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Research

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Prevalence, trends, and magnitude of bovine tuberculosis in slaughtered cattle across States in Nigeria, 2020-2022: a retrospective study

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Abstract

Introduction: *tuberculosis is one of the prioritized zoonoses in Nigeria and is globally targeted for elimination by the year 2035. This can only be achieved through a One Health approach. Nigeria has over 250 million people, with 22.4 million cattle and an unknown population of wildlife ruminants. These factors provide opportunities for easy transmission and spread of bovine tuberculosis (BTB). We determined the prevalence and trends of BTB in Nigeria from 2020 to 2022.* ***Methods:*** *we conducted a retrospective study on BTB in Nigeria from 2020 to 2022. A three-year surveillance records of slaughtered cattle from monthly abattoir records across all states were reviewed. The diagnosis was based on characteristic BTB lesions during postmortem meat inspection by veterinarians. Extracted variables were slaughter figures, the total number of monthly tuberculosis cases for each state every year, and the number of states that consistently reported. Descriptive analysis was performed using Microsoft Excel, version 2007.* ***Results:*** *a total of 629,938 cattle were slaughtered, out of which 18,536 presented suggestive tuberculous lesions. The overall prevalence for the study period was 2.94%. The highest prevalence of BTB was in the year 2022 (3.33%) while the lowest was in 2021 (2.69%). The highest seasonal prevalence for the study period was in July (4.52%) while the lowest was in January (1.39%). There is a lower prevalence in the Northern region (1.81%) compared to the Southern region (2.96%) of the country. Zamfara State had the highest prevalence (6.2%) of BTB while the State with the lowest prevalence was Kaduna with 0.3%. Twenty-nine states and the Federal Capital Territory (FCT) reported BTB disease out of the 36 States and (FCT) and they do not do so routinely. There were no records of BTB in 7 States (Anambra, Bauchi, Enugu, Katsina, Kebbi, and Gombe). In 2022, only six (6) states reported BTB (Sokoto, Adamawa, Abia, Ogun, Imo and Rivers).*

Conclusion: *the study indicates the endemicity of BTB distributed across various States in Nigeria. Trend analysis reveals the seasonality of BTB; which peaks in July and August (rainy season). The disease has lesser occurrence during the dry season. A national baseline survey for BTB is needed to estimate the actual burden of disease in the country. There is a need for effective meat inspection and proper reporting of the disease to prevent spread and transmission to humans. A One Health approach in the control and eradication of the disease in the country is required.*

Introduction

Bovine tuberculosis is a chronic bacterial disease mainly caused by *Mycobacterium bovis* belonging to the family of *Mycobacterium tuberculosis* complex [1,2]. It is a major zoonotic disease, and cattle are the main source of infection for humans, the disease also affects domestic and wild animals and is globally associated with huge economic loss and negative public health impacts [2-5]. Members of the *Mycobacterium tuberculosis* complex and *Mycobacterium tuberculosis* which causes tuberculosis in humans have been isolated from cattle and implicated for tuberculosis in cattle [6,7].

The global pooled prevalence of BTB in cattle was estimated at 13.12%; Africa had 10.3%, Asia at 13.8%, Europe had 17.8%, North America 33.6%, and South America at 20.5% [8]. In 2018, the WHO reported a global estimate of human cases at 143,000 and 12,300 deaths due to zoonotic tuberculosis (zTB) caused by *M. bovis* [9]. About two billion people, amounting to one-fourth of the world´s population may be infected with tuberculosis (TB) and about 10.6 million become ill each year [9]. Worldwide, over 3,500 people die daily as a result of TB amounting to about 1.3 million deaths yearly [10]. The World Organization for Animal Health (WOAH), the World Health Organization (WHO), the Food and Agriculture Organization of the UN (FAO) and the International Union Against Tuberculosis and Lung

Disease (The Union) jointly launched the first-ever roadmap to tackle zTB in October 2017 [2]. It is based on a One Health approach, recognizing the interdependence of animal and human health sectors for addressing the major health and economic impacts of this disease [2]. Clinically, it is not possible to differentiate infections caused by *M. tuberculosis* from those caused by *M. bovis*, which is estimated to account for up to 10% of human tuberculosis cases in some countries [2]. Diagnosis may be further complicated by the tendency of *M. bovis* infections to be located in tissues other than the lungs (extrapulmonary infection) and *M. bovis* is naturally resistant to one of the antimicrobials (pyrazinamide) used as a first-line treatment for human tuberculosis [2] makes it one of the contributory factors for the development of drug-resistant tuberculosis in humans.

Nigeria is the most populous country in Africa with a projected population of 216,783,381 people in 2022 [11] and has about 19.5 million cattle and an unknown population of wildlife ruminants [12]. These factors demonstrate opportunities for easy transmission and spread of BTB, evidenced by the country ranking fourth with Tuberculosis in the world and first in Africa [13,14]. The constant uncontrolled transborder influx of herders and cattle from neighboring states and countries without adequate and complete inspection, limited access to veterinary services, poor diagnostic facilities, and inadequately trained manpower have immensely contributed to the endemicity of the disease in Nigeria [15-17]. In Nigeria, overall pooled BTB prevalence in animals is 7.0%; cattle (8.0%), goats (0.47%), sheep (0.27%), camels (13.0%), and wildlife (13.0%) [18]. Furthermore, huge economic losses have been encountered due to the condemnation of affected carcasses as well as indirect losses associated with the disease in the country ranging between 18,000 - over 2 million USD [5,19,20] which is a threat to the economy; food security, food safety, animal and public health and livestock subsector and rural livelihood [21,22] and consequently, a threat to local and international trade in Nigeria where the livestock industry generates 94% of animal protein and contributes about 5% of national gross domestic product (GDP) [23].

Tuberculosis is aimed for eradication by the WHO in the year 2035 [24] but this will only be realistic if BTB is controlled in the animal health sector through collaboration using the One Health approach. The paucity of funds and inconsistent routine surveillance data of BTB along with the disease dynamics and burden poses a hindrance to effective and strategic prevention and control. This study will generate information on the disease dynamics which will aid expert policy and decision-making for effective prevention and control, which will in turn reduce transmission at the animal-human interface. It will further strengthen the inter-sectoral and collaborative approach (One Health) for effective prevention and control of BTB in Nigeria to improve the economy, promote livestock productivity and trade, food safety, and public health, and contribute information for further research. Our research questions were; what is the prevalence of BTB across States in Nigeria? what is the trend of BTB in slaughtered cattle in Nigeria? are all states reporting cases of BTB routinely in Nigeria? We aimed at determining the prevalence, distribution and trends of BTB cases across States in Nigeria as well as the number of states participating in disease reporting for three years.

Methods

Study area: Nigeria is in West Africa and covers an area of 923,769 square kilometers (356,669 square meters). It is the most populous country in Africa and the world's sixth-most populous country. Nigeria borders Niger in the north, Chad in the northeast, Cameroon in the east, and Benin in the west [25]. Nigeria is a federal republic comprising 36 states and the Federal Capital Territory (FCT), where the capital, Abuja, is located [25].

Study design: we conducted a retrospective study for a period of three years (from January 2020 to December 2022). Abattoir records from major abattoirs and slaughter slabs nationwide were retrieved. Eligibility criteria are all slaughtered cattle at major abattoirs and slaughter slabs across states in Nigeria between the periods of January 2020 to December 2022 that had tuberculous-like lesions during postmortem inspection and were recorded as such. The basis for the diagnosis of BTB was tentative; based on tuberculous-like lesions observed at postmortem; tubercles in the lungs, spleen, liver, kidney, chest cavity, diaphragm, and lymph nodes; whether generalized or localized suspected TB lesions. We categorized a complete BTB report as a report that has filled in data for all the variables captured on the NADIS disease report form, while an incomplete report is a report that has missing data under some of the variables in the NADIS disease report form and captured in the NADIS as such.

Study population: all cattle slaughtered at major abattoirs and slaughter slabs across states in Nigeria.

Data collection: monthly abattoir records from all 36 States of the Federation plus the FCT were submitted to NADIS, domiciled in the Federal Ministry of Agriculture and Rural Food Security. Inputted data from January 2020 to December 2022 of cattle slaughtered monthly and numbers of slaughtered cattle with suggestive tuberculosis lesions recorded were extracted. Variables extracted for all the States and the FCT were; monthly slaughter figures, total number of tuberculosis cases per month, and the number of states that consistently reported BTB.

Data analysis: data were cleaned and analyzed using Microsoft Excel to determine the prevalence and trend of BTB cases in slaughtered cattle, as well as assess states that routinely submit abattoir reports in Nigeria. Calculation of prevalence was done using the formula [26]:

$$\text{Prevalence} = \frac{\text{Number of bTB positive cases}}{\text{Total number of slaughtered cattle}} \text{ X } 100$$

Quantum Geographic Information System (QGIS) version 3.16 was used in creating the study map on disease reporting in Nigeria.

Quality assurance: data cleaning was done to ensure that quality data were analyzed. This involved removing duplicate data entries and missing data.

Ethical clearance: secondary data was used for this study. The study did not involve the use of animals. However, permission for the release of data for the study was issued by the Chief Veterinary Officer of Nigeria.

Results

Annual prevalence of BTB year 2020 to 2022: the annual prevalence of BTB were; 2.7% (9126/338486) in year 2020, 2.98% (2560/85918) in year 2021 and 3.33% (6850/205534) in year 2022. The annual prevalence of BTB indicates that year 2022 had the highest prevalence 3.33%, followed by year 2021 while the least prevalence (2.70%) was year 2020. The total prevalence for the period of study is 2.94% (18536/629938).

Prevalence of BTB in the Northern region of Nigeria, 2020 to 2022: in the Northern region, total prevalence is 1.81%. In year 2020, Adamawa State had the highest prevalence (6.12%) of BTB while Sokoto State had the least prevalence (0.14%) and there was no report from Kogi State (Table 1). In year 2021, only Sokoto and Adamawa States reported BTB in the region. Adamawa had a prevalence of 2.99% while Sokoto had 1.69% (Table 1). In year 2022, Zamfara State had the highest prevalence (14.3%) while the least was Kwara State with a prevalence of 0.96% (Table 1).

Prevalence of BTB in the Southern region of Nigeria, 2020 to 2022: in the Southern region, total prevalence is 2.96%. In year 2020, Ondo State had the highest prevalence (8.86%) while the

least prevalence (1.21%) was from Edo State (Table 1). In year 2021, Rivers State had the highest prevalence (5.68%) while the least was Oyo State with 0.61% (Table 1). In year 2022, only Lagos State did not report BTB in the region. Four States had the highest prevalence of 8.58%; Osun, Rivers, Bayelsa and Oyo, the least prevalence was Ebonyi State (Table 1). Overall, there is higher prevalence in the Southern region (3.09%) compared with the Northern region (2.87%).

Seasonal prevalence of BTB occurrence in Nigeria, 2020 to 2022: the seasonality of BTB; the total monthly prevalence of BTB from 2020 to 2022 indicates that the highest prevalence of 4.52% was in July, followed by August with 4.29% while the least was January (1.39%) (Table 2).

Magnitude and trends of BTB in Nigeria, 2020-2022: top 5 states with the highest prevalence of BTB were; Zamfara (6.2%), Rivers (5.8%), Ondo (5.5%), Osun (4.5%) and Adamawa (4.3%) and the state with the least prevalence of 0.3% was Kaduna State (Figure 1). The trend analysis indicates that there is a steady increase in the prevalence of BTB (Figure 2) and the peak monthly prevalence were in July and August for annual and total prevalence (2020-2022) (Figure 2, Figure 3).

Frequency of submission of BTB reports in Nigeria, 2020 to 2022: seven States had no BTB report/record during the period of study, year 2020 to 2022 (18.92%), the States were; Anambra, Bauchi, Enugu, Gombe, Jigawa, Katsina and Kebbi (Figure 4). In year 2020, ten states (Anambra, Bauchi, Delta, Enugu, Gombe, Jigawa, Kogi, Cross-River, Katsina, Kebbi) had no record of BTB (Figure 4). In year, 2021, only 6 States (Sokoto, Adamawa, Abia, Imo, Ogun and Rivers) reported BTB nationwide, the rest of the states (30 States plus the FCT) had no record of BTB. In year 2022, twenty-four States reported BTB nationwide; 24/37 (64.86%) (Figure 4). Thirty states (twenty-nine states plus the FCT) out of the 37 states (75.68%) of the federation were found to submit report to the Federal Ministry of Agriculture and Food Security (FMAFS) (Figure 4).

Discussion

The duration of the study revealed an annual prevalence that ranged from 2.7 to 3.33% and a total prevalence of 2.94%; this finding is quite low when compared to other cross-sectional studies that were conducted in the country [5,27-31] but similar to studies conducted by Tillo *et al*. [32] and Oluwasile *et al*. [33]. There was a lower prevalence (2.84%) of BTB in the Northern region of the country compared to the Southern region (3.06%). This may not be the true picture in the country because the reporting system is sub-optimal in monitoring and tracking of priority zoonoses, especially at the national level [34]. Secondly, most of the cattle population are located in the northern part of the country and often the healthy cattle are usually transported from the northern to the southern part of the country.

Zamfara State had the highest prevalence of BTB in this study ranging from 4.3 to 14% with an average prevalence of 6.2% due to lack of BTB report from the State in 2021. Similarly, a cross-sectional study conducted in the state in the year 2014 revealed a prevalence of 6.1% of carcasses having tuberculosis-like lesions at postmortem inspection [1]. The prevalence of BTB in Adamawa State ranged from 2.99 to 6.12%. The study by Tillo *et al*. [32] in Yola, Adamawa State revealed an overall prevalence of 2.36% (148/6,280) using the Ziehl-Neelsen staining method which is lower than what was obtained in this study. In Plateau State, BTB prevalence ranged from 1.15 to 1.71%. The result obtained was much lower than what was obtained from a retrospective study by Okeke *et al*. [28] where a range of 3.1 to 16.3% between the years 2007 to 2012 with an overall prevalence of 11.2% (4, 658/52, 262) in Jos, Plateau State, with an average yearly prevalence of 9.1%. Gombe state is among the States in this study that had no record of BTB report and studies conducted in that state reveal that the State might probably be among the States with the high prevalence of BTB ranging from 0.78% [35] to 14% [29].

Furthermore, reports from Borno State indicated a prevalence of 0.53 to 2.69% with an average prevalence of 1.83% in the study. This is quite less than what was obtained in previous cross-sectional studies from Maiduguri abattoir based on gross tubercle lesions in cattle slaughtered at Maiduguri abattoir which revealed a prevalence of 6.41% [5] and 9.3% [30]. This is also a point that more will be gained in conducting a national BTB survey to determine the baseline prevalence of the disease nationwide. Also, the FCT revealed that BTB prevalence ranged from 0.36 to 2.19% with an average prevalence of 0.85%. This result is similar to a retrospective study in the FCT abattoirs from 2015 to 2019 with 0.75% of slaughtered heads of cattle had BTB lesions [36]; much lower in a crossectional study where the Lateral Flow Technique (Rapid Kit Test) was used to detect BTB in FCT abattoirs amounting to a prevalence of 17.3% [27]. Benue State had a 5.47% prevalence of BTB in the year 2020 which was higher than what was obtained by Ejeh *et al*. [4] (1.90%) from a retrospective study from 2008 to 2012. The same study reported an annual prevalence of bTB range from 0.90% in 2008 to 4.04% in 2012 which did not differ much from what was obtained in this study [4].

In the southern part of the country, Lagos State had a prevalence of 1.26% in the year 2020. Studies of BTB by Agbalaya *et al*. [31] in Lagos State reported a prevalence of 25.7% in cattle using the lateral flow technique and 7.0% by ZN technique. Thus, indicating a much higher rate of the disease in the State. In the year 2022, Cross River had a 5.78% prevalence of BTB which is higher than the result obtained by Bikom and Oboeegbulem [37] (1% prevalence) from a 9-year retrospective survey (2001-2010). Ogun State had BTB prevalence of 2.39 to 4.29% with an annual average of 2.87%. A cross-sectional study conducted by Oluwasile *et al*. [33], at Lafenwa Abattoir, Abeokuta, Ogun State, reported a prevalence of 1.78%.

Trend analysis revealed a cyclical pattern which peaked in July, then August, with September closer behind, which are rainy months, January had the least prevalence of BTB. This trend shows bovine tuberculosis is seasonal, and that season has effects on its rate of transmission. This study agrees with several studies conducted in the country which further affirms our findings [28,35,36]. They further relate to our findings that BTB prevalence is higher in the rainy seasons (April to September) than in dry seasons (October to March) [28,35,36]. Contrary to our finding are the reports of Shitaye JE *et al*. [38] and Oluwasile *et al*. [33] where a greater prevalence of BTB was demonstrated during the dry season (October-March) compared to the wet season (April-September). Meanwhile, Ejeh *et al*. [4] reported that there was no seasonal difference in the prevalence of bTB.

This study revealed poor reporting of BTB in the country. There were a lot of inconsistencies in BTB reporting from all the States; over 75% of the States submit clean reports but only a few routinely report BTB cases. The study reveals the need for improvement in the national BTB reporting system. This will involve the overhauling of the primary, secondary and tertiary stages of reporting in the country. Disease notification inefficiency at the primary stage (first Tier) may be due to reluctance on the part of the farmers to report cases, lack of awareness in rural areas of the state, distance of the clinic(s) from their villages and inappropriate recording of cases in the clinics [39] while in the second and third tier notification inefficiency in the disease reporting system are due to negligence and failure to submit all the reports received to the state monitoring officers and inability of the system to fully incorporate the private practitioners [39]. Furthermore, the promotion of efficient functioning of the Veterinary Health System will require a well-coordinated and articulated system for effective disease reporting which will eventually improve prevention and control of diseases in the country [40]. Factors that determine effective disease reporting are; effective surveillance and early detection of

diseases [40]. The majority of countries have transformed disease reporting mechanisms which are solely designed for routine endemic disease occurrences which tend to have deficiencies such as overlong reporting chains from local, State to national offices resulting in delays and distortion of information at each level; and collection and transmission of information that is based on poor epidemiological surveillance or diagnostic methods or is inadequate for good disease control decision making [41].

Tuberculosis has been targeted for elimination by the year 2035 [24]. The deficiency of the current national animal disease reporting due to underreporting of the disease is a call for prudent action in the area of disease surveillance in the country. The test and slaughter method used in the control and eradication of BTB implemented by most countries [2] is hardly visible in Nigeria as an option due to the endemicity of the disease in the country. Moreover, this will involve slaughtering large numbers of cattle and may not be practical as a result of limited funds as well as human resources. However, this measure (test-and-slaughter method) may be implemented at the final stage of disease eradication [2]. Other measures which are already in place and should be employed in the control and eradication process of the disease are; post mortem meat inspection to detect infected animals and herds, intensive surveillance including on-farm visits, removal of infected and in-contact animals, implementation of local legislation [42], efficient movement control, the use of animal identification and traceability system [2].

Furthermore, other measures that are likely to improve our animal surveillance systems are to; conduct active surveillance (baseline surveys) to estimate the actual burden among the cattle population in the Nation; intensify public awareness campaigns for livestock owners and abattoir workers on the public health implication of bovine tuberculosis; training of more veterinarians to be posted to abattoirs and control post for effective and routine disease surveillance; upgrading of dilapidated abattoirs across states to support hygienic meat processing and waste management to support disease prevention and control; and finally, submitting of abattoir reports to the ministry should be timely and made mandatory across all states. In rapidly changing societies such as Nigeria, decision-makers at all levels must acknowledge the current and future impact of the livestock sector on public health, the environment and livelihoods [43].

Limitations of the study include the use of secondary data where the sex of the cattle was not captured. Hence, the prevalence of BTB in terms of sex could not be determined. Routine submission of reports was largely deficient; results presented may differ from what would have been obtained if all the States had submitted the number of reports required for the period study. Nevertheless, the study serves as a baseline of national information on BTB across major abattoirs in the 36 States and the FCT.

Conclusion

This study shows that bovine tuberculosis is endemic and prevalent in Nigeria and poses a threat to animal and public health. Furthermore, it undermines the growth of the nation´s economy, trade, and food security. There is a need for baseline surveys for its management. One Health approach is relevant in the control of BTB in Nigeria.

What is known about this topic

- *Bovine tuberculosis is endemic in Nigeria;*
- *The global pooled prevalence of BTB in cattle was estimated at 13.12%;*
- *Bovine tuberculosis is zoonotic.*

What this study adds

- *The overall prevalence of bovine tuberculosis in Nigeria from year 2020-2022 is 2.94%;*

- *The highest seasonal prevalence of bovine tuberculosis in Nigeria was in July (4.52%) while the lowest was in January (1.39%);*
- *There is a higher prevalence of bovine tuberculosis in the Southern region (2.96%) compared with the Northern region (1.81%); Zamfara (6.2%) State had the highest prevalence of BTB while the State with the lowest prevalence was Kaduna (0.3%).*

Competing interests

The authors declare no competing interests.

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Authors' contributions

Janada Danladi and Taiwo Olasoju; conception of the study and development of study proposal, data extraction from NADIS; Taiwo Olasoju and Hamza Ibn Ibrahim, data analysis and interpretation; Janada Danladi, Hamza Ibn Ibrahim, Maryam Ibrahim Buba and Ayi Vandi Kwaghe. First manuscript draft; Janada Danladi, Second Manuscript draft; Ayi Vandi Kwaghe, final manuscript; all authors read through the manuscript by revising critically for important intellectual content before drafting the final manuscript. All the authors have read and agreed to the final manuscript.

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Tables and figures

Table 1: annual prevalence of bovine tuberculosis across States in Nigeria from year 2020 to 2022

Table 2: total monthly Prevalence of bovine tuberculosis in Nigeria, year 2020-2022

Figure 1: average prevalence rate of bovine tuberculosis in slaughtered cattle in major abattoirs and slaughter slabs across states in Nigeria, 2020 to 2022

Figure 2: a three-year trend of bovine tuberculosis in slaughtered cattle in major abattoirs across States in Nigeria, 2020 to 2022

Figure 3: trend of seasonal prevalence of BTB in Nigeria showing peak prevalence in July, year 2020 to 2022

Figure 4: bovine tuberculosis reporting in Nigeria, year 2020 to 2022

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Table 1: annual prevalence of bovine tuberculosis across States in Nigeria from year 2020 to 2022

S/N0		State	Year 2020			Year 2021			Year 2022			Average Prevalence (2020-2022)	Regional prevalence (2020-2022)
			Total N0. of slaughtered cattle	Positive Cases	Prevalence	Total N0. of slaughtered cattle	Positive Cases	Prevalence	Total N0. of slaughtered cattle	Positive Cases	Prevalence		
NORTHERN REGION	1	Taraba	22049	671	3.04%	0	0	0%	12554	338	2.69%	1.83%	
	2	Borno	4466	24	0.53%	0	0l	0%	10233	218	2.13%	0.95%	1.81%
	3	Sokoto	19449	348	0.14%	21330	350	1.64%	0	0	0%	0.61%	
	4	Kano	52759	1243	2.36%	0	0	0%	0	0	0%	2.36%	
	5	Plateau	5486	94	1.71%	0	0	0%	1742	20	1.45%	0.95%	
	6	Adamawa	2365	146	6.17%	3012	90	2.99%	3000	110	3.67%	4.26%	
	7	Nasarawa	7337	285	3.88%	0	0	0%	0	0	0%	1.29%	
	8	Yobe	12315	251	2.04%	0	0	0%	0	0	0%	0.68%	
	9	Niger	511	3	0.59%	0	0	0%	4232	195	4.61%	1.73%	
	10	Kogi	0	0	0%	0	0	0%	400	24	6%	2.00%	
	11	Benue	12213	669	5.48%	0	0	0%	0	0	0%	1.82%	
	12	Fct	1100	4	0.36%	0	0	0%	2513	55	2.19%	0.85%	
	13	Kwara	3560	108	3.03%	0	0	0%	2924	28	0.96%	1.33%	
	14	Zamfara	7251	339	4.68%	0	0	0%	3725	533	14.31%	6.20%	
	15	Kaduna	202	2	0.99%	0	0	0%	0	0	0%	0.33%	
SOUTHERN REGION	16	Abia	17256	609	3.53%	18551	736	3.97%	30807	897	2.91%	3.47%	
	17	Imo	9128	368	4.03%	39716	1239	3.12%	19295	492	2.55%	3.55%	2.96%
	18	Ogun	33547	775	2.31%	3080	132	4.29%	36478	698	1.91%	2.87%	
	19	Osun	1591	70	4.40%	0	0	0%	4617	396	8.58%	4.48%	
	20	Ondo	10127	897	8.86%	0	0	0%	9423	690	7.32%	5.48%	
	21	Delta	20898	530	2.54%	0	0	0%	20769	520	0.25%	0.91%	
	22	Cross River	0	0	0%	0	0	0%	1125	65	5.78%	1.93%	
	23	Rivers	7576	229	3.02%	229	13	5.68%	9666	258	2.67%	5.76%	
	24	Lagos	13920	176	1.26%	0	0	0%	1341	27	2.01%	0.42%	
	25	Akwa Ibom	7326	223	3.04%	0	0	0%	2548	183	7.18%	3.41%	
	26	Ekiti	9185	199	2.17%	0	0	0%	3028	171	5.65%	2.64%	
	27	Ebonyi	695	22	3.31%	0	0	0%	3574	1	0.03%	1.11%	
	28	Edo	5768	133	2.31%	0	0	0%	12696	609	4.80%	2.24%	
	29	Bayelsa	2605	35	1.34%	0	0	0%	1130	97	8.58%	2.86%	
	30	Oyo	4780	672	1.41%	0	0	0%	7714	225	2.92%	3.33%	

Table 2: total monthly prevalence of bovine tuberculosis in Nigeria, year 2020-2022

Month	Slaughter figure	Total BTB Cases	Prevalence
January	54744	763	1.39%
February	70079	1566	2.23%
March	71920	1749	2.43%
April	28423	694	2.44%
May	47565	1507	3.17%
June	38410	1366	3.56%
July	53363	2412	4.52%
August	14644	628	4.29%
September	64529	2576	3.99%
October	36362	1445	3.97%
November	57841	1645	2.84%
December	92048	2185	2.37%
Total	629938	18536	2.94%

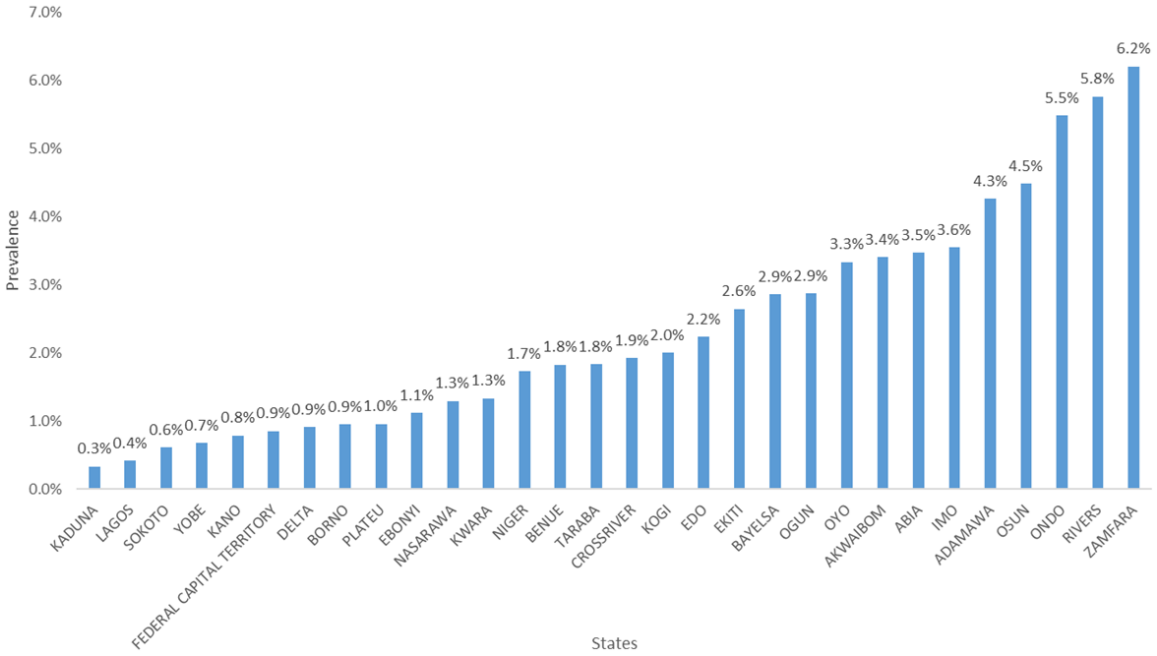

Figure 1: average prevalence rate of bovine tuberculosis in slaughtered cattle in major abattoirs and slaughter slabs across states in Nigeria, 2020 to 2022

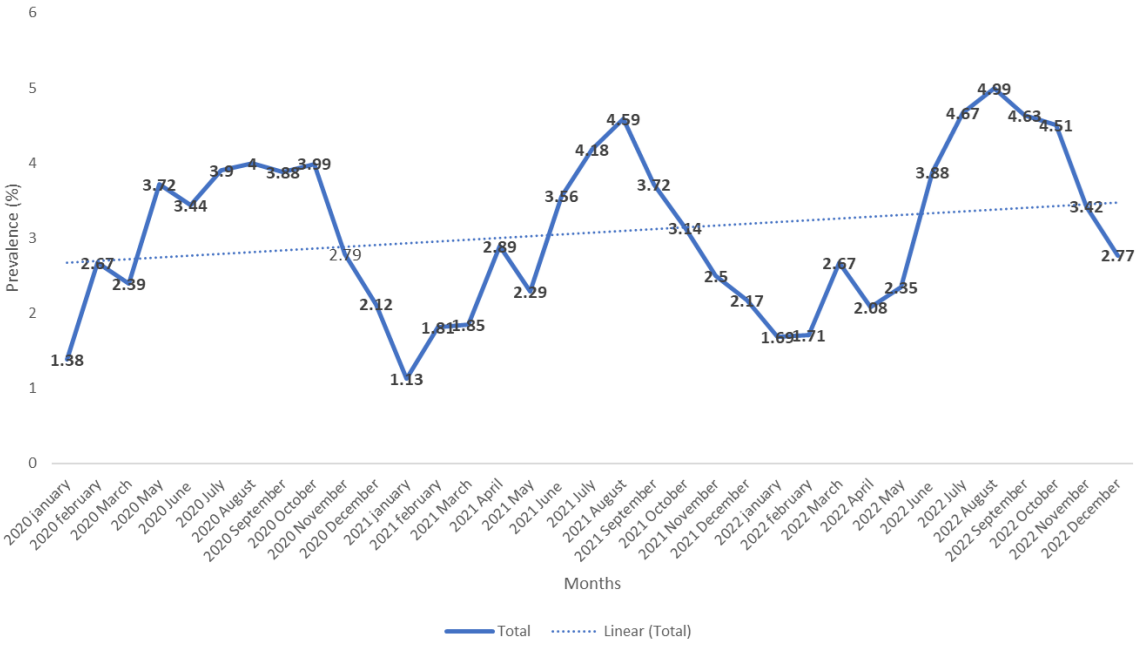

Figure 2: a three-year trend of bovine tuberculosis in slaughtered cattle in major abattoirs across States in Nigeria, 2020 to 2022

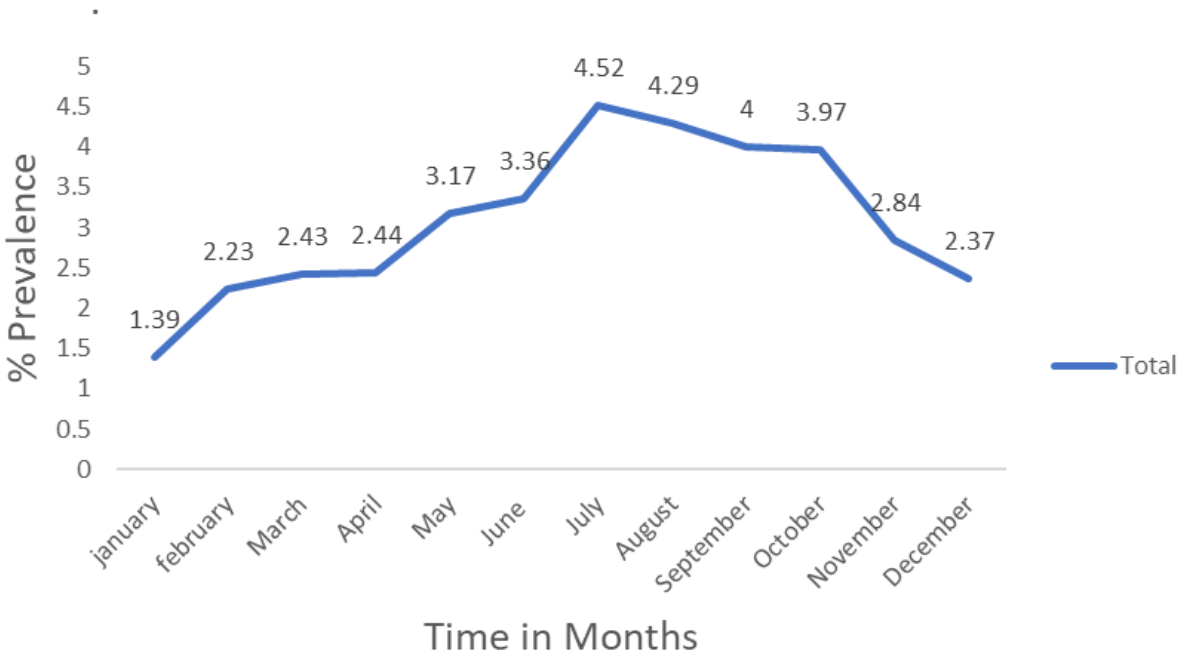

Figure 3: trend of seasonal prevalence of BTB in Nigeria showing peak prevalence in July, year 2020 to 2022

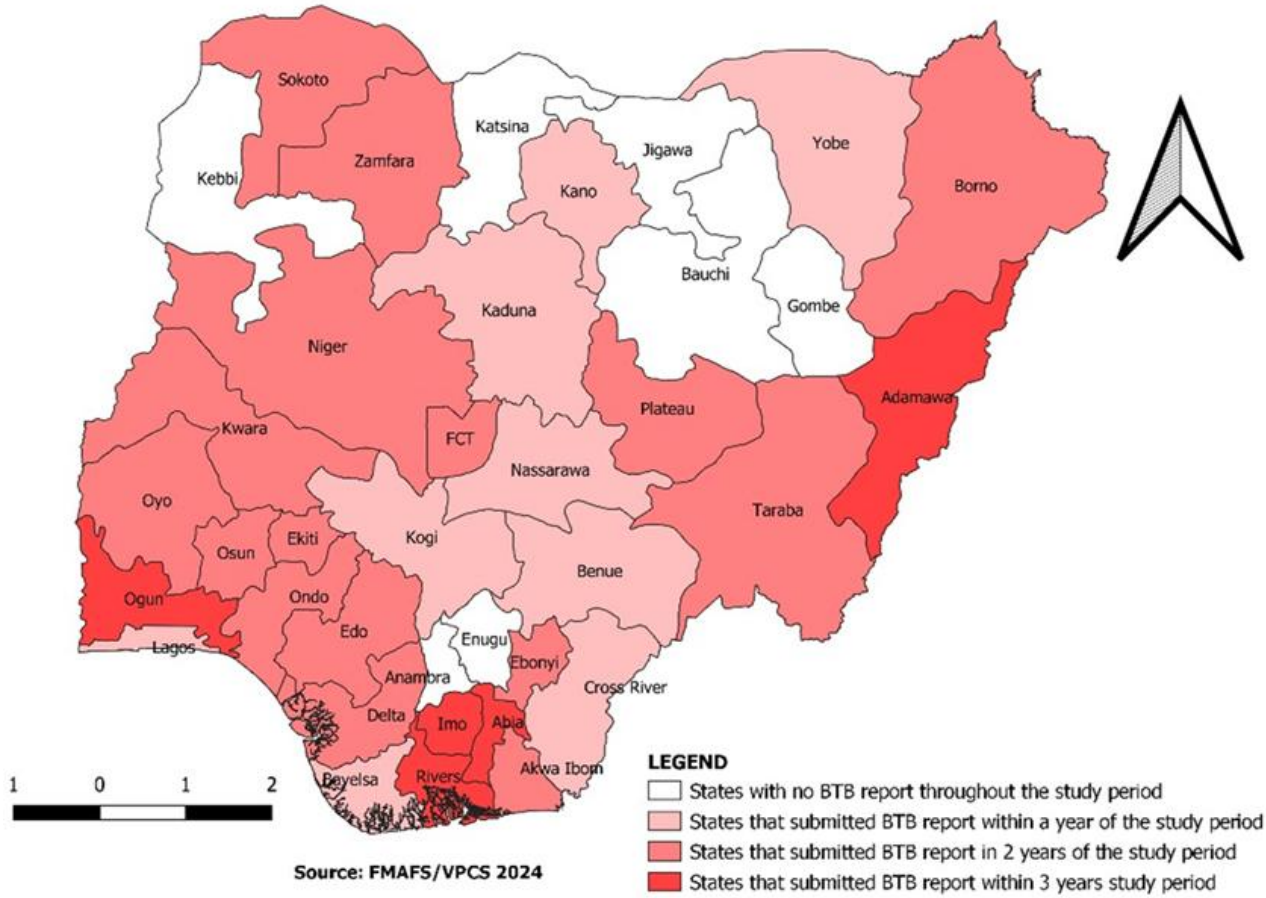

Figure 4: bovine tuberculosis reporting in Nigeria, year 2020 to 2022