disease) if they had a dCXR reading and/or if they submitted sputum in the absence of symptoms.

Bivariate logistic regression was used to calculate the association between demographic and clinical characteristics and screening-identified TB. Any characteristic with $P < 0.2$ in the bivariate model or that was biologically plausible was included in the multivariate regression model. We ran separate models stratified by HIV status and compared the resultant odds ratios (ORs). The final multivariate model included variables independently associated with TB disease based on $P < 0.05$.

RESULTS

The overall inmate population for the 16 facilities was 57660 (range 1030–8247), with an average occupancy rate of 132.9% (range 96.8–185.2) (Table 1). Over half (55.2%) of the estimated incarcerated population underwent TB screening, but the proportion differed widely across facilities. Of the 31843 individuals present at screening, 175 reported current TB treatment; 31668 were screened for TB disease. Most screened inmates were male

(96.9%), with age ranging from 15 to 90 years (median 32, interquartile range [IQR] 27–39). The amount of time spent in incarceration varied, with 37.1% having spent <1 year incarcerated (data not shown). Of all the screened inmates, 20.3% consented to HIV testing, with 2115 (6.7%) either self-reporting antiretroviral therapy (ART) at the time of screening or testing positive for HIV during screening.

Of the 31668 inmates not on TB treatment at screening, 19506 (61.6%) reported ≥1 symptom: 10126 (32.0%) reported only 1 symptom, and 9380 (29.6%) reported ≥2 symptoms. Of those with symptoms, 17473 (89.6%) submitted sputum for Xpert; 16179 (92.6%) had Xpert results (Figure). Overall, 12460 (39.3%) inmates underwent dCXR read by CAD. CAD results were presumed to have indicated possible TB disease (CAD score ≥50) in 5573 inmates (44.7% of those receiving CAD). Overall, 2778 inmates with a presumed CAD score of ≥50 (49.9%) submitted sputum. Of asymptomatic inmates with a presumed CAD score of ≥50, 1525 (38.8%) submitted sputum. We could not locate the radiologist readings for 1058 inmates (19.0%) who were presumed to have a CAD score of ≥50 based on sputum submission while asymptomatic. Of all sputum samples submitted for Xpert testing, 92.4% returned a valid result. Overall, 684 inmates (2.2%) had screening-identified TB during the screening campaign: 12 inmates had screening-identified TB based on positive results from both Xpert and radiologist interpretation (4.8% of radiologist-positive results with an Xpert result); 173 inmates had screening-identified TB based on Xpert alone (0.9% of those with a successful Xpert result); 499 inmates (9.0% of those presumed to have a CAD score of ≥50; 73% of screening-identified TB) were considered to have screening-identified TB based on radiologist interpretation only. Prevalence estimates were calculated only for the 12 facilities that had >30% of their estimated population screened (n = 31547). A total of 837 inmates had TB disease (173 on TB treatment and 664 screening-identified TB) at these 12 facilities, giving an overall prevalence of 2653/100000 (Table 1). Prevalence rates ranged from 933/100000 (Facility L) to 6240/100000 (Facility A).

All inmates screened without known TB at screening were included in logistic regression models examining the association between demographic and clinical factors and screening-identified TB disease. Only 7584 inmates (23.9%) had known HIV status: 6152 (20.3%) tested for HIV during screening and 1432 (4.5%) were on ART. Of inmates screened for TB, 2115 (6.7%) were either on ART at the time of screening or tested positive for HIV during screening. In the initial bivariate logistic regression analysis, the odds of TB disease for the screened population was significantly higher among persons known to have HIV (OR 1.4, 95%CI 1.1–1.9; P = 0.008) than persons who did not or had an unknown HIV status (data not shown).

To assess the potential effect modification by HIV status, the crude model was stratified, and the effects of demographic and clinical factors were compared in those with known HIV infection vs. those either known to be HIV-negative or with unknown HIV status. Effect estimates (ORs) in those known to be HIV-infected were then compared with those known to be HIV-negative. Substantial differences in the estimated ORs were observed in each stratified comparison. Therefore, ORs and adjusted odds ratios (aORs) were calculated only for known HIV-positive (Table 2) and known HIV-negative inmates (Table 3).

Sixty-three inmates (3%) with known HIV infection had screening-identified TB. In bivariate analysis, only previous TB was associated significantly with increased odds of screening-identified TB (Table 2) (OR 4.3, 95%CI 2.5–7.3; $P \leq 0.0001$).

Of the 5469 inmates who consented to HIV testing and were found to be HIV-negative, 46 (0.8%) had screening-identified TB. The final multivariate model for known HIV-negative inmates included previous TB status and number of symptoms (reference: 0 vs. 1, ≥2). Inmates with a history of previous TB disease had 4.9 times (95%CI 1.7–14.1; $P = 0.003$) the odds of having screening-identified TB. Inmates who reported one symptom had 8.9 times the odds of having screening-identified TB compared with those reporting no symptoms (95%CI 1.2–67.7; $P = 0.04$). Inmates who reported ≥2 symptoms had 21.7 times the odds of having screening-identified TB compared with those with no symptoms (95%CI 3.0–158.8; $P = 0.003$).

DISCUSSION

For the 12 facilities in which ≥30% of their inmate population was screened, the estimated total prevalence rate of TB (2653/100000) and estimated prevalence rate of screening-identified TB (2116/100000) indicated a higher TB burden in these facilities than that observed in the global general population (174/100000) or in South Africa in 2015 (520/100000).[6] Our estimates are similar to the rates estimated in studies conducted in South African correctional facilities, with an overall prevalence of TB disease of 2100/100000[5] and of 3500/100000[7] for screening-identified TB disease.

Our results suggest that CAD may be a valuable adjunctive test for routine TB screening. CAD machines are mobile and can drastically reduce the amount of time and manpower needed to conduct large-scale CXR screening. Although most inmates in this campaign were symptomatic, the importance of CAD as part of routine screening is evidenced by the 3935 asymptomatic inmates who were determined to have possible TB based on CAD alone. Of these, 344 were considered to have active TB (11 using Xpert, 333 by a radiologist).

A recent evaluation conducted at a Zambian health facility showed CAD (at a threshold of 60) to have 100% sensitivity compared with a TB diagnosis made using Xpert in people with suspected TB.[8] However, results of Xpert-positive inmates who underwent dCXR/CAD but for whom sputum submission was indicated based on symptoms alone suggest that routine dCXR/CAD should be considered in addition to routine symptom screening/Xpert testing (Figure). This strategy is in line with the World Health Organization (WHO) recommendation to use CXR for TB screening in addition to highly sensitive and specific bacteriological confirmatory testing.[9] Overall, 499 inmates had screening-identified TB based on the radiologist's reading, whereas 173 had screening-identified TB based on Xpert testing. Only 12 inmates had screening-identified TB based on both a radiologist reading and Xpert.

Having TB previously was associated significantly with screening-identified TB regardless of HIV status. Nevertheless, the importance of the association between self-reported symptoms and screening-identified TB was dependent upon HIV status. These results

support previous evidence suggesting that the significance of symptoms as predictors of TB disease may be modified by HIV status, and that symptoms are less reliable as predictors of TB disease in persons infected with HIV.[9] Our results support observations from studies that found HIV infection, higher symptom scores and previous TB to be associated with increased odds of TB disease.[10,11] One recent modeling study using demographic and prevalence data from Cape Town, South Africa, found that active case finding, combined with lifelong preventive therapy using isoniazid among persons with previous TB disease could reduce incident TB cases and TB mortality by respectively 40% and 41%.[12] Similar targeted interventions could be considered in correctional settings.

We used programmatic data that was not intended for research purposes. Data were not collected on confirmatory tests or clinician diagnoses that took place after screening activities. The issue of low overall screening coverage (55.2%) was addressed by excluding facilities with poor screening coverage (<30%) from prevalence estimates. CXRs with a CAD score of ≥50 were read by a single radiologist, and information on intra- or inter-rater reliability was not available. Furthermore, due to limitations in CAD data collection, it was necessary to presume inmates' CAD status by a radiologist result and/or sputum submission for asymptomatic inmates. We could not therefore identify the CAD status for any inmate who was symptomatic and, in reality, had a CAD score of ≥50, but who did not have a radiologist reading. Limited availability of mobile dCXR also led to low coverage (39.3%) of dCXR and CAD. We were unable to locate radiologist readings for 1,058 asymptomatic inmates, who were presumed to have a CAD score of ≥50 (due to asymptomatic sputum submission).

A low prevalence of consent for HIV testing (20.3%) limited precise estimation of the risk factors for screening-identified TB. However, by stratifying our logistic regression models by HIV status, we aimed to avoid bias due to effect modification by HIV infection. Another limitation of our risk factor analysis was that as symptom status was self-reported by inmates, we could not verify the true presence or lack of symptoms in these inmates. Also, we could not control for TB risk factors such as drug use, alcohol consumption, or nutritional status. A recent risk factor analysis conducted among inmates in a correctional facility in Johannesburg, South Africa, did not identify a significant association between self-reported smoking or alcohol consumption and newly diagnosed TB disease when controlling for relevant factors.[7] However, poor nutritional status has been found to be a risk factor for TB in correctional facilities in some sub-Saharan nations.[14] Future screening efforts may consider adding nutrition and lifestyle questions to the assessment, as well as further analyzes to optimize the CAD threshold for radiologist review.

Despite sub-optimal screening, sputum submission, and CAD/radiologist coverage/data collection, the 31843 inmates who were screened, enumerated, and recorded constitute one of the largest populations screened for TB in the course of 1 year. The results of this study were strengthened through the use of multiple diagnostic methods and the inclusion of facilities across four regions of South Africa.

We reported a high prevalence of TB disease in selected South African correctional facilities. These results support previous evidence that correctional facilities may have

much higher TB burdens than those of the general population.[2,15,16] Routine TB screening should be implemented in South African correctional facilities to identify, treat, and reduce the burden of TB disease. CAD, in combination with radiologist interpretation, may be considered as a routine tool to supplement TB symptom screening and Xpert testing to identify persons with TB disease.

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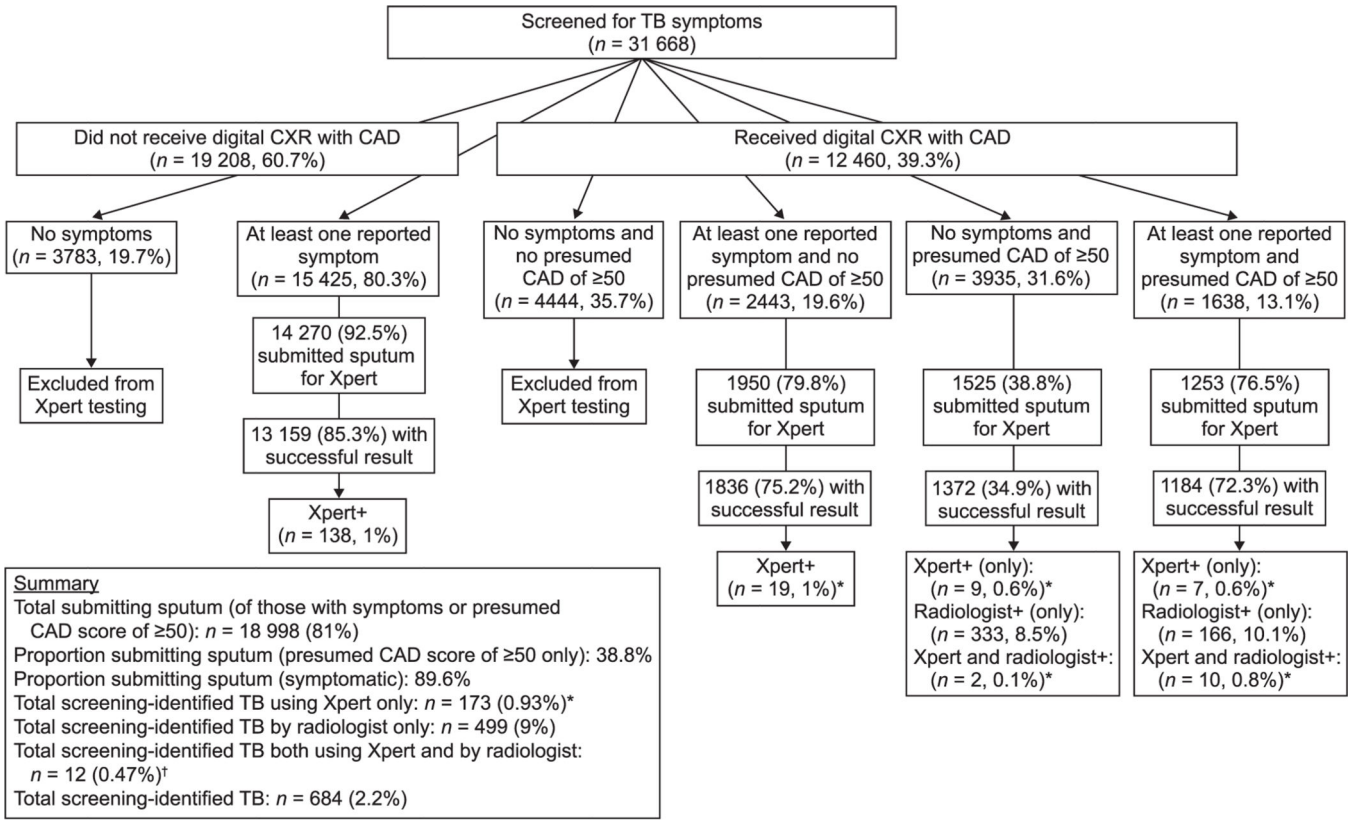

*Proportion based on patients who submitted sputum and had a successful Xpert result.
†Proportion based on those who had a CAD score of >50, submitted sputum and had a successful Xpert result.

Figure.

Population present at screening, population screened, and results of symptom and CAD screening in 16 South African correctional facilities, 2015. TB = tuberculosis; CXR = chest X-ray; CAD = computer-assisted digital X-ray.

*Proportion based on patients who submitted sputum and had a successful Xpert result.

†Proportion based on those who had a CAD score of >50, submitted sputum and had a successful Xpert result.

Table 1

Population and total screened for TB and HIV for 16 South African correctional facilities, 2015

Facility	2015 prison population *n* (% capacity)	Total present at screening* *n* (%)	On TB treatment at time of screening *n* (%)	Screening-identified TB using Xpert® *n* (%)†	Screening-identified TB by radiologist only *n* (%)‡	Total with TB disease *n* (%)	TB prevalence rate/100 000
A	3 863 (127.1)	1 314 (34)	3 (0.2)	3 (0.2)	76 (5.8)	82 (6.2)	6 240
B	1 692 (96.8)	2 160 (127.7)	11 (0.5)	7 (0.3)	36 (1.7)	54 (2.5)	2 500
C	3 832 (134)	4 178 (109)	37 (0.9)	34 (0.8)	28 (0.7)	99 (2.4)	2 370
D	8 247 (169.6)	2 900 (35.2)	28 (1)	3 (0.1)	82 (2.9)	113 (3.9)	3 897
E	2 642 (144.3)	3 816 (144.4)	7 (0.2)	38 (1)	32 (0.9)	77 (2)	2 018
F	3 024 (100)	2 393 (79.1)	10 (0.4)	16 (0.7)	53 (2.2)	79 (3.3)	3 301
G	4 005 (123.3)	3 744 (93.5)	27 (0.7)	17 (0.5)	37 (1)	81 (2.2)	2 163
H	4 602 (114.9)	2 841 (61.7)	6 (0.2)	22 (0.8)	45 (1.6)	73 (2.6)	2 570
I	1 796 (185.2)	816 (45.4)	7 (0.9)	0	18 (2.2)	25 (3.1)	3 064
J	1 603 (100.3)	1 604 (100)	13 (0.8)	4 (0.3)	59 (3.7)	76 (4.7)	4 738
K	5 277 (122.7)	2 138 (40.5)	19 (0.9)	7 (0.3)	18 (0.9)	44 (2.1)	2 058
L	2 728 (163.2)	3 643 (133.5)	5 (0.1)	15 (0.4)	14 (0.4)	34 (0.9)	933
M§	7 673 (142.1)	6 (0.8)	0	0	0	—	—
N§	3 266 (150)	215 (6.6)	1 (0.5)	3 (1.4)	0	4 (1.9)	—
O§	1 030 (127.5)	34 (3.3)	0	0	1 (2.9)	1 (2.9)	—
P§	2 380 (129.6)	41 (1.7)	1 (2.4)	16 (40)	0	17 (41.5)	—
Total	57 660 (132.9)	31 843 (55.2)	175 (0.6)	185 (0.6)	499 (1.6)	859 (2.7)	2 653

*Includes those who reported being on TB treatment at the time of screening.

†Denominator excludes those who reported being on TB treatment at time of screening.

‡Denominator excludes those who reported being on TB treatment at time of screening and those who were identified using Xpert.

§Facilities excluded from prevalence estimates due to <30% of prison population screened.

TB = tuberculosis; HIV = human immunodeficiency virus.

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Table 2

Bivariate associations between demographic and clinical variables and screening-identified TB disease using Xpert® or by a radiologist in those known to be HIV-positive in 16 South African correctional facilities, 2015 (*n* = 2115)

				Bivariate analysis			
					95%CI		
Factor	**Known HIV-positive (*n* = 2115) *n* (%)**	**Screening-identified TB (*n* = 63) *n* (%)**	**TB-negative (*n* = 2052) *n* (%)**	**OR**	**Lower**	**Upper**	***P* value**
Age (continuous)	2113 (99.9)	63 (3)	2050 (97)	1.0	0.98	1.05	0.38
Time in prison, years							
<1	803 (38)	16 (25.4)	787 (38.4)		Reference		—
1–2	407 (19.2)	15 (23.8)	392 (19.1)	1.9	0.92	3.85	0.08
3–4	356 (16.8)	12 (19.1)	344 (16.8)	1.7	0.80	3.67	0.16
5–9	409 (19.3)	16 (25.4)	393 (19.2)	2	0.99	4.05	0.05
≥10	112 (5.3)	3 (4.8)	109 (5.3)	1.4	0.39	4.72	0.64
Previous TB							
No	1831 (86.7)	39 (61.9)	1792 (87.5)		Reference		—
Yes	281 (13.3)	24 (23.1)	257 (12.5)	4.3	2.54	7.25	<0.0001
Cough							
No	917 (43.4)	25 (39.7)	892 (43.5)		Reference		—
Yes	1195 (56.6)	38 (60.3)	1157 (56.5)	1.2	0.70	1.96	0.54
Fever							
No	1544 (73)	48 (76.2)	1496 (72.9)		Reference		—
Yes	570 (27)	15 (23.8)	555 (27.1)	0.8	0.47	1.52	0.57
Night sweats							
No	1373 (65)	39 (61.9)	1334 (65)		Reference		—
Yes	741 (35.1)	24 (38.1)	717 (35)	1.2	0.68	1.92	0.61
Weight loss							
No	1539 (72.9)	44 (69.8)	1495 (73)		Reference		—
Yes	571 (27.1)	19 (30.2)	552 (27)	1.2	0.68	2.02	0.58
Number of symptoms							
No symptoms	514 (24.3)	15 (23.8)	499 (24.3)		Reference		—
1	694 (32.8)	22 (34.9)	672 (32.8)	1.1	0.56	2.12	0.80

Factor	Known HIV-positive (*n* = 2115) *n* (%)	Screening-identified TB (*n* = 63) *n* (%)	TB-negative (*n* = 2052) *n* (%)	Bivariate analysis			
				OR	95%CI		*P* value
					Lower	Upper	
≥2	907 (42.9)	26 (41.3)	881 (42.9)	1.0	0.52	1.87	0.96
ART status at screening							
ART-positive	1432 (67.7)	42 (66.7)	1390 (67.7)		Reference		—
ART-negative	683 (32.3)	21 (33.3)	662 (32.3)	1.1	0.62	1.79	0.86

TB = tuberculosis; HIV = human immunodeficiency virus; OR = odds ratio; CI = confidence interval; ART =antiretroviral therapy.

Table 3

Bivariate and multivariate associations between demographic and clinical variables and screening-identified TB using Xpert or a radiologist in individuals known to be HIV-negative in 16 South African correctional facilities, 2015 ($n = 5469$)

				Bivariate analysis				Multivariate analysis			
					95%CI				95%CI		
Factor	**Known HIV-negative (n = 5469) n (%)**	**Screening-identified TB using Xpert or CXR (n = 46) n (%)**	**TB-negative (n = 5423)**	**OR**	**Lower**	**Upper**	***P* value**	**aOR**	**Lower**	**Upper**	***P* value**
Age (continuous)	5454 (99.8)	46 (0.8)	5408 (99.2)	1.0	0.99	1.95	0.14	—	—	—	—
Sex											
Female	47 (0.9)	0	47 (0.9)	—	—	—	—	—	—	—	—
Male	5398 (98.7)	46 (100)	5352 (98.7)	—	—	—	—	—	—	—	—
Race											
Black/African	4973 (90.9)	42 (91.3)	4931 (90.9)		Reference		—	—	—	—	—
Non-African	477 (8.7)	4 (8.7)	473 (8.7)	1.0	0.36	2.82	0.99	—	—	—	—
Time in prison, years											
<1	2859 (52.3)	28 (60.9)	2831 (52.2)		Reference						
1–2	1008 (18.4)	8 (17.4)	1000 (18.4)	0.8	0.37	1.78	0.60	—	—	—	—
3–4	628 (11.5)	6 (13)	622 (11.5)	1.0	0.40	2.37	0.96	—	—	—	—
5–9	643 (11.8)	3 (6.5)	640 (11.8)	0.5	0.14	1.56	0.22	—	—	—	—
≥10	253 (4.6)	1 (2.2)	252 (4.7)	0.4	0.05	2.96	0.37	—	—	—	—
Previous TB											
No	5360 (98)	42 (91.3)	5318 (98)		Reference		—		Reference		—
Yes	98 (1.8)	4 (8.7)	94 (1.7)	5.4	1.89	15.33	0.002	4.9	1.71	14.09	0.003
Cough											
No	2401 (43.9)	5 (10.9)	2396 (44.2)		Reference		—	—	—	—	—
Yes	3062 (56)	40 (87)	3022 (55.7)	6.3	2.5	16.09	0.0001	—	—	—	—
Fever											
No	4056 (74.2)	26 (56.5)	4030 (74.3)		Reference		—	—	—	—	—
Yes	1410 (25.8)	20 (43.5)	1390 (25.6)	2.2	1.24	4.01	0.007	—	—	—	—
Night sweats											
No	3989 (72.9)	23 (50)	3966 (73.1)		Reference		—	—	—	—	—
Yes	1478 (27)	23 (50)	1455 (26.8)	2.7	1.52	4.88	0.0007	—	—	—	—

Factor	Known HIV-negative (*n* = 5469) *n* (%)	Screening-identified TB using Xpert or CXR (*n* = 46) *n* (%)	TB-negative (*n* = 5423)	Bivariate analysis				Multivariate analysis			
				OR	95%CI		*P* value	aOR	95%CI		*P* value
					Lower	Upper			Lower	Upper	
Weight loss											
No	4188 (76.6)	24 (75.8)	4164 (76.8)		Reference		—	—	—	—	—
Yes	1276 (23.3)	22 (47.8)	1254 (23.1)	3.0	1.70	5.45	0.0002	—	—	—	—
Number of symptoms											
No symptoms	1385 (25.3)	1 (2.2)	1384 (25.5)		Reference		—		Reference		—
1	2045 (37.4)	13 (28.3)	2032 (37.5)	8.9	1.16	67.72	0.036	8.9	1.15	67.69	0.04
≥2	2039 (37.3)	32 (69.6)	2007 (37)	22.1	3.01	161.59	0.002	21.7	2.96	158.8	0.003

TB = tuberculosis; HIV = human immunodeficiency virus; CXR = chest X-ray; OR = odds ratio; CI = confidence interval.