

Epidemiological Trends of Tuberculosis and HIV/Hepatitis Coinfections in Borno State, Nigeria from 2013 to 2024

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Abstract

Background

Tuberculosis remains a major public health challenge in Borno State, Nigeria, where conflict, poverty, and weak health systems exacerbate disease transmission.

Objective

This retrospective study investigated the prevalence and comorbidity of tuberculosis (TB) in Borno State, Nigeria, using hospital records from the University of Maiduguri Teaching Hospital between 2013 and 2024.

Methods

This retrospective study was carried out by using hospital base data collated from patients' records at the University of Maiduguri Teaching Hospital following the approval of the study permit. A total of 2,903 participants were analyzed for TB, HIV, hepatitis, and other comorbidities. The data was collated in excel and imported into IBMSPSS version 27. Chi-Square was used to determine the association between tuberculosis prevalence and independent variables. A p value less than 0.05 was considered significant.

Results

The overall TB prevalence was 8.9%, with the highest burden among individuals aged ≥ 45 years (17.2%) and those with AA genotype (10.0%). TB prevalence was significantly higher among patients with hepatitis (17.9%) and HIV (19.2%) compared to non-comorbid groups. No significant gender or marital status differences were observed. Annual trends revealed a decline in TB prevalence from 2013 to 2021, with fluctuations, thereafter, likely influenced by the Stop TB program and COVID-19 disruptions.

Interpretation & conclusions:

Findings highlight the dual burden of TB/HIV and TB/hepatitis coinfections, which complicate treatment and increase risk of drug toxicity. Integrated approaches targeting age, genotype, and socio-economic vulnerabilities are essential for effective TB control in conflict-affected regions.

Background to the Study

Tuberculosis (TB) can be prevented by vaccination and public health hygiene. The disease is also treatable. Yet, TB remains the world's leading cause of death from a single infectious agent [1], and causes more deaths than HIV/AIDS [2–4]. Over ten million people globally continue to fall ill with TB every year. In Nigeria, more than four hundred and fifty thousand (450000) people fell ill with tuberculosis in the previous year [5, 6]. The incidence of tuberculosis reported in Borno state in 2024 was over 10,000 [7]. The World Health Organization (WHO) was concerned over the high rate of new cases of TB in Borno State [8]. Although the disease is difficult to eradicate because of the increasing incidence of HIV, poverty and humanitarian crises. Moreover, Borno is yet to recover

from the impact of the Boko Haram terrorism, in which over 50% of the health facilities were destroyed. Hence, urgent action is required by all stakeholders to prevent, control potential emergency resulting tuberculosis and HIV/AIDS in Borno State [9, 10].

Tuberculosis (TB) and human immunodeficiency virus (HIV) coinfection constitute a profound public health challenge in Borno State, Nigeria, where ongoing humanitarian crises exacerbate disease vulnerability and weaken health system capacity [11]. The dual epidemic of TB and HIV is recognized globally as a critical health concern, with sub-Saharan Africa bearing the greatest burden [12–14]. TB remain the most prevalent opportunistic infection and the leading cause of death among individuals living with HIV. When occurring concurrently, TB and HIV synergistically compromise host immunity, thereby accelerating disease progression and reducing life expectancy in the absence of timely and effective therapeutic interventions [15–20]. The World Health Organization estimates that individuals living with HIV are 15–21 times more likely to develop TB compared to HIV-negative populations. The bidirectional interaction between TB and HIV intensifies disease severity: HIV infection predisposes individuals to the reactivation of latent TB infection and increase the incidence of active TB. While TB infection accelerates HIV disease progression, undermines treatment efficacy, diminishes quality of life, and shorten survival [21]. This complex interplay underscores the necessity of integrated TB/HIV control strategies, particularly in fragile contexts such as Borno State, where conflicts and displacement further impede access to comprehensive healthcare services [4, 22].

Despite the endemicity of TB and TB/comorbidity in Borno State, there are few studies that evaluate the prevalence of TB, TB/HIV, and TB/hepatitis comorbidity. This retrospective prevalence study has provided a comprehensive report on the prevalence of tuberculosis, TB/HIV, and other comorbidities in Borno State. The study, which encompasses the latest reports from 2013 to 2024, will serve as a critical reference for governments and international organizations in formulating future TB prevention and control strategies.

Materials and Methods

Study Area

The study was conducted at the University of Maiduguri Teaching Hospital (UMTH), located in Maiduguri, Borno State, Nigeria. UMTH is situated in Jere Local Government Area of the Maiduguri Metropolis and serve as a major tertiary referral center in the northeast Nigeria. The hospital has a capacity of more than ten thousand beds, with specialized wards and clinics that provide advanced medical care to patients from Borno and neighboring states. Its role as a teaching hospital ensures the availability of skilled personnel, comprehensive patient records, and institutional infrastructure suitable for large-scale epidemiological research [23, 24].

Maiduguri, the capital of Borno State, is strategically positioned in the northeast region of Nigeria. Borno is the largest State in the country by landmass, covering approximately 116,595Km², which accounts for about 8–12% of Nigeria's total area (Statistical yearbook, 1980). The state share boundaries with Yobe, Adamawa and Gombe States, and international frontiers with Chad, Niger, and Cameroon. This geographical positioning makes Maiduguri a critical hub for cross-border surveillance and disease control.

The city lies at latitude 11.5° North and longitude 30.05° East, with an elevation of 34 meters above sea level. Its location, combined with the ongoing humanitarian crises in the region, creates unique challenges for healthcare delivery and disease management. UMTH, as the largest tertiary hospital in the area, provides a representative

patient population for the studying tuberculosis and associated comorbidities in a conflict-affected setting this makes it an ideal site for generating evidence to inform both local and regional public health interventions [25].

Collection of Data.

Hospital records of tuberculosis, TB/HIV, TB/hepatitis, TB/Other comorbidities were collated from the facility listed above for a period of ten years beginning from 2013 to 2024.

Data on suspected tuberculosis diagnoses per year were extracted. These include the number of cases diagnosed per year, number of TB/HIV coinfections, history of hepatitis, other sexually transmitted infections, age, sex, and HIV status.

Sample collection

Adults aged 18 years and above who were clinically diagnosed as suspected TB patients were included in the study. Also, intending marriage couples who test positive for HIV were included in the study. HIV patients who are attending the ART clinic were also enrolled in the study. All patients who consented after counselling about HIV were tested for HIV infection. Information about the participants was collected from hospital records after approval from the Hospital management. The data collated include age, sex, hepatitis result, HIV result, GeneXpert, and acid-fast bacilli test results. The sputum sample was tested by using GeneXpert and Ziehl-Neelsen Microscopy. The blood sample was tested for hepatitis B and C using real-time PCR.

Statistical analysis

Descriptive statistical methods were used to summarize data on socio-demographic characteristics and prevalence tuberculosis, TB/HIV, TB/hepatitis, /TB/other STDs coinfection among suspected TB patients who are attending the University of Maiduguri Teaching Hospital, in Maiduguri, Borno State. Data were entered into Microsoft Excel and later imported into SPSS version.27.0 for statistical analysis. Data were summarized as categorical variables' frequencies (n) and percentages (%). Furthermore, we presented the data in tables and graphs. Chi-square was used to determine the level of difference among the categorical variables. A p-value of less than 0.05 was considered significant.

Results

Demographic Characteristics of the Study Population

Of the total number of participants, male 1450 males (49.9%) nearly equal female 1453 (50.1%). The majority of them were aged 25–34 (61.5% combined). The participants were predominantly single, 2354 (81.1%). And mostly Muslim 1873 (64.5%). The most common genotype was AA 1883 (64.9%). 7.2% tested positive for HIV (Table 1).

Table 1
Demographic Characteristics of the Study
Population (n = 2903)

Variables	Frequency	Percentage (%)
Gender		
Male	1450	49.9
Female	1453	50.1
Age group		
< 25years	223	7.7
25–29	1084	37.3
30–34	702	24.2
35–39	208	7.2
40–44	237	8.2
≥ 45	449	15.5
State		
Borno	1812	62.4
Adamawa	398	13.7
Bauchi	345	11.9
Gombe	179	6.2
Yobe	169	5.8
Marital Status		
Single	2354	81.1
Married	549	18.9
Religion		
Christianity	1030	35.5
Islam	1873	64.5
STDs		
Yes	12	0.4
No	2091	99.6
Hepatitis		
Negative	2758	95.0
Positive	145	5.0

Variables	Frequency	Percentage (%)
Gender		
Genotype		
AA	1883	64.9
AC	724	24.9
AS	37	1.3
SS	259	8.9
HIV Status		
Negative	2695	92.8
Positive	208	7.2
Total	2903	100

TB Prevalence by Demographics (2015–2024)

The overall prevalence of TB in Borno State from 2015–2025 in this study was 261 (8.9%). Among genders, TB prevalence was identical (9.0%). The highest TB prevalence in the age group greater than or equal to 45 years 404 (17.2), and lowest was in the 35–39 years old, 10 (4.8%). The prevalence of TB was slightly higher among married 53 (9.7%) than single 208 (8.8%). No demographic variables showed significant differences with TB prevalence (p-value > 0.05) (Table 2).

Table 2
Distribution of Prevalence of Tuberculosis in Borno State According to
Demographic Characteristics from 2015–2024

Demographic Characteristics from 2015 - 2024				
Variables	No. Sample	Negative (%)	Positive (%)	χ ² (p-value)
Gender				
Male	1450(49.9)	1320(91.0)	130(9.0)	0.002(0.962)
Female	1453(50.1)	1322(91.0)	131(9.0)	
Age group				
< 25years	223(7.7)	209(93.7)	14(6.3)	8.863(0.115)
25–29	1084(37.3)	983(90.7)	101(9.3)	
30–34	702(24.2)	638(90.9)	64(9.1)	
35–39	208(7.2)	198(95.2)	10(4.8)	
40–44	237(8.2)	210(88.6)	27(11.4)	
≥ 45	449(15.5)	404(90.0)	45(17.2)	
Marital Status				
Single	2354(81.1)	2146(91.2)	208(8.8)	0.364(0.546)
Married	549(18.9)	496(90.3)	53(9.7)	
Religion				
Christianity	1030(35.5)	933(90.6)	97(9.4)	0.355(0.551)
Islam	1873(64.5)	1709(91.2)	164(8.8)	
Total	2903 (100.0)	2642 (91.1)	261 (8.9)	

Table 3 showed that TB prevalence was highest among AA genotype 189 (10.0%) and lowest among SS 13 (5.0%). Genotype distribution was significantly associated with TB prevalence ($p = 0.027$). Figure 1 showed the monthly TB prevalence trend in Borno State from 2015–2025. There were seasonal fluctuations in TB prevalence. The annual prevalence of TB suggests a gradual increase or variability in TB prevalence over the years. The prevalence was highest in 2013 and lowest in 2022 (Fig. 2).

Table 3
Distribution of Prevalence of Tuberculosis in Borno State According to
Genotype from 2015–2024

Genotype	No. Sample	Negative (%)	Positive (%)	χ ² (p-value)
AA	1883(64.9)	1694(90.0)	189(10.0)	9.199(0.027)
AC	724(24.9)	667(92.1)	57(7.9)	
AS	37(1.3)	35(94.6)	2(5.4)	
SS	259(8.9)	246(95.0)	13(5.0)	
Total	2903 (100.0)	2642 (91.1)	261 (8.9)	

TB Comorbidity (2013–2024)

Sexually transmitted diseases (STDs), excluding HIV patients, had a higher TB prevalence 2 (16.7%), but the difference was not significant ($p = 0.352$). TB prevalence nearly doubled in hepatitis individuals, 26 (17.9%). (p -value < 0.001). TB prevalence was more than double in HIV patient 40 (19.2%) compared to HIV negative 221 (8.2%) (Table 4).

Table 4
Prevalence of tuberculosis Comorbidity in Borno State from 2013–2024

Comorbidity	No. Sample	Negative (%)	Positive (%)	χ ² (p-value)
STDs other than HIV				
Yes	12(0.4)	10(83.3)	2(16.7)	0.868 (0.352)
No	2091(99.6)	2632(91.0)	259(9.0)	
Hepatitis				
Negative	2758(95.0)	2523(81.3)	235(8.5)	14.909 (< 0.001)
Positive	145(5.0)	119(82.1)	26(17.9)	
HIV Status				
Negative	2695(92.8)	2474(91.8)	221(8.2)	28.713 (< 0.001)
Positive	208(7.2)	168(80.8)	40(19.2)	
Total	2903 (100.0)	2642 (91.1)	261 (8.9)	

Discussions

The overall prevalence of TB in Borno State from 2014–2024 in this study was 8.9%, this finding showed a decline from in TB prevalence compared to previous studies. [9] reported a prevalence of 22.7% in a retrospective study from 2003 to 2012, [26] also reported a higher TB prevalence of 19.1% among presumptive cases. The low TB prevalence in this study may be because of the success of the Stop TB Program launched in 2009. Efforts had been in place to reduce the prevalence of TB in Nigeria, especially in the northeast region. The major factors that

may be responsible for the high TB prevalence in the previous studies include internal displacement, serious humanitarian crises, hunger, and kidnapping for ransom due to the Boko Haram terrorism [13, 14, 27]. Others include socio-economic factors such as poverty. Recent studies reported that financial constraint due to high cost of treatment, non-medical expenses like food, travel expenses, delay in access to healthcare, malnutrition, overcrowding, and high rate of mycobacteria bacilli release or reinfection are major factors that contribute to high TB burden in the community. Other important factors are a weak drug supply chain, poor health facilities, outdated infrastructure, and inadequate human resources [28, 29].

We found no significant difference in tuberculosis prevalence between males and females. The reason may be that both males and females are exposed to the same environment or similar factors that favour the transmission and development of TB. However, global data from the WHO and previous studies consistently revealed that TB is more prevalent in males than in females. This is because males have a higher risk of infection than females. The difference is influenced by multiple factors, such as biological differences like hormones and immune responses [30–33]. Others include sociological, behavioral, and cultural factors [16, 34, 35].

The trend in TB prevalence showed that the highest TB prevalence was among the age 45 years and above, while the lowest was among those aged 25–35. The result obtained here was like the global trend in age distribution of TB prevalence reported by the WHO in 2021 [36]. Age plays a significant role in TB prevalence; in most studies, TB was most common among infants. And maybe due to their weak immune response [15, 37, 38]. Older adults with a weak immune system are vulnerable and most susceptible to TB, which may explain the high prevalence of TB in the age group 45 years and above in this study. Understanding age-specific TB prevalence is crucial for targeted TB control and prevention.

We found a significant association between TB prevalence and human genotypes. The prevalence of TB in this study was highest among individual AA genotype. The relationship between human genotype and tuberculosis is in a complex scenario. Genetic variations can influence susceptibility to TB, disease progression, and development. However, environmental factors such as bacilli load, exposure to MTB bacilli, and socio-economic conditions like poverty, malnutrition, and poor housing conditions play a crucial role in TB prevalence in Borno state. Further research is needed in this area to investigate the role of human genotype in the TB control program.

Coi

Infection of tuberculosis (TB) and sexually transmitted diseases (STDs), excluding HIV, presents unique challenges in diagnosis and treatment. Moreover, there is a lack of information on tuberculosis/STDs other than HIV in Nigeria. The findings of this study revealed that only 2 out of the 2903 participants had TB/STDs coinfection other than HIV in Borno state from 2014 to 2024. While the prevalence of TB/STDs coinfection was not statistically different among participants who had STDs and those without it, it is important to note that STDs can weaken the immune system (Cohen, 1998; Wira et al., 2014; Monin et al., 2020), potentially increasing the risk of TB infection or accelerating its progression. Similarly, TB can impact the body's ability to fight off STDs [19, 36, 39].

Our report shows that the prevalence of TB among HIV patients was significantly higher than that of those without HIV coinfection. This finding was in agreement with previous studies in Nigeria [3, 40, 41]. Individuals with HIV are at a 20-fold higher risk of developing active TB compared to those without HIV. This is primarily due to HIV's impact on the immune system, which weakens the body's defenses against infections. TB/HIV coinfection poses significant challenges due to the increased risk of both diseases accelerating each other's progression. HIV weakens the immune system, making individuals more susceptible to TB infection and increasing the likelihood of

TB disease [19, 21, 42]. Conversely, TB accelerates HIV replication, potentially worsening the course of HIV infection [43, 44]. Effective management requires integrated approaches that include early diagnosis, prompt treatment of both TB and HIV, and adherence to antiretroviral therapy (ART). The specific approaches to management are often complicated by drug interactions between medications for the two diseases. Thorough care and support are crucial for improving outcomes.

A statistically significant differences ($\chi^2 = 14.909$; $p\text{-value} = < 0.0001$) was observed between individual with TB/hepatitis coinfection and those with TB infection only. An earlier study by [45] reported a higher (23.6%) prevalence of TB/HCV coinfection in Enugu State. The authors also revealed that age, alcohol intake, and cigarette smoking were identified as predicting factors for hepatotoxicity among TB/HCV-infected patients. Another study reported a lower prevalence (2.8%) of TB/HCV in Jos, Plateau State [46]. The dual burden of TB and hepatitis could complicate the treatment regimen and increase the risk of drug toxicity and adverse effects [47, 48]. The coinfection of TB and hepatitis in this study presents a complex public health problem that requires integrated approaches for effective management. Continued research and surveillance are essential to understand the challenges of these infections and to develop targeted interventions that can improve patients' quality of life. Moreso, the challenge of STDs, HIV and other chronic diseases coinfection with tuberculosis is real, and there is the need for urgent action to nip the problem in the bud. Therefore, this study provides baseline data for informed health and policy decisions.

The annual distribution of tuberculosis prevalence in Borno State from 2013 to 2024 revealed a substantial drop in the prevalence of TB from 2013 to 2016. The decline was sustained for over five years (2016–2021). In 2020, we notice a slight increase then followed by a sharp decrease in the prevalence of TB in 2021. The substantial decline in TB prevalence noticed from 2016 to 2020 may be because of the efforts in the implementation of the Stop TB program in Nigeria [49]. Similarly, the impact of the post-COVID-19 pandemic may be responsible for the decrease in TB prevalence observed from 2021 to 2023. A previous study reported that COVID-19 significantly disrupted tuberculosis (TB) control efforts in Nigeria, leading to reduced case detection, treatment delays, and worsened patient outcomes. The pandemic resulted in health system strain in which COVID-19 diverted resources—staff, funding, and infrastructure—away from TB programs to pandemic response efforts. Also, Lockdowns and fear of infection during the COVID-19 pandemic discouraged patients from visiting health facilities, leading to a drop in TB case notifications and treatment initiation [36, 50, 51].

Conclusion

Tuberculosis prevalence in this study was highest in ≥ 45 years, lowest in 25–35 years. Older adults are more vulnerable due to weaker immunity. The prevalence of TB among AA genotype individuals suggests genetic susceptibility but may be influenced by environmental and socio-economic factors. HIV increases TB risk 20-fold; TB accelerates HIV replication. Management of TB/comorbidity is complicated by drug interactions. TB/Hepatitis is statistically significant association. Dual burden of TB/HIV or TB/hepatitis complicates treatment and increases risk of drug toxicity.

Tuberculosis prevalence is declining but remains a major health challenge in Borno State. Conflict, poverty, and weak health systems remain key drivers. Coinfections (HIV, HCV or HBV) complicate management and require integrated approaches. Targeted interventions by age, genotype, and socio-economic status are crucial. Continued research, surveillance, and investment in healthcare infrastructure are needed.

Declarations

Funding: This study did not receive any funding or grant.

Data availability: The datasets generated and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Ethics approval and consent to participate: The National Open University of Nigeria, Abuja, Maiduguri Study Center, Borno State's Research and ethics committee is under the National Open University of Nigeria (NOUN) Directorate of Research Administration (DRA) which oversees research ethics, requiring prior approval for projects involving human or animal subjects. The Faculty Research and Ethics Committee (FREC) of NOUN reviewed the research and gave approval for the conduct of this study. All procedures were conducted in accordance with the ethical standards of this institutional committee and the 1964 Helsinki Declaration and its later amendments. Informed consent was waived by the Faculty Research and Ethics Committee (FREC) of the National Open University of Nigeria, Maiduguri Study Center. Also, the researchers do not have contact with any members of the study participants. Data was anonymous and patients' information used is not traceable to an individual. Permission to use the hospital data was obtained from the University of Maiduguri Teaching Hospital, Maiduguri, Nigeria.

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Figures

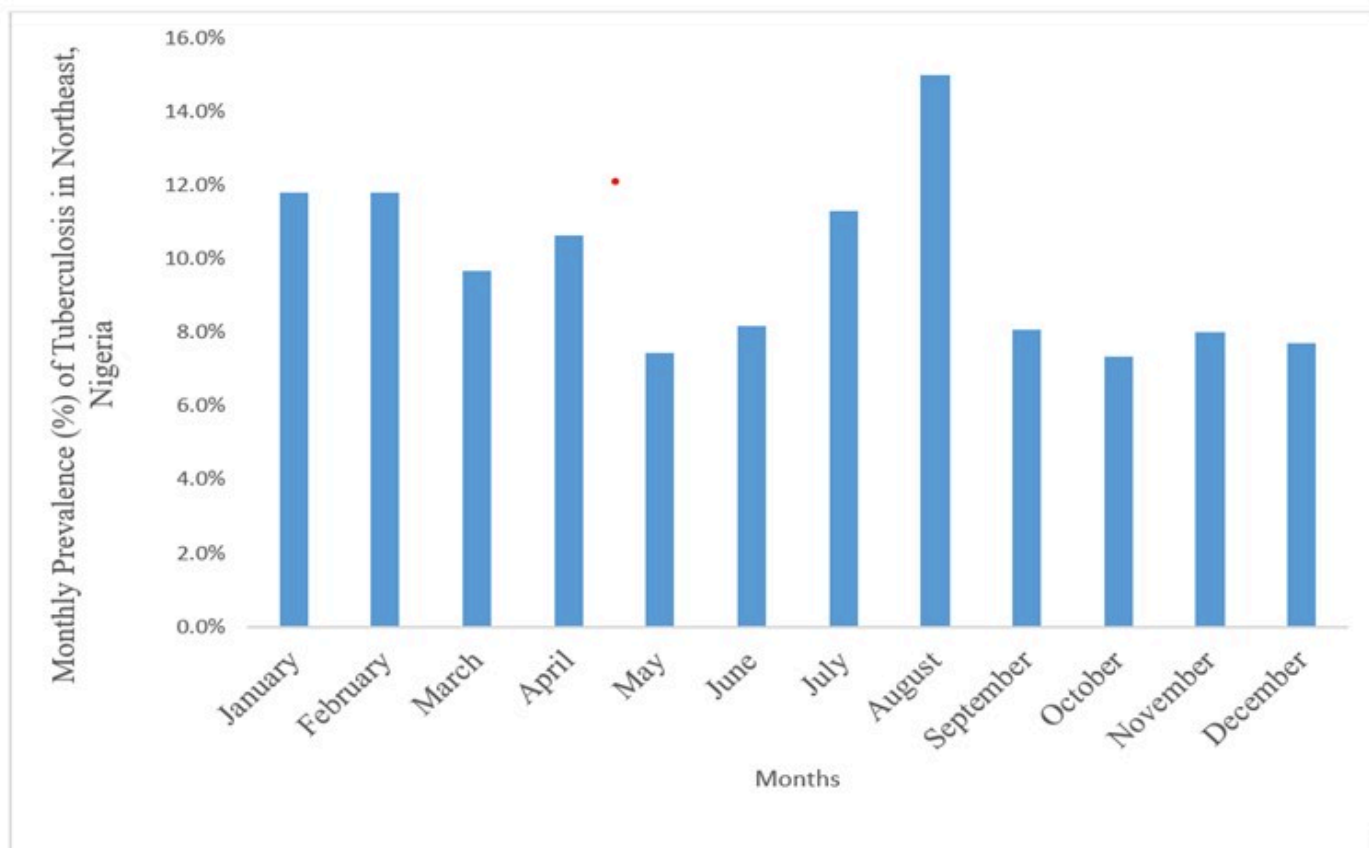


Figure 1: Monthly Distribution of the Prevalence of tuberculosis in Borno State from 2013-2024

Figure 1

See image above for figure legend.

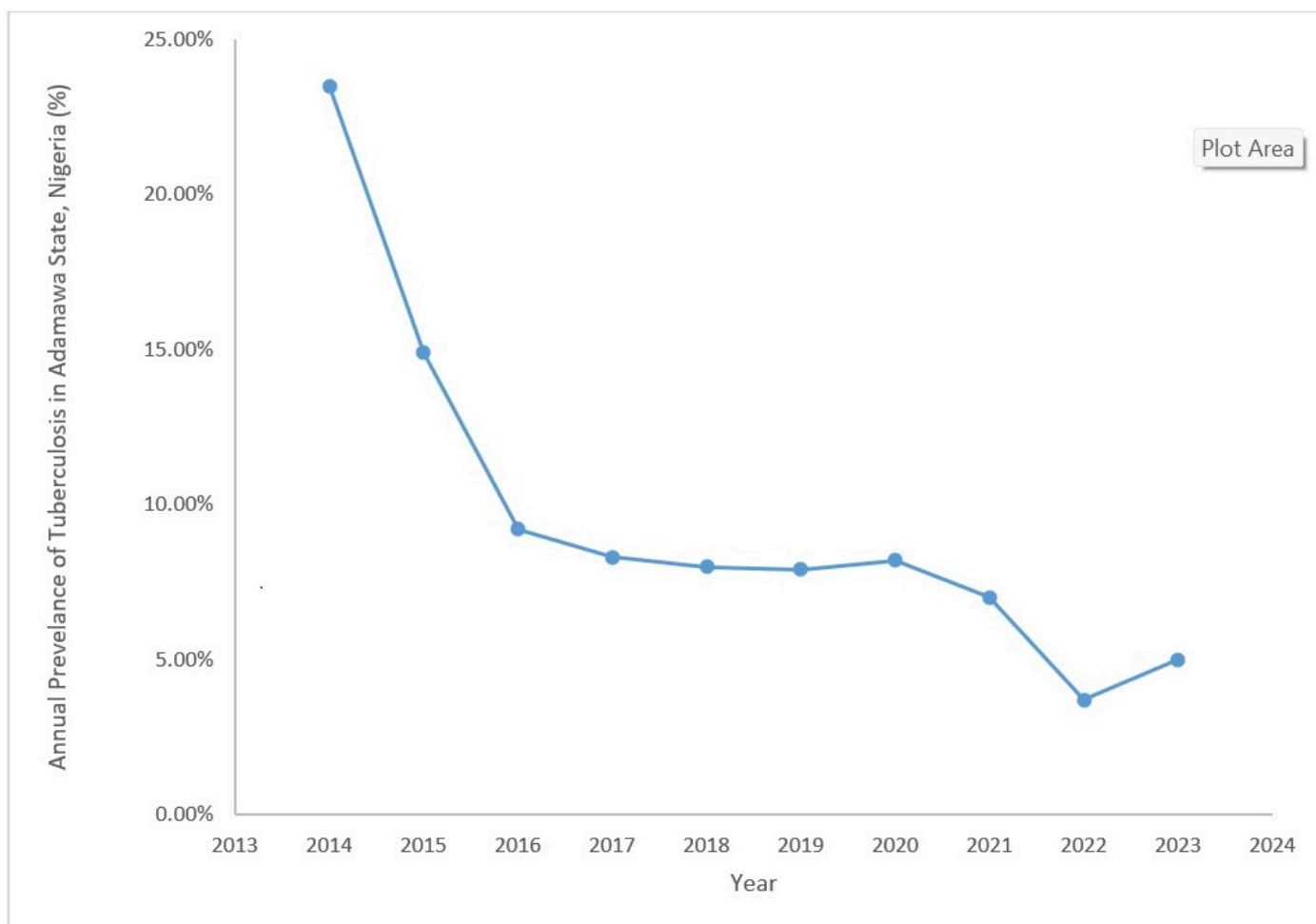


Figure 2: Annual Distribution of the Prevalence of tuberculosis in Borno State from 2013-2024

A

Figure 2

See image above for figure legend.

Supplementary Files

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