Lassa Fever in post-Ebola Sierra Leone. Sociodemographics and case fatality rates of in-hospital patients admitted at the Kenema Government Hospital Lassa Fever Ward between 2016-2018

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Abstract

Background Lassa fever (LF) is a zoonotic acute viral illness mainly found in West Africa. The disease is endemic in some parts of West Africa including Sierra Leone, Liberia, Guinea and Nigeria; while other neighboring countries at high risk of its outbreak since the animal vectors are distributed throughout the region.

Methods This is a retrospective mixed cohort study that analysed the treatment history containing the sociodemographic and clinical characteristics of 52 laboratory-confirmed LF cases that were admitted to the Kenema Government Hospital Lassa Fever Ward (KGHLFW) during 2016 to 2018; i.e. during the post Ebola outbreak in Sierra Leone. The LF patients whose treatment history we analysed came from either within or outside Kenema district were the KGHLFW is located.

Results Majority (59.6%, n = 31/52) of the LF cases recorded during the period under review were adults; females (65.4%, n = 34/52). 2016 recorded more (40.4%, n = 21/52) LF cases; 2017 (28.8%, n = 15/52) and 2018(30.8%, n = 16/52).

Conclusions We highlighted the significance of LF preventive and control measures that can target its seasonal epidemics. These measures could include strategies that can reduce human contact with the rodent vector as well as raise sensitization and awareness about LF among local residents especially those residing along the LF belt in eastern Sierra Leone.

Introduction

Lassa fever (LF) is a zoonotic acute viral illness mainly found in West Africa. The disease was named after a town in Nigeria where the first case was discovered in 1969 which led to two deaths of female missionaries.[1] LF is endemic in Sierra Leone, Liberia, Guinea and Nigeria; while other neighboring countries are at high risk of its outbreak since the animal vectors are distributed throughout the region. The first LF case in Mali occurred in 2009[2] and that for Ghana in 2011[3]. Few isolated LF cases have been reported in Ivory Coast, Central African Republic, Senegal, Congo and Burkina Faso.[4] The animal reservoirs of LF are *Mastomys natalensis*[5,6,7], the Guinea multimammate rat, *Mastomys erythroleucus and the African wood rat Hylomyscus pamfi*[8]*. Mastomys natalensis* is the reservoir in Sierra Leone and is commonly found in rural environment where they breed frequently. These LF vectors are widely distributed throughout central, west and east Africa. Their excreta contain the Lassa virus (LASV) and are the source of transmission of LF. Humans are infected by coming in contact with the contaminated excreta of these rats or by eating the rat vectors themselves.

An estimated 100,000 to 300,000 LF cases with approximately 5,000 deaths[9] reported annually; although these figures are largely under reported. The case fatality rate (CFR) from LF for healthy population with no underlying comorbidity was estimated between 1-2%[10], 2-5% for in-hospital LF cases, spiking to 20-60% for laboratory confirmed or nosocomial outbreak LF cases.[11,12,13]

In Sierra Leone, LF which is one of few diseases for which weekly epidemiological reporting to the health ministry is requested for accounts for 10% - 16% of hospitalized cases annually.[14]

Methods

Study Design

In this retrospective mixed cohort study we analysed the treatment history containing the sociodemographic and clinical characteristics of 52 laboratory-confirmed LF cases that were admitted to the KGHLFW during 2016 to 2018 (i.e. during the post Ebola outbreak in Sierra Leone). The LF patients whose treatment history we analysed came from either within or outside Kenema district were the KGHLFW is located. These LF patients were diagnosed at the KGHLFW triage after they presented with signs and symptoms of LF.

Study setting

Sierra Leone is bordered by Liberia and Guinea in West Africa. There are five provinces and 16 districts in the country with each province having one government referral and District Health Hospitals (DHHs), several Community Health Centers (CHCs) and Community Health Posts (CHPs). The Kenema Government Hospital (KGH) which housed the KGHLFW and provided the dataset for this study is the largest government district hospital in the eastern province and the only one with the facility to handle LF cases. Prior to the Ebola outbreak in 2014-2016, the KGH was a 350-bed hospital that catered for 670,000 people.15 It had 472 staff and volunteers and was equipped with a surgical, adult medicine, pediatric, and maternity wards.16

Ethics Review

We obtained ethical approval for this study from the Njala University Institutional Review Board which waivered the requirement to obtain individual informed consent from the LF patients whose medical records we were analyzing since these data were healthcare facility-specific aggregated patient records.

Statistical Analysis

R software package version 3.3.117 was used for all descriptive statistical analysis in this study and p-values < 0.05 were considered significant for all two-sided statistical tests. Our descriptive analysis outputs were presented as frequencies, proportions, means and standard deviations (for normally distributed continuous variables); medians and interquartile ranges (for not normally distributed continuous variables). We used Chi-square test to compare the association between two categorical variables.

Results

LF patient sociodemographic characteristics

There were 52 confirmed LF admitted cases at the KGHLFW for the period 2016 - 2018 (Figure 1); adults (59.6%, n = 31/52), children (40.4%, n = 21/52). Majority (65.4%, n = 34/52) of the confirmed LF cases were females; 9.5% (n = 2/21) of female LF cases were pregnant women. 2016 recorded more (40.4%, n = 21/52) LF cases than 2017 (28.8%, n = 15/52) and 2018(30.8%, n = 16/52). Majority (66.7%, n = 14/21) of the LF cases in 2016 were females; slightly more (42.9%, n = 9/21) LF cases were recorded for patients < 15 years than for men (33.3%, n = 7/21). Male and patients < 15 years recorded the same number (40.0%, n = 6/15) of LF cases in 2017; slightly more (60.0%, n = 9/15) LF cases were recorded for females. Majority (68.8%, n = 11/16) of the LF cases for 2018 were also females (Figure 1).

Firgure 1: Distribution of LF cases by sex and year

2016 recorded the highest LF cases for the period under review; 2017 and 2018 recorded almost equal number of LF cases.

2016 recorded the highest number of < 15 LF cases in this study for the period under review; 2018 recorded the lowest.

4.1 Monthly trend analysis of LF

For 2016, most of the LF cases were recorded in January (14.3%, n = 3/21) and February (14.3%, n = 3/21); no LF case was recorded for the months of April, May, October, November and December (Table 1).

Majority of the LF cases for 2017 were recorded in August (53.3%, n = 8/15); no LF case was recorded for the months of July and December.

Majority (50.0%, n = 8/16) of the LF cases were recorded in January 2018; no LF case was recorded for the months of July, August, September, November and December.

4.3 LF and case fatality rates

The overall case fatality rate (CFR) for the period under review was 67.3%. Comparatively, 2018 recorded the highest (CFR = 75.0%, n= 12/16) for the period under review; 2016 (CFR = 71.4%, n= 15/21), 2017 (CFR = 53.3%, n= 8/15). Men generally had higher CFR compared to women. The CFR for all categories (children and adult) of men and women in 2016 was 100% (n = 7/7) and 57.1% (n = 8/14) respectively. The CFR for all categories (children and adult) of men and women in 2017 was 66.7% (n = 4/6) and 44.4% (n = 4/9) respectively, while the CFR for all categories (children and adult) of men and women in 2018 was 80.0% (n = 4/5) and 72.7% (n = 8/11) respectively (Table 1, 2, 3). The CFRs for adults in 2017 (66.7%, n = 6/9) and 2018 (100%, n = 10/10) were higher than that of children. The CFR for children in

2017 and 2018 were 33.3% (n = 2/6) each respectively. The CFR for children in 2016 was higher (88.8%, n = 8/9) than that of adults (58.3%, n = 7/12).

Table 1. Confirmed LF cases admitted at the KGH Lassa Fever Ward in 2016

Category	No. of confirmed cases		No. of death	
	Children	Adult	Children	Adult
Female	5	9	4	4
Male	4	3	4	3
Total	9	12	8	7
CFR (%)			88.8	58.3

Majority of the LF cases for 2016 were adults but children have the highest CFR.

Table 2. Confirmed LF cases admitted at the KGH Lassa Fever Ward in 2017

Category	No. of confirmed cases		No. of death	
	Children	Adult	Children	Adult
Female	4	5	1	3
Male	2	4	1	3
Total	6	9	2	6
CFR (%)			33.3	66.7

From table 2, majority of the LF cases in 2017 were adults; adult also recorded the highest CFR.

Table 3. Confirmed LF cases admitted at the KGH Lassa Fever Ward in 2018

Category	No. of confirmed cases		No. of death	
	Children	Adult	Children	Adult
Female	3	8	0	8
Male	3	2	2	2
Total	6	10	2	10
CFR (%)			33.3	100

From table 3, majority of the LF cases in 2018 were adults; all adult cases died during treatment.

Discussion

Viral hemorrhagic fevers are among few infectious diseases with high CFR and severe clinical manifestations. Unlike most viral hemorrhagic fevers such as Ebola which are only recognized during outbreaks, LF is endemic in some parts of West Africa. We summarized the sociodemographics, epidemiology and CFRs of 52 LF patients that were admitted at the KGHLFW after the end of the West Africa Ebola outbreak of 2014-2016. There is paucity of research publications on the treatment outcome of LF outbreaks which is assumed to be due to underreporting since LF presents with non-specific clinical presentations especially during the early phases of its outbreak coupled, the dynamics of its outbreak dynamics and the attached societal structures the favour its transmission.

Our study reported an overall high CFR for the entire period under review. We also reported a disproportionately high LF prevalence for female than male - which is consistent with one Nigerian LF study[18]. Isere EE and colleagues reported that majority (52.6%) of confirmed LF cases during the December 2015 to April 2016 outbreak in Nigeria were females.[18] Ilori EA and colleagues however reported lower female LF cases compared to males (37.9% vs. 62.1%) for the January-May 2018 outbreak.[19] This sex-based difference in LF prevalence once more highlights the changing epidemiology of the disease. Our finding also underpins the influence of gender role in the transmission of LF. Women in Sierra Leone spend more time at home and hence have increased contact period with the rodent vectors than their men counterparts. We also reported high LF cases among adults than children < 15 years; which is also consistent with the finding by Ilori EA and colleagues.[19] There was a progressive decline in LF prevalence as we move away from 2016 to 2018. The high LF prevalence in 2016 can be attributed to the disruption of LF surveillance, preventive and control activities caused by the 2014-2016 Ebola (EVD) outbreak in Sierra Leone. The 2014-2016 EVD outbreak greatly affected the health sectors in Sierra Leone, Liberia and Guinea which are also foci for LF outbreak. During the 2014-2016 EVD outbreak great human resources and logistics were channeled towards bringing the outbreak to an end. As the EVD waned the health sector in the affected West African countries picked up and became better organised with foreign aid in the area of disease surveillance, prevention of health care associated infection and

control - this was reflected in the successive reduction in the prevalence of LF in 2017 and 2018. Sierra Leone became the first Africa country in 2019 to employ the electronic Integrated Disease Surveillance and Response System (eIDSR) for its disease surveillance and monitoring activities;[20] which provides accurate, timely, and comprehensive health surveillance data in a more efficient manner than the traditional paper-based IDSR system. [21]

With the exception of 2017, January witnessed high LF cases in the affected regions for the period under review. This finding was also corroborated by Akhmetzhanov Andrei R and colleagues who reported that the high-risk for LF transmission to human peaks in January-March.[22] The early months of the year in Sierra Leone is characterized by winter-like climate of low temperature, high humidity and few rainfalls. The average night-time and daytime temperatures in the interior of Sierra Leone in the early months of the year is around 18/20°C and 32/34 °C respectively. These climatic conditions in the interior of Sierra Leone around January-March are out of the optimal climatological factors that favor LAF transmission. Fichet-Calvet and colleagues have shown previously that rainfall was an important abiotic factor for LF transmission[23] and that LASV transmission hike greatly in the raining season than dry season.[14,19] Sierra Leone's raining season start in May and extend till October. Because the highest LF prevalence in our study is out of the raining season period we are assuming that other factors interplay with climate in the transmission of LASV in Sierra Leone.

Our in-hospital CFRs for the laboratory-confirmed LF cases was similar to previous studies done in Sierra Leone[14] and Nigeria[19] but also higher than those reported for LF outbreaks in other countries[10,11,12,24, 25, 26]. CFR can reach 50% among hospitalized LF patients including those with the severe form of the infections.[25,26] Our high CFR is interesting considering the low number of LF cases which were expected to produce a decrease in the statistical effect size for this study.

Generally men recorded high CFR throughout the study period compared to women; though they recorded lower prevalence than women. We are also of the opinion that because men most often stay away from the house for a longer period of time compared to women they may be unfamiliar with the signs and symptoms of LF which also put them at elevated risk of dying from the infection because of delays in seeking treatment. Knowledge about a disease is paramount in preventing and controlling its transmission, as well as obtaining successful treatment.

Conclusion

We reported a high LF prevalence among adults than children < 15 years which indicates the significance of age in the general epidemiology of the disease during outbreaks. Our progressive decline in LF cases as we move away from 2016 to 2018 emphasizes the need for maintaining a robust public health surveillance system in those countries that lies along the LF belt. A weak public health system is a recipe for LF outbreak. Our high LF cases observed in January for 2016 and 2018 once more showed the seasonality of LF; which has implication for its control and preventive measures. Our high CFR among men compared to women could be attributed to the fact that because men stay away from the house for

a longer period of time may be unfamiliar with the signs and symptoms of LF which makes them to seek treatment late. Knowledge about a disease is paramount in obtaining a successful treatment outcome.

Recommendations

Our study highlights the significance of LF preventive measures that will target its seasonal epidemics: (i) to reduce human contact with the rodent vector (ii) to raise sensitization and awareness about LF among local residents especially those residing the LF belt in eastern Sierra Leone. LF eradication campaign programs can be designed to target rural areas with agricultural activities as well as public markets in urban and periurban settings the rodent vectors are usually seen. Additional preventive measures including the strengthening or improvement of hygiene practices, proper food coverage especially at night time are also recommended.

Declarations

Ethics approval and consent to participate

The Institutional Review Board at Njala University in Sierra Leone provided ethical clearance for conducting this study.

Consent for publication

Not Applicable

Availability of data and materials

The datasets generated and analyzed during the current study are not for public access due to patient confidentiality. This study used aggregate dataset that is being protected by the Institutional Review Board at Njala University in Sierra Leone to protect patients' identity.

Competing interests

All authors declared they have no competing interest.

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Authors' contribution

JK, FKK and RCL conceived and designed this study as well as organized the conduct of this research in the research field. JK, FG, and RCL performed the statistical analysis. JK and FKK drafted the manuscript. JK, FKK, FG and RCL critically reviewed and revised the manuscript. RCL and FKK oversaw the collection and collating of the research data. JK obtained ethical clearance.

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Authors' information

Not applicable.

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Figures

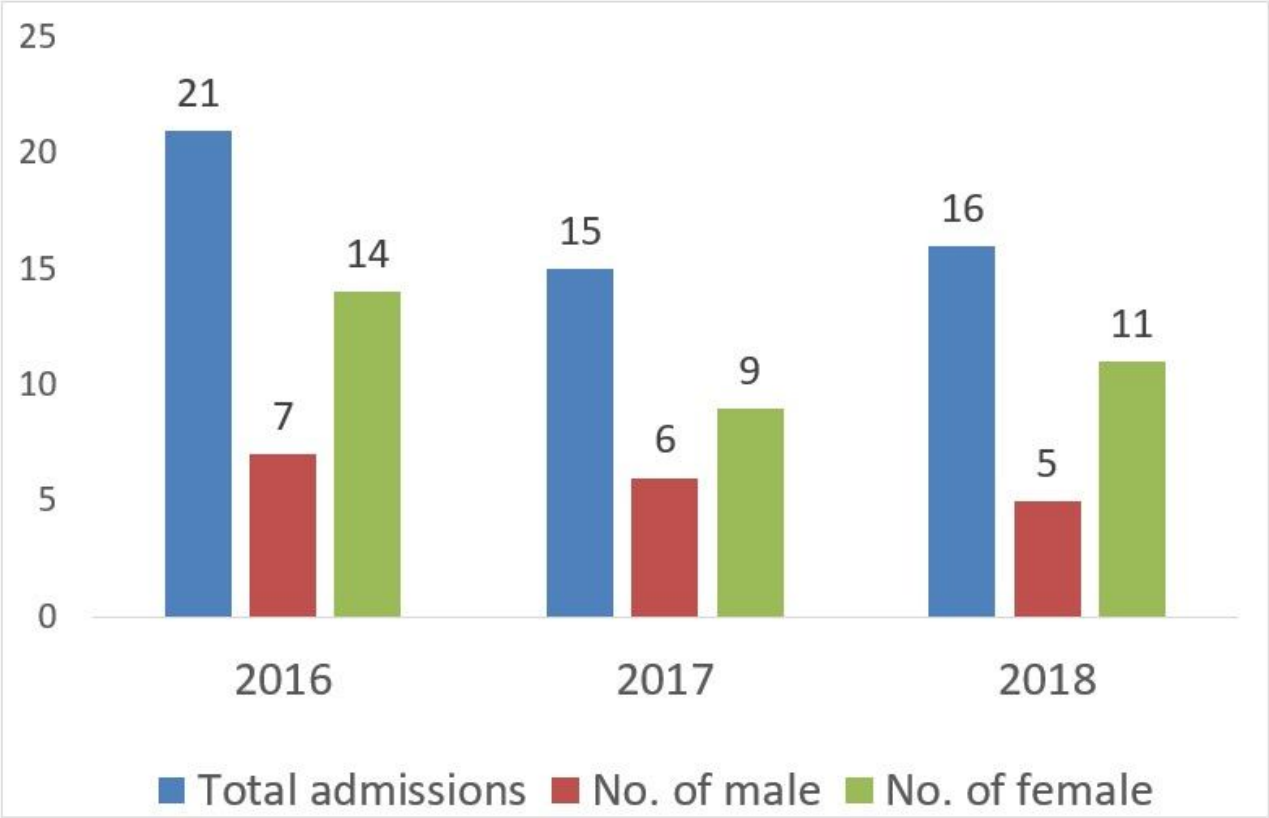

Figure 1

Distribution of LF cases by sex and year