RISK FACTORS FOR PULMONARY TUBERCULOSIS AMONG PRISON INMATES IN AKWA IBOM NIGERIA

I..F. Agwu[1], A.E. Ekuma[2], I. Nweke[3], S. Ibok[1], A. Mgbedimma[4], C. Amagwu[5], I. Onwuezobe[2], O. Obunge[6], A.C. Enyinnaya[7]

1. Department of Medical Microbiology and Parasitology, University of Uyo Teaching Hospital, Uyo, Akwa Ibom.
2. Department of Medical Microbiology and Parasitology, University of Uyo, Uyo, Akwa Ibom.
3. Department of Medical Microbiology and Parasitology, Alex Ekwueme Federal University Teaching Hospital, Abakiliki, Ebonyi.
4. Department of Medical Microbiology and Parasitology, Veritas University Abuja.
5. Department of Medical Microbiology and Parasitology, Enugu State University Teaching Hospital, Enugu.
6. Department of Medical Microbiology and Parasitology, University of Port Harcourt, Port Harcourt, Nigeria.
7. Department of Medical Microbiology, College of Medicine and Health Science, Gregory University, Uturu, Abia State.

Correspondence:
Dr. I.A. Francis
Dept. of Medical Micro. and Parasitology,
University of Uyo Teaching Hospital,
Uyo, Akwa Ibom
Email: agwuman@yahoo.ca

Submission Date: 8th April, 2026
Date of Acceptance: 3rd July, 2026
Publication Date: 31st Aug., 2026

Copyright Statement
The copyright of this manuscript is vested in this journal and in its publisher, the Association of Resident Doctors, University College Hospital, Ibadan.

This article is licensed under the Creative Common Attribution-Non Commercial License 3.0 (CC BY-NC 3.0).

ABSTRACT

Introduction: **Prison inmates are at a disproportionately high risk and abandoned reservoirs and vulnerable population for tuberculosis.**

Objective: **To determine prevalence of pulmonary tuberculosis and associated factors among prisoners in federal prisons in Akwa Ibom state South-South Nigeria.**

Materials and Methods: **All inmates in the three federal prisons in Akwa Ibom State, South-South Nigeria, who had a cough for 2 or more weeks were included in the study. All the participants were interviewed and requested to provide a sputum sample, which was analysed for MTB by molecular techniques after obtaining consent. A cross-sectional study design was performed on 423 study participants to assess the prevalence and risk factors of pulmonary tuberculosis Structured questionnaire was used to collect data on risk factors of pulmonary tuberculosis. Bivariate and multivariable binary Logistic regression was used to identify predictors of pulmonary tuberculosis.**

Result: **A total of 423 prison inmates were included in the study. Among those, 27 (6.38%) prison inmates were found to have tuberculosis. We tested a number of potential risk factors like alcohol and smoking habits. Only total length of time spent in prison in lifetime showed significant association with occurrence of pulmonary tuberculosis.**

Conclusion: **The prevalence of tuberculosis among Prison inmates in Akwa Ibom State, Nigeria is troubling and calls for unceasing surveillance through regular tuberculosis screening**

Keywords: Tuberculosis, Multidrug resistant, Nigeria, Prisons

INTRODUCTION

Tuberculosis continues to be a major cause of morbidity and mortality in many developing countries and a significant public health problem worldwide. However in developing countries, the number of tuberculosis cases is still reported to be increasing, especially in sub-Saharan Africa, where tuberculosis is a leading cause of mortality due to poverty, decay in healthcare facilities, high rate of HIV infection[1].

Identification of groups at risk of acquiring tuberculosis is useful in the planning of interventions to control the infection. In both developing and the developed countries, prison inmates constitute a high risk-group for tuberculosis[2]. Prison systems worldwide are known to be focal points for the concentration and dissemination of tuberculosis amongst inmates and prison staff due to the enclosed nature of prisons and associated limited air exchange.[3] Prisons are increasingly becoming breeding environments from which infection is transmitted to the general population and account for up to 25% of tuberculosis burden in some countries.[4]

The prevalence of tuberculosis in prison is many times higher when compared to that of the general population; tuberculosis in prison is often 5 to 10 times higher than the national rates, and in some cases, as much as 30 to 50-fold.[5] Worldwide, poor prison living

conditions, low education, homelessness, low income, excess alcohol use, overcrowding, and length of imprisonment, re-imprisonment, the concentration of people with high tuberculosis risk and the lack of access to health services inside these congregate settings, convert prisons into reservoirs for tuberculosis transmission[2] It is approximated that 90% of the patients diagnosed with tuberculosis live in vulnerable environments with insufficient health resources such as individuals living in correctional facilities[6]

Prisons are not isolated systems; many people enter and leave prisons every day. These include prison staff, lawyers, social workers, health personnel, the clergy and prisoners' family members. Many prisoners themselves stay only a short period in prison and return to their families. For this reason, prison health is an important aspect of public health as tuberculosis within and outside prisons are interwoven.[7]

This study will provide information on risk factors of pulmonary tuberculosis among prison inmates in Akwa Ibom State prisons which will help in designing targeted interventions.

MATERIALS AND METHODS

Study sites

This study was carried out in the four federal prisons in Akwa Ibom State in the south-south region of Nigeria. The Uyo Prison is a medium security penitentiary facility located in Uyo, the capital city of Akwa Ibom state. Inmates are accommodated in 20 cells in 10 bungalows with each cell measuring about 10 by 15 square meters and about 20 inmates are held in each cell, each inmates occupies average of 7 square meters. The cells are poorly illuminated and ventilated with one high-set window that allows natural daylight and low air circulation. Ikot Ekpene prisons was built in 1919. The inmates are accommodated in 14 wards consisting of 24 cells. The dimension of each cell is about 15 by 15 metres and about 15 inmates are held in each cell, each inmates occupies average of 9 square meters. The cells are poorly lit up and ventilated with two high-set windows that allows natural daylight and air circulation. Ikot Abasi prison has capacity of 300 prison inmates. Inmates are accommodated in 12 cells in 4 bungalows measuring about 10 by 10 square meters, about 12 inmates are accommodated in each cell, each inmates occupies average of 11 square meters. The cells are bad lightening and stuffy with one high-set window that allows natural daylight and low air circulation. Eket Prison has a capacity of 400 prison inmates. The inmates are accommodated in 16 cells in 6 bungalows with each cell measuring about 10 by 10 square meters and about 18 inmates are held in each cell, each inmates occupies average of 7.5 square meters. The cells are lighted and ventilated with two windows that allows natural daylight and air circulation.

Study design and subjects

This was a prospective cross-sectional prison-based study. All inmates who had a cough of two or more weeks' duration and agreed to participate in the study were recruited. Inmates who were already on treatment for tuberculosis were excluded. All participants were interviewed and requested to provide a sputum sample which was analysed for *M. tuberculosis* by molecular techniques after obtaining consent.

Ethical considerations

Ethical approval for this study was obtained from the university of Uyo Teaching Hospital institutional Health Ethical Research Committee (IHERC) Institutional Health Ethical Research committee (IHERC), the ethical approval number NHREC/24/06/22/ UUTH. All prison inmates were informed about the procedures of the study, and the possibility of AFB being found in their sputum samples. Written informed consent was obtained from the study subjects. The respondents were assured of confidentiality and anonymity. All the cost in this study were fully borne by the researcher. Inmates who had positive AFB were referred to their respective prison clinics for further management.

Sputum collection, transport and storage

Two sputum specimens were obtained from each inmate with suspected pulmonary tuberculosis after consented. A structured questionnaires for smoking cigarettes prior to incarceration, alcohol use before imprisonment, total length of time spent in prison in lifetime, sharing cell with coughing person and TB vaccination were administered to consented participants. The first specimen was obtained immediately after identifying the inmate as a tuberculosis suspect while the second specimen was produced the next morning and submitted.

The Xpert MTB/RIF test – this was carried out using an Xpert MTB/RIF (Cepheid, USA). One volume of the sputum sample was homogenized with 2 volumes of decontamination and lysis solution of the kit and shaken vigorously 10–20 times. Specimens were incubated for 5 minutes at room temperature then shaken vigorously 10–20 times before re-incubation for another 10 minutes. Two millilitres of the clear solution were pipetted and deposited in the cartridge, and then placed in the GeneXpert 4 instrument within 30 minutes of adding the sample to the cartridge. Results were obtained from the machine after about 2 hours.

Data analysis

Data obtained was analysed using statistical package for the social science (SPSS) version 24 (World Health Organization) for data analysis. Multivariate analysis was applied to determine independent risk factors for *M. tuberculosis*. The level of confidence was set at 0.05 and 95% confidence intervals and was used throughout in expressing differences in proportions.

RESULTS

Sociodemographic characteristics of prison inmates

A total of 423 prison inmates who met the inclusion criteria were recruited for this study. Majority of participants were males (92.43%) and their mean age was 35.84±12.11 with most of them being previously unemployed (53.90). Most participants were educated up to secondary school level (41.61%) and majority resided in urban areas before incarceration (71.16%). More inmates were recruited from Uyo prisons (39.4%) than the other prisons (Table 1).

Prevalence of pulmonary tuberculosis

A total of 27 participants were positive for *M. tuberculosis* with 48% (13) from Uyo prison, 33% (9) from Ikot Ekpene prison and 19% (5) from Eket prison, there was no participant from Ikot Abasi prison who tested positive.

Risk factors associated with tuberculosis

We tested a number of potential risk factors like alcohol and smoking habits, overcrowding, and share cell with coughing person, only total length of time spent in prison in lifetime showed significant association with pulmonary tuberculosis (Table 3)

Table 1: Socio-demographic characteristics of Respondents

Variables	Frequency	Percentage
Age		
Below 37	228	53.90
37 and above	195	46.10
Mean age (**Mean + SD**)	35.84 ± 12.11	
Sex		
Males	391	92.43
Females	32	7.57
Occupation prior to incarceration		
Unemployed	228	53.90
Students	105	24.82
Farmer	79	18.68
Civil servant	11	2.60
Highest Level of education		
Primary	103	24.35
Secondary	176	41.61
Tertiary	144	34.04
Residence		
Urban	301	71.16
Rural	122	28.84
Marital status		
Single	193	45.63
Married	230	54.37
Prison sites		
Uyo	167	39.48
Eket	69	16.31
Ikot Ekpene	135	31.91
Ikot Abasi	52	12.29

Table 2: Prevalence of tuberculosis among prison inmates

Site	No of inmates tested	TB cases	Prevalence of TB
Uyo	167	13	7.78
Ikot Ekpene	135	9	6.67
Eket	69	5	7.24
Ikot Abasi	52	0	0
Total	423	27	6.38

Table 3: Risk factors associated with tuberculosis

Variables	TB positive	TB negative	Total	*P*
Had Tb vaccination				
Yes	6 (22.22)	151 (38.13)	157 (37.12)	0.10
No	151 (38.13)	6 (22.22)	157 (37.12)	0.10
Location				
Uyo	13 (48.15)	154 (38.89)	167 (39.48)	.058
Ikot Ekpene	9 (33.33)	126 (31.82)	135 (31.91)	
Eket	5 (18.52)	64 (16.16)	69 (16.31)	
Ikot Abasi	0 (0.00)	52 (13.13)	52 (12.29)	
Alcohol intake	10 (37.04)	162 (40.91)	172 (40.66)	0.69
Number of inmates per room				
1-10	0 (0)	0 (0)	0 (0)	0.99
11-19	25 (92.59)	359 (90.66)	384 (89.83)	
>19	2 (7.41)	37 (9.34)	39 (9.22)	
Total length of time spent in prison in lifetime				
< 1 year	22 (81.48)	374 (94.44)	396 (93.62)	0.029
1-3 years	3 (11.11)	14 (3.54)	17 (4.02)	
>3 tears	2 (7.41)	8 (2.02)	10 (2.36)	
Share cell with coughing persons	3 (11.11)	56 (14.14)	59 (13.95)	0.660
Smoke prior to imprisonment	5(18.52)	64(16.16)	69(16.31)	0.748
Alcohol use prior to imprisonment	10(37.04)	162 (40.91)	172 (40.60)	0.69

DISCUSSION

Tuberculosis poses a serious public health threat across the globe, particularly in prisons in developing countries like Nigeria. This prospective study has been one of the very few research endeavours to determine factors associated with the development of Tuberculosis amongst inmates of four federal prisons in Akwa Ibom State, Nigeria. We found a prevalence of *Mycobacterium tuberculosis* (MTB) of 6.38% among all participants ranging from 0-7.78% across the different prison sites. This prevalence in this study is similar to the prevalence of 5.7% obtained in a study among inmates in Thailand where 4,751 participants were tested for MTB using culture technique[5,8] but lower than prevalence from studies conducted in Northern Gondar, Mbuji-Maji and Gamo Goffia prisons where 10.4%,17.7 % and 19.4% were obtained when 250 and 124 inmates were tested for MTB using Microscopy for AFB and GeneXpert techniques respectively.[9,10,11] On the other hand, the prevalence of this study was higher than 2.4% and 4.9% recorded in prisons of Kuje and Wolaita Zone Southern Ethiopia, where light microscopy for AFB was used on 2002 and 302 inmates respectively.[12,2] These differences appear to be due to the variation in participant selection and diagnostic methods used, in Wolatlta, HIV positive inmates were recruited and light microscopy was used while GeneXpert which is more sensitive was used in our study.

Of all the risk factors tested among the participants, only the total length of time spent in prison in lifetime was significantly associated with *Mycobacterium tuberculosis* infection. This is in line with a study conducted in Pakistan, SSA, South Africa and India which showed positive association between long duration in prisons and occurrence of tuberculosis.[13,14,4,15] In contrast, a study conducted in Southern Ethiopia showed that duration of stay in prison had a slight protective effect on tuberculosis as compared to those who stayed for short duration.[2] As seen in our study, prisoners incarcerated in overcrowded cells (eg Uyo and Ikot Ekpene) with poor ventilation were seen to have more tuberculosis than those who were incarcerated in less crowded cells with good ventilation as seen in Ikot Abasi and Eket prisons. It is supported by other studies conducted in the East Gojjam zone, Ethiopia and Zambia which reported that both inadequate ventilation and crowded living conditions increase the risk of contracting tuberculosis.[16,14,17] Sharing of cells with a tuberculosis patient or a chronically coughing inmates was identified to be risk factors for contracting tuberculosis. This is partly explained by the lack of isolation of tuberculosis patients, absence of tuberculosis screening before incarceration and overcrowding that prolong the period of transmissibility, therefore supporting transmission of *M. tuberculosis*. The cross-sectional sort of our study could be one of the possible reasons for not observing the significant association of this factor. In our study, we have found no association between smoking and alcohol use and contracting of tuberculosis in prisons which is in disagreement with the studies done in Brazil.[18,6]

RECOMMENDATIONS

To address this problem and successfully implement the control and end Tuberculosis strategy in the Akwa Ibom prisons, regular tuberculosis screening of the inmates, prompt diagnosis of TB, appropriate ventilation of the cell, and contact history should be established. For improved diagnosis, treatment, and reduction of the TB burden among prison inmates, CXR, Culture, or molecular diagnostics should be advocated

LIMITATIONS OF THE STUDYG

The limitation of this study is the risk of recall bias. The response of study participants about risk factors might not be always correct, (in other words, there is possibility of over or under reporting). Prison staffs were not included in the study, despite their frequent contact with prisoner and the general community.

CONCLUSION

We tested a number of potential risk factors like drinking of alcohol, smoking habits, overcrowding, only length of time spent in prison in the life time showed significant association with pulmonary tuberculosis in our study. These findings are serious problems that should no longer be ignored due to the vulnerability of incarcerated individuals

Conflict of interest: The authors declare no conflict of interests.

Contribution of authors: conceptualization: IAF, AEE, IN, CA, IO, OO, data collection: IAF, SI, data analysis: IAF, AEE, IN, manuscript preparation: IAF, AEE, AM, CA, manuscript review and approval: IO, OO

Funding for the study: The study was funded entirely by the authors

Acknowledgement: The authors acknowledge the contributions of staff of Nigeria Correctional Services, UUTH TB Laboratory and Zankli Tuberculosis Reference Laboratory

REFERENCES

1. **Reid SE,** Topp SM, Turnbull ER, *et al.* Tuberculosis and HIV Control in Sub-Saharan African Prisons/ : "' Thinking Outside the Prison Cell .'" J Infect Dis. 2012;205:265–273.
2. **Begashaw B,** Mekiso AB, Legesse T. Prevalence of Pulmonary Tuberculosis and Associated Factors among Prisoners in Wolaita Zone, Southern Ethiopia: Cross-sectional Study. Am J Public Heal Res. 2016;4(4):142–148.
3. **Reid SE,** Topp SM, Turnbull ER, *et al.* Tuberculosis and HIV Control in Sub-Saharan African Prisons: "'Thinking Outside the Prison Cell.'" J Infect Dis. 2012;205:265–273.
4. **Nyasulu P,** Mogoere S, Umanah T, Setswe G. Determinants of Pulmonary Tuberculosis among Inmates at Mangaung Maximum Correctional Facility in Bloemfontein, South Africa. Tuberc Res Treat 2015;2015:1–7.
5. **Banu S,** Hossain A, Khaja M, *et al.* Pulmonary Tuberculosis and Drug Resistance in Dhaka Central Jail , the Largest Prison in Bangladesh. PLoS One. 2010;5(5):1–5.
6. **Scholze AR,** Alves JD, Berra TZ, *et al.* The burden of alcohol , tobacco and others drugs among incarcerated population diagnosed with tuberculosis/ : time trends and spatial determinants in Southern Brazil. BMC Public Health. 2022; 2022;1–12.
7. **Oscar OS.** Infections in Prison in Low and Middle Income Countries/: Prevalence and Prevention Strategies. Open Infect Dis J. 2010; 4: 33–37.
8. **Sretrirutchai S,** Silapapojakul K, Palittapongarnpim P, *et al.* Tuberculosis in Thai prisons: Magnitude, transmission and drug susceptibility. Int J Tuberc Lung Dis. 2002 Mar 1;6:208–214.
9. **Moges B,** Amare B, Asfaw F, *et al.* Prevalence of smear positive pulmonary tuberculosis among prisoners in North Gondar Zone Prison, northwest Ethiopia. BMC Infect Dis. 2012;12.1-7
10. **Kalonji GMP,** Connick G De, Ngongo LO, *et al.* Prevalence of tuberculosis and associated risk factors in the central prison of Mbuji-Mayi, DEmocratic republic of Congo. Trop Med Health. 2016;44(1):1–6.
11. **Zerdo Z.** Prevalence of Pulmonary Tuberculosis and Associated Risk Factors in Prisons of Gamo Goffa Zone, South Et;1hiopia: A Cross-Sectional Study. Am J Heal Res. 2014;2(5):291-297.
12. **Lawal MA,** Omili M, Bello TO, *et al.* Tuberculosis in a Nigerian Medium Security Prison. Benin J Postgrad Med Tuberc. 2009;11:1–8.
13. White MC. Commentary: Evaluating the tuberculosis burden in prisoners in Pakistan. Int J Epidemiol. 2003;32(5):799–801.
14. **Genet A,** Girma A. Magnitude , associated risk factors , and trend comparisons of identified tuberculosis types among prisons in Ethiopia/ : A systematic review and meta analysis. 2024; 2023);1-18.
15. **Dolan K,** Wirtz A., Moazen B, *et al.* Series HIV and related infections in prisoners 1 Global burden of HIV, viral hepatitis , and tuberculosis in prisoners and detainees. Series . 2016;388(10049): 1089–1102.

16. **Mucheye Gizachew Beza,** 1 Emirie Hunegnaw 2 and Moges Tiruneh1. Prevalence and Associated Factors of Tuberculosis in Prisons Settings of East Gojjam Zone, Northwest Ethiopia". Int J Bacteriol. 2017;2017:1-7.
17. **Banda G.** Factors Associated with the Development of Pulmonary Tuberculosis among Inmates in Four (4) Correctional Facilities of Copperbelt Province -. 2022;(4):1–10.
18. **Crispim JDA,** Arroyo LH, Berra TZ, *et al.* Risk factors associated with drug- resistant tuberculosis in prisons in Sâo. 2021;15(11);1661-1669