

Treatment outcomes of drug-susceptible tuberculosis and its predictors among male prison inmates in Bauchi State, Nigeria, 2014-2018

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Abstract

Background : Tuberculosis (TB) is a contagious disease and its transmissibility potential is increased in congregate settings like the prisons. TB incidence rates are five to fifty times higher among prison inmates than the general population which has a direct impact on the outcome of TB treatment. There is paucity of information on TB treatment outcomes and its predictors in Nigerian prisons. We therefore assessed TB treatment outcomes among prison inmates in Bauchi State, Nigeria.

Method: We conducted a retrospective data analysis of inmates with TB in the five main prisons in Bauchi State. We extracted sociodemographic, clinical and treatment outcome characteristics from TB treatment register of inmates treated for TB between January 2014 and December 2018, using a standardized checklist. We estimated the TB treatment success rate (TSR) and explored the relationship between the TSR and sociodemographic and clinical characteristics. Related variables were modelled in multiple logistic regression to identify predictors of TSR at 5% level of significance.

Results: All 216 inmates were male with mean (SD) age of 37.6 ± 11.4 years. Seventy-six (35.2%) were cured, 61 (28.2%) completed treatment, 48 (22.2%) were lost to follow-up, 17 (7.9%) were transferred out without evaluation and 14 (6.5%) died. Overall TSR was 72.9%. Predictors of successful treatment outcome were age; 20-29 years (AOR=10.5; 95% CI: 3.2-35.1), 30-39 years (AOR=4.2; 95% CI: 1.3-13.1), pretreatment weight; ≥ 55 kg (AOR= 13.3; 95% CI: 6.0-29.6), imprisonment for ≤ 2 years (AOR= 2.6; 95% CI: 1.3-5.4) and being HIV negative (AOR=3.3; 95% CI:1.4-7.8).

Conclusion: The predictors of successful TB treatment outcome were being less than 40 years of age, having a pretreatment body weight of or greater than 55 kg, imprisonment for less than 2 years, and being HIV negative. We recommended that to improve TB TSR among prison inmates; age, duration of imprisonment, weight and TB/HIV co-infection should be the major consideration during pretreatment, psychological and nutritional counselling and a tracking system be developed by the prisons authority to follow-up inmates transferred-out to other health facilities to ensure they complete the treatment and outcomes evaluated.

Background

Tuberculosis (TB) is a preventable and curable disease with effective drugs, despite this, TB has remain a major killer with over 4,500 dying daily from the infection globally.^{1,2} In 2017, TB was reported worldwide as the 10th leading cause of death; with 10 million cases and 1.6 million deaths attributed to the disease.³ The high global prevalence of TB is driven by HIV infection, lack of TB diagnostic laboratories, poverty and weak healthcare systems.⁴ Nigeria ranked 7th in the world and 2nd in Africa among the 30 countries with the highest burden of TB, in 2017.³

Tuberculosis transmissibility potential is increased in congregate settings such as prisons due to a high prevalence of HIV infection among prison inmates, overcrowding, poor nutrition, poor hygiene, prolonged

indoor confinement without adequate ventilation and limited access to healthcare.⁵⁻⁸ Overcrowding in Nigerian prisons has been on a steady rise; the total prison population in 2018 was 73,631 up from 44,450 in 2000 and 57,313 in 2015 without a corresponding expansion of the capacity of the prisons.⁹ Globally, TB burden among prison inmates is 5-50 times higher than among the general population and is estimated to be the leading cause of death among prison inmates.¹⁰ A case of active Pulmonary TB (PTB) can infect 10-15 persons over the course of a year, this might be higher among prison population due to overcrowding and prolonged close contacts.^{11,12} In sub-Saharan African prisons, TB remains one of the fastest growing infectious diseases.¹²⁻¹⁴

The goal of TB treatment is to cure those infected, prevent deaths from the disease and stop transmission of tubercle bacilli from infected individual to the host community.¹⁵ Treatment outcome is influenced by socio-demographic characteristics, socio-economic factors (such as poverty, housing), nutrition, HIV coinfection, Multi-Drugs Resistant TB (MDR-TB), and strategies for TB management including Directly Observed Treatment short (DOTS) course.^{2,16,17}

Tuberculosis treatment success is the sum of cured and treatment completed, and unsuccessful TB treatment outcome is the sum of treatment failure, lost to follow-up, transferred out and died. Treatment Success Rate (TSR) is the percentage of all new TB cases in a given year that successfully completed treatment with bacteriological evidence (cured) or without bacteriological evidence (treatment completed) of success among all who commenced the treatment. The numerator are TB cases that successfully completed treatment and the denominator are the new cases. World Health Organization (WHO) set $\geq 90\%$ as the global target for TSR to eliminate TB as a global public health concern and a cure rate of $\geq 85\%$.¹⁸ The TB TSR globally was 83% in 2017 and the corresponding TSR for sub-Saharan Africa was 76%.^{16,18} In 2015, TB TSR in Nigeria was 84% below the WHO target, and ranked 84th in the global rating and 23rd in Africa.¹⁹

TB TSR among prison inmates in the European region in 2015 was 59.7%, likewise a study in 2017 among 162 prison inmates with TB in Ethiopia, reported TSR of 63.62%.^{19,20} No available data for TB TSR among prison population in Nigeria.

The prison population is a dynamic and unstable one and this might impact negatively on TB treatment outcomes. Poorly treated TB case in the prison could compound TB burden within the prison and increase the risk of MDR-TB outbreaks in the general population; however, there is limited information about TB treatment outcome among prison inmates in Nigeria. Assessing TB treatment outcome and identifying possible predictors of successful outcome could reveal gaps in the TB treatment programme in the prison and this will help policy makers to institute evidence based interventions in the prisons. We therefore conducted this study to assess TB treatment outcomes and its predictors among prison inmates in Bauchi State, Nigeria.

Methods

Study setting, diagnostic criteria and treatment regimen

The study was conducted in all the five main prisons (Bauchi, Azare, Ningi, Misau and Jama'are) in Bauchi State. The prisons housed both male and female inmates and lock-up above its maximum capacity and the holding cells are usually overcrowded. The maximum capacity of Bauchi prison is 500, Azare 320, Misau 120, Ningi 110 and Jama'are 151. At the time of the study the total inmates' population was 2106 out of this figure, eleven were females. Bauchi prison had 1006 inmates, Azare 501, Misau 204, Ningi 159 and Jama'are 236. The prisons have clinics with various cadre of healthcare workers (Doctor, nurses, community health officers, pharmacy assistant, dental assistant, community health extension workers, laboratory technologists and radiographer) that provides mainly curative services for inmates, staff and staff relations. These prisons clinic were poorly equipped with no Gene Xpert, sputum microscopy or drug susceptibility testing services. TB diagnosis in these prisons relied mainly on referral of inmates with presumptive TB to public health facilities outside the prisons. Bauchi prison refer to State specialist hospital, Bauchi; Azare prison to federal medical center, Azare; Ningi, Jama'are and Misau prisons refer to Ningi, Jama'are and Misau general hospital respectively. Presumptive TB case is an inmate with cough of ≥ 2 weeks with at least one of the following symptoms; fever, night sweats, shortness of breath, chest pain, haemoptysis and or unintentional weight loss. The diagnosis was carried out at the referral hospitals using Gene X-pert MTB/RIF rapid diagnostic test or the direct smear microscopy and/or chest X-ray, and histopathological investigation. A presumptive TB case positive for Gene X-pert, or with at least two sputum smear positive for AFB (Acid Fast Bacilli) by direct smear microscopy or one sputum smear positive for AFB with radiological abnormalities consistent with active pulmonary TB is considered as a smear positive TB case. A presumptive TB case negative for Gene X-pert, or all three sputum samples negative for AFB by direct smear microscopy and with radiological abnormalities consistent with pulmonary TB is considered as a smear negative TB case. An inmate with TB of other organs outside the lungs as detected by tissue biopsy or based on strong clinical evidence consistent with active extra-pulmonary TB.

Prison inmates diagnosed of TB by the public health facilities are placed on Anti-TB drugs for the full course depending on the treatment category but continued the treatment in the prisons under the supervision of the TB desk officers, who also kept the TB treatment cards. Inmates diagnosed with TB are kept in isolation cells within the prisons during the intensive phase of treatment and the drugs are administered through the DOTS strategy. The treatment is based on new or retreatment TB cases; new cases (treatment category 1) received 6 months treatment regimen of two months of intensive phase of combination of four drugs (Rifampicin, Isoniazid, Pyrazinamide and Ethambutol) and four months of continuation phase of two drugs (Rifampicin and Isoniazid) while previously treated cases (category 2) received 8 months regimen consisting of two months treatment with Streptomycin, Rifampicin, Isoniazid, Pyrazinamide and Ethambutol followed by a month treatment of Rifampicin, Isoniazid Pyrazinamide and Ethambutol during the intensive phase followed by five months continuation phase with Rifampicin, Isoniazid and Ethambutol. The dosage of the drugs depends on the patient's pre-treatment weight. Follow-up bacteriological test is done during treatment at the end of second, fifth and sixth months for all new sputum smear positive cases and at the end of the third, fifth and eight months of treatment for

previously treated sputum smear positive cases. Weight follow-up measurements are done at the end of the second, fifth and at the end of the last month of treatment. Inmates on Anti-TB are not allowed to be transferred to other prisons but those discharged from prisons are given transfer form by the desk officer to the nearest DOTS center to the inmate's residence. These inmates are not followed up to know if they actually reported to the DOTS center or continued the treatment. All presumptive TB cases are counselled and tested for HIV using determine (rapid HIV test kit), positive cases were confirmed with Stat-Pak (rapid HIV diagnostic kits), while Uni-Gold recombinant assay is used as tie-breaker for discordant results.

Study design and population

We conducted a review of the treatment outcomes of all prison inmates treated for TB from January 2014 to December 2018 in all five prisons in Bauchi State. All prison inmates treated for TB with Anti-TB drugs from January 2014 to December 2018 were included. Inmates with missing variable(s) of interest in the TB treatment register were excluded (Figure 1).

Data tool and collection

The data source was the TB treatment register and patient health records in the five selected prisons. Data were extracted using a structured checklist. The checklist collected information on age, pretreatment weight, duration of imprisonment, TB class (Smear Positive Pulmonary Tuberculosis [SPPTB], Smear Negative Pulmonary Tuberculosis [SNPTB], Extra-Pulmonary Tuberculosis [EPTB]), treatment category (New, Retreatment, Unknown), HIV status, treatment outcomes (cured, treatment completed, failure, lost to follow-up, transferred out and died), from the TB treatment registers in the various study prisons by five trained healthcare workers (HCWs). The five HCWs (one from each prison) were trained for a day on how to collect the data and use the checklist. The principal researcher daily reviewed the filled format and strictly supervised the trained research assistants. Data were collected over a period of five weeks. Each prison was assigned a week; this enable the researcher to supervised the process of data abstraction.

Measurement

The dependent variable (treatment outcome) was dichotomized as successful (cured and treatment completed) and unsuccessful (treatment failure, lost to follow-up, transferred out and died) and the independent variables were socio-demographic characteristics (age, weight, duration of incarceration) and clinical characteristics (HIV status, TB class and treatment history). The following operational definitions were adopted from WHO for drug-susceptible TB.²¹

Cured: A PTB case with bacteriologically confirmed TB at the beginning of treatment who was smear or culture negative in the last month of treatment and on at least one previous occasion.

Treatment completed: A TB case who completed treatment without evidence of failure but without records to show that sputum smear or culture results in the last month of treatment and on at least one previous occasion were negative, either because tests were not done, or results were unavailable.

Treatment failure: A TB case whose sputum smear or culture is positive at month 5 or later during treatment.

Lost to follow-up: A TB case who did not start treatment or whose treatment was interrupted for two consecutive months or more.

Not evaluated: A TB case for whom no treatment outcome is assigned. This includes cases transferred out to another treatment unit as well as cases for whom the treatment outcome is unknown to the reporting unit.

Died: A TB case who dies for any reason during treatment.

New TB patient: A TB case who has not previously been treated for TB and is now diagnosed and has started the current treatment.

Relapse/Retreatment: A TB case who was previously treated for TB and was declared cured and now diagnosed and started the current treatment.

Data analysis

Extracted data were checked for its completeness, correctness and analyzed using Epi-info software version 7.2.2.6. Descriptive statistics was used to generate summary frequencies, percentages, and means. Bivariate analysis was performed to measure association between treatment outcome and independent variables. Covariates with p-value of ≤ 0.2 in the bivariate analysis were included in the multiple logistic regression model to identify predictors of treatment outcomes at 95% confidence intervals (CIs).

Ethical consideration

Ethical approval was obtained from the Bauchi State Health Research Ethics Committee. Permission was sought and obtained from the Controller of Prisons, Bauchi State command, where the aim and objectives of the study were explained. The information obtained was made anonymous and de-identified prior to analysis to ensure confidentiality.

Results

Out of 228 TB patients treated for TB during the period, only 216 (95%) had complete variable of interest and were therefore used for the analysis (Figure 1). Although there were few female inmates, all of the 216 TB patients registered during the study period were males.

The mean age (SD) was 37.6 ± 11.4 years. The mean (SD) weight was 55.2 ± 9.8 kg with 98 (72.1%) having weight ≥ 55 kg, 97 (44.9%) were incarcerated in Bauchi prison, the median (IQR) duration of imprisonment was 21 months (14-28 months) and 134 (62.0%) were imprisoned for less than 2 years (Table 1). One

hundred and eighty-eight (87.0%) were newly diagnosed, 152 (70.3%) were SPPTB and 46 (21.3%) TB patients were co-infected with HIV (Table 2).

Seventy-six (35.2%) were cured while 61 (28.2%) had completed treatment, with no treatment failure recorded during the study period. Forty-eight (22.2%) were lost to follow-up, 17(7.9%) were transferred out without evaluation and 14 (6.5%) patients died. (Figure 2)

The overall TSR was 72.9%. The highest TSR was observed in Azare prison (82.9 %) and the lowest in Jama'are prison (57.1 %), Bauchi prison (78.1%), Ningi prison (70.8%) and Misau prison (57.9%), over the five year-period. The difference in the treatment outcome across the five prisons formation was not statistically significant $p= 0.158$ (Figure 3)

The trend in TSR of all TB patients decreased from (79.5 %) in 2014 to (76.8 %) in 2015, to (69.5 %) in 2016, further down to (58.4 %) in 2017 and rose to (77.8 %) in 2018. (Figure 4) TSR was higher in HIV negative patients (77.1 %) compared with HIV positive patients (57.1 %) $p\leq 0.001$; SPPTB (73.4%), compared to SNPTB (60.0 %) and EPTB (57.1 %) $P\leq 0.001$ TSR was higher among age group 20-29 years (89.5%), compared to 30-39 years (83.1%), 40-49 years (56.8%), lowest among age group ≥ 50 years (42.9%); $p\leq 0.001$ and in those with weight ≥ 55 kg (99.0%) compared to <55 kg (43,2%); $p\leq 0.001$.

The TSR for TB cases that were evaluated excluding those lost to follow-up and transferred out was 95.1%.

The Odds of having successful treatment outcome was higher among the younger age groups compared to older age; 20-29 years (AOR=10.5; 95% CI: 3.2-35.1), 30-39 years (AOR=4.2; 95% CI: 1.3-13.1), and higher among TB patients with heavier weight; ≥ 55 kg (AOR=13.3; 95%CI: 6.0 – 26.8), those imprisoned for ≤ 2 years had a 2.3 times odds of successful treatment than those who were imprisoned for >2 years (AOR=2.3; 95%CI=1.1-4.9). TB patients who were not co-infected with HIV were more likely to have a successful treatment outcome compared to those co-infected with HIV (AOR=3.3; 95% CI: 1.4-7.8). TB treatment history, year of enrollment into treatment, prisons formation and TB class were not predictors of successful treatment outcomes. (Tables 3&4)

Discussion

This paper describes TB treatment outcome and its predictors among male prison inmates in Bauchi State. We found a high treatment success rate among the inmates. The high TSR could be due to the dedication of trained TB desk officers in all the prisons with administration of the drugs under strict supervision and the inmates are readily accessible to the desk officers. This rate though high was still below the national and international recommended minimum level for treatment success. This may not be unrelated to overcrowding, the poor sanitary condition of the prisons and the mobile nature of the inmates as they are transferred out without evaluation. The risk of reinfection could be high, likewise the risk of treatment interruption resulting in treatment failure.

An effective TB control programme is determined mainly by access to TB treatment. Tuberculosis treatment is free for prison inmates in Nigeria as it is for the general population but the prisons are known to cause TB treatment interruption resulting in poor treatment outcomes. The high rate of lost to follow-up and transferred out without evaluation negatively impacted on the TSR. The TSR was 95.1% after excluding TB cases that were not evaluated, indicating the negative impact of this on the TSR in this study.

The cure rate in this study is higher than the studies conducted in Northern Ethiopian prisons and in North Shoa, Ethiopia but lower than that recorded in El-Salvador prison.^{20,22,23} The low cure rate in this study compared to the El-Salvador study could be attributed to the lower sample size in this study and the high rates of loss to follow-up and transferred-out, since there was no system to track their progress, the final treatment outcomes of these patients were not known, so were not evaluated.

All the TB patients studied were males, this is similar to the study among prison inmates in North Shoa Ethiopia.²⁰ The prison population are predominantly male and most prisons are male only institutions, including prisons staff. Worldwide, females make up just 7% of prison population, and is much lower in African countries including Nigeria.²⁴ Female inmates constitute 2% of the total prison population in Nigeria.²⁴ Over three-fifths of the patients studied were in the age group <40 years, this is similar to other findings among prison inmates with TB in North Shoa, Ethiopia but lower than that found among prison inmates in North West province, South Africa and in the general population in Western Ethiopia.^{10,20,25} This could be so because of high mobility, high criminal activities and imprisonment among this age group.

Tuberculosis TSR provides a useful indicator of the quality of health services. A low rate suggests that infectious patients may not be receiving adequate treatment and stand the risk of developing drug resistant TB and could serve as a potential reservoir for the transmission of MDR-TB. The overall TSR for this study is lower than the WHO set target and the Nigerian national average but similar to the rate among prison inmates in Ethiopia and higher than the rate among inmates in Uganda^{20,26,27,28} The lower TSR in this study compared to the WHO target and the Nigeria national average results from the large number of TB patients lost to follow-up and transferred-out without evaluation of their treatment outcomes, and the significant cases of TB/HIV coinfection which is a predictor for poor TB treatment outcome in this study.

We found out that age, duration of imprisonment, weight and HIV status were predictors of successful TB treatment outcome in this study. The odds of successful treatment outcome decrease with advancing age, this is comparable with the study in Zimbabwe on age-stratified tuberculosis treatment outcomes, where the elderly had a poorer treatment outcome compared to the younger patients.²⁹ This might be due to better immune response among the younger age group and probably other associated comorbidities among the older age group. Duration of incarceration was significantly associated with successful treatment outcome, this is similar to the finding among inmates in Ethiopia prisons.²² This similarity could be attributed to poor adherence to treatment protocol due to difficulty of prison life and mental

stress associated with prolonged incarceration. The odds of successful treatment outcome increase with heavier body weight. Similarly, a study in Ethiopia revealed that pretreatment weight category of 55.0-70.9kg and ≥ 71.0 kg were significantly associated with successful treatment outcome³⁰ This might be explained by undernutrition which increases the risk of advanced TB disease and lowers immune response, resulting to poor treatment outcome. This study revealed that TB/HIV coinfection was associated with poor treatment outcome. HIV negative TB patients had a higher odds of successful treatment outcome compared to HIV positive TB patients. This is in contrast to finding among prison inmates in northern Ethiopia where HIV coinfection was not associated with treatment outcomes but similar to that in Ethiopian university hospital.^{22,30} This could be attributed to the immune compromised associated with both disease, poor adherence to drugs due to large daily pills intake and the negative drug-to-drug interaction between Anti-TB and Anti-Retroviral drugs.

Our study is limited by our inability to add other variables of interest which were not in the TB treatment register and may influence the treatment outcome such as height so we couldn't calculate Body Mass Index (BMI), educational status, cigarette smoking, comorbidity, substance use as the study relied on historical records. Also data analysis from historical records might affect the validity of the results and the study used 5.4% of the national inmates' population which might affect the generalizability of the study. For the purposes of understanding the predictors of treatment outcome of drug-susceptible TB among prison inmates in Bauchi State, the sample was adequate.

Conclusion

This study demonstrated that TB treatment success rate among prison inmates in Bauchi state was lower than the recommended WHO target. The TSR in this study was significantly influenced by age, duration of imprisonment, pretreatment body weight and HIV status, hence to improve TB TSR among prison inmates, these factors should be the major consideration during pretreatment, psychological and nutritional counselling and the prison authority should develop a follow-up strategy to track inmates with TB transferred-out or discharged from prison while on treatment, this has impacted negatively on the treatment outcome and has implication for TB control programme with the risk of those who interrupted treatment developing drug-resistant TB and could serve as reservoir for the transmission of resistant strains to contacts. Dissemination meeting was held with the TB desk officers and the superintendents of the five-prisons where findings were communicated for sensitization and resolutions reached for improved treatment outcome.

Abbreviations

EPTB	Extra Pulmonary Tuberculosis
HCW	Healthcare Worker
HIV	Human Immunodeficiency Virus

MDR	Multi-Drug Resistant
SD	Standard Deviation
SNPTB	Smear Negative Pulmonary Tuberculosis
SPPTB	Smear Positive Pulmonary Tuberculosis
TB	Tuberculosis
TSR	Treatment Success Rate

Declarations

Ethics approval and consent to participate

Ethical approval was obtained from ethical committee of Bauchi State Ministry of Health. Consent to participate is not applicable.

Availability of data and material

The data generated and used for this research is available from the corresponding author on reasonable request

Competing interest

The authors have no conflict of interest to declare

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Consent for publication

Not applicable

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Tables

Table 1: Sociodemographic characteristics and successful treatment outcome of TB patients treated in five main prisons in Bauchi State from January 2014 to December 2018 (n=216)

Variable	Frequency (%)	Successful n (%)	Unsuccessful n(%)
Age (years)			
20-29	64 (29.6)	51 (79.7)	13 (20.3)
30-39	68 (31.5)	49 (72.1)	19 (27.9)
40-49	50 (23.2)	25 (50.0)	25 (50.0)
≥50	34 (15.7)	11 (32.3)	23 (67.7)
Weight (kg)			
≥50	111 (51.4)	98 (72.1)	13 (16.2)
<50	105 (48.6)	38 (27.9)	67 (83.8)
Duration of imprisonment			
≤2 years	134 (62.0)	99 (72.8)	35 (43.8)
>2 years	82 (38.0)	37 (27.2)	45 (56.2)
Prison formation			
Azare	40 (18.5)	29 (21.4)	11 (13.8)
Bauchi	97 (44.9)	63 (46.2)	34 (42.5)
Jama'are	30 (13.9)	16 (11.8)	14 (17.5)
Misau	24 (11.1)	11 (8.1)	13 (16.2)
Ningi	25 (11.6)	17 (12.5)	8 (10.0)
Year of enrolment			
2014	54 (25.0)	36 (26.1)	18 (23.1)
2015	64 (29.6)	43 (31.2)	21 (26.9)
2016	42 (19.5)	27 (19.6)	15 (19.2)
2017	34 (15.7)	18 (13.0)	16 (20.5)
2018	22 (10.2)	14 (10.1)	8 (10.3)

Table 2: Clinical characteristics and successful treatment outcome of TB patients treated in five main prison formation in Bauchi State from January 2014 to December 2018 (n=216)

Variable	Frequency (%)	Successful n (%)	Unsuccessful n(%)
Treatment history			
New	188 (87/0)	124 (89.9)	64 (82.1)
Retreatment	6 (2.8)	3 (2.2)	3 (3.9)
Unknown	22 (10.2)	11 (8.0)	11 (14.0)
HIV status			
Positive	46 (21.3)	19 (13.4)	27 (33.7)
Negative	170 (78.7)	123 (86.6)	47 (66.3)
TB class			
SPPTB**	152 (70.4)	103 (74.6)	49 (62.8)
SNPTB ⁺	43 (19.9)	21 (15.2)	22 (28.2)
EPTB [□]	21 (9.7)	14 (10.2)	7 (9.0)

**Smear Positive Pulmonary Tuberculosis

+Smear Negative Pulmonary Tuberculosis; □Extra Pulmonary Tuberculosis

Table 3: Socio-demographic and clinical variables associated with treatment outcome of tuberculosis in five main prisons in Bauchi State from January 2014 to December 2018

Variable	Successful (%)	n	Unsuccessful (%)	n	cOR	P-value
Age (years)						
20 - 29	51 (37.5)		13 (16.3)		8.2 (3.2 - 21.0)*	p≤0.001*
30 - 39	49 (36.0)		19 (23.7)		5.4 (2.2 - 13.2)*	
40 - 49	25 (18.4)		25 (31.2)		2.1 (0.8 - 5.2)	
≥50	11 (8.1)		23 (28.8)		1	
Weight (kg)						
≥55	98 (72.1)		13 (16.2)		13.3(6.6-26.8)*	p≤0.001*
<55	38 (27.9)		67 (83.8)		1	
Duration of imprisonment						
≤ 2years	99 (72.8)		35 (43.8)		3.4 (1.9 - 6.2)*	p≤0.001*
>2years	37 (27.2)		45 (56.2)		1	
Prison formation						
Bauchi	63 (46.2)		34 (42.5)		1.4 (0.6 - 3.2)	p=0.119*
Jama'are	16 (11.8)		14 (17.5)		2.3 (0.9 - 6.3)	
Misau	11 (8.1)		13 (16.2)		3.1 (1.1 - 9.0)	
Ningi	17 (12.3)		8 (10.0)		1.2 (0.4 - 3.7)	
Azare	29 (21.4)		11 (13.8)		1	
Year of enrollment						
2014	36 (26.5)		18 (22.5)		1.1 (0.4 - 3.2)	p=0.690
2015	41 (30.1)		23 (28.8)		1.2 (0.4 - 3.2)	
2016	27 (19.9)		15 (18.7)		1.0 (0.4 - 3.0)	
2017	18 (13.2)		16 (20.0)		0.6 (0.2 - 1.9)	
2018	14 (10.3)		8 (10.0)		1	
Treatment history						
New	124 (91.2)		64 (80.0)		1.9 (0.8 - 4.7)	p=0.261
Retreatment	3 (2.2)		3 (3.8)		1.0 (0.2 - 6.1)	
Unknown	9 (6.6)		13 (16.2)		1	
HIV status						
Positive	17 (12.5)		29 (36.3)		1	p≤0.001*
Negative	119 (87.5)		51 (63.7)		4.0 (2.0 - 7.9)*	
TB class						
SPPTB	103 (78.7)		49 (61.3)		1.1 (0.4 - 2.8)	p=0.071*
SNPTB	19 (13.0)		24 (30.0)		0.4 (0.1 - 1.2)	
EPTB	14 (10.3)		7 (8.7)		1	

*Statistically significant

cOR- Crude Odds Ratio

Table 4: Predictors of successful treatment outcome of tuberculosis in five main prisons in Bauchi State from January 2014 to December 2018

Variables	Successful n (%)	Unsuccessful n (%)	cOR	aOR
Age (years)				
20-29	51 (79.7)	13 (20.3)	8.2 (3.2-21.0)*	10.5 (3.2-35.1)*
30-39	49 (72.1)	19 (27.9)	5.4 (2.2-13.2)*	4.2 (1.3-13.1)*
40-49	25 (50.0)	25 (50.0)	2.1 (0.8-5.2)	2.8 (0.1-0.7)*
≥50	11 (32.3)	23 (67.7)	1	1
Duration of imprisonment				
≤2 years	99 (72.8)	35 (43.8)	3.4 (1.9-6.2)*	2.6 (1.3-5.4)*
>2	37 (27.2)	45 (56.2)	1	1
HIV status				
Positive	19 (14.0)	27 (33.7)	1	1
Negative	117 (86.0)	47 (66.3)	4.0 (1.3-12.1)*	3.3 (1.4-7.8)*
Weight (kg)				
≤50	98 (72.1)	13 (16.2)	13.3 (6.6-26.8)*	13.3(6.0-29.6)*
>50	38 (27.9)	67 (83.8)	1	1
Prison formation				
Bauchi	63 (46.2)	34 (42.5%)	1.4 (0.6-3.2)	0.8 (0.3-2.4)
Jama'are	16 (11.8)	14 (17.5)	2.3 (0.9-6.3)	0.4 (0.1-1.6)
Misau	11 (8.1)	13 (16.2)	3.1 (1.1-9.0)*	2.3 (0.1-1.4)
Ningi	17 (12.5)	8 (10.0)	1.2 (0.4-3.7)	0.6 (0.1-2.5)
Azare	29 (21.4)	11 (13.8)	1	1
TB class				
SPPTB	103 (78.7)	49 (61.3)	1.1 (0.4 - 2.8)	1.0 (0.3 - 4.0)
SNPTB	19 (13.0)	24 (30.0)	0.4 (0.1 - 1.2)	1.0 (0.2 - 4.8)
EPTB	14 (10.3)	7 (8.7)	1	1

* Statistically significant; cOR-Crude Odds Ratio; aOR-Adjusted Odds Ratio

SPPTB- smear positive pulmonary TB; SNPTB- smear negative pulmonary TB

EPTB- extra-pulmonary TB

Figures

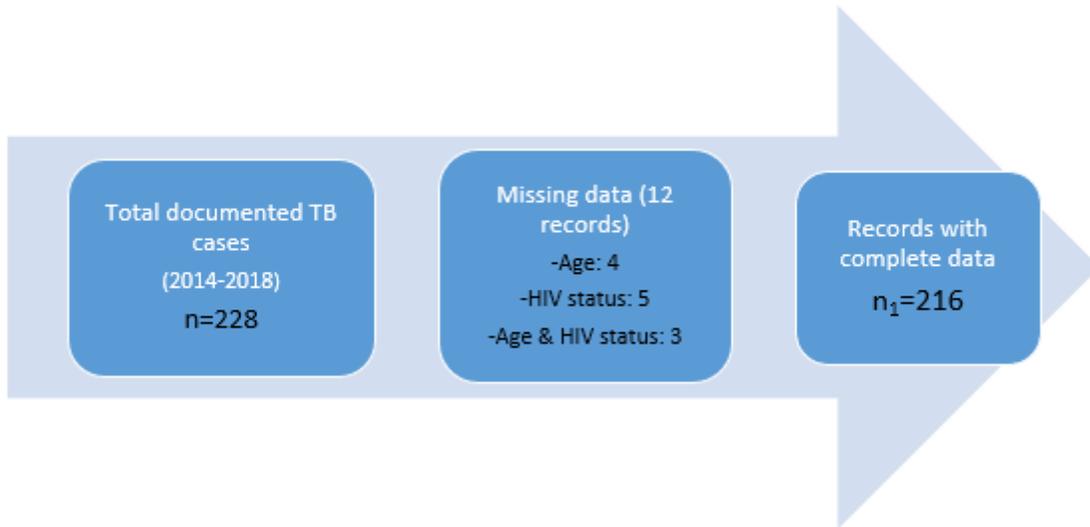


Figure 1

Data collection flowchart

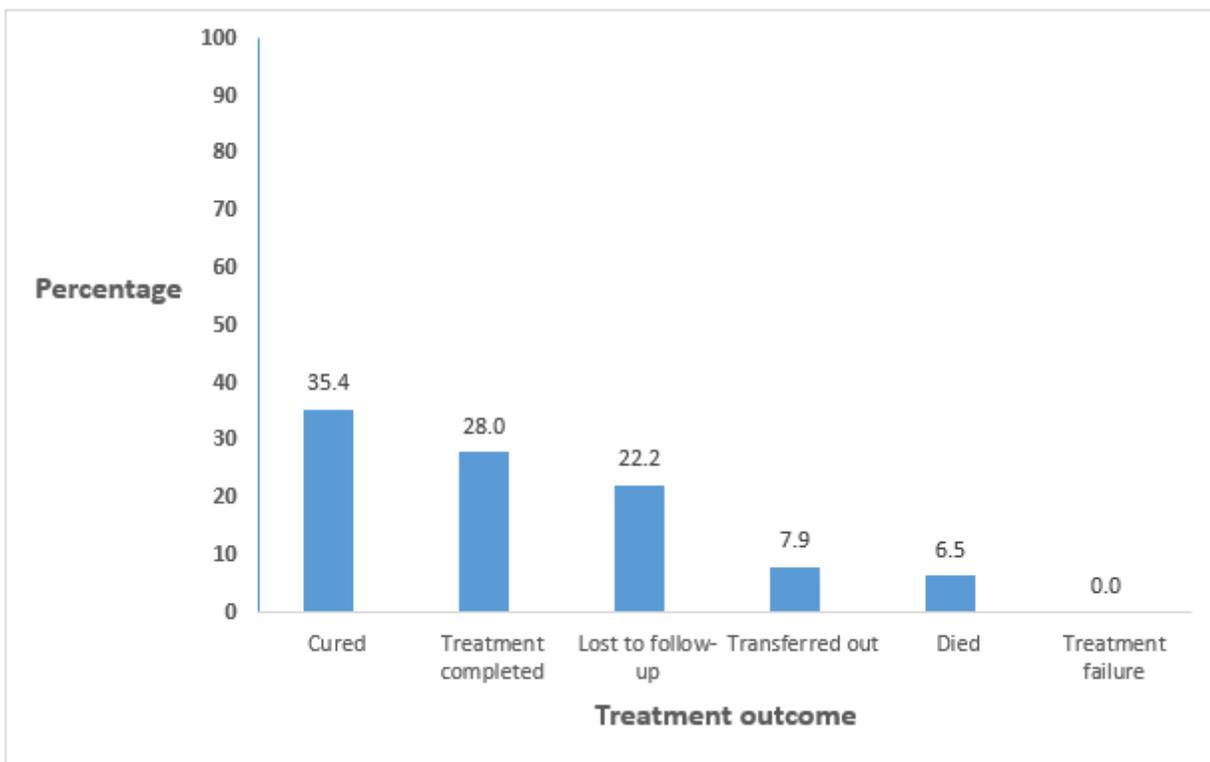


Figure 2

Treatment outcome of TB cases in the five main prisons in Bauchi State from January 2014 to December 2018

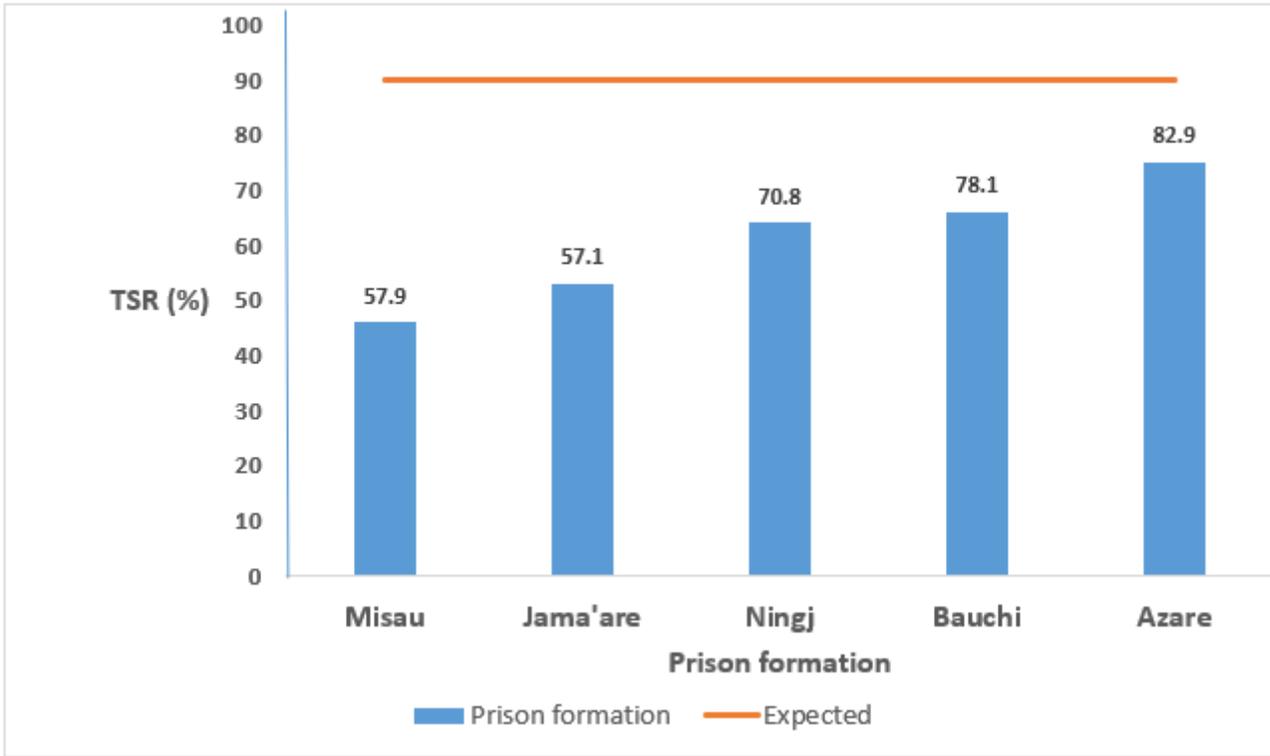


Figure 3

Treatment success rates of TB patients in the five main prisons in Bauchi State from January 2014 to December 2018

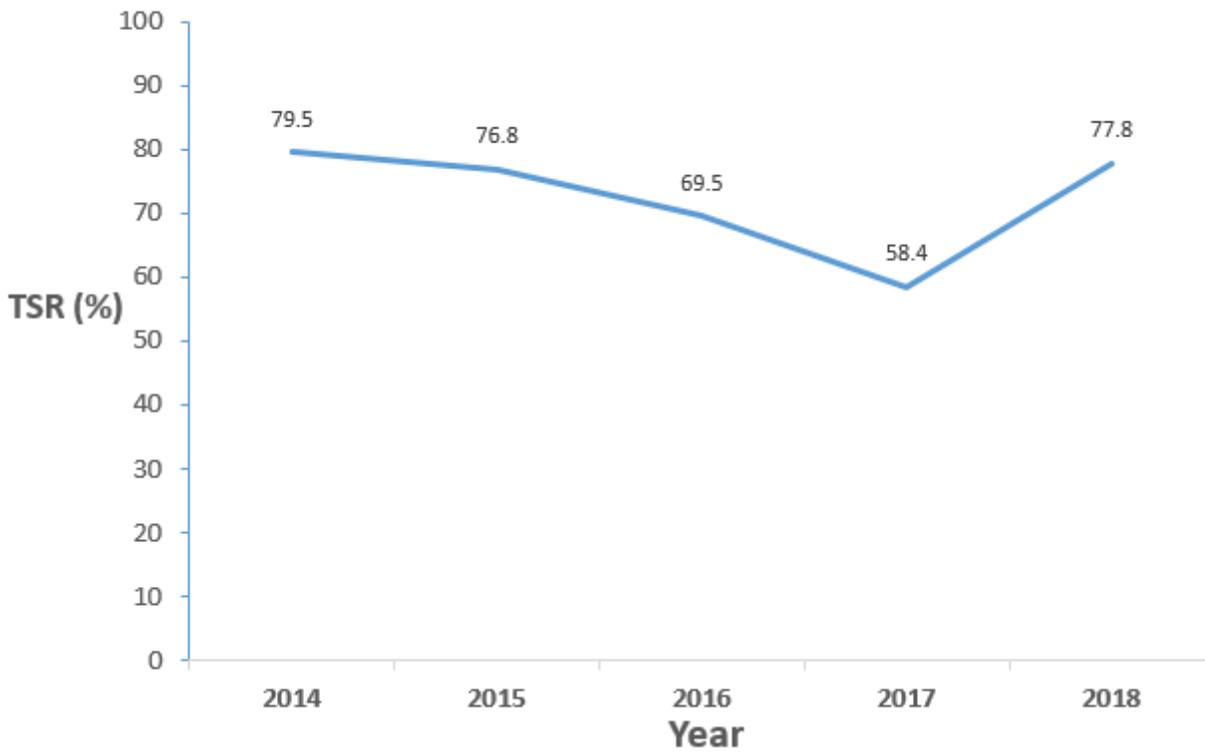


Figure 4

Trends of treatment success rates of TB patients in five main prisons in Bauchi State from January 2014 to December 2018