


BMJ Open Cross-sectional assessment of tuberculosis and HIV prevalence in 13 correctional facilities in Zambia

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ABSTRACT

Objective To determine the prevalence of tuberculosis (TB) and HIV in 13 Zambian correctional facilities.

Methods Cross-sectional study.

Setting 13 correctional facilities in seven of the 10 provinces in Zambia.

Participants All incarcerated individuals were eligible for TB and HIV screening and testing. Of the total study population of 9695 individuals, which represent 46.2% of total correctional population at the beginning of the study, 8267 and 8160 were screened for TB and HIV, respectively.

Interventions TB and HIV screening and testing was done between July 2018 and February 2019.

Primary outcome measures All forms of TB, bacteriologically confirmed TB, drug-resistant TB, HIV.

Results Prevalence of all forms of TB and bacteriologically confirmed TB was 1599 (1340–1894) per 100 000 population and 1056 (847–1301) per 100 000 population, respectively. Among those with bacteriologically confirmed TB, 4.6% (1.3%–11.4%) had drug-resistant TB.

There was no statistically significant difference in the prevalence of all forms of TB, bacteriologically confirmed TB and drug resistant TB between adults and juveniles: ($p=0.82$), ($p=0.23$), ($p=0.68$) respectively. Of the bacteriologically confirmed TB cases, 28.7% were asymptomatic. The prevalence of HIV was 14.3% (13.6%–15.1%). The prevalence of HIV among females was 1.8 times the prevalence of HIV among males ($p=0.01$).

Conclusion Compared with the study in 2011 which screened inmates representing 30% of the country's inmate population, then the prevalence of all forms of TB and HIV in correctional facilities has reduced by about 75% and 37.6%, respectively. However, compared with the general population, the prevalence of all forms of TB and HIV was 3.5 and 1.3 times higher, respectively. TB/HIV programmes in correctional facilities need further strengthening to include aspects of juvenile-specific TB programming and gender responsive HIV programming.

INTRODUCTION

Globally, correctional facilities are disproportionately affected by tuberculosis (TB) and the HIV.^{1–3} In some correctional facilities, the prevalence of TB has been reported to be up to 100 times higher than the prevalence in the general population¹ while the prevalence

Strengths and limitations of this study

- This is the only study on prevalence of tuberculosis (TB) and HIV in Zambian correctional facilities in the past 8 years.
- Results are generalisable to the 13 correctional facilities as a large sample was screened for TB and HIV.
- Data disaggregates can inform targeted interventions to reduce the burden of both diseases.
- Variations in TB screening algorithms could have underestimated TB prevalence.
- Asymptomatic TB was not consistently screened for.

of HIV has been reported to be up to 23 times higher than the prevalence in the general population.³ The poor living conditions in correctional facilities perpetuate TB and HIV. While overcrowding, poor ventilation, HIV, poor nutrition and late case detection perpetuate TB, sexual violence, sharing of sharp objects and lack of access to condoms perpetuate HIV.^{4,5} Additionally, incarcerated people often come from socioeconomically disadvantaged backgrounds where the burden of TB and HIV is already high.^{1,3}

In 2011, the prevalence of all forms of TB in six Zambian correctional facilities representing 30% of the total incarcerated population was 6428 per 100 000 population, which was 18 times higher than the national estimates.⁶ In the same study, 0.6% of those with bacteriologically confirmed TB had rifampicin-resistant TB and the overall prevalence of HIV was 22.9%, which was 1.5 times the national prevalence.

Since the last documented prevalence survey, several interventions including test and treat for HIV, health systems strengthening, nutritional support, TB and HIV entry screening, among others, have been put in place to control the burden of TB

and its associated risk factors in Zambia correctional facilities.^{7–10}

This study aimed to determine the current prevalence of all forms of TB, bacteriologically confirmed TB and drug-resistant (DR) TB, and the prevalence of HIV in 13 Zambian correctional facilities.

METHODS

Study design

We present an analysis of cross-sectional data collected under programmatic conditions by the Elton John Juvenile Offenders' Health (EJJOH) project. The EJJOH project was a health system strengthening project aimed at supporting provision of holistic and integrated health services to juvenile offenders. While the project primarily targeted juveniles, its support was extended to adults being held in the same facility with the juveniles so as to improve infectious disease control. The project screened the incarcerated population as part of its baseline assessment.

Study setting and population

Zambia has 87 correctional facilities with a total capacity of 9150 incarcerated individuals.¹¹ However, the total incarcerated population in Zambia was slightly over 21 000 in 2018 and 22 823 in 2019. In 2019, almost one in five individuals detained were in pretrial detention.¹¹ The data were collected between July 2018 and February 2019 in 13 correctional facilities with a combined population of 9695, representing 46.2% of the total correctional facility population in Zambia in 2018. The 13 correctional facilities had been purposefully selected by the EJJOH project because they held a significant number of juveniles. The facilities include Lusaka Central, Kamwala Remand, Livingstone Central, Katombora Reformatory School, Nakambala Approved School, Mukobeko Medium, Ndola Remand, Kamfinsa State, Chingola, Insakwe Approved School, Chipata Central, Mongu Central and Kasama Central (locations shown in online supplemental figure 1). The reformatory and approved schools hold ordered (convicted) juveniles (persons less than 19 years old)¹²; the other facilities are intended only for adults and circumstantial children¹³ but also hold juveniles who are still undergoing trial.

Across Zambia, routinely incarcerated people should undergo universal TB screening and HIV testing at entry or within 7 days of admission into correctional facilities. However, in some facilities, entry screening is not done due to various constraints. Depending on availability of logistics, periodic TB and HIV mass screening is carried out, with freedom to opt out of HIV testing but not TB screening and testing. TB screening is mandatory to increase early TB detection and treatment so as to protect other inmates from TB.

Study procedures

A project-specific register was used; it was a modification of the National Presumptive TB Register with additional

data elements on entry point, category of individual and history of TB. All inmates were screened for TB; those who did not opt out were tested for HIV. The screening point was documented under one of the following categories: mass screening, entry screening from the community or entry screening transfer from other correctional facility. The categories of individuals included adults and juveniles. Those already on anti-TB treatment at the time of screening were documented as TB cases and those on antiretroviral therapy (ART) were recorded as HIV positive and were not retested. Those with cough, fever, weight loss, nightsweats, chest pain and shortness of breath, irrespective of duration, were considered patients with presumptive TB and submitted sputum for testing using GeneXpert (Xpert MTB/Rif Assay; Cepheid, Sunnyvale, California, USA). Symptomatic individuals with a negative GeneXpert were referred for chest X-ray (CXR) depending on the clinician's discretion. There were three variations to this algorithm: (1) in Lusaka Central, a random proportion of the incarcerated population received CXR in addition to symptoms screening and those with either abnormal CXR or symptoms submitted sputum for GeneXpert; (2) at Ndola Remand, all except those already on TB treatment submitted sputum irrespective of symptoms; and (3) in Kabwe Medium, fluorescent microscopy (FM) was used for sputum examination instead of GeneXpert.

Alere Determine HIV-1/2 test (AlereHIV-1/2; Abbott, Chicago, Illinois, USA) was used for HIV screening and SD Bioline HIV-1/2 (SD Bioline HIV-1/2; Abbott) for confirmation of positive screening test, following the standard Zambian HIV testing algorithm. All individuals received pretest and post-test HIV counselling. HIV-positive inmates were commenced on ART within 1–2 days.

Data analysis

STATA Statistical Software V.14 (StataCorp, College Station, Texas, USA) was used for data analysis. A descriptive analysis was done to determine the characteristics of the population screened and the prevalence of TB and HIV; overall prevalence and prevalence among subgroups were determined. The prevalence of all forms of TB included bacteriologically confirmed TB and clinically diagnosed TB. Bacteriologically confirmed TB prevalence included those who had a positive GeneXpert or FM result, while patients already on TB treatment at time of screening were excluded from this analysis since data on the type of TB had not been collected. DR TB prevalence included incarcerated people with rifampicin resistance on GeneXpert. Missing data were excluded from the analysis.

Additionally, a χ^2 test was done to determine if there was a statistically significant difference in prevalence of TB and HIV between residents and new entrants into correctional facilities. New entrants were defined as incarcerated people whose entry point was entry screening from community while residents were defined as those whose

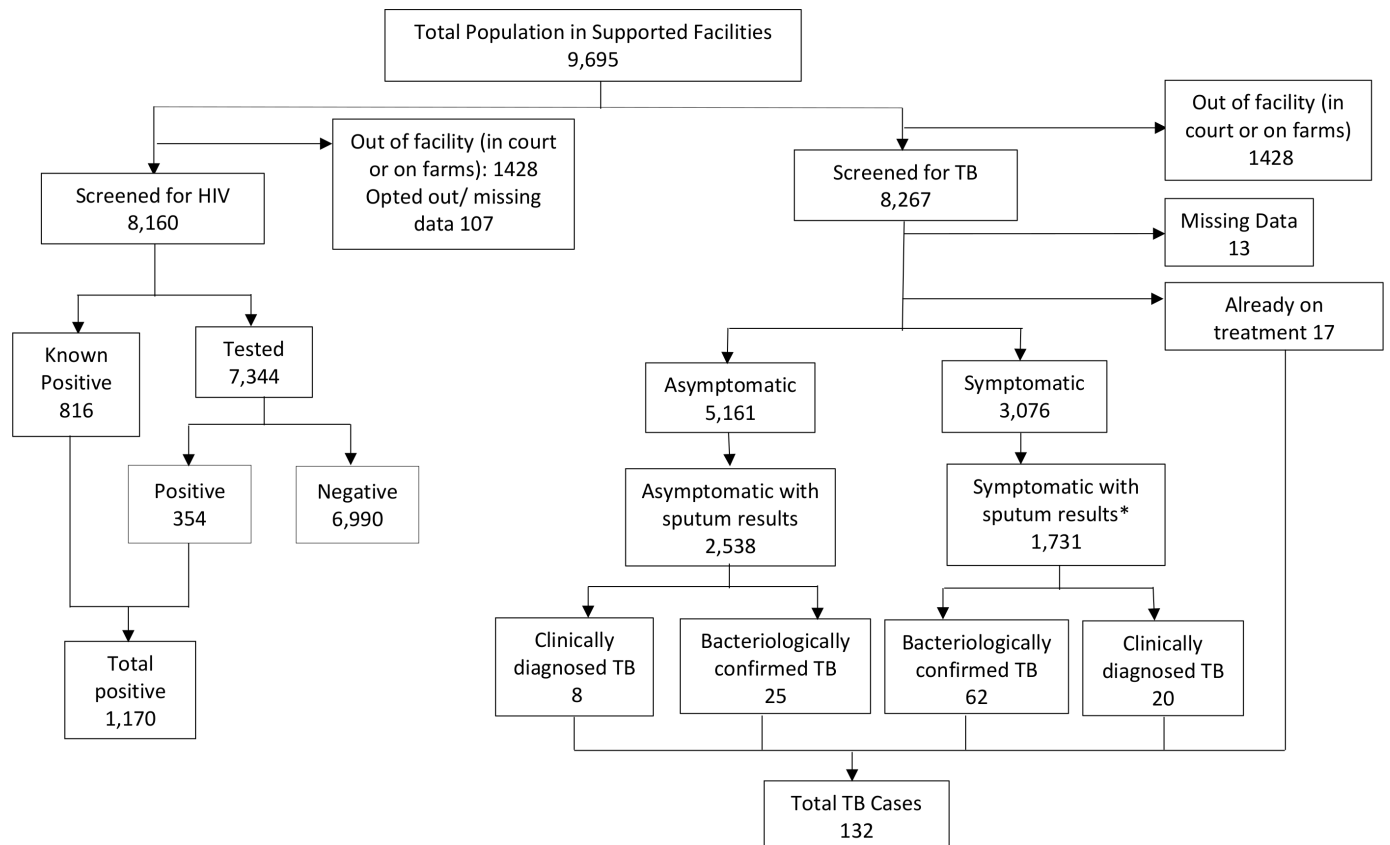


Figure 1 Flow diagram of tuberculosis (TB) screening and diagnosis. *All symptomatic patients submitted sputum; however, some correctional facilities only documented results of patients with positive results.

entry point was either mass screening or entry screening transfer from other correctional facility.

Patient and public involvement

The development of the research questions was intended to inform priority setting by the EJJOH project based on the disease burden in correctional facilities. The incarcerated population were not involved in the design of the project. The correctional health committees constituting of the incarcerated persons, correctional officers and healthcare workers were involved in the data collection. A representative of the correctional health committee at each correctional facility participated in the dissemination meeting on project findings.

RESULTS

Flow diagram and participant characteristics

Of the total adult and juvenile population of 9695 in the 13 correctional facilities, 8160 (84.2%) were screened for HIV and 8267 (85.3%) were screened for TB (figure 1). Individuals not screened were 1428 (14.7%) and they constituted those either in court or the farms. Of those screened for HIV, 1170 (14.3%) were HIV positive, of which 816 were known positive and 354 were new positives, while 6990 (85.7%) were HIV negative. Of those screened for TB, 17 (0.2%) were already on treatment, 3076 (37.3%) individuals had symptoms of TB, 5161

(62.5%) were asymptomatic while 13 (0.2%) had missing data. A total of 4269 individuals had documented sputum results. Eighty-seven bacteriologically confirmed TB cases were reported including 25 (28.7%) asymptomatic individuals and 62 (71.3%) symptomatic individuals. A total of 132 TB cases were identified including 87 (65.9%) bacteriologically confirmed TB cases, 28 (21.2%) clinically diagnosed TB cases and the 17 (12.9%) that were already on TB treatment at the time of screening.

Of those screened, 7805 (94.41%) were adults and 462 (5.58%) were juveniles (table 1). The overall median age (IQR) of the participants was 32 years (IQR 10–93); the median ages for the adults and juveniles were 33 (IQR 19–93) and 17 (IQR 10–18), respectively. The males were 8167 (98.79%), participants with a history of TB were 467 (5.65%), resident inmates were 7767 (93.95%) while new entrants were 497 (6.01%).

Prevalence of all forms of TB and bacteriologically confirmed TB

The overall prevalence of all forms of TB was 1598 (1339–1892) per 100 000 population while the overall prevalence of bacteriologically confirmed TB was 1056 (844–1301) per 100 000 population (table 2). There was no statistically significant difference in the prevalence of both all forms of TB and bacteriologically confirmed TB between males and females, ($p=0.51$) and ($p=1.00$), respectively. It was

Table 1 Characteristics of population screened

Variable	Participants (n=8267)
Category of individual, n (%)	
Adults	7805 (94.41)
Juveniles	462 (5.58)
Median age (IQR)	
Overall	32 (10–93)
Adults (≥19 years)	33 (19–93)
Juveniles (<19 years)	17 (10–18)
Sex, n (%)	
Male	8167 (98.79)
Female	89 (1.08)
Missing	11 (0.13)
History of TB, n (%)	
Yes	467 (5.65)
No	7786 (94.18)
Missing	14 (0.17)
Type of screening visit, n (%)	
Mass screening	7602 (91.92)
Entry screening other correctional facility	165 (2.00)
Entry screening community	497 (6.01)
Missing	3 (0.04)

TB, tuberculosis.

the same for adults and juveniles, ($p=0.82$) and ($p=0.23$), respectively, and the new entrants and residents, ($p=0.25$) and ($p=0.21$), respectively.

Prevalence of DR TB

Among the bacteriologically confirmed TB cases, the overall prevalence of DR TB was 4.6% (1.3%–11.4%) (table 3). There was no statistically significant difference in prevalence of DR TB between males and females ($p=0.95$), between adults and juveniles ($p=0.68$), between those with and those without history of TB ($p=0.72$) and between the new entrants and residents ($p=0.26$).

Prevalence of HIV

The overall HIV prevalence was 14.3% (13.6%–15.1%) (table 4). The prevalence of HIV among males was 14.1% (13.4%–14.9%) and among females 25.8% (16.6%–35.1%) ($p=0.01$). The prevalence of HIV among adults and juveniles was 15.0% (14.1%–15.7%) and 3.9% (2.3%–6.2%) ($p<0.01$), respectively. There was no statistically significant difference in prevalence of HIV between residents and new entrants ($p=0.05$).

DISCUSSION

Statement of principal findings

This study found that in Zambian correctional facilities, the prevalence of all forms of TB, bacteriologically confirmed TB and DR TB was 3.5 times higher,¹⁴ 1.7 times higher¹⁴ and 3.5 times higher,¹⁵ respectively, than the respective prevalence in the general population. Additionally, the overall prevalence of HIV was 1.3 times higher than the prevalence in the general population,¹⁶ and the prevalence of HIV among females was 1.8 times higher than the prevalence of HIV among males within

Table 2 Prevalence of all forms of TB and bacteriologically confirmed TB

	Cases/participants (n/N)	Prevalence of all forms of TB per 100 000 (CI)	P value	Cases/participants (n/N)	Prevalence of bacteriologically confirmed TB per 100 000 (CI)	P value
Overall	132/8254*	1599 (1340 to 1894)		87/8237*†	1056 (847 to 1301)	
Sex						
Male	129/8154	1582 (1322 to 1877)	0.60	84/8137	1032 (824 to 1276)	0.79
Female	1/89	1124 (28 to 6102)		1/89	1124 (28 to 6102)	
Missing gender	2/11			2/11		
Category of individual						
Adult (≥19 years)	124/7792	1591 (1325 to 1894)	0.82	79/7775	1016 (805 to 1265)	0.23
Juvenile (<19 years)	8/462	1732 (750 to 3383)		8/462	1732 (750 to 3383)	
Entry point*‡						
Residents	121/7757	1560 (1296 to 1861)	0.25	79/7740	1020 (809 to 1270)	0.21
New entrants	11/494	2227 (1117 to 3949)		8/494	1619 (702 to 3166)	

Residents include those screened through mass screening and those under entry screening as a transfer from other correctional facility. New entrants include those screened under entry screening from the community (police cells).

*Thirteen participants had missing values on TB.

†Seventeen participants were already on TB treatment, bacteriological status unknown.

‡Three participants had missing values on entry point.

TB, tuberculosis.

Table 3 Prevalence of drug-resistant TB

	Cases/ participants (n/N)	Prevalence of DR TB % (CI)	P value
Overall	4/87	4.6 (1.3 to 11.4)	
Sex			
Male	4/84	4.8 (1.3 to 11.7)	0.95
Female	0/1	0 (0 to 97.5)*	
Missing	0/2		
Category of individual			
Adults (≥19 years)	4/79	5.1 (1.4 to 12.5)	0.68
Juveniles (<19 years)	0/8	0 (0 to 3.7)*	
History of TB			
No	3/64	4.7 (1.0 to 13.1)	0.72
Yes	1/23	4.3 (0.1 to 21.9)	
Entry point			
Residents	3/76	3.8 (0.8 to 10.7)	0.26
New entrants	1/8	12.5 (0.3 to 52.7)	

Residents include those screened through mass screening and those under entry screening as a transfer from other correctional facility. New incarcerated individuals include those screened under entry screening from the community (police cells).

*One sided, 97.5% CI.

DR TB, drug-resistant tuberculosis.

correctional facilities. Of the bacteriologically confirmed TB cases, 28.7% were asymptomatic.

Study findings in relation to other studies

It is noteworthy that there is no statistically significant difference in prevalence of all forms of TB and bacteriologically confirmed TB between juveniles and adults and that in fact the point estimates for TB in juveniles were higher; generally older adults have a higher TB burden than adolescents.^{17 18} This suggests that the disproportionate access to TB services and health services in general among juveniles in Zambian correctional facilities reported between 2009 and 2010 has persisted.¹⁹ Another significant contrast relative to the general population is the absence of a statistically significant difference in prevalence of bacteriologically confirmed TB between males and females.¹⁴ This could be due to absence of gender-related differences in exposure to risk factors for TB infection and disease but could also be due to the small sample size and very wide CIs among females.

In comparison to the 2010–2011 study, the prevalence of all forms of TB has reduced by about 75% while the prevalence of bacteriologically confirmed TB has reduced by 50%.⁶ The reduction in prevalence of all forms of TB

Table 4 Prevalence of HIV

	Cases/ participants (n/N)	Prevalence of HIV % (CI)	P value
Overall	1170/8160*	14.3 (13.6 to 15.1)	
Sex			
Male	1139/8061	14.1 (13.4 to 14.9)	0.00
Female	23/89	25.8 (17.4 to 36.2)	
Missing sex	8/10		
Category of individual			
Adults (≥19 years)	1153/7727	15.0 (14.1 to 15.7)	0.00
Juveniles (<19 years)	17/433	3.9 (2.3 to 6.2)	
Entry point*†			
Residents	1118/7699	14.5 (13.7 to 15.3)	0.06
New entrants	52/460	11.3 (8.6 to 14.6)	

Residents include those screened through mass screening and those under entry screening as a transfer from other correctional facility. New incarcerated individuals include those screened under entry screening from the community (police cells).

*One hundred and seven participants either opted out of HIV testing or had missing data.

†Three³ participants had missing entry point, 2 of which also had missing HIV status.

and bacteriologically confirmed TB could be a result of the TB interventions being implemented within the Zambian correctional facilities since 2011. This explanation is supported by findings from an observational and modelling study done in Brazil: entry screening, active screening for TB among inmates, TB preventive therapy and annual mass screening independently reduce the incidence of TB in correctional facilities by 10.3%, 35%, 23.5% and 47.5%, respectively, after a period of 10 years and a combination of these interventions reduces the TB incidence by 79.2% after a period of 10 years.²⁰ However, it is worth mentioning that though the previous study used a more sensitive algorithm involving X-ray and culture^{21 22} for all inmates, the reduction is so large that it cannot simply be explained by use of different algorithms. Other countries in sub-Saharan Africa with results involving multiple correctional facilities report TB prevalence ranging from 457 to 888 per 100 000 population.^{23–25} However, a direct comparison to the prevalence reported in the other countries can not be done due to differences in definitions of TB used and differences in prevalence in the general population.

The prevalence of DR TB among people with no history of TB is similar to the prevalence among people with history of TB, suggesting significant transmission of DR TB either in correctional facilities or in the



communities where the incarcerated people come from, or both. Strengthening TB infection control can reduce transmission of DR TB.²⁶ In comparison to the 2010–2011 study, the prevalence of DR TB has increased by 667%.⁶ The increasing trend of DR TB in the Zambian correctional facility setting is also seen at the global and national levels.²⁷ The prevalence of DR TB in this study can not be directly compared with other correctional facility settings since the forms of drug resistance reported are different.^{28–30}

Similar to the national picture, the prevalence of HIV was higher among adults than juveniles and was higher among females than males.¹⁶ However, the prevalence of HIV in women relative to the prevalence of HIV in men is much higher in the incarcerated population than the general population because women with HIV risk factors like sex worker status, intimate partner violence and drug and substance abuse are over-represented in this population.³¹ Additionally, women are exposed to sexual abuse while in custody and they have more access barriers to HIV prevention, testing and treatment services compared with men.³² Despite the very high rates of HIV in this group, relative to the study done by Simooya *et al* in 1999, which showed a prevalence of 33% in females, the prevalence of HIV has reduced.³³ There has been a 37.6% reduction in overall prevalence of HIV since the study in 2010–2011.⁶ The reduction in prevalence of HIV in correctional facilities is attributable to the reduction of HIV prevalence in the general population,¹⁶ the implementation of test and treat across Zambia,³⁴ entry HIV testing and treatment⁶ and use of correctional health committees to strengthen TB/HIV service delivery at facility level.⁹ Among African countries with studies involving several correctional facilities, Zambia's prevalence is lower than South Africa's²⁵ but higher than Burkina Faso and Uganda.

The difference in prevalence of TB and HIV between residents and new entrants into correctional facilities was not statistically significant. This is possibly due to the following reasons: (a) individuals entering correctional facilities come from socioeconomically disadvantaged backgrounds where prevalence of TB and HIV is already high¹; (b) there are high rates of recidivism³⁵; and (c) detainees spend long periods in police cells, which have similar conditions to the correctional facilities.^{36 37} However, the small sample size and wide CIs especially for the new entrants are a limiting factor for drawing any inferences from this comparison. This finding highlights the contribution of imported TB and HIV cases to the burden of disease in correctional facilities and underscores the importance of entry screening within this setting.

Strengths and limitations

This study provides the most recent evidence on prevalence of TB and HIV in Zambian correctional facilities. The results of this study are generalisable to the 13 correctional facilities, as a large sample representing 85% and 84% of the 13 correctional facility population

was screened for TB and HIV, respectively. By virtue of the data being disaggregated, it provides an opportunity for targeting of interventions that can reduce the burden of both diseases. However, there were variations in the strength of screening algorithms for TB, hence the prevalence of TB could have been underestimated in some correctional facilities. That said, among all forms of TB cases, it is possible that some of the clinically diagnosed TB cases might not be true TB cases as there are other differential causes of CXR abnormalities that mimic TB. Inmates in court or on the farms were not screened for TB which could have introduced bias during data collection. Additionally, asymptomatic TB was not consistently screened for.

CONCLUSION

Despite significant progress over the last decade in controlling TB and HIV in Zambian correctional facilities, these continue to be disproportionately affected by both diseases. TB/HIV programmes in correctional facilities need further strengthening to include aspects of juvenile-specific TB programming, gender responsive HIV programming and holistic integrated service delivery as TB and HIV are not exclusive health concerns of incarcerated individuals. Additionally, there is a need to consider use of more sensitive algorithms that include CXR to minimise the risk of missing asymptomatic TB cases. Additional studies are required to determine the true prevalence of asymptomatic TB in correctional facilities, to better understand the reason for high HIV burden among females in correctional facilities and to determine the prevalence of TB and HIV using a sample whose results can be generalised to all the correctional facilities in Zambia.

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Contributors Conceived and designed the study: MK, SH, CM, MM. Database design and data curation: PS, JB. Implemented the study: MK, SH, MT, TZ, CM, MM. Data analysis: PS, MK, FMB. Wrote the original draft: MK. Reviewed the manuscript: SH, MT, JB, PS, TZ, FMB, CM, MM. Approved the final version to be published: MK, SH, PS, MT, JB, TZ, FMB, CM, MM.

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Competing interests None declared.

Patient consent for publication Not applicable.

Ethics approval Approval to use the programmatic data was obtained from the University of Zambia Biomedical Research Ethics Committee (No: 018-11-18) and the London School of Hygiene & Tropical Medicine Ethics Committee (No: 21332). Since data were collected under programmatic conditions, no consent was sought for TB screening and verbal consent and assent were obtained for HIV testing.

The EJJOH project had obtained permission from the Zambia Correctional Service and the Ministry of Community Development and Social Services to conduct the screening activities including testing of juveniles. When migrating data from the paper-based registers to the electronic database, participant-identifying information was excluded.

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Data availability statement Data are available upon reasonable request.

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