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# Spatial-temporal Distribution of Tuberculosis Infections in Rivers State from 2009-2018

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## Abstract

***Background:*** *Tuberculosis has remained a disease of public health importance and one of the leading global public health problems. It accounts for more years of healthy potential life lost with a high case fatality rate. This study aims to determine the spatial-temporal distribution of tuberculosis infections in Rivers State from 2009-2018.*

***Methods:*** *It was an ecological time-series study of tuberculosis infections in the local government areas of Rivers State. Data were extracted from National Tuberculosis, Buruli ulcer, and Leprosy Control Programme Rivers state. ArcGIS Desktop version 10.5 was used for the spatial and spatial-temporal analyses. The temporal analysis was done using time series plots.*

***Results:*** *There were 22,446 cases of TB infections from January 2009-December 2018. Most of the cases were in the age group 25-34 years 5,436 (24.22%). TB incidence for all forms of TB was 287 per 100 000. The temporal trend of TB incidence in Rivers State showed an upward trend with two peaks in 2012 and 2018. The trend of HIV/TB co-infection had a peak in 2010 and 2014, between 2016 and 2017 it remained stationary and made a downward decline in 2018*

*However, the trend in the sex and age group showed an upward and downward trend at different times. There were consistently very high clusters of TB infections in 17% of the LGAs - Ahoada East, Khana, Obio/Akpor, and Port Harcourt LGAs and these clusters increased over the study period.*

***Conclusion:*** *There were very high clusters of Tuberculosis infections in 17% of the LGAs of Rivers State which include Ahoada East, Khana, Obio/Akpor, and Port Harcourt. There was an upward trend in TB infections within the study period. Therefore, there should be targeted interventions at these local government areas to help reduce the spread of Tuberculosis.*

***Keywords****: Tuberculosis, Spatial distribution, Temporal sequence, HIV infection, Case notification rate.*

## Introduction

Tuberculosis has been a disease of public health importance even in the 21st century[1]. It is one of the most serious global health issues that WHO in 1993 declared TB a global health emergency[2]. But to date, it is still the ninth leading cause of death worldwide[1]. It is projected that 5% to 15% of the general population would have tuberculosis[1].

The spread of TB is heterogeneous and unevenly dispersed in space and social networks. Spatial analysis shows these geographical variations in disease and the risk factors that may be responsible for these pattern[3].

Temporal analysis is a quantitative analysis of time-series data to detect any change in disease pattern overtime[4]

Globally, 10 million people were infected with TB and 1.4 million died in 2019[1]. The global tuberculosis infection is still increasing at the rate of 1% yearly and each day TB kills more than five thousand men, women, and children and leaves no country untouched[5]. Eight countries including Nigeria account for two-thirds of these cases[1]. The number of TB cases in Nigeria in 2016 was 219 per 100 000 making up 4% of the global total of TB cases[6]. Also, Nigeria was unable to meet up the 2015 stop TB target.

Studies done in various regions of the world showed areas of high TB clustering especially in the urban and rural areas with high populations, places with high migrants, and HIV infections[7,8,9]. In Nigeria, Clustering has been found in LGAs in Oyo state[10] and Kebbi state[11]. In a study done in Rivers State, the prevalence of TB infections was found to be increasing[12].

Moreover, much remains to be understood about the relationship between space and disease, and the spatial and temporal dynamics of tuberculosis infections in Rivers State. As it is one of the states in Nigeria with a high burden of HIV[13] and the ability to map spatial and temporal variation in disease risk is becoming very important given the rising burden of diseases in Africa. Moreover, the spatial targeting of intervention can achieve a major reduction in the disease burden and reduce spillover transmission from hotspots[14].

This information could be used to inform targeted TB public health responses, optimize implementation; and the progress made in the TB control programme could also be intensified by knowing the areas of TB clusters that this study aims to identify

The objective of this study was to determine the spatial and temporal distribution of tuberculosis infections in the local government areas of Rivers State 2009-2018.

## Methods

**Study Area**: Rivers State is one of the 36 states of Nigeria located in the south-south region of the country. It has a population of about 5,198,716 according to the 2006 census.

Its capital is Port Harcourt and it has 23 Local Government Areas (LGA) with 385 primary health centres, 23 general hospitals, and 2 teaching hospitals. It has urban, suburban and rural areas

**Study design**: It was an ecological time-series study of tuberculosis infections in Rivers State.

**Data Sources:** Data were obtained from the NTBLCP Rivers State from 2009-2018. Demographic data obtained from the National Population Census of 2006 for each 23 LGAs were projected from 2009-2018 using the growth rate for each year.

The projected population provided the denominator to calculate the TB case notification rates per 100,000 population for each LGA. A digitized map of the state

at the lowest administrative unit (LGAs) was used.

Analysis: for descriptive analyses – mean and standard deviation were used for continuous data while proportions and frequencies were used for categorical data. ArcGIS Desktop version 10.5 was used for spatial and spatial-temporal analyses. The temporal analysis was done using time series plots

**Ethical Clearance:** Ethical approval was obtained from the Research Ethics Committee of the University of Port Harcourt, Rivers State, Nigeria.

Permission was obtained from the National Tuberculosis, Buruli ulcer and Leprosy Control Programme River State; River State Ministry of Health.

**Results**

**Temporal trend**: A total of 22, 446 cases of TB were registered in Rivers State between 2009 and 2018. the total male TB cases were 11 663(57.3%), total female TB cases were 8674(42.7%).

Most of the cases were in the age group 25-34 years. 5, 436(24.22%). TB incidence for all forms of TB was 287 per 100 000. Table 1. TB CNR was less than 50/ 100 000 in most of the LGAs (8.24-42.08). The highest rates were in Obio/Akpor and Port Harcourt LGAs, and also in 2018.

Table 1. Summary of the incidence of Tuberculosis in Rivers State

| | |
|---|---|
| Total number of male TB cases | 11 663 (57.3%) |
| Total number of female TB cases | 8 674 (42.7%) |
| Total number of HIV positive cases | 5 651 (27.8%) |
| 0-4yrs | 643(2.86%) |
| 5-14 yrs | 639(2.85%) |
| 15-24 yrs | 2993(13.33%) |
| 25-34 yrs | 5436(24.22%) |
| 35-44 yrs | 4187(18.65%) |
| 45-54 yrs | 2276(10.14%) |
| 55-64 yrs | 1259(5.61%) |
| >- 65 yrs | 772(3.4%) |
| CNR range | 8.24-42.08 per 100 000 population |
| Total number of TB cases 2009-2018 | 22 446 |
| Total population of the state | 7 809 035 million |
| TB incidence | 287 per 100 000 |
| TB cases not classified in gender or age group | 2109 cases |

CNR -case notification rate

The temporal trend of TB incidence in Rivers State showed an upward trend with two peaks in 2012 and 2018.

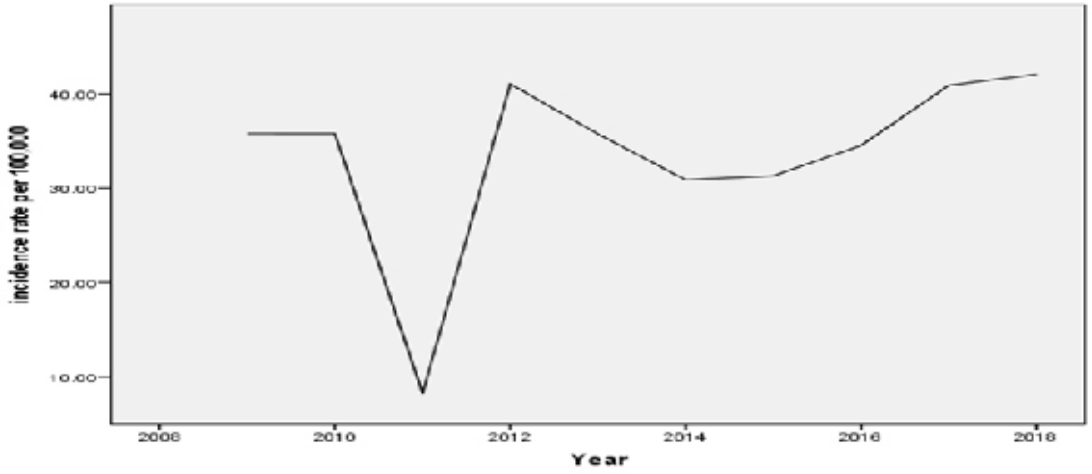


Fig 1. Temporal trend of TB cases by incidence rate in Rivers State from 2009 to 2018
The trend of HIV/TB co-infection had a peak in 2010 and 2014, between 2016 and 2017 it remained stationary and made a downward decline in 2018.

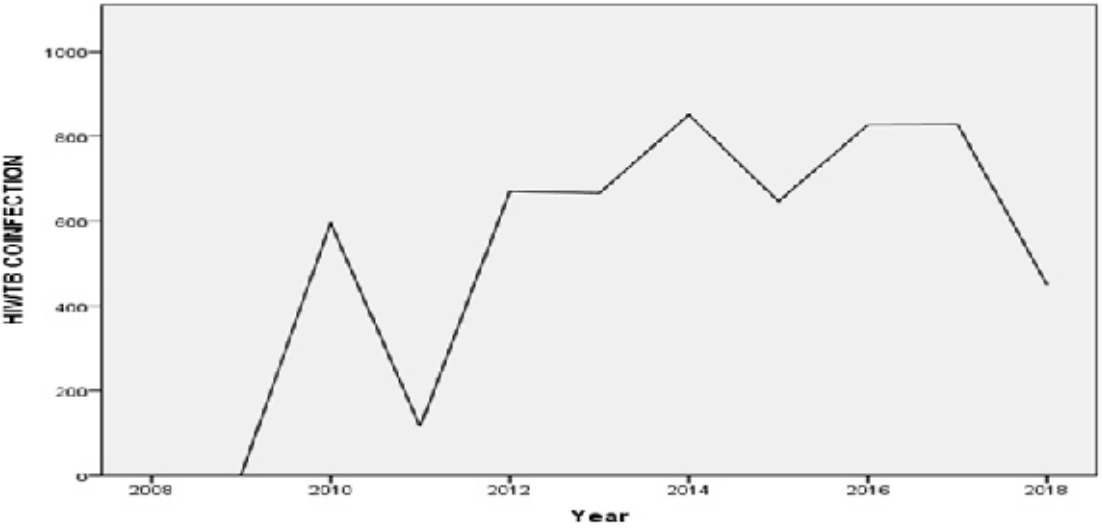


Fig 2. Temporal trend of TB cases by HIV/TB Co-infection in Rivers State from 2009 to 2018

However, trend in the sex and age group showed an upward and downward trend at different times.

**Spatial-temporal analyses:** Spatial-temporal clustering of TB over ten years (2009-2018) in Rivers State was consistently high in 17% of the LGAs of Port Harcourt, Obio/Akpo, Ahoada East, and Khana LGAs but consistently low clusters were found at Abual Odual, Ahoada West, Ogubolo, Akuku Toru, Andoni, Asari Toru, and Degema LGAs. The other 11 LGAs fluctuated between high and low clusters of TB infections over the years

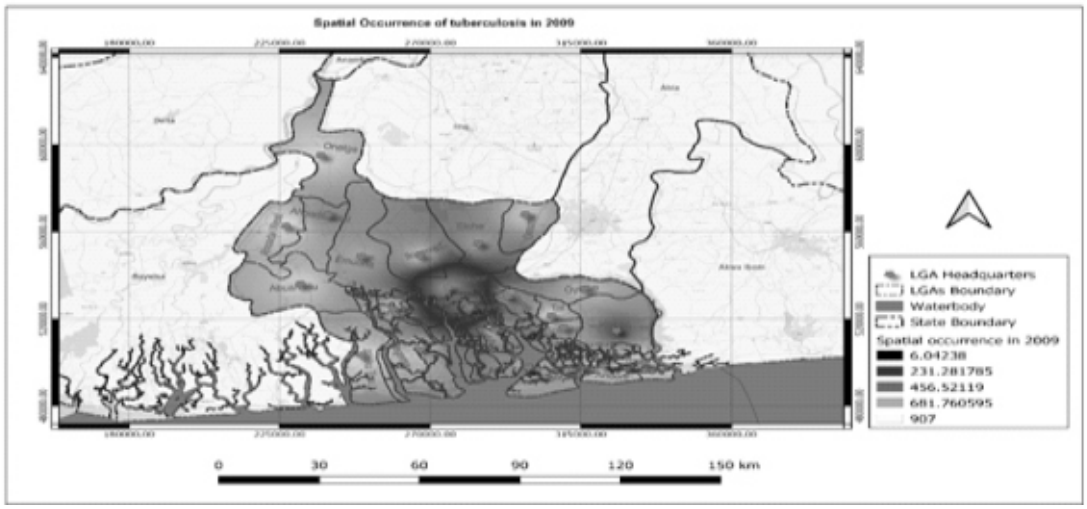


Fig 3. spatial-temporal clusters of TB infections in LGAs of Rivers State 2009

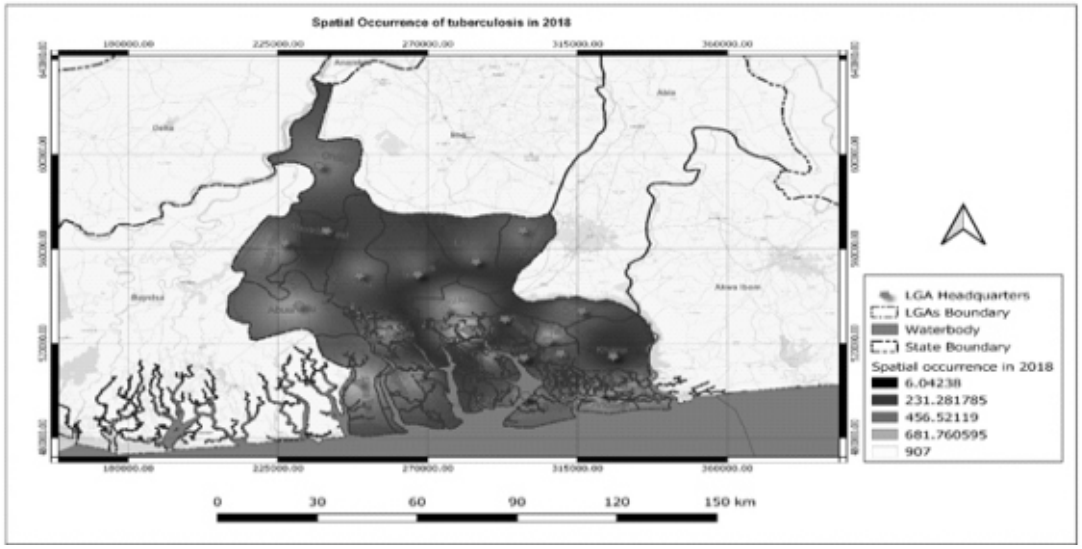


Fig 4. Spatial-temporal clusters of TB infections in the LGAs of Rivers State 2018

## Discussion

The outcome of the study showed that the incidence of tuberculosis was clustered by distribution and changed over time. This finding is consistent with the findings of Sa ad et al in a study carried out in Northwest Nigeria in 2015[15]. The temporal trend of TB incidence in Rivers State showed both upward trends with two peaks in 2012 and 2018. The finding was completely different from what was seen in a study in Lagos State which showed a consistent downward trend in the incidence of TB[16]. The observed difference might be related to the higher prevalence of HIV in Rivers State compared to Lagos State. However, the trend in the sex and age group showed an upward and downward trend at different times. These findings collaborate with that done in other studies on the temporal distribution of TB.[17,18]

The trend of HIV/TB co-infection had a peak in 2010 and 2014, between 2016 and 2017 it remained stationary and made a downward decline in 2018. This decline perhaps may have been as a result of

possible improvement to antiretroviral and isoniazid preventive therapy for people living with HIV/AID as recorded in a study in Zimbabwe.[19]

## Conclusion

The purpose of this research was to identify the spatial-temporal distribution of tuberculosis infections in Rivers State. Based on the analyses it could be stated that there are clusters of tuberculosis infections in LGAs of Rivers state that varied with location and time and are more pronounced among young people between 25-44 years of age. There is an upward trend in TB incidence in Rivers State. Therefore, with the appropriate approximation of diseases in the LGAs this study supports the need for the structuring of an LGA-based surveillance system and prioritization of population groups for further interventions.

**Key words**: Tuberculosis, Spatial distribution, Temporal sequence, HIV infection, Case notification rate

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