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Original article

Prevalence of *Mycobacterium tuberculosis* among inmates of Nigerian Correctional Services Centre, Jos, attending Faith Alive Foundation Hospital, Jos, Nigeria

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ABSTRACT

Background: The prevalence of tuberculosis (TB) caused by *Mycobacterium tuberculosis (M. tuberculosis)* has increased greatly and continues to be impacted by co-infection with HIV/AIDS. **Aim:** The aim of this study is to determine the prevalence of TB and rifampicin-resistant *M. tuberculosis* among inmates. **Methods:** A total of 90 male and female inmates of age 18 years and above from the Nigerian Correctional Services Centre attending Faith Alive Foundation Hospital Jos, Nigeria were randomly recruited for the study. Sputum samples were collected in a large mouth transparent close cap container. Samples were analyzed using the Zheil-Neelsen staining technique and then confirmed using the Gene-Xpert technology. Data obtained were analyzed using IBM SPSS Statistics Version 21 software. **Results:** The overall prevalence of rifampicin-resistant *M. tuberculosis* was 0(0.0%) while that of *M. tuberculosis* was 11(12.2%), with a male and female prevalence of 8(11.4%) and 3(3.3%) respectively. The prevalence of *M. tuberculosis* was highest amongst participants between ages 51– 60 years, 3(75%), who have tertiary education, 3(27.3%), with a positive HIV status, 6(30%), and who were non-smokers, 8(17.4%). There was a statistically significant relationship between the presence of *M. tuberculosis* and participants' age group (p = 0.016), and HIV status (p = 0.023). **Conclusion:** Although there was no positive case of RIF/MTB, the findings indicate the presence of TB therefore, there is a need for continued advocacy on proper treatment and management of TB among inmates to forestall the emergence of rifampicin-resistant TB.

Introduction

Worldwide, tuberculosis (TB) is one of the top 10 causes of death and the leading cause from a single infectious agent (above HIV/AIDS). There is a continuous rise in the prevalence of TB every year.

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Globally, 3.5% of new TB cases and 18% of previously treated cases had MDR/RR-TB. The highest proportions (>50% in previously treated cases) are in countries of the former Soviet Union. Worldwide in 2017, 6.4 million new cases of TB were officially notified to national authorities and then reported to World Health Organization [1]. However, according to Kanabus 2022, newly diagnosed TB cases dropped from 7.1 million in 2019 to 5.8 million in 2020 [2].

Multi-drug-resistant TB presents a major concern to health policy because of the difficulties associated with treatment, especially in areas with a high disease burden like Nigeria. The challenge in the control of TB starts with a delay in diagnosis. The conventional sputum microscopy used for diagnosis results in a delay in diagnosis, and in the case of TB and human immunodeficiency virus (HIV) coinfection, the low rate of detection of TB by sputum microscopy is an even bigger challenge. Diagnostic delay due to the high proportion of smear-negative pulmonary TB, especially in human immunodeficiency virus (HIV)-associated TB leads to increased mortality, secondary resistance, and ongoing transmission [3]. A number of factors make people more susceptible to TB infections. The most important risk factor globally is HIV; 13% of all people with TB are infected by the virus [4]. This in particular is a serious problem in sub-Saharan Africa, where rates of HIV are high [5]. Thirty per cent (30%) of those co-infected with HIV develop the active disease [6]. Drug resistance has made the treatment of TB much more difficult. Therapy requires the use of second-line drugs which have a greater risk of adverse effects and lower potency than first-line drugs [4,7]. Drug-resistant TB is a significant and growing public health threat. The additional costs of drug-sensitivity testing, second-line drugs and the medical care associated with them are expensive; it was discovered that the cost of treating a patient carrying MDR strains is hundreds of times greater than that for patients carrying drug-sensitive strains. Since most cases of TB infection result in latent infection, it was estimated that there may be as many as 50 million people who are now infected with MDR-TB [8,9]. Tuberculosis was declared a global health emergency in 1993 by the World Health Organization (2017). In 2006, the Stop TB Partnership developed a global plan to stop TB that aimed to save 14 million lives between its launch and 2015 [4]. It was discovered that targeted objectives were not achieved by 2015, due to the increase in HIV co-infection and the emergence of MDR-TB [10].

There is also an increase in rifampicin-resistant *Mycobacterium tuberculosis (M.tuberculosis)* in the world; although, this increase persists there is no current accurate data for the prevalence of MTB/RIF. Currently, there is no data on MTB/RIF on the inmates of Jos Correctional Services. There is currently no country-wide drug resistance survey hence, the exact data on the prevalence and pattern of rifampicin resistance tuberculosis is unknown. Moreover, there is a paucity of data on the prevalence of TB in Nigeria in general and North-Central Nigeria in particular, hence the need for this study [1]. The introduction of the Gene-Xpert MTB system for rapid diagnosis of Mycobacterium tuberculosis (MTB) in sputum and detection of rifampicin resistance has revolutionized efforts at TB control, especially in countries with high TB burden such as Nigeria. Gene-Xpert improves the detection of MTB in smear Negative TB, especially in HIV-co-infected patients. Previous studies have provided evidence that the Gene-Xpert MTB/RIF system also provided sensitive detection of rifampicin resistance directly from untreated sputum in less than 2 hours with minimal hands-on time, thus providing more rapid diagnosis and reducing the risk of TB transmission [11,12]. The WHO recommends the use of Gene-Xpert MTB/RIF assay for the diagnosis of suspected drug-resistant TB (DR/TB) as the first test in persons living with HIV (PLWHA) suspected of coinfection. The Gene-Xpert MTB/RIF assay is a fully automated nested real-time polymerase chain reaction (PCR) system, which simultaneously detects MTB complex DNA in sputum and identifies mutations in the gene that are associated with rifampicin resistance [13]. Therefore the purpose of this study is to determine the prevalence of TB and rifampicin-resistant TB among the inmates of the Nigerian Correctional Services attending Faith Alive Foundation Hospital.

Materials and Methods

Study area and study population

Faith Alive Foundation Hospital is located in Jos, Plateau State. FAFH is located at the heart of the northern part of Jos which is surrounded by mountains and the population is approximately a 3.5million people comprising different ethnic groups who are mainly into agriculture due to a favourable climate which is between 18^{o}c-25^{o}c.

Faith Alive Foundation is a non-governmental institution situated in Jos metropolis, the capital city of Plateau State, Nigeria. The State is named after the picturesque Jos Plateau, a mountainous area in the north of the state with captivating rock formations. It has a population of around 3.5 million people and over forty ethnolinguistic groups. These ethnic groups are predominantly farmers and have similar cultural and traditional ways of life as people from other parts of the country.

This research was centred on inmates from the Nigerian Correctional Service attending Faith Alive Foundation Hospital (FAFH). The total population of the inmates is 856 comprising 845(98.7%) males and 11(1.3%) females. This population was selected due to the close relationship between the inmates and also the close their contact with each other that could pose a high-risk factor of transmission of TB from infected to uninfected inmates.

Sample size determination

The sample size for the study was calculated using Naing's [14] Formula. The expected prevalence used was (6.0%) as reported by Onyedum *et al.* 2017 [15]. Therefore, a total of 90 samples were collected from the inmates at Nigerian Correctional Services attending Faith Alive Foundation Hospital and analyzed in the present study.

Ethical clearance

Ethical approval for the study was obtained from the Research Ethics committee of Faith Alive Foundation Hospital, Jos. Informed consent was obtained from all study participants according to the requirements of the ethics committee of Faith Alive Foundation Hospital, Jos, Nigeria.

Sample collection

Sputum specimen was collected from randomly selected inmates from Nigerian correctional Service Jos attending Faith Alive Foundation Hospital. They were asked to inhale deeply and cough from within before carefully spitting into an air-tight sputum container (20 ml) provided. Each patient produced 10ml of sputum, the sample was inspected for quality, and if appropriate, was taken to the laboratory. Protective precautionary laboratory procedures like using of laboratory coats, hand gloves, and face masks as well as frequent hand washing with the use of disinfectants were applied.

Sample analyses

The samples were analyzed using the Zheil-Neelsen staining technique for tubercle bacillus before sample reagent was added to the sample in a ratio of 2:1 for Gene-Xpert assay. The analysis was carried out according to the instructions on the Gene-Xpert/MTB/Rif manual [4]. The samples were shaken and kept at room temperature. A sterile pipette was used to transfer 2ml to the cartridge which was loaded into the Gene-Xpert machine and processed according to the manufacturer's manual.

Statistical analyses

Results from this research were analyzed using IBM SPSS Statistics Version 21 software. The Chi-square test was used to determine Relationships between categorical variables and a *p*-value of 0.05 was considered to be statistically significant.

Results

Table 1 shows the prevalence of rifampicin-resistant *M. tuberculosis* and *M. tuberculosis* in relation to demographic and risk factors among inmates of Jos Correctional Services Centre Attending Faith Alive Foundation Hospital, Jos, Nigeria. The prevalence of rifampicin-resistant *M. tuberculosis* was 0(0.0%) for all the variables assessed in the present study. The overall prevalence of *M.tuberculosis* in the study population was 11(12.2%), with a male and female prevalence of 8(11.4%) and 3(3.3%) respectively. The prevalence of *M.tuberculosis* was highest amongst participants between ages 51 – 60 years 3 (75%), who have tertiary education 3 (27.3%), with a positive HIV status 6 (30%), and who were non-smokers 8 (17.4%). There was a statistically significant relationship between the presence of *M. tuberculosis* and participants' age group (p= 0.016), and HIV status (p= 0.023).

Table 1. Prevalence of rifampicin-resistant *M. tuberculosis* and *M. tuberculosis* in relation to demographic and risk factors among inmates of Jos Correctional Services Centre Attending Faith Alive Foundation Hospital, Jos, Nigeria.

Demographic Factors	**No. of Samples Examined**	**No. (%) Positive for Rifampicin Resistant *M. tuberculosis***	**No. (%) Positive for *M. tuberculosis***	χ^2	***p-value***
Age Group(years)					
18-30	29	0(0.0)	1(3.5)		
31-40	30	0(0.0)	4(13.3)		
41-50	19	0(0.0)	3(15.8)		
51-60	4	0(0.0)	3(75)		
≥ 61	8	0(0.0)	0(0.0)	15.6	0.016
Gender					
Male	79	0(0.0)	8(11.4)		
Female	11	0(0.0)	3(3.3)	3.16	0.21
Total	90	0(0.0)	11(12.2)		
Level of Education					
Non-formal	32	0(0.0)	4(12.5)		
Primary	16	0(0.0)	2(12.5)		
Secondary	31	0(0.0)	2(6.5)		
Tertiary	11	0(0.0)	3(27.3)	3.29	0.772
HIV Status					
Positive	20	0(0.0)	6(30)		
Negative	70	0(0.0)	5(7.1)	7.57	0.0231
Smoking Habits					
Smoking	42	0(0.0)	3(6.8)		
Not smoking	48	0(0.0)	8(17.4)	2.3	0.31

Discussion

This study shows an overall TB prevalence of 11(12.2%) which is greater than the 9.6% recorded in research conducted by Agbaji *et al*. 2013 among patients attending the HIV clinic of the Jos University Teaching hospital, Nigeria [16]. The prevalence of TB in the present study is however lower than the 34.4% reported in a study carried out at the Dalhatu Araf Specialist Hospital in Lafia, Nigeria [17]. The disparity in prevalence may be due to differences in sample size, methodology, level of TB sensitization, study population and level of education. This research also showed that the prevalence of rifampicin-resistant *M. tuberculosis* among inmates of Jos Correctional Center was 0(0.0%). This implies that there are no strains of RIF/MTB among the sampled inmates and this might be because of the close confines of the prison and the lack of close association with inmates and other TB-vulnerable populations. As a result, there are reduced chances of exposure to new strains of TB, and infected inmates are less likely to transmit to other populations. Another reason might be because the TB-infected inmates were consistent in taking their drugs thereby preventing the development of drug resistance. In addition, the inmates are prevented from self-medication which

could facilitate the emergence of drug resistance. Males were shown to have a greater prevalence of tuberculosis in this study than females. This could be as a result of the behavioural attitude of males and the uneven spread of the sampled inmates amongst the two sexes. This study is in line with earlier reported works by Alfred and Silas, 2005 [18] in Uyo, Akwa Ibom State, Nigeria, Obioma et al. 2011 [19] in Port Harcourt, Rivers State, Nigeria. However, the prevalence from the present study is not in agreement with the report of Nwachukwu et al. 2009 [20] from in Abia State, Nigeria.

The age groups with the highest prevalence of TB were age groups 31-40 years, 41-50 years and 51-60 years with a TB prevalence of 13.3%, 15.8% and 75.0% respectively. The high prevalence of tuberculosis among these age groups could be a result of poor personal hygiene or ignorance of the risk factors that cause TB [21]. A higher prevalence of infection in these age groups could also be a result of crowding in most of the cells. In addition, 53(58.8%) of the sampled inmates in this study fall within these age groups. This finding is in agreement with the findings of **Sani et al.** [22] in the study of the prevalence of pulmonary tuberculosis (PTB) in Minna and Suleja, Niger State, Nigeria who reported a higher prevalence of TB between the age of 21- 60 years.

The prevalence of TB in relation to the level of education may have differed due to the different degrees of awareness on TB transmission among the inmates and differences in personal hygiene and general health habits. Globally, delayed TB diagnosis and treatment have been shown to increase its transmission, exacerbate the disease, and increase the likelihood of mortality and may be a reason why TB incident cases have not reduced considerably compared to TB mortality [10]. Evidence from regional areas of Nigeria found that delayed diagnosis and treatment of TB was due to factors such as a lack of awareness of TB symptoms by primary health professionals, older age, distance to public health facilities, male gender, and first clinic visit to a non-TB control program providers [23,24]. Additional studies have suggested that a lack of knowledge about TB in the community and patients' preference for private healthcare practitioners are the major reasons why patients delay TB treatment [25, 26]. However, Lambert and Van der Stuyft argued that the failed healthcare system should be blamed and not the patient because there is limited evidence to indicate that health education about TB could reduce treatment delays [27]. Improving timely diagnosis and treatment of TB in Nigeria will require improved human resources, better coordination and decentralization of TB control programs [28], as well as increased monitoring of public health financing [29].

Conclusion

Although there was no positive case of RIF/MTB, the findings indicate the presence of TB therefore, there is a need for continued advocacy on proper treatment and management of TB among inmates to forestall the emergence of rifampicin-resistant TB. The present study also showed that the prevalence of tuberculosis among inmates was dependent on age and HIV status and these have been shown to be the greatest risk factors associated with tuberculosis. It is therefore recommended that early diagnosis of tuberculosis among inmates should be encouraged so as to prevent the spread of the bacteria and the progression of HIV to AIDS which can result in death. The Nigerian government should take serious measures in decongesting the Nigerian Correctional services Centre to prevent the spread of TB among the inmates. In addition, further prevalence studies should include staff of the Nigerian Correctional services Centre to understand the dynamics of the infection and curb the spread of the bacterium between inmates and staff or staff and their families.

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Conflict of interest

All authors declared no conflict of interest

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References

1. **World Health Organization (WHO).** Global tuberculosis report 2018. Geneva: Licence: CC BY-NC-SA 3.0 IGO, 2018. Accessed September 19, 2022
2. **Kanabus A.** "Information about Tuberculosis", GHE. 2022. Accessed September 15, 2022.

3. **World Health Organization (WHO**). Definitions and reporting framework for tuberculosis–2013 revision. Accessed September 15, 2022
4. **World Health Organization (WHO)**. Towards universal access to diagnosis and treatment of multidrug-resistant and extensively drug-resistant tuberculosis by 2015. WHO progress report 2011. (ed. WHO). Geneva. Accessed September 15, 2022.
5. **Chaison RE, Martison NA**. Tuberculosis in Africa — Combating an HIV-Driven Crisis**.** New England Journal of Medicine 2008; 358(11):1089-92.
6. **Gibson N, Cave A, Doering D, Ortiz L, Harm P**. Socio-cultural factors influencing prevention and treatment of tuberculosis in immigrant and Aboriginal communities in Canada. Soc Sci Med 2005; 61(5):931-42.
7. **Gler MT, Skripconoka V, Sanchez-Garavito E, Xiao H, Cabrera-Rivero JL, Vargas-Vasquez, DE, Gao M, Awad, M, Park, SK, Shim, TS, et al.** Delamanid for multidrug-resistant pulmonary tuberculosis. N Engl J Med 2012; 366, 2151–2160.
8. **Zumla, A, Raviglione, M, Hafner, R, Von Reyn CF**. Tuberculosis. N Engl J Med 2013; 368:745–55.
9. **World Health Organization (WHO).** Global Report on Surveillance and Response 2010. Geneva, Switzerland: World Health Organization; 2010. Multidrug and Extensively Drug-Resistant TB (M ⁄ XDR-TB) Available at: http://www.whqlibdoc.who.int/2010/. Accessed September 15, 2022.
10. **World Health Organization (WHO)**. Global tuberculosis report 2017. Geneva: World Health Organization; Licence: CC BY-NCSA 3.0 IGO. Accessed September 15, 2022.
11. **Fadeyi, A, Desalu, OO, Ugwuoke C, Opanwa, OA, Nwabuisi C, Salami AK**. Prevalence of rifampicin-resistant tuberculosis among patients previously treated for pulmonary tuberculosis in North-Western, Nigeria. Journal of the Nigerian Medical Association 2017; 58:161–166.
12. **Huanhuan Z, Hong L, Meiyu T, Zhenhao L, Jie G, Yi Z, Huiming S.** GeneXpert MTB/RIF combined with conventional methods for tuberculosis in Shanghai Regional Medical Center: a retrospective diagnostic study. Ann Transl Med 2022; 10(10): 575.
13. **Ioannidi P, Papaventsis D, Karabela S, et al**. Cepheid GeneXpert MTB/RIF assay for Mycobacterium tuberculosis detection and rifampin resistance identification in patients with high clinical suspicion of TB and smear negative microscopy. J. Clin. Microbiol 2011; 49(8):3068–3070.
14. **Naing NN**. Determination of sample size, Malaysian Journal of Medical Sciences 2003; 10 (2):84-86.
15. **Onyedum, CC, Alobu I, Ukwaja KN**. Prevalence of drug-resistant tuberculosis in Nigeria: A systematic review and meta-analysis. PLoS ONE 2017; 12(7): e0180996.
16. **Ebonyi AO, Meloni ST, Anejo-okopi J**, et al., Factors associated with pulmonary tuberculosis-HIV coinfection in treatment-naïve patients in Jos north-central Nigeria. J AIDS Clin Res 2013; 4: 222.
17. **Gyar SD, Dauda E, Reuben CR.** Prevalence of tuberculosis in HIV/AIDS patients in Lafia central Nigeria. Int J Curr Microbiol App Sci 3 2014; 831-838.
18. **Alfred, YI, Silas MU.** Epidemiology and endemicity of pulmonary tuberculosis (PTB) in South-Eastern Nigeria. The Southeast Asian

journal of tropical medicine and public health, 2005; 36(2):317-23.

19. **Obioma A, Ramesh P, Faith A, Omokaro O.** TB. Journal of Advanced Pharmacy Education & Research 2011; 1:1-11.
20. **Nwachukwu NC, Orji A, Kanu IO**. Epidemiology of Pulmonary Tuberculosis in some parts of Abia State, Federal Republic of Nigeria. Asian J. of Epidemiol 2009; 2(1): 13-19.
21. **Nwanta JA, Umeononigwe CN, Abonyi GE Onunkwo JI**. Retrospective study of bovine and human tuberculosis in abattoirs and hospitals in Enugu State, Southeast Nigeria. Journal of Public Health and Epidemiology 2011; 3(7): 329-336.
22. **Sani RA, Garba SA, Oyeleke SB, Abalaka ME.** (2015). Prevalence of Pulmonary Tuberculosis (PTB) in Minna and Suleja Niger State, Nigeria. American Journal of Medicine and Medical Sciences 5(6): 287-291.
23. **Takarinda KC, Harries AD, Nyathi B, Ngwenya M, Mutasa-Apollo T, Sandy C**. Tuberculosis treatment delays and associated factors within the Zimbabwe national tuberculosis programme. BMC Public Health 2015; 15(1):29.
24. **Ukwaja KN, Alobu I, Nweke CO, Onyenwe EC**. Healthcare-seeking behavior, treatment delays and its determinants among pulmonary tuberculosis patients in rural Nigeria: a cross-sectional study. BMC Health Serv Res 2013; 13(1):25.
25. **Sullivan BJ, Esmaili BE, Cunningham CK**. Barriers to initiating tuberculosis treatment in sub-Saharan Africa: a systematic review focused on children and youth. Glob Health Action 2017; 10(1):1290317.
26. **Sreeramareddy CT, Qin ZZ, Satyanarayana S, Subbaraman R, Pai M**. Delays in diagnosis and treatment of pulmonary tuberculosis in India: a systematic review. Int J Tuberc Lung Dis 2014;18(3):255–66.
27. **Babatunde OI, Bismark EC, Amaechi NE, Gabriel EI, Olanike AUR.** Determinants of treatment delays among pulmonary tuberculosis patients in Enugu Metropolis, South-East, Nigeria. Health 2015; 7(11).
28. **Federal Ministry of Health – Nigeria.** The National Strategic Plan for Tuberculosis Control - Towards Universal Access to Prevention, Diagnosis and Treatment 2015–2020. Abuja: Federal Ministry of Health 2015.
29. **Ogbo FA, Page A, Idoko J, Claudio F, Agho KE.** Have policy responses in Nigeria resulted in improvements in infant and young child feeding practices in Nigeria? Int Breastfeed J 2017; 12:9.