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MODELLING THE MORBIDITY PATTERN OF TUBERCULOSIS AND ITS ASSOCIATED FACTORS IN OYO STATE, NIGERIA

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Abstract

Background: With the advent of HIV, the risk of Tuberculosis (TB) has increased. The trend in the number of cases of TB in Oyo State over the past five years has not been documented. Hence, this study reviewed the number of cases of TB and determined some of its associated factors.
Materials and Methods: A retrospective analysis was conducted on TB surveillance data reported between January 1st 2011 and December 31st 2014. Data were obtained from the integrated disease surveillance and response (IDSR) of Oyo State Ministry of Health, Nigeria. Number of TB cases, age, local government areas (LGA), month and year of reporting was extracted. Data were analyzed using descriptive statistics, negative binomial and the Poisson regression models. Model fit was assessed using the AIC and the -2LogL.
Results: The incidence of TB was highest in 2013 (23 per 10000 population) in Ibarapa East LGA. The risk of Tuberculosis was 62.8% higher in 2014 (IRR = 1.628; 95%CI = 1.281, 2.068) and also 17% higher in 2012 (IRR = 1.170; 95%CI = 1.010, 1.356). Also, the risk of TB was highest in Ibarapa East LGA (IRR = 2.576; 95%CI = 1.945, 3.412) and lowest in Ogbomoso South LGA (IRR = 0.229; 95%CI = 0.069, 0.764). Adolescents and adults also had higher risk of TB compared to children.
Conclusion: The frequency of Tuberculosis declined overtime and older adults had a higher risk. The low frequency of TB in the state may be an indication and good evidence of concerted control measures. Efforts should be put in place to further bring down the number of cases especially in the identified hotspots.

Keywords: Tuberculosis, Morbidity pattern, Surveillance data, Oyo State.

List of Abbreviations: TB - Tuberculosis, LGA - Local Government Area, MDG - Millennium Development Goals, NTBLCP -National TB Leprosy Control Programme, DOTS - Directly Observed Treatment Short Course, IDSR - Integrated Disease Surveillance and Response, PHC - Primary Health Care, AIC - Akaike Information Criteria, -2LogL: - 2 Log Likelihood, IRR- Incidence rate ratio, WHO - World Health Organization.

Introduction

Tuberculosis (TB) remains a public health threat in both developed and developing countries. It is a chronic infectious disease with strong social determinants (Hargreaves et al., 2011; Maciel, 2012). Tuberculosis affects almost every organ in the body, but the usual site of the disease is the lungs, which accounts for more than 80 percent of cases (NTBLCP, 2004). Worldwide, TB is the second highest cause of mortality after HIV/AIDS (WHO, 2010). There were around 1.8 million TB-related deaths worldwide in 2003 and 1.45 million in 2010; majority of which occurred in the

developing countries in sub-Saharan Africa and Asia (WHO, 2009). Tuberculosis affects mainly the economically productive age group 15-54 years (WHO, 2004).
More than 2 billion people (about one-third of the world's population) are estimated to be infected with Mycobacterium tuberculosis with new infections occurring in about 1% of the population each year (WHO, 2009).

Globally, the incidence of TB was 9 million in 2005, and 8.8 million in 2010. Among the 15 countries with the highest estimated incidence rates of TB, 13 are in Africa which accounts for 31% of the global estimates. In addition, in the sub-Saharan region, HIV infection increases the risk of TB infection. Despite the decline in TB prevalence in the developed world, it remains a major cause of high morbidity and mortality in Nigeria (Chaulk and Kazandijian, 1998). Nigeria ranks fourth with the highest TB burden in the world and the highest in Africa (311 per 100,000) (WHO, 2012). In Nigeria, there were 33,000 deaths as a result of TB in 2009. Out of the 210,000 new cases of all forms of TB that occurred in 2010, Lagos, Kano and Oyo states had the highest rates (WHO, 2010).

The global aims and indicators for TB control have been developed within the framework of World Health Organization (WHO), Millennium Development Goals (MDGs), and Stop TB partnership. This framework aims to reduce the prevalence and death rates by half by 2015 and to halt its incidence (Bello, 2010). As part of control activities, the Federal Ministry of Health gave the mandate to control TB and leprosy in Nigeria by establishing the National Tuberculosis and Leprosy Control Programme (NTBLCP, 2005). The vision of the Programme is to eliminate TB while its goal is to reduce the burden of TB (to less than 1 case per million population) by year 2050.

Research has shown that females have a higher risk of developing TB than males (Holmes et al., 1998). A similar female preponderance has been reported in a Nigerian study (Frank-Peterside et al., 2012). Also, in Jigawa State, North-western part of the country, the prevalence of TB increased between 2009 and 2014 (Baba and Hincal, 2016). In addition, there have been studies on TB and gender disparity (Jumbo et al., 2013).

A strong association has been established between poverty and TB. Studies have shown that TB is high among individuals living in rural areas, those below the poverty line and also in economically-underprivileged countries (WHO, 2005; Legesse et al., 2010). Despite the huge resources allocated to eradicate the disease, problems such as late detection of cases as well as limited number of staffs still persist (Awofeso et al., 2008; Okuonghae and Omosigho, 2010). In Nigeria, patients do not engage in adequate healthcare-seeking behavior which may reduce the incidence of the disease. A major factor has been the lack of knowledge about the cause, symptoms and transmission of the disease (Lienhardt, 2001; Koay, 2004; Legesse et al, 2010;).

In a five-year review of TB mortality in Ile-Ife Nigeria, risk factors such as age, gender related disparities, occupation, HIV status, history of TB in the family, and number of people living in a house have been identified (Erhabor et al., 2006). Several studies have also reported the factors associated with the disease, knowledge of management (Adewole et al., 2010; Okuonghae and Omosigho, 2010; Olakunle et a.l, 2014; Agho et al., 2014; Ojiezeh et al, 2015) and treatment outcomes of TB patients (Ofoegbu and Odume, 2015). Despite all of these studies, there is still paucity of specific local data on the pattern and trend of TB occurrence in Nigeria. Therefore, this present study seeks to describe and model the pattern of morbidity as well as determine some of the factors associated with TB in Oyo State, South-Western Nigeria.

Materials and methods

Study Area

Oyo State, the second largest State in south-western Nigeria, has 33 Local Government Areas (LGAs) and a population of 6 million. It is mainly inhabited by the Yoruba ethnic group. The State has 1729 health facilities disaggregated into 712 Primary Health Centres (PHCs), 46 Secondary Health Facilities, 3 Tertiary Health Centres and 968 registered private health facilities. The climate is equatorial with dry and wet seasons and relatively high humidity.

Study Design

Tuberculosis surveillance data (2011 to 2014) was obtained from the Integrated Diseases Surveillance and Response (IDSR) of Oyo State Ministry of Health, Nigeria.

Study Population and Data Extraction

Outpatient and inpatient records from the health facilities in the 33 LGAs in Oyo state were used. Data were extracted and re-entered into an excel spreadsheet. A total of 4923 observations of TB cases were obtained. The explanatory variables used for the analysis were age of respondents, Local Government Areas (LGAs), month and year of reporting. Ethical approval was obtained from the Oyo State Research Ethical review committee on the 3rd October 2017, N0: AD 13/479/544.

Data Management

Descriptive statistics such as means and standard deviations (SD) were used to check the presence of under and over-dispersion. Frequency tables were used to describe the pattern of TB over the period of four years in the 33 LGAs. The Poisson and negative binomial regression models were fitted. The Poisson regression expresses the logarithm outcome rate as a linear function of a set of predictor variables. It makes an assumption that; for a sample of observations, the mean and the variance of the distribution are equal. A random variable X is said to have a Poisson distribution with parameter α if it takes integer values; 0, 1, 2 . . . ∞

The probability distribution is given as:

$$\Pr(X = x) = \frac{e^{-\alpha}\alpha^{x}}{x!}$$

With mean and variance expressed as: E(X) = α and Var (X) = α.

The negative binomial regression is a more generalized model than the Poisson regression with the assumption that the mean follows a gamma distribution with mean $E(\alpha_i) = \mu_i$ and $Var(\alpha_i) = \mu_i v_i^{-1}$. Consider the Poisson distribution $X_i \mid \alpha_i$ with a conditional mean $E(X_i \mid \alpha_i) = \alpha_i$, the marginal distribution can be shown to follow a negative binomial distribution (Farhana, 2013)

The probability density function of a negative binomial distribution is given as:

$$\Pr(X_i = x_i) = \frac{\Gamma(x_i + v_i)}{\Gamma(x_i + 1)\Gamma(v_i)} \left(\frac{v_i}{v_i + \mu_i}\right)^{v_i} \left(\frac{\mu_i}{v_i + \mu_i}\right)^{x_i}$$

Where, mean = $E(X_i) = \mu_i$ and variance = $Var(X_i) = \mu_i + \mu_i^2 v_i^{-1}$, v is the dispersion parameter.

The Poisson and negative binomial models were fitted and compared and the best was selected using the Akaike criteria (AIC) and -2logL. Incidence rate ratios (IRR), 95%CI and their p-values were reported.

Results

The total number of TB cases reported between 2011 and 2014 was 4,923 with the highest cases (1,737) reported in 2012 (Mean =5.09, variance = 48.05) and lowest (521) in 2014. (Mean =5.11, variance = 38.81). Table 1 shows the descriptive statistics of the number of cases of TB. The number of cases increased from 1159 in 2011 to 1737 in 2012. There was a decrease to 1506 in 2013 and a further decline to 521 in 2014. About 37% of TB cases were among those aged 20- 40 years, 34% among those above 40 years of age and 5% among under-five children. (Figure 1). There were more cases of TB in April, 2013 (312) and lesser number of cases (47) was reported in February, 2011. (Figure 2). The highest incidence of 23 per 10000 population was recorded in Ibarapa East LGA (2013) and the lowest was found in Orelope LGA (2013). (Table 2).

Table 1: Descriptive Statistics of Number of TB cases in Oyo state by Year.

Year	No of observations	Mean	Variance	Range	No of TB cases
2011	241	4.81	45.10	59	1159
2012	341	5.09	48.05	61	1737
2013	236	6.38	58.33	35	1506
2014	102	5.11	38.81	29	521
Total	920	5.35	49.12	61	4923

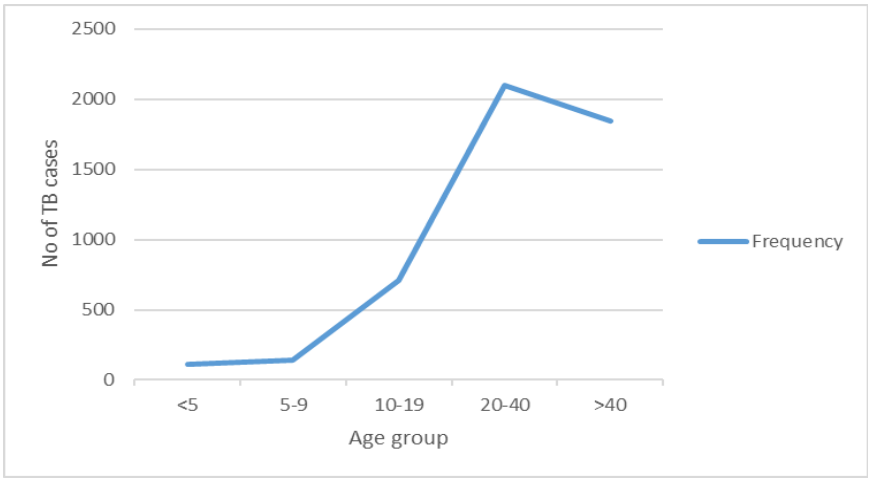

Figure 1: Number of TB cases in Oyo state disaggregated by Age group.

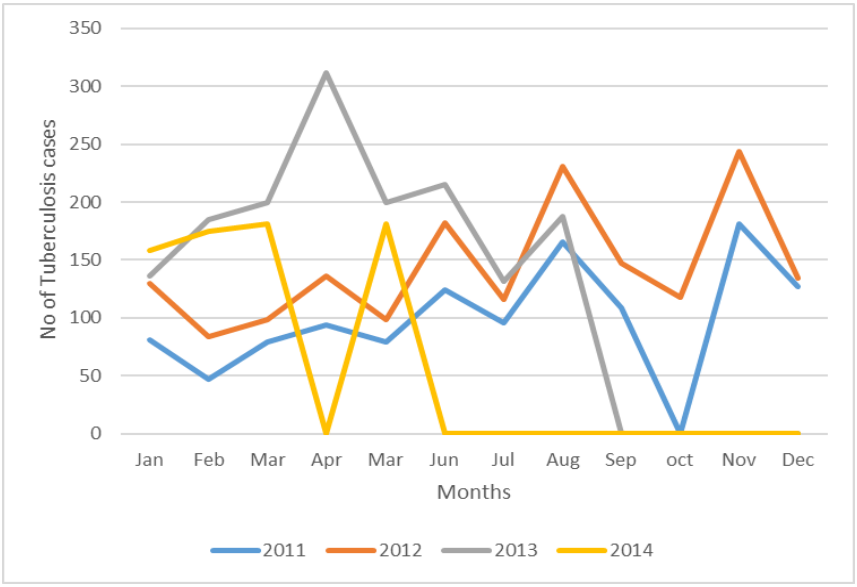

Figure 2: Trends in the Number of TB cases in Oyo State, disaggregated by month and year.

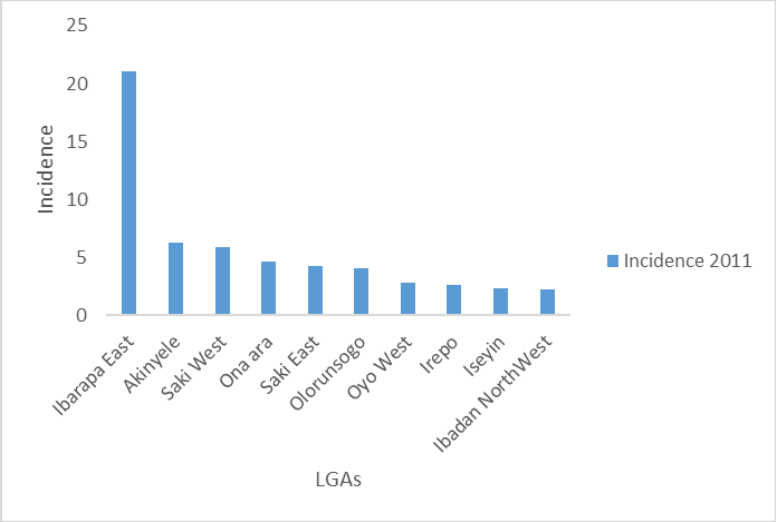

Figure 3: TB Incidence in Ten high- burden LGAs, 2011

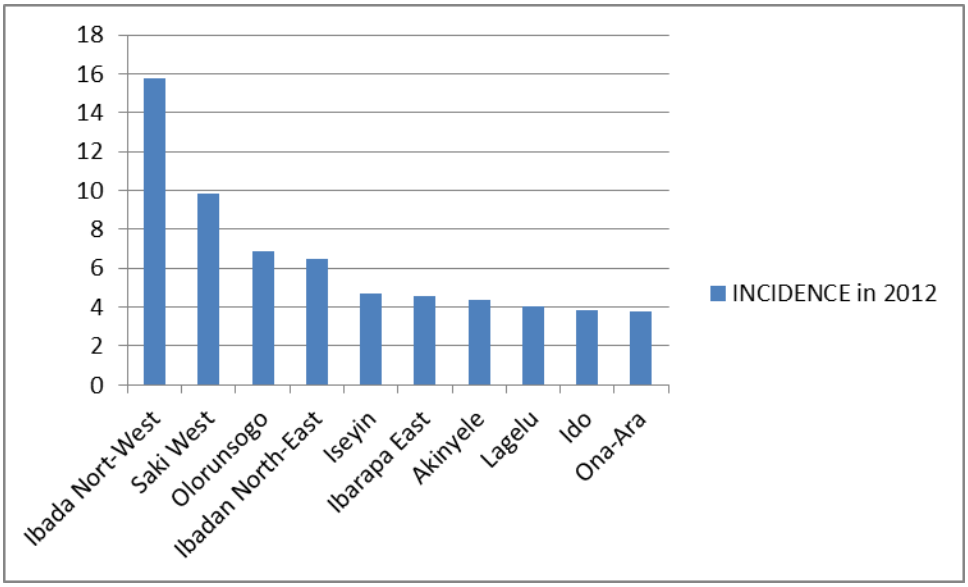

Figure 4: TB Incidence in Ten high- burden LGAs, 2012

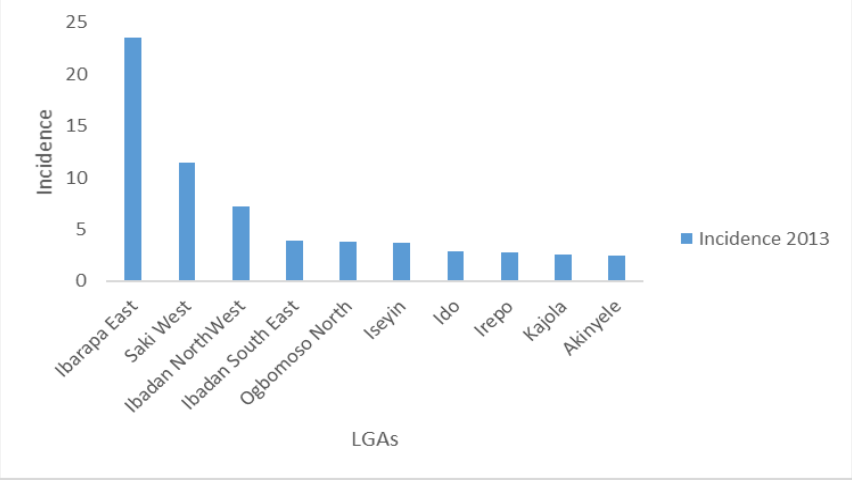

Figure 5: TB Incidence in Ten high- burden LGAs, 2013.

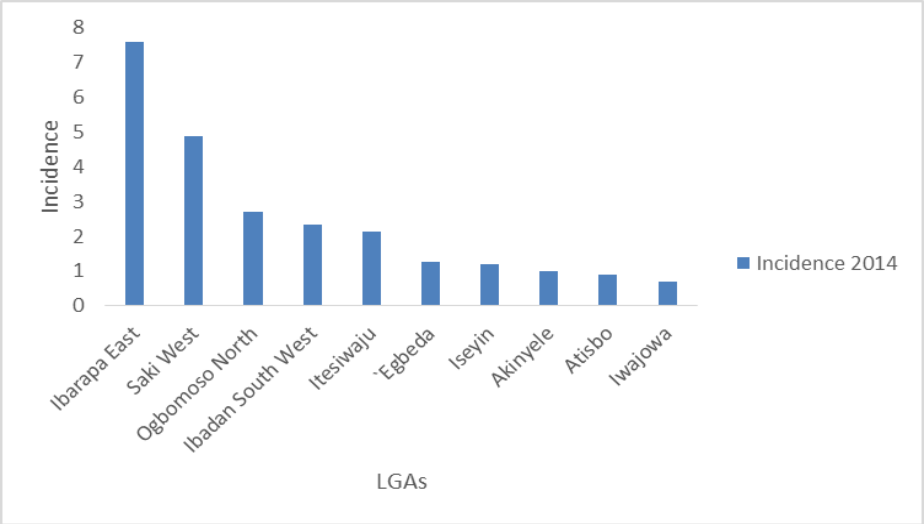

Figure 6: TB Incidence in Ten high- burden LGAs, 2014.

From the Poisson regression model, the incidence of TB was 51.7% higher in 2014 (IRR = 1.517; 95%CI = 1.337, 1.721) and 18.1% higher in 2012 (IRR = 1.181; 95%CI = 1.091, 1.278) compared to the incidence in 2011.

The incidence of TB was two times higher in Ibarapa East LGA (IRR = 2.779; 95%CI = 2.416, 3.197) compared to Akinyele LGA. Ibadan North-east LGA had 95.3% higher incidence (IRR = 1.953; 95%CI = 1.675, 2.277) while Ogbomoso South LGA (IRR = 0.221; 95%CI = 0.082, 0.594) had a lower risk of TB compared to Akinyele LGA.

The incidence of TB was about three times higher among children 10-19 years (IRR = 2.561; 95%CI = 1.357, 4.833) compared to children 0-28 days. Adults older than 40 years (IRR = 2.534; 95%CI = 1.343, 4.783), also had a higher risk of TB. However, children 1-11 months (IRR = 0.627; 95%CI = 0.296, 1.328) had a lower risk of TB compared to children 0-28 days (Table 3).

From the negative binomial regression model, TB incidence was 62.8% higher in 2014 (IRR = 1.628; 95%CI = 1.281, 2.068) and 17% higher in 2012 (IRR = 1.170; 95%CI = 1.010, 1.356) compared to the incidence in 2011. The incidence of TB was about three times higher in Ibarapa East LGA (IRR = 2.576; 95%CI = 1.945, 3.412) and Ibadan North-East LGA (IRR = 2.094; 95%CI = 1.525, 2.875) compared to Akinyele LGA. Also, Saki West LGA had 78.4% increased risk of TB (IRR = 1.784; 95%CI = 1.394, 2.284) while Atisbo LGA (IRR = 0.224; 95%CI = 0.120, 0.421) and Ogbomoso South LGA (IRR = 0.229; 95%CI = 0.069, 0.764) had the least risks compared to Akinyele LGA.

Tuberculosis risk was about three times higher among children 10-19 years (IRR = 2.828; 95%CI = 1.101, 7.267) and adults older than 40 years (IRR = 2.732; 95%CI = 1.063, 7.018) compared to children 0-28 days (Table 4).

The negative binomial regression model had the smallest AIC and -2logL values (4654.704 and 4552.704 respectively) compared to the Poisson regression model (6072.026, 5972.026 respectively) which indicates superiority over the Poisson regression model (Table 5).

Table 2: Incidence of TB in Oyo state by LGA-Year

LGA	Population	Incidence2011(95% CI)	Incidence2012 (95% CI)	Incidence2013(95% CI)	Incidence2014(95% CI)
Akinyele	211,359	6.29 (5.22,7.36)	4.40(3.51,5.29)	2.41(1.75,3.08)	0.99(0.57,1.42)
Atiba	169,702	0.24(0.004,0.467)	0	0	0.41(0.11,0.72)
Atisbo	110,792	0.36(0.01, 0.71)	0.27(-0.04,0.58)	0	0.90(0.34,1.46)
`Egbeda	319,388	0	0.44(0.21,0.67)	2.41(1.87,2.95)	1.28(0.89,1.68)
Ibadan North	856,988	0.27(0.16,0.38)	1.61(1.34,1.88)	1.18(0.94,1.41)	0.04(-0.01,0.07)
Ibadan Northeast	330,399	0.91(0.58,1.23)	6.45(5.58,7.31)	0.85(0.53,1.16)	0.09(-0.01,0.19)
Ibadan NorthWest	152,834	2.29(1.53,3.05)	15.77(13.78,17.76)	7.20(5.85,8.54)	0
Ibadan South East	266,457	0.56(0.28,0.85)	1.01(0.63,1.40)	3.94(3.19,4.69)	0
Ibadan South West	283,098	0.07(-0.03, 0.17)	0.81(0.48,1.14)	0	2.33(1.77,2.89)
Ibarapa Central	116,809	0	0.17(-0.07,0.41)	0.60(0.16,1.04)	0
Ibarapa East	118,288	21.05(18.44,23.66)	4.57(3.35,5.78)	23.50(20.74,26.26)	7.61(6.04,9.18)
Ido	117,129	1.11(0.51,1.71)	3.84(2.72,4.96)	2.82(1.86,3.78)	0.26(-0.03,0.55)
Irepo	139,012	2.59(1.74,3.44)	3.09(2.17,4.02)	2.73(1.86,3.60)	0.50(0.13,0.88)
Iseyin	260,000	2.38(1.79, 2.98)	4.73(3.89,5.57)	3.65(2.92,4.39)	1.19(0.77,1.61)
Itesiwaju	145,920	1.03(0.51,1.55)	2.47(1.66,3.27)	1.17(0.61,1.72)	2.12(1.38,2.87)
Iwajowa	287,221	0.56(0.28,0.83)	0.73(0.42,1.04)	0.31(0.11,0.52)	0.70(0.39,1.00)
Kajola	139,412	1.72(1.03,2.41)	3.37(2.41,4.34)	2.58(1.74,3.43)	0.50(0.13,0.87)
Lagelu	147,957	1.35(0.76,1.94)	4.06(3.03,5.08)	0.41(0.08,0.73)	0
Ogbomoso North	113,853	1.32(0.65,1.98)	6.06(4.63,7.49)	3.78(2.64,4.91)	2.72(1.76,3.68)
Ogbomoso South	73,939	0.27(-0.10,0.65)	0.27(-0.10,0.65)	0	0
OgoOluwa	225,561	0.27(0.05,0.48)	0.58(0.26,0.89)	0.22(0.03,0.42)	0.09(-0.03,0.21)
Olorunsogo	92,739	4. 10(2.79,5.40)	6.90(5.21,8.59)	0.97(0.34,1.60)	0
Oluyole	734,377	1.02(0.79,1.25)	0.34(0.21,0.47)	1.53(1.24,1.81)	0
Onaara	118,465	4.64(3.42,5.87)	3.80(2.69,4.91)	0	0
Orelope	300,659	0.53(0.27,0.79)	0	0.03(-0.03,0.10)	0.07(-0.03,0.16)
Oyo East	118,465	0.51(0.10,0.91)	0.25(-0.03,0.54)	0.25(-0.03,0.54)	0.68(0.21,1.14)
Oyo West	154,532	2.78(1.95,3.61)	3.24(2.34,4.13)	0.45(0.12,0.79)	0
Saki East	125,026	4.24(3.10,5.38)	0.48(0.10,0.86)	0.64(0.20,1.08)	0
Saki West	278,002	5.94(5.03,6.84)	9.86(8.69,11.02)	11.44(10.18,12.70)	4.89(4.07,5.71)
Surulere	126,692	0.32(0.01,0.63)	0.24(-0.03,0.50)	0.71(0.25,1.17)	0.16(-0.06,0.38)

Incidence is per 10000 population

Table 3: Parameter Estimates of the Poisson Regression

Parameters	**Coefficient**	**IRR**	**95%CI for IRR**		**P-value**
			Lower bound	**Upper bound**	
2011*					
2012	0.167	1.181	1.091	1.278	<0.001
2013	0.325	1.384	1.273	1.505	<0.001
2014	0.417	1.517	1.337	1.721	<0.001
Akinyele*					
Atiba	-0.533	0.587	0.320	1.078	0.086
Atisbo	-1.502	0.223	0.136	0.364	<0.001
Egbeda	-0.140	0.869	0.705	1.071	0.187
Ibadan North	0.430	1.537	1.300	1.817	<0.001

Ibadan North East	0.418	1.953	1.675	2.277	<0.001
Ibadan North west	0.669	1.519	1.287	1.793	<0.001
Ibadan South East	-0.300	0.741	0.607	0.904	0.003
Ibadan South West	0.455	1.576	1.236	2.008	<0.001
Ibarapa Central	-1.013	0.363	0.186	0.707	0.003
Ibarapa East	1.022	2.779	2.416	3.197	<0.001
Ido	-0.735	0.480	0.380	0.606	<0.001
Irepo	-0.232	0.793	0.642	0.978	0.031
Iseyin	0.354	1.425	1.213	1.674	<0.001
Itesiwaju	-0.754	0.470	0.374	0.591	<0.001
Iwajowa	-1.030	0.357	0.273	0.467	<0.001
Kajola	-0.865	0.421	0.339	0.523	<0.001
Lagelu	-0.344	0.709	0.556	0.904	0.005
Ogbomoso North	-0.330	0.719	0.592	0.873	0.001
Ogbomoso South	-1.509	0.221	0.082	0.594	0.003
OgoOluwa	-1.029	0.358	0.239	0.535	<0.001
Olorunsogo	0.410	1.507	1.206	1.882	<0.001
Oluyole	0.531	1.700	1.421	2.034	<0.001
Onaara	-0.666	0.936	0.743	1.178	0.571
Orelope	-0.365	0.694	0.435	1.108	0.126
Oyo East	-0.873	0.418	0.265	0.658	<0.001
Oyo West	-0.192	0.826	0.655	1.040	0.104
Saki East	0.173	1.017	0.777	1.332	0.900
Saki West	0.609	1.838	1.611	2.097	<0.001
Surulere	-1.352	0.259	0.161	0.417	<0.001
Jan*					
Feb	-.0418	0.959	0.850	1.082	0.495
Mar	-0.026	0.974	0.834	1.138	0.743
Apr	-0.419	0.658	0.578	0.749	<0.001
May	-0.535	0.586	0.516	0.665	<0.001

Jun	-0.535	0.586	0.511	0.672	<0.001
Jul	-0.253	0.776	0.686	0.878	<0.001
Aug	-0.377	0.686	0.604	0.778	<0.001
Sep	-0.317	0.728	0.632	0.839	<0.001
Oct	0.078	1.081	0.944	1.239	0.259
Nov	-0.541	0.582	0.473	0.715	<0.001
Dec	-0.370	0.691	0.591	0.807	<0.001
Age					
0-28*Days					
1-11 months	-0.467	0.627	0.296	1.328	0.223
12-59 months	0.429	1.536	0.811	2.908	0.188
5-9 yrs	-0.407	0.666	0.340	1.304	0.236
10-19yrs	0.940	2.561	1.357	4.833	0.004
20-40yrs	-0.189	0.828	0.430	1.594	0.573
>40 yrs	0.930	2.534	1.343	4.783	0.004

*****reference

Table 4: Parameter Estimates of the Negative Binomial Regression

Parameters	**Coefficient**	**IRR**	**95% CI for IRR**		**P-value**
			Lower bound	**Upper bound**	
2011*					
2012	0.157	1.170	1.010	1.356	0.037
2013	0.331	1.392	1.183	1.639	<0.001
2014	0.487	1.628	1.281	2.068	<0.001
Akinyele*					
Atiba	-0.512	0.599	0.239	1.502	0.275
Atisbo	-1.494	0.224	0.120	0.421	<0.001
Egbeda	-0.177	0.838	0.582	1.206	0.341
Ibadan North	0.468	1.597	1.152	2.214	0.005
Ibadan North East	0.739	2.094	1.525	2.875	<0.001
Ibadan North west	0.385	1.469	1.064	2.028	0.019
Ibadan South East	-0.340	0.712	0.506	1.001	0.051
Ibadan South West	0.366	1.442	0.875	2.374	0.151
Ibarapa Central	-1.023	0.359	0.145	0.893	0.028
Ibarapa East	0.946	2.576	1.945	3.412	<0.001
Ido	-0.723	0.485	0.337	0.699	<0.001
Irepo	-0.245	0.783	0.549	1.117	0.177
Iseyin	0.378	1.459	1.074	1.984	0.016

Itesiwaju	-0.733	0.481	0.338	0.683	<0.001
Iwajowa	-1.015	0.362	0.246	0.533	<0.001
Kajola	-0.826	0.438	0.314	0.609	<0.001
Lagelu	-0.384	0.681	0.463	1.002	0.051
Ogbomoso North	-0.325	0.722	0.521	1.001	0.051
Ogbomoso South	-1.474	0.229	0.069	0.764	0.016
OgoOluwa	-0.990	0.372	0.211	0.653	0.001
Olorunsogo	0.525	1.690	1.082	2.6s41	0.021
Oluyole	0.518	1.678	1.170	2.408	0.005
Onaara	-0.0004	0.999	0.679	1.472	0.998
Orelope	-0.286	0.751	0.375	1.505	0.420
Oyo East	-0.868	0.420	0.222	0.794	0.008
Oyo West	-0.139	0.870	0.590	1.283	0.483
Saki East	0.152	1.164	0.706	1.919	0.552
Saki West	0.579	1.784	1.394	2.284	<0.001
Surulere	-1.295	0.274	0.149	0.503	<0.001
Jan*					
Feb	-0.059	0.943	0.728	1.221	0.655
Mar	0.041	1.042	0.755	1.438	0.802
Apr	-0.516	0.597	0.458	0.778	<0.001
May	-0.617	0.539	0.420	0.692	<0.001
Jun	-0.564	0.569	0.436	0.742	<0.001
Jul	-0.329	0.719	0.559	0.925	0.010
Aug	-0.433	0.649	0.505	0.833	0.001
Sep	-0.429	0.651	0.492	0.861	0.003
Oct	0.034	1.035	0.776	1.379	0.815
Nov	-0.530	0.589	0.405	0.856	0.006
Dec	-0.349	0.705	0.523	0.951	0.022
0-28* days					
1-11months	-0.331	0.718	0.237	2.178	0.558
12-59 months	0.555	1.742	0.673	4.505	0.252
5-9 years	-0.157	0.855	0.315	2.317	0.758
10-19 years	1.040	2.828	1.101	7.267	0.031
20-40 years	0.044	1.045	0.395	2.767	0.929
>40 years	1.005	2.732	1.063	7.018	0.037

*****reference

Table 5: Model Comparison

Model	No of Observations	DF	AIC	-2logL
Poisson Regression	920	50	6072.026	5972.026
Negative Binomial Regression	920	51	4654.704	4552.704

Discussion

Prior to 2012, national estimates of TB incidence were unavailable as it will require long-term planning, large cohorts of people and several resources (WHO, 2015a). However, in 2012, Nigeria conducted the first national TB prevalence survey. The survey provided direct estimates of the burden of TB as against the indirect estimates previously reported by WHO based on surveillance data which had its antecedent challenges (NTBLCP, 2012). This analysis presents the estimates and pattern of TB disease burden between 2011 and 2014 in the 33 LGAs of Oyo state.

Although TB remains a global public health problem, its incidence in Nigeria particularly in Oyo state appears to be decreasing. This reduction in the burden may not be unconnected to the national and international efforts in decreasing the burden of the disease in order to achieve the Millennium development goals (MDG) set for 2015.

Also, "The Stop TB Strategy" was another approach recommended by WHO to reduce the burden of TB in line with global targets set for 2015. The post 2015 global strategy has the vision to stop TB and have zero deaths, reduce disease and suffering and the ultimate goal is to end the global TB epidemic (WHO, 2014).

Our results showed that the highest incidence was recorded in the year 2013 in Ibarapa East. However, this result is much lower than the one reported in the 2012 prevalence survey. It is also lower than the estimate for SW Nigeria (71 per 100000) as well as in the northern geopolitical zones (WHO, 2012). The South East zone had the lowest case notification of 41 per 10000. Incidences in subsequent years and in the 33 LGAs in the state were also lower than the 2012 survey reports. The low incidence in these LGAs may also be partly due to the more extensive DOTS programs in the LGAs.

Our findings further showed that the incidence of TB was higher in adults than in the younger ages, the age group 20 to >40yrs carrying the highest burden of the disease. This group represents the productive workforce and the TB control program should increase measures to combat or control TB among them so as to halt transmission in the community. This age differential in TB is not unexpected as this is in line with the epidemiology of the disease. This finding is also in conformity with the 2012 prevalence survey (WHO, 2014). The finding of a low occurrence of TB in children 0 to 28days is also in conformity with the epidemiology of the disease. Despite the overall decrease by year, there was however an increase in number of cases as age increases. This finding was similar to the reports from Cambodia where prevalence of TB also increased with increasing age (Mao et al., 2012). This is in contrast with the observation of Nwachokor and Thomas, in a study conducted at the University College Hospital, Ibadan (Nwachokor and Thomas, 2000). It was observed that TB infection was predominant in individuals below 40 years of age. Fahrettin *et al*, also observed a mean age of 32.5 years in an evaluation of TB treatment outcomes among PTB patients in Turkey (Fahrettin et al., 2008).

Out of the 33 local government areas (LGAs) in Oyo state, only 31 LGAs had reported cases of tuberculosis between 2011 and 2014, hence, there were no cases of TB in Ibarapa North LGA and Oriire LGA during these periods. Although it is essential to focus on TB control in general, it is also important to identify such "hot spots" such as Ibarapa East LGA so that special considerations can be given to them. The regression analysis further showed that older adults had a higher risk than the younger ones. This finding is consistent with reports from different countries (WHO, 2014).

Conclusion

This analysis and review of TB cases marks an important landmark in TB monitoring in the state. Our results suggest that TB still remains a significant public health problem in the state although a reduction in incidence has been observed. Despite the activities of the DOTS since 1993 and the WHO STOP TB strategy since 2006, it appears that the services may not have penetrated some communities. We have identified areas (LGAS) where efforts can be strengthened. Oyo state is 'doing' well in terms of the 2025 milestones of the post 2015 global strategy; one of which is the 75% reduction in TB deaths and also 50% reduction in TB incidence (i.e. less than 55 cases per 100000 population) i.e. halving the rate of TB which has been met in 11 high-burden countries (Brazil, Cambodia, China, Ethiopia, India, Myanmar, Pakistan, the Philippines, Uganda, Vietnam and Zimbabwe (WHO, 2015b). The incidence in our surveillance data is lower than the 55/100000 population recommended. However, our design does not allow us to draw conclusions about the cause of this decline.

Recommendations: We recommend national population-based surveys to complement surveillance data so as to be able to accurately estimate the disease burden, and address the problem of TB. Such efforts may ultimately lead to the end of a deadly and costly disease.

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