

## **Prevalence of previously undetected tuberculosis and underlying risk factors for transmission in a prison setting in Ibadan, South-Western Nigeria**

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### **Abstract**

**Background:** People with congregational tendencies such as the prison inmates constitute an important target group in the global efforts towards the control of tuberculosis (TB). The prison setting in most developing countries particularly Nigeria, currently does not have routine diagnostic procedures for TB despite the existing risks that could facilitate disease transmission.

**Methods:** We conducted a cross sectional study among the inmates in a major prison in south-western Nigeria for TB by screening their sputum samples using a simple random sampling method coupled with questionnaire interview, on the assumption of sub-clinical pulmonary TB infection.

**Results:** The overall TB prevalence found was 1.2% (2/164). Significant risk factors that could facilitate disease transmission in the prison included lack of BCG immunization ( $p = 0.017$ ); history of contact with TB patients ( $p = 0.020$ ); prolonged cough ( $p = 0.016$ ) and drug abuse ( $p = 0.019$ ).

**Conclusion:** Our findings of 1.2% undetected pulmonary TB infection among the inmates though low; still reiterate previous observation that the prison setting constitutes a veritable environment for TB transmission and a threat to public health. Efforts are therefore needed to institute routine screening and reduce the risk factors associated with TB transmission among prison inmates in Nigeria.

**Keywords:** Tuberculosis, prevalence, prison, public health, Nigeria

### **Résumé**

Les gens avec des tendances de congrégation tels que les détenus constituent un groupe cible important dans les efforts mondiaux de lutte contre la tuberculose (TB). L'établissement de prison dans la plupart des pays en voie de développement en particulier le Nigéria, ne dispose pas actuellement des procédures de diagnostic systématique pour la tuberculose malgré les risques existants qui pourraient faciliter la transmission de la maladie.

Nous avons mené une étude de cross-section pour la tuberculose parmi les détenus dans une prison majeure dans le sud-ouest du Nigeria par le dépistage de leurs échantillons de crachats en utilisant une méthode d'échantillonnage aléatoire simple couplé d'un interview à l'aide de questionnaire, sur l'hypothèse d'une infection sous-clinique de la tuberculose pulmonaire.

La prévalence totale de la tuberculose trouvée était de 1,2% (2/164). Les facteurs de risque importants qui pourraient faciliter la transmission de la maladie dans la prison inclus, manque de vaccination par le BCG ( $p = 0,017$ ) ; histoire de contact avec des patients tuberculeux ( $p = 0,020$ ); toux prolongée ( $p = 0,016$ ) et la toxicomanie ( $p = 0,019$ ).

Notre résultat de 1,2% d'infection de tuberculose pulmonaire inaperçue parmi les détenus bien que faible ; réitère encore la précédente observation que le milieu pénitentiaire constitue un véritable environnement pour la transmission de la tuberculose et une menace pour la santé publique. Les efforts sont donc nécessaires pour instituer un dépistage de routine et de réduire les facteurs de risque associés à la transmission de la tuberculose chez les détenus au Nigeria.

**Mots-clés:** Tuberculose, prévalence, prison, santé publique, Nigeria

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## Introduction

An estimated 8–10 million people are incarcerated worldwide on any given day, with many more detained for short periods of time [1]. The demographics of the prison population such as low socioeconomic status, large number of migrants, homeless and drug users, in addition to the situational and environmental vulnerabilities of the prison setting like overcrowding, poor ventilation [2-3] increase the risk of contracting tuberculosis (TB) among prisoners. The scourge of TB in prisons remains a persistent problem; the rates among inmates remain much higher, from 5 to 50 times than those of national average across both the developed and the developing world [4-8].

Population of prisoners represents a high proportion of poorly educated and socioeconomically disadvantaged individuals who have increased risk of diseases including TB infection [9]. Other conditions that exacerbate the risk of TB among prisoners include intravenous drug abuse; overcrowding, poor nutrition, poor hygiene, and poor access to prison health services. Whilst several studies have been conducted on TB in Nigeria, most however focused on TB patients attending DOTS centres and other people who are probably at risk including those with immunocompromised conditions. The people with congregational tendencies such as prison inmates, who in most cases come to congregate from different settings, have been grossly neglected. Inmates have long been recognized to be at a higher risk than the general population for active TB with cases of TB in prisons accounting for up to 25% of a country's burden [10]. Despite this, little or no attention is given to assess the health status of prison inmates before entry into the prison or release to the general society. The gaps in establishing the TB status among prisoners undermines the efforts of the public health sector towards effective control of TB in Nigeria, hence the imperative of this study.

## Materials and methods

### *Study design and site*

This cross sectional study was conducted in Ibadan, Oyo State, a cosmopolitan city in south-western Nigeria. Oyo State has a total of 3000 new cases of human TB, based on those presenting with persistent cough at DOTS centres in 2013 (Data from Oyo State TB Control

Programme). The major prison within the state, Agodi Prison was the site used for this study.

### *Ethical Approval*

The protocol for this study was reviewed and approved by the University of Ibadan/University College Hospital Institution Review Board.

### *Community entry*

We obtained permission to conduct the study from the management of the prison and then identified their peculiar set-up, regulations guiding access to the inmates and their operations. This was in view of protecting the rights of the subjects.

### *Sampling strategy and data collection*

Based on the earlier reported 7% prevalence of TB in the state (Data from Oyo State TB Control Programme), a sample size of 100 prison inmates was calculated. A total of 20 inmates were randomly selected from each cell per time. After explaining the purpose of the study to them, consenting inmates were then asked to produce sputum into sterile containers provided. Thereafter, oral interview was conducted to obtain socio-demographic and other data such as previous history of TB, contact with TB patient and length of stay from each consenting prison inmate. The sampling and data collection were done over a period of one month.

### *Laboratory analysis*

#### *Sample processing*

Sputum samples were processed using the Becton Dickinson digestion and decontamination procedure (BD, Sparks, MD, USA) [11]. The concentrate thus obtained was inoculated into Löwenstein-Jensen slopes with pyruvate and/or glycerol and incubated at 37°C for 12 weeks during which positive mycobacterial growths were detected and read.

#### *Data analysis*

Data were analysed using Stata Version 12. Group differences were tested using chi-square statistics for categorical variables. A multi-variable adjusted logistic regression was carried out using all the variables that were statistically significant at the 10% level with the main outcome measure (risk for TB transmission) in bivariate analysis. All tests were two-tailed and statistical significance was set at  $p < 0.05$ .

## Results

A total of 164 inmates participated in the study. Among these, 1.2% (2/164) was positive for acid fast bacilli by culture. In all, 153 (93.3%) were males; 87 (53.1%) were aged between 21- 30 years; 113 (68.9%) were artisans; 105 (64%) had been there for more than 3 months and 53 (32.3%) had prior prolonged cough before incarceration. In addition, only 32 (19.5%) were screened for TB at the time of entry into the prison while 33 (20.2%) had undergone TB screening test before incarceration. The results also show that 44 (27%) never received BCG immunization; 78 (47.6%) had had contact with TB patients and 96 (58.5%) had a cellmate with prolonged cough; 28 (17.1%) had prolonged cough and 93 (56.7%) were involved in drug abuse (Table 1). Logistic regression analysis

showed that lack of BCG immunization ( $p = 0.017$ ), contact with TB patients ( $p = 0.02$ ), prolonged cough ( $p = 0.016$ ) and drug abuse ( $p = 0.019$ ) were significant exposure risk factors for possible transmission of TB (Table 2).

## Discussion

We found a rate of 1.2% TB among inmates coupled with the presence of factors that could enhance transmission of the disease in a major prison in Ibadan, Nigeria. The results of this study further underscore previous observations that the scourge of TB in prisons remains a persistent problem [12-14]. Our findings also re-emphasize the underlying exposure risk factors that could facilitate TB transmission in the prison facilities, in addition to the situational and environmental vulnerabilities of the prison

**Table 1:** Socio-demographic data of the prison inmates screened for tuberculosis in Ibadan, South-Western Nigeria

Variable	Category	Frequency(n)	Percentage (%)
Sex	Male	153	93.3
	Female	11	6.7
Age group (years)	16-20	12	7.3
	21-30	87	53.1
	31-40	42	25.6
	≥41	23	14.0
	Occupation	Artisans	119
	Professional	2	1.2
	Livestock worker	9	5.5
	Civil servant	6	3.7
	Others	28	17.0
Duration in prison	<3 months	59	36.0
	> 3 months	105	64.0
History of previous prolonged cough	None	111	67.7
	Yes	53	32.3
History of sputum screening at entry	None	132	80.5
	Yes	32	19.5
History of previous TB screening	None	131	79.9
	Yes	31	20.1
History of BCG immunization	None	44	26.8
	Yes	120	73.2
History of contact with TB patient	None	86	52.4
	Yes	78	47.6
History of cellmate with history of prolonged cough	None	68	41.5
	Yes	96	58.5
Presence of cough	None	136	82.9
	Yes	28	17.1
History of drug abuse	None	71	43.3
	Yes	93	56.7

**Table 2:** Logistic regression results showing significant potential risk factors for tuberculosis transmission among prison inmates in Ibadan, south-western Nigeria.

Variable	Odds ratio	p-value	95% CI
<i>BCG vaccination</i>			
Absent	19.79	0.017	7.39-52.98
Present	1 (reference value)		
<i>Contact with tuberculosis patients</i>			
Yes	16.08	0.020	5.19-49.79
No	1 (reference value)		
<i>History of prolonged cough</i>			
Present	10.26	0.016	4.87-21.59
Absent	1 (reference value)		
<i>Drug abuse</i>			
Present	9.79	0.019	4.10-23.36
Absent	1 (reference value)		

setting such as overcrowding and poor ventilation [2-3].

From the results of our study, the prevalence of 1.2% is comparable to 2.4% found among inmates from other similar prison facilities in Nigeria [9]. It is, however, lower when compared with previous reports which indicate that TB prevalence among inmates may be up to 83.6 times higher than those in the general population [15] and between 5 and 50 times those of national average across both the developed and the developing world [3, 5, 16]. The lower rate in our study might be explained by the fact that only one sputum sample was obtained per participant which could have led to low case detection rate given the vulnerability of the inmates.

Notwithstanding the lower prevalence, the majority of inmates in prison facilities in developing countries are mostly awaiting trial [9]. This group poses a lot of risk to the general population since they come in contact with many people when they are moved from prisons to court rooms and when they receive visitors ranging from lawyers, human right groups and family members as well. Although the fraction of TB in the general population attributed to the incarcerated groups remains unclear [12]; incidentally, available report attributed 24% of TB from prisons to the general population to be multi-drug resistant TB (MDR-TB) [10]. Therefore, TB in prison facilities remains a major public health concern not only affecting inmates, but also the larger community [3].

Based on further analyses, we found some

significant risk factors that may be associated with TB transmission among the inmates and these included: lack of previous BCG immunization; history of contact with TB patients; prolonged cough and drug abuse. These findings are in agreement with a previous report [17] which indicated that drug abuse and contact with TB patients were significant behavioural factors for TB transmission. This finding therefore merits attention because drug abuse in particular is a highly prevalent hazardous habit among prison inmates. Furthermore, the state of most prisons in developing countries including Nigeria is a matter of concern for TB control considering such factors as overcrowding, poor ventilation [2-3], malnutrition and poor health care facilities which characterize the setting. Again, recent research has shown a clear relationship between the rate of growth of prison populations and the increased incidence of TB and MDR-TB [18]. As previously reported, prisons act as a reservoir for TB for the civilian community through infected staff, visitors and inadequately treated former inmates [15]. Therefore, improving TB control in prisons will benefit the community at large.

Moreover, routine sputum screening prior to admission was not practised in the prison studied. As observed, 80.5% of the inmates did not have their sputum samples examined for TB at the point of admission. Meanwhile, a review reported a higher TB prevalence in prison facilities without routine TB programmes [19], suggesting that screening at regular intervals potentially decreases overall TB prevalence.

This is further supported by the reports which indicated that increased TB screening will lead to increased diagnosis as well as early detection and, if treated, reduced TB prevalence [20-21]. In addition, promoting entry and regular screening, as well as self-referral for all inmates, medical staff and prison guards have previously been advocated [22-23].

Our results notwithstanding, some of the limitations of this study included the fact that only on-the-spot sample was collected instead of the routinely recommended three samples from each participant. Hence, the possibility of undetected cases might exist. Second, production of the sputum samples by the inmates was only minimally supervised given the vulnerability of the group; therefore analysis of saliva instead of sputum could present false negative results thereby underestimating the burden of the infection.

Despite these limitations, our findings show the presence of previously undetected TB among the prison inmates screened in Nigeria. Risk factors such as lack of BCG immunization, contact with TB patients, prolonged cough and drug abuse were significant for potential transmission of TB within the prison setting. Therefore, the prison setting constitutes a major point of public health concern in the control of TB in the general population. To mitigate some of these problems, we recommend enhanced diagnostic procedures including routine entry screening for TB control in prison facilities. This should be combined with strong political and financial commitments, high-level involvement and support of national and international stakeholders as previously recommended [24]. Finally, improvements of prison health systems and incarceration conditions need to be prioritized when aiming at the successful control of TB in this high-risk setting.

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