Trends in Lassa Fever Outbreak in Plateau State Nigeria

Elizabeth O. Okoh, Simji S. Gomerep, Esther A. Envuladu, Yetunde O. Tagurum, Adokole F. Okoh, Amina Mohammed, Ayuba I. Zoakah

ABSTRACT

Background: Since the first case of Lassa fever was reported in Plateau State, Nigeria in 1969, several outbreaks have occurred, and many more cases are being reported every year. This study aimed to describe the trends in Lassa fever outbreak in Plateau State, Nigeria from 2015 to the first half of 2019.

Methodology: A time series study was carried out employing a retrospective analysis of records of Lassa fever cases (from January 2015 – June 2019) obtained from Plateau State Epidemiological Unit. Cases were identified using the WHO case definition. Age-adjusted cumulative incidence, case positivity and case fatality rates were calculated for each year to study the trends. Data were retrieved and analyzed using Microsoft Excel.

Results: Cases were mainly of the younger age group and were more concentrated in the Northern senatorial zone. Despite the increasing trend in incident cases from 5 in 2015 to 126 in 2019, and age-adjusted cumulative incidence from 1 case per 10,000 population in 2015 to 348 per 10,000 population in 2019, case fatality rate showed a downward trend from 29.6% in 2016 to 12.9% in 2019. Case positivity rates varied from 27.3% to 34.1% to 19.4% and back to 27.3% from 2016 to 2019, and the cumulative Case Positivity Rate was 25.7%.

Conclusion: The incidence of Lassa fever in Plateau State showed an increasing trend while that of mortality was on a downward trend. More efforts should be put in place by the State government and other stakeholders to reduce the burden of this disease.

Keywords: Lassa fever, trends, outbreak, Plateau state.

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I. INTRODUCTION

Lassa fever is an acute viral haemorrhagic fever caused by Lassa virus, a single stranded RNA virus from the family *arenaviridae* [1]. It is a highly infective zoonotic infection that is transmitted to man primarily by the reservoir multimammate rat, *Mastomys natalensis* species, through its faecal or urine contamination of food and drinks. Secondary human to human transmission of the virus is also common with potential for nosocomial outbreak [2]. About 80% of infected individuals are asymptomatic [3]. Symptomatic patients however, show non-specific symptoms which makes clinical diagnosis difficult especially at the early phase of the disease. More severe disease may present with symptoms like haemorrhage, hearing loss, tremors and encephalitis [2].

Since Lassa fever was first discovered in 1969 in Lassa, Borno State, Nigeria. It has remained endemic in some parts of West Africa (including Sierra Leone, Liberia, Guinea, and Nigeria) and flares up in epidemics [1]. Epidemics usually occur during the late rainy seasons and dry seasons in these areas. A number of Lassa fever outbreaks have been reported in various parts of Nigeria especially in the three disease-endemic zones: the northeastern region around Lassa, the central region around Jos, and the southern region around Onitsha [4]. Due to the increasing upsurge of Lassa fever outbreak in Nigeria which is spilling over across many West African countries, it is projected that up to 2 - 3 million cases and between 5,000 and 10,000 deaths may occur every year across the region [3].

Lassa fever (LF), mainly a disease of West Africa where the rodent population is high, has been reported virtually in most regions of the world. It occurs sporadically in other parts of the world mostly as a result of case importation from West African countries and incidence remains low in these regions [5]. Its incidence ranges from 1.8% in developed to 55% in developing countries [6]. In the West African sub-region, Lassa fever affects approximately 100,000 persons per year [6]. The incidence of the disease varies depending on the location and endemicity. The Lassa virus-specific seroconversion incidence ranges from 5% to 20% in the non-immune population yearly [3]. The prevalence of Lassa antibodies has also been found to be 7% in Guinea and 15–20% in Sierra Leone and Liberia, and over 20% in Nigeria [7]. Other countries that have reported outbreaks of the disease in the last decade include Mali, Central African Republic, Republic of Benin, Ghana, Togo, and Burkina Faso [7]. In Mali, incidence rate for 2016 was found to be 6.3% [8]. Although 20 out of 100 infected individuals develop severe or systemic disease, on the average, death rate is 1% in the general population but ranges from 15–20% among hospitalized patients in West Africa [7]. When hospital acquired outbreaks occur, death rates could be as high as 36% to 65% [3].

Over the years, Nigeria has experienced variation in the trends of LF outbreak.⁹ Between 1969 and 1980, ten cases of LF were recorded in Nigeria out of which eight were from Plateau State and the first was from Borno State in Lassa town. Between 1980 and 2000, Aba and Edo recorded most cases with Edo alone recording over 70% of cases [3]. However, since 2000 till date many more States in Nigeria have had records of the epidemic with some States including Plateau experiencing outbreaks every year [3]. A gradual decline in number of reported cases was observed nationally from 1723 in 2012 to 1191 suspected cases in 2013 [10], 990 cases in 2014 [10], and 430 in 2015. The number of cases rose to 921 cases in 2016 [11] but decreased to 733 cases in 2017 [11]. Since 2017, many more cases have been reported. The number of cases rose to 3498 in 2018 and then to 5057 in 2019 and 6791 in 2020 [12].

There seems to be a widening geographical spread and increasing endemicity of the disease across the country, with increasing incident cases of nosocomial infections [3], [13]. In recent times, LF has spread to over 27 States of the Federation and Plateau State remains one of the worst affected states [12]. Case Fatality Rate (CFR) has also been on the gradual rise as it was 2.9% in 2013 [10], 3.6% in 2014 [10], 9.3% in 2015 [10], 12.9% in 2016 [3], 16.4% in 2017 [14] and 27% in 2018 [15]. By 2019, CFR reduced again to 20.9% and slightly further reduced to 20.5% in 2020 [12]. In 2018, the country experienced the worst outbreak with regards to mortality with 23 states, including Plateau State recording at least one confirmed case of LF [16], [17].

Since the first ever diagnosis of Lassa fever was made 50 years ago in Nigeria, there are still reports of outbreaks almost every year. In the last few years, many more cases have been reported and mortality among cases is being observed across the country which has now become endemic to the infection. Since 1969, Plateau State has also been experiencing outbreaks of Lassa fever and remains one of the endemic States in Nigeria. A trend analysis conducted in Plateau State

between 2012 and mid-2014 showed that all senatorial zones of the State had reported LF cases with 81.3% of cases from Northern Plateau, 8.5% from Central Plateau and 3.4% from Southern Plateau [18]. There was also a decline in CFR from 70% in 2012 to 36.4% 2013 and to 18.5% in 2014 [18]. Since then, there have been more outbreaks recorded in the State and claiming more lives every year. It is, therefore, important to understand how the occurrence of LF cases has evolved over more recent years in the state. Little is also known about the Case Positivity Rate (CPR) and incident rate of the disease especially in Plateau State. The determination of trends in CPR provides an insight into the accuracy level of clinical detection/suspicion among health workers and how it has evolved over time. Many of the studies that have been carried out in the State have also focused more on specific health institutions and lack important information such as incidence and mortality rates which provides information on the risk of contracting and dying from the disease in the general population. When age-adjusted using the WHO reference population, the incidence measured in this study can be compared to incidence rates generated from studies carried out in other locations and the information generated can be useful in formulating and implementing policies and strategies for LF control.

This study, therefore, aimed to describe the trends in LF outbreak (incidence rate, case positivity rate and mortality rate) in Plateau State, Nigeria from 2015 to the first half of 2019.

II. METHODOLOGY

A. Study Area

The study area is located in Plateau State, North Central, Nigeria with a projected population of 4,433,500 inhabitants for the year 2018. The state is divided into three senatorial zones: Northern, Central and Southern senatorial zones and has 17 Local Government Areas (LGAs). Plateau State is known to be endemic to LF since it was first discovered in 1969, and frequently reports outbreaks of the disease till date [17].

Plateau State Epidemiological Unit is a unit of the State Ministry of Health that collates and analyzes surveillance data obtained from all the 17 LGAs in the State before sending it to the Epidemiological division of the Federal Ministry of Health. The Jos University Teaching Hospital (JUTH) and Bingham University Teaching Hospital (BUTH) are the Lassa fever referral centres for the State and some other parts of the north central zone of Nigeria [19]. These teaching hospitals have infectious disease units responsible for managing LF cases.

B. Study Design and Study Population

A time series study design involving a retrospective analysis of records of all LF cases (suspected and confirmed) in the State Epidemiological Unit was carried out for the period of January 2015 – June 2019. The database had 343 cases for this time frame and all the cases were included in the study.

C. Study Instruments

Line lists for LF cases in the State Epidemiological Unit served as the main instruments for data retrieval. They were used to extract the following information on cases: number of suspected and confirmed cases; sociodemographic information like age, sex, place of residents, occupation; and outcome of illness.

D. Data Collection Technique

Two research assistants were trained for two hours on data extraction from records and data entry. Permission for the study was obtained from the Plateau State Commissioner for Health, State Director Public Health and Medical Directors of the teaching hospitals. With permission granted, records of LF cases from 2015 – 2019 in the State Epidemiological Unit were collected and used for the study. Cases were reported based the WHO case definition.

E. Data Analysis

Data were retrieved and analyzed using Microsoft Excel 2016. Quantitative variables include age were summarized using mean and standard deviation. Qualitative variables such as sex, place of residence (LGA and geopolitical zone), occupation, laboratory confirmation status and mortality status were summarized using tables and charts. The trends in incidence cases, Case Positivity Rate (CPR) and Case Fatality Rates (CFR) were calculated and presented in figures, tables and charts.

Incident cases of LF = No. of new cases of LF in a given year.

$$\text{CasePositivityRate (CPR)} = \frac{\text{No. of positive LF cases}}{\text{Total No. of cases tested for LF}} \times 100$$

Cumulative incidence was determined and standardized using direct method of standardization. Age-Specific Cumulative Incidence (ASCI) was calculated to obtain Age-adjusted Cumulative Incidence (AACI) for the State. The standard population used was the WHO standard population.

$$\text{ASCI} = \frac{\text{No. new LF cases within age - group in a year}}{\text{Total population at risk within that age - group}} \times 100$$

$$\text{Expected CI for each age group} = [\text{ASCI}] \times \\ \times [\text{Age - group of StandardPopulation}]$$

$$\text{Age - AdjustedCI} = \frac{\text{Total Expected Cumulative Inc}}{\text{Total Standard population}} \times 100$$

$$\text{CFR of LF} = \frac{\text{No. of deaths from LF in a given year}}{\text{No. of LF cases that year}} \times 100$$

F. Ethical Consideration

Ethical clearance was obtained from Plateau State Specialist Hospital (PSSH) ethical committee. Permission was obtained from the Commissioner for Health, Director of Health in State Ministry of Health and from the health facility heads. All records obtained for the study were treated with utmost confidentiality.

G. Limitation of the Study

There were records that were incomplete especially for the year 2015. Records became more robust as the years advanced. However, records with incomplete information were excluded from some analysis such as case positivity rate that excluded 2015 records since it lacked information on laboratory diagnosis.

III. RESULTS

A. Socio-demographic Characteristics of LF Cases

The total number Lassa fever cases seen in Plateau State within the study period was 343. Mortality records were available for 338 cases (98.5% of total cases), results of laboratory tests were available for 323 cases (94.2%). The year 2019 had more complete records including occupation for some of the cases.

The mean age of LF patients was (24.5±10.2) years ranging from less than 1 year to 78 years. For the period studied, majority of the cases were seen in the first half of 2019 (38.5%). More of the cases were males (60.1%), children less than 18 years (38.8%) and students/pupils (18.1%). Northern senatorial zone had the highest record of cases at 230 cases or 67.1% (Table I).

TABLE I: SOCIO-DEMOGRAPHIC CHARACTERISTICS OF LF CASES (JAN 2015 – JUN 2019)

Parameters	Frequency	%
<i>Year (n=343)</i>		
2015	5	1.5
2016	44	12.8
2017	55	16.0
2018	107	31.2
2019	132	38.5
<i>Gender (n=343)</i>		
Males	206	60.1
Females	137	39.9
<i>Age group in years (n=343)</i>		
Children (0-17)	133	38.8
Young Adults (18-39)	132	38.2
Middle age (40-59)	71	20.7
Elderly (> 60)	7	2.0
<i>Senatorial Zones (n=343)</i>		
Northern Zone	230	67.1
Central Zone	36	10.5
Southern Zone	61	17.8
Outside Plateau	16	4.7
<i>Occupation* (n=105)</i>		
Student/Pupil/Child	62	18.1
Self employed	17	5.0
Housewife	14	4.1
Public Worker	5	1.5
Health worker	3	0.9
Others**	4	1.2

*for year 2019 only.

**Clergy, artisan.

Fig. 1 shows that most of the LF cases were reported in Jos North LGA (37.9%) when compared to other LGAs of the State. Jos North, Jos South and Bassa were the three LGAs with the highest number of cases for the period of study and since these three LGAs are located in the Northern senatorial zone, it contributed to the high number of cases recorded in the Northern zone when compared to other zones as seen in Table I.

Fig. 1. Distribution of LF cases by LGA.

B. Trends in Incidence of LF in Plateau State from 2015 – 2019

Over the study period, there was an increase in number of new cases of Lassa fever which rose gradually from 5 in 2015 (1.5% of total) to 126 (37.7%) in 2019 (Table II).

TABLE II: INCIDENT CASES OF LASSA FEVER FROM JAN 2015 – JUN 2019

Year	Incident Cases (n = 334)	%
2015	5	1.5
2016	43	12.9
2017	55	16.5
2018	105	31.4
2019	126	37.7

A look at the pattern of occurrence of cases from 2015 to 2019, more cases were observed during the earlier parts of the years. From 2017 to 2019, cases were recorded almost throughout the year.

(a)

(b)

(c)

(d)

(e)

Figs. 2 a–e. Pattern of occurrence of LF cases from 2015–2019.

The calculations for the Age-adjusted cumulative incidence for 2015–2019 was obtained by multiplying the expected cumulative incidence and the WHO standard populations for the various age-groups.

The age-adjusted cumulative incidence showed gradual increase from about 1 per 10,000 population in 2015 to 348 per 10,000 in 2019. There was, however, a decrease from 132 to 113 per 10,000 cases from 2016 to 2017. But it rose again to more than twice the value in 2018 and kept rising to 348/10,000 in the first half of 2019 (Fig. 3).

Fig. 3. Trend in Age-adjusted Cumulative Incidence (AACI).

C. Trends in Case Positivity Rates

The average CPR for the period of study was 25.7%. Although fluctuations in CPR were observed between 2016 and first half of 2019 and the highest was in 2017 (34.1%), the rate remained the same in 2016 and 2019.

TABLE III: CASE POSITIVITY RATES FOR 2015 TO 2019

Year	Positive cases	Cases tested	CPR (%)
2016	12	44	27.27%
2017	15	44	34.09%
2018	20	103	19.42%
2019	36	132	27.27%
TOTAL	83	323	25.70%

N.B: No records of laboratory testing for 2015.

D. Trends in Case Fatality Rates

The CFR decreased from 29.6% in 2016 to 12.9% in 2019. However, there was an increase from 18.2% in 2017 to 20.6% in 2018 (Fig. 4). Although the number of cases in 2019 was more (table 2), the CFR was lower than preceding years.

Fig. 4. CFR for each year. N/B: No record of deaths for 2015.

A look at the pattern of mortality among cases shows that the higher the number of suspected cases at any point in time, the higher the mortality observed among them. Just as cases are seen to be increasingly distributed throughout the year, mortality among cases was also found to occur almost throughout the year as clearly shown for 2017 and 2018 (Fig. 5b and c). Mortality was also found to be higher in the first quarter of most years.

(a)

(b)

(c)

(d)

Fig. 5 a-d. Mortality patterns among cases from 2016–2019.

IV. DISCUSSION

Every year from 2015 to 2019, more incident cases of LF were observed with the highest seen in the first six months of 2019. This was also the trend that was observed nationally during the same period [10]. Other studies have similarly shown that over the years there has been an increase in the number of reported cases. Between 2012 and 2016, a study carried out in Plateau state showed that there was a steady rise in the number of observed LF cases, although that of 2015 was lower than the preceding year [20]. A study carried out in Irrua specialist Hospital, Nigeria also showed increasing caseload of LF from 2015 to 2018 [21]. The rising number of cases observed over these years could be linked to a number of factors which may include increasing index of suspicion among health workers, improvements in case identification and reporting, deteriorating environmental sanitation favoring the proliferation of the rodent, population growth, increasing population movements and overcrowding, increased rodent-human transmission, rapid urbanization and proliferation of slums [3], [22], [23]. These may also probably explain the concentration of cases around the urban city of Jos North where these demographic factors prevail.

In a study carried out in Plateau State between 2012 and 2014, all the senatorial zones reported cases of LF and most cases (81.3%) were from Northern zone, 8.5% from Central zone and 3.4% from Southern zone [18]. Findings from this study similarly show that more cases were from Northern zone. Southern Plateau recorded higher number of cases compared to Central Plateau probably because of the contributions from Langtang North LGA which was up to 6.7%. All 17 LGAs have reported suspected cases of LF over the years of study. Jos North suffered more of the outbreak recording 37.9% of cases followed by Jos South and Bassa LGAs and these contributed to the high number of cases seen in the Northern zone. Although the epidemic was more pronounced in the first few months of the year, cases have gradually been spread throughout the year as seen from 2017 to 2019 and as opposed to 2015 and 2016 where cases were mainly found in the first quarter or the dry season (Fig. 2 a-e). Looking at the national trends, the upsurge of cases being reported during the rainy season also became pronounced in 2017, blurring the seasonality of the disease and this has been possibly linked to increased food availability which leads to an increased probability of human-rodent contact or improved surveillance and case-detection following training of health workers nationally that year. [24], [25] The overall picture shows that there is an increasing geographical spread of the disease and an increasing endemicity as shown in reports from other parts of Nigeria and West Africa. [3], [26], [27] This calls for all-year round preparedness for the control of the disease in the region.

The total Case Positivity Rate (CPR) for the period of study was 25.7% and varied between 19 and 27% implying that out of every 10 suspected cases, about 2 or 3 will be confirmed positive. This almost corresponds to the observation nationwide in which CPR was found to be 30% in 2017 [28], 18.1% in 2018 [17], and 21-24% in the first half of 2019 [28], [29]. Both the CPR observed in the study for 2017 (34%) and that recorded nationwide for the same year (30%) were the highest recorded during the study period in Plateau State and Nigeria respectively. The nation-wide training of health

workers and improvement in surveillance activities that occurred that year could have contributed to this finding [25]. It also shows that case identification through screening is generally higher in the State when compared to national average. A high CPR suggests that clinical suspicion and case detection of LF among health workers is good. Although the number of suspected cases increased over the years, the study showed a variation in CPR during the study period which did not improve by 2019. This could be attributed to various reasons ranging from the similarity in symptoms LF shares with other infections like malaria and other viral haemorrhagic fevers [7], [30], and the need to improve case identification among health workers by increasing accuracy of clinical screening using case definitions in the state. In contrast, CPR gradually improved across the country from 5.8% in 2015 to 18.1% in 2018 and 20.7% in 2019 even though it is still lower than what has been observed in Plateau State [10], [31], [32]. CPR obtained from records in Irrua Teaching Hospital also showed a gradual increase from 7.9% in 2015 to 9.6% in 2016 to 12.8% in 2017 and 17.8% in 2018 [21].

The trend in age-adjusted Cumulative Incidence (AACI) showed gradual increase from 1 per 10,000 population in 2015 to 348 per 10,000 in 2019. There is no known report on incidence rate for LF in the State or country as a whole, but a rise in LF cases has also been observed across the country especially since 2013 till date as more cases are being reported year in year out [10], [12], [17], [31]. Using the population of Nigeria for different years [33] and the reported number of LF cases over the years (430 in 2015, 921 in 2016, 733 in 2017 and 3498 in 2018) [10], [11], [34], it can be deduced that the unadjusted cumulative incidence of the disease increased from 2.4/1,000,000 population in 2015 to 4.9/1,000,000 in 2016. It later decreased to 3.8/1,000,000 in 2017 and shot up again to 17.8/1,000,000 in 2018. This is assuming that cases from previous years were not included. These rates are comparatively lower than the rates observed in this study probably because of the differences in methods of calculation or the differences in geographical size. It may also be explained by the fact that Plateau State is one of the worst hit states for LF in the country as compared to other states that are also considered when computing national values. The incidence rates observed across the country showed an increasing trend except for the drop in 2017 which was also the pattern observed in this study. This may imply that transmission of the disease decreased that year possibly as a result of effective control strategies that should be explored and emulated for future years.

Although, there was a general decrease in CFR during the study period, the CFR for 2018 was slightly higher than that of 2017 in Plateau State. This trend was also observed nationally where the CFR shot up to 27.0% in 2018 from 9.7% observed in 2017 [15], [32]. The rise that was observed across the country that year could have been due to actual increase in disease burden, increased rodent-human transmission, and not necessarily due to any new virus strains [17], [23]. Reports have suggested that desperate measures should be taken to reduce rodent population and their contact with humans if trend is to be reversed [21], [23]. The decreasing trend observed in CFR during the study period even with the corresponding increase in incidence rates may

imply that efforts are actually been made to control disease burden especially with regards to mortality. For example, there has been an increased access to ribavirin and other control efforts across the country since 2012 – 2016 [18]. The observed declining trend in CFR in Plateau State during the study period is in keeping with observed trends from 2012 to 2014 in the State [35] and between 2006 to 2018 in Edo State [21]. But it differs from national trends showing an increase from 3.6% in 2014 [10] to 12.7% in 2015 [15] and then to 27.0% in 2018 [32] which reduced to 22.6% in the first half of 2019 [29].

V. CONCLUSION

There was observed an increasing trend in age-adjusted cumulative incidence of Lassa fever in Plateau State from 1 case per 10,000 population in 2015 to 348 per 10,000 population in 2019 which cuts across all the zones of the state affecting more of the Northern zone. Case Positivity Rate which was cumulatively 25.7% showed variations for the observed period of study. Despite the increasing trend in incidence of Lassa fever, Case Fatality Rate showed a downward trend from 29.6% in 2016 to 12.9% in 2019.

VI. RECOMMENDATIONS

The government should invest more in the training and retraining of all private and public health workers including those in primary health care centres in order to improve their index of suspicion of the disease and improve prompt referral of cases. This will help in improving early case identification and invariably improve case positivity rates and outcome.

Lassa fever has changed its pattern as a purely epidemic disease to one that is becoming endemic and flares up in epidemics. The dynamics of this disease needs to be properly understood for adequate control measures to be instituted in the State. Further studies to analyze the changing pattern and dynamics are recommended.

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