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Knowledge and practices associated with Lassa fever in rural Nigeria: Implications for prevention and control

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Abstract. Lassa fever (LF) is a haemorrhagic illness endemic in West Africa, which can be attributed to poor rat control and poor sanitation, especially in the rural communities. Increasing awareness and education about LF has been advocated for its prevention and control. This study investigated the level of awareness and knowledge associated with LF among the residents of Iwo and Oluponna areas of Osun State, southwest Nigeria. A descriptive cross-sectional study was carried out among the adult residents using a structured questionnaire. Descriptive and inferential statistics were used in analysing the data. In total, 534 (79.11%) respondents had heard about LF, but only 15.4% had good knowledge of the disease. Their main source of information was the media (46.3%, P=0.002, P<0.01), while only 21.2% got information from health workers. About 45% of respondents have rats in their houses. Respondents from Iwo were better informed than Oluponna. Multiple logistic regression analysis indicated location to be significantly associated with awareness (OR=1.62, C.I=1.078-2.433, P<0.05), knowledge of prevention (OR=5.88, C.I=2.807-12.317, P=0.000, P<0.01) and treatment (OR=1.648, C.I=1.122-2.420, P=0.011, P<0.05). Although the residents of Iwo are better informed about LF than Oluponna residents, the knowledge of the disease is poor in both areas. Health workers should be well informed, and the government should increase enlightenment programmes about LF, especially in rural communities of Nigeria, so as to curtail the spread and prevent outbreaks.

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Introduction

Lassa fever (LF) is an acute viral haemorrhagic illness endemic in West Africa, with an increased prevalence reported in Sierra Leone, Guinea, Liberia, and Nigeria (1-4). Not less than 100,000-300,000 people are infected annually, with an estimated 5,000 deaths in West Africa alone (1,5,6). Although endemic in West Africa, there have been cases of LF transported to Europe and some other parts of the world by travellers from the endemic region (7,8). Several reports of LF outbreak have been documented in Nigeria (9-11) (Fig. 1) after the first occurrence in Lassa town, Borno State, Northeast, Nigeria in 1969, when two missionaries died as a result of the disease (5,9,12,13).

Lassa fever is transmitted to humans by the Lassa virus (LV) (1,5,14,15) It is a single-stranded RNA virus, belonging to the family Arenaviridae (13). The primary host of the virus is Mastomys natalensis (13,16,17). Also known as the multimammate mouse. Infected mice are carriers of the virus, though asymptomatic but are capable of discharging the Lassa virus through urine, feaces, saliva, respiratory secretions, and exposed blood vessels into the environment (1,5,18,19). Lassa fever can be transmitted to humans through ingestion of food contaminated with the feaces, urine, or blood of an infected mouse, as well as direct contact with an infected person's body fluid (16,20). The consumption of infected rodents is another possible means of transmission. Due to the stability of Arenavirus, infections via the aerosol route in non-human primates have been documented (17,21,22). Infection could occur six to twenty-one days after exposure to the virus (16,23). Eighty percent of those infected have mild or no symptoms (24,25). Symptoms usually begin with flu-like illness, fever, and malaise, which may be accompanied by cough, sore throat, severe headache, chest and abdominal pain, vomiting, and diarrhea; and may later result to bleeding from the mucosa openings, severe haemorrhagic fever, facial edema, and multi-organ dysfunction, which could eventually lead to death (15,24,26,27). Infection of the fetus and loss of the fetus is common in 90% of cases in pregnant women (22). Lassa fever can cause death within fourteen days in fatal cases and deafness in 25% of recovered cases (15). Presently, there is no vaccine for Lassa fever, but an antiviral drug (ribavirin)

has been found effective if administered within the early days of the infection (28).

Lassa fever is endemic in Nigeria, where the annual outbreak is usually high during the dry season (December-April), following the reproductive cycle of the Mastromy rat in the wet season (May-June) (29). Nigeria is presently experiencing a Lassa fever outbreak in twenty-nine states out of thirty-six states (Fig. 1), of which there are 2,847 total confirmed laboratory cases and 837 deaths (case-fatality ratio ranging between 3 and 27%) recorded between January 2014 and June 6, 2020 (Fig. 2). The number of cases is increasing over the year, spreading from 13 states in 2014 to 29 states in 2020. Seventy-five percent of the confirmed cases in Nigeria are in Ondo (36%), Edo (32%), and Ebonyi (7%) (17,22). Infectious diseases can be abated if the populace is well-informed about the diseases. This will consequently give room for early presentation and diagnosis, leading to the right choice of treatment. Accessing the level of knowledge of LF among the residents of Osun State, which is the central state connected to five other states in southwest Nigeria (Fig. 1), is pivotal to its control in Nigeria. This is because; an outbreak in Osun State could easily spread to other connecting states and across southwest Nigeria. Ondo State is the highest-risk state in Nigeria and it shares a border with Osun State. Despite the high risks of LF in many cities in Nigeria, there is a dearth of information on the level of awareness, knowledge, and preventive practices among residents in many towns and villages across Nigeria. Adequate knowledge and good prevention practices among the residents of a place is the first measures in preventing any disease outbreak. This study presents the level of awareness and knowledge of LF among adult residents of Iwo, a semirural area and Oluponna, a rural and agrarian community in Osun State, southwest Nigeria.

Materials and methods

Study area. The study was conducted in Iwo and Oluponna, Osun State, southwest Nigeria. Iwo is situated at latitude 7˚38'06''N and longitude 4˚10'53''E and has a land area of approximately 245 Km^2 with a population size of 191,377 according to the last census conducted in Nigeria (30). Worthy of note is the popular Odo-Ori market, which attracts many traders from within and neighbouring towns as well as the presence of two tertiary institutions. While Oluponna is located at latitude 7˚36'0''N and longitude 4˚10'60''E, the population size is about 76, 309, with a land space of about 262 Km^2 and agriculture is their mainstay of the economy. The average temperature and rainfall of the study areas range between 23-31˚C and 1850-1950 mm, respectively.

Study design. A cross-sectional study was carried out between February and March 2020. Consenting adults (≥18 years old) living in Iwo and Oluponna were chosen for participation in this study. Individuals less than 18 years old and non-consenting adults were excluded from the study.

Determination of sample size. The sample size was determined using Raosoft software (http://www.raosoft.com/samplesize.html) which gave a required minimum sample size of 662 for a total population of 267,686, a 5% margin of error and a 99% level of confidence.

Sampling technique. A simple random sampling technique was employed in this study, using a structured questionnaire with a focus on the demographic characteristics, level of awareness, knowledge, and preventive practices of LF. The interview was conducted person to person after receiving the verbal consent of the respondents.

Validity of research instrument. The study was conducted using a validated questionnaire from a previous study in Nigeria (6,9) and the questionnaire was also accessed for correctness and accuracy by an expert in public health and epidemiology study before the commencement of the survey.

Statistical analysis. The data obtained was presented as frequencies and percentages. The Chi-square test was used to determine the univaraite association between two categorical variables, and multiple logistic regression analysis with p set as <0.05 was used to determine associations between demographic variables and level of awareness, knowledge, and prevention practices [Statistical Package for Social Sciences (SPSS) software program for Windows version 20.0].

Results

Six hundred and seventy-five respondents took part in the survey, among whom, 310 (45.93%) were females, while 365 (54.07%) were males (Table I). More than half of the respondents were aware of Lassa fever (79.11%). The proportions of respondents who were single, married, divorced, and widowed were 37.3, 38.7, 15.1, and 7.6%, respectively. The ethnicity distribution among the respondents was Yoruba (45%), Igbo (30.1%), and Hausa (17.1%), while only 7.9% were Fulani. The percentage of respondents who had a secondary school education was 29.5, 24.7% had a university degree; and 14.4% did not have access to any form of formal education. The percentages of respondents in the two areas were almost the same (55.1% in Oluponna and 44.9% in Iwo). Awareness of LF was found to be significantly associated with location (P=0.009, P<0.01) and religion (P=0.020, P<0.05), and more than half of the respondents who were not aware of the disease were residents of Oluponna (65.2%). Other demographic variables as shown in Table I were not significantly associated (P<0.05) with awareness of LF.

Out of the total participants, 247 (46.3%) heard about it through the media, 21.9% through family and friends, and only 21.2% heard about it through health workers (Table II). More respondents in Iwo than in Oluponna had heard information through the media (53.5% vs. 39.6%, P=0.002, P<0.01) and in the market (12.2% vs. 6.1%, P=0.020, P<0.05).

Knowledge of the respondents about Lassa fever is presented in Table III. Although 534 (79.11%) of the respondents had heard of Lassa fever before, only 286 (53.6%) were aware of LV as the causative agent of the disease. From the data, 183 (34.3%) knew that the disease is transmitted through the consumption of rats, 25.7% believed it can be transmitted though the consumption of food contaminated with rat urine or feaces , while 14.4% think it can be transmitted by a direct contact with an infected person. Some of the myths and

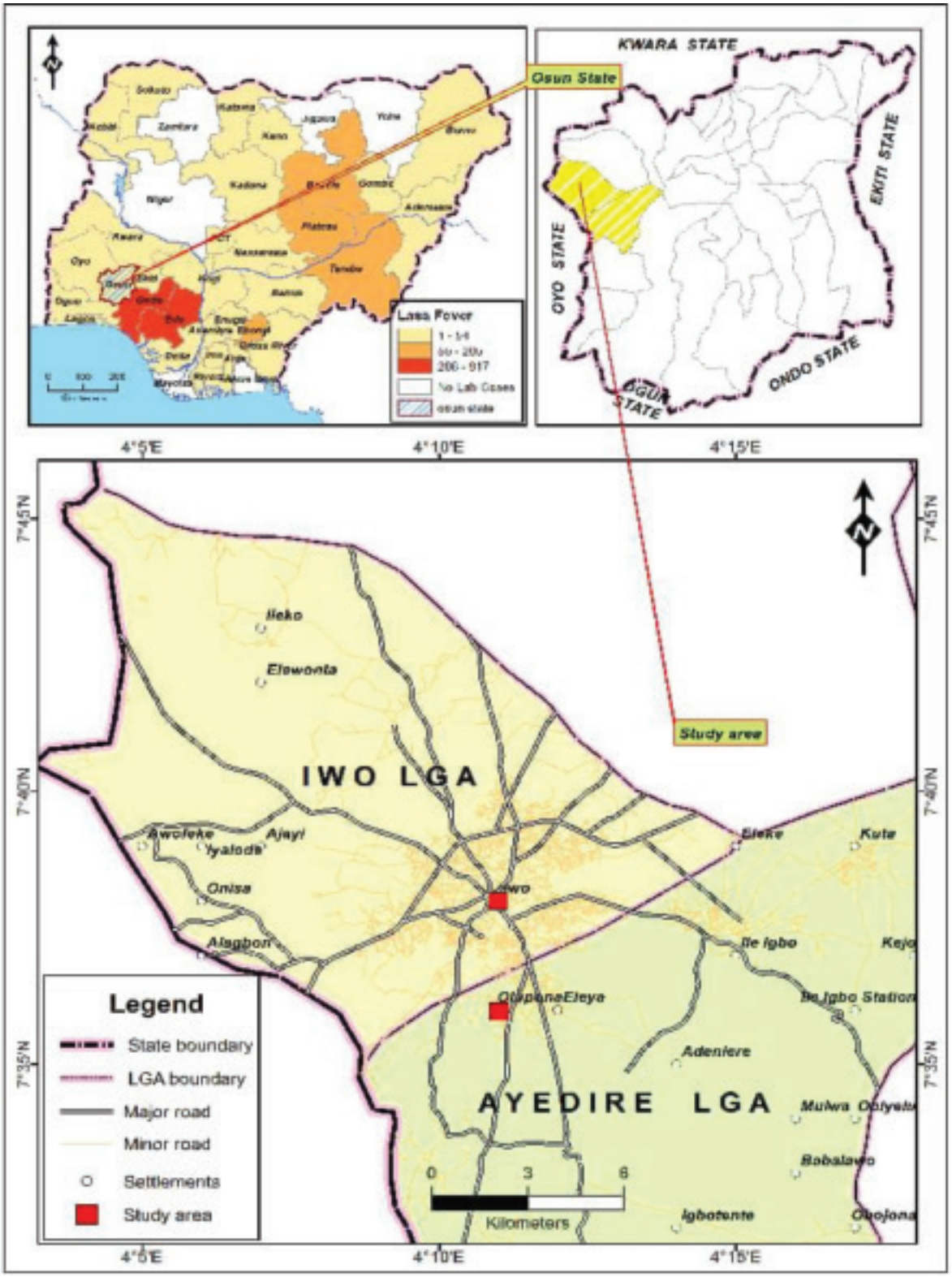

Figure 1. Maps of Nigeria showing Lassa fever endemic States (A) Osun State (B) and study area (C).

misconceptions about LF transmission include mosquito bites (20%), and dog bites (6%). Common symptoms known by the respondents as associated with LF include fatigue (38.8%), fever (21%), and general weakness (19.9%). The least mentioned symptom was miscarriage in pregnant women (2.4%), while 53 (9.9%) did not even have any idea of the symptoms of the disease. One hundred and fifty-four respondents believed there is vaccine for LF and only 259 (48.5%) believed it could be prevented. While 61% of the respondents will go to the hospital when they observe symptoms, 14.4% will do self-medication, and 11.2% will consult religious houses. Only 29.4% agreed that LF can be prevented by blocking rat holes, 43.6% will practise good hygiene and keep the environment clean and 17.6% will keep garbage away from their homes. In general,

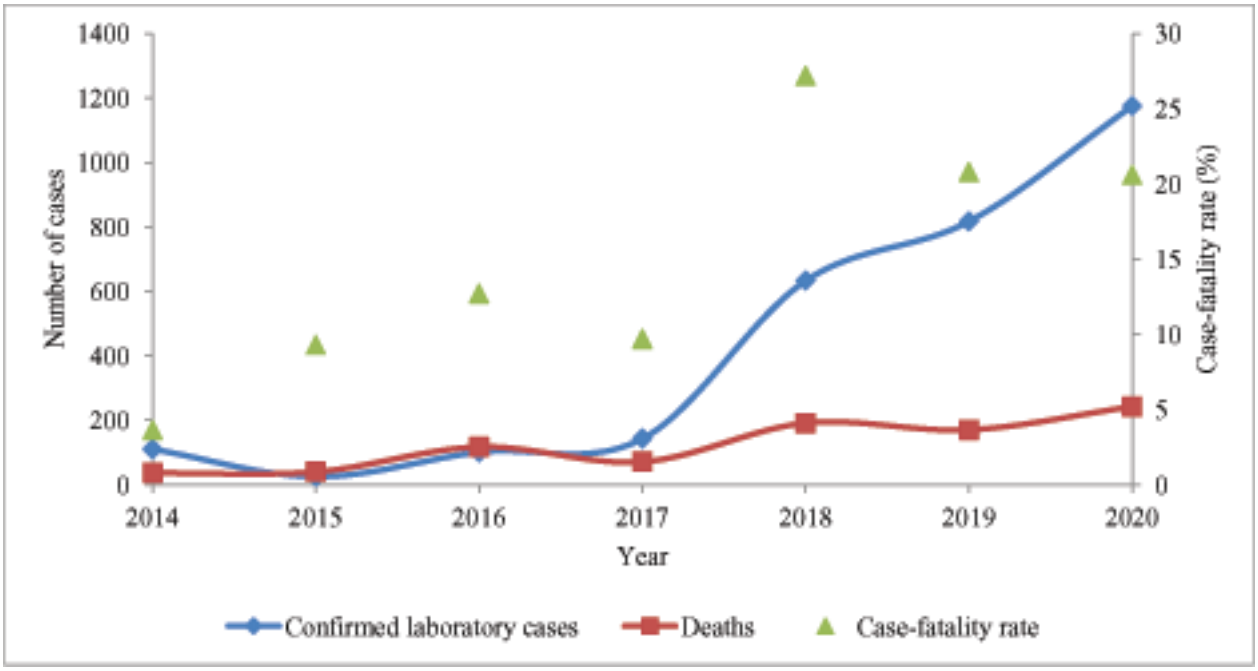

Figure 2. Number of confirmed laboratory cases of Lassa fever, deaths and case-fatality rate recorded annually from (2014-2020). Data source- www.ncdc.gov.ng; accessed December 31st, 2020.

the result showed that respondents in Iwo had better understanding of the causative organism (55.5% vs. 51.8%, P=0.002, P<0.01), treatment (68.1% vs. 54.6%, P=0.02, P<0.05) and knowledge of prevention (20.9% vs. 3.9%, P<0.05) of LF when compared with Oluponna respondents.

Table IV shows that 45.5% of the respondents have rats in their houses every day, of which Oluponna residents see rats more often than Iwo residents (48.1% vs. 42.2%, P=0.015, P<0.05). While 34.7% have plenty of rats in their houses, it was revealed that 41.5% have <5 rats in their houses, indicating that the number of rats in the houses was not significantly associated with locations (P=0.099, P>0.05).

Multiple logistic regression analysis showed that only location was significantly associated with awareness (P=0.020, P<0.05) (OR=1.62, C.I=1.078-2.433, P<0.05), treatment (P=0.011, P<0.05) (OR=1.648, C.I=1.122-2.420, P=0.011, P<0.05) and knowledge of prevention (P=0.000, P<0.01) (OR=5.88, C.I=2.807-12.317, P=0.000, P<0.01) of LF (Tables V and VI). This implied that the level of awareness, treatment, and knowledge of prevention of LF were quite higher in Iwo than in Oluponna. There was reduced odds of knowledge of causative organism (P=0.008, P<.01) and treatment (P=0.028, P<.05) among the widow than other marital statuses. A reduced odds of knowledge of prevention were reported among farmers (P=0.007, P<0.01), transporters (P=0.028, P<.05), and other occupations (P=0.024) compared with that of respondents who were unemployed, or work in an office.

Discussion

There have been several reports on the epidemiology of LF in different regions within West Africa (31-35). In a recent study, Shaffer *et al* (31). and Jetoh *et al* (32). reported a high prevalence of LF (>60%) in Sierra Leone. A high incidence was also reported from Liberia (69%), which is more than previous reports (33-35). The first diagnosis of LF in Guinea was in 2011, and the CFR has increased to 88% as at 2021 (35). Recent reports of high CFR may not be the actual values as the confirmed cases are underestimated in many of the regions (33) and there is a paucity of data in many West African countries. Nigeria is presently experiencing LF outbreaks in some major cities, and LF may soon become a global concern if nothing is done to curtail the disease in the endemic regions. This is because, it can be imported from endemic areas to other countries (7,36,37). More than 867 people have died of LF in Nigeria in recent years, with CFR ranging between 3.64% and 27.2% (4). Despite the alarming increase in CFR, its awareness and knowledge are undetermined in many local communities within the country. Poor/inadequate knowledge and wrong preventive practices could aid the spread of infectious diseases among people. Poor epidemic preparedness has been indicated as one of the key factors contributing to disease outbreaks (22). Therefore, it is necessary to investigate the level of awareness, knowledge, and prevention practices among the people about the disease, especially in the local communities where they are more prone to LF because of the prevalence of rodents (1,3).

The number of the respondents who were aware of LF in the present study is higher than the findings in similar studies in Nigeria (9,38). The high level of awareness among the respondents could be attributed to an increase in awareness through the mass media over time. Usuwa *et al* (39). Reported that 63.2% of the female respondents had heard of Lassa fever before a particular study in Ebonyi State, southeast Nigeria, which is contrary to the findings of this study. More awareness about LF among male compared to female respondents in this study could be attributed to the fact that males have access to health-related information than females (9). More Christians

Table I. Socio-demographic characteristics of respondents in Iwo and Oluponna, Osun State, Nigeria.

Variables	Aware (n=534)	Not aware (n=141)	Total (n=675)	χ^2-calc.	P-value
Gender					
Male	291 (54.5)	74 (52.1)	365 (54.1)	0.110	0.740
Female	243 (45.5)	67 (47.5)	310 (45.9)		
Age (years)					
18-24 years	136 (25.5)	41 (29.1)	177 (26.2)	6.315	0.097
25-39 years	208 (39.0)	44 (31.2)	252 (37.3)		
40-59 years	133 (24.9)	32 (22.7)	165 (24.4)		
60 years and above	57 (10.7)	24 (17.0)	81 (12.0)		
Religion					
Muslim	163 (30.5)	45 (31.9)	208 (30.8)	9.826	0.020[a]
Christianity	270 (50.6)	59 (41.8)	329 (48.7)		
Traditional	78 (14.6)	22 (15.6)	100 (14.8)		
Others	23 (4.3)	15 (10.6)	38 (5.6)		
Marital status					
Single	202 (37.8)	50 (35.5)	252 (37.3)	2.447	0.654
Married	207 (38.8)	54 (38.3)	261 (38.7)		
Divorced	82 (15.4)	20 (14.2)	102 (15.1)		
Widow	37 (6.9)	14 (9.9)	51 (7.6)		
Widower	6 (1.1)	3 (2.1)	9 (1.3)		
Ethnicity					
Yoruba	248 (46.4)	56 (39.7)	304 (45.0)	3.134	0.371
Igbo	158 (29.6)	45 (31.9)	203 (30.1)		
Hausa	90 (16.9)	25 (17.7)	115 (17.0)		
Fulani	38 (7.1)	15 (10.6)	53 (7.9)		
Education					
No formal education	78 (14.6)	19 (13.5)	97 (14.4)	1.165	0.884
Less than secondary	88 (16.5)	21 (14.9)	109 (16.1)		
Secondary education	154 (28.8)	45 (31.9)	199 (29.5)		
Higher college	84 (15.7)	19 (13.5)	103 (15.3)		
University	130 (24.3)	37 (36.2)	167 (24.7)		
Occupation					
Unemployed	131 (24.5)	34 (24.1)	165 (24.4)	4.952	0.422
Farming	67 (12.5)	27 (19.1)	94 (13.9)		
Trading	132 (24.7)	31 (22.0)	163 (24.1)		
Transporting/Driving	61 (11.4)	17 (12.1)	78 (11.6)		
Office	134 (25.1)	29 (20.6)	163 (24.1)		
Others	9 (1.7)	3 (2.1)	12 (1.8)		
Location					
Oluponna	280 (52.4)	92 (65.2)	372 (55.1)	6.895	0.009[b]
Iwo	254 (47.6)	49 (34.8)	303 (44.9)		

[a]Significant at 5 % (P<0.05); [b]Significant at 1% (P<.01).

had heard of LF, probably because church leaders often organise health promotion programs (40). The low level of information about LF from health workers could be ascribed to their poor knowledge of the disease (6,10). Despite the high awareness, however, there are some fables about LF in the study area. Oladeinde *et al* (9). Also reported misconceptions about the cause of LF to be mosquito bites (67.8%) and dog bites (20.7%) among the rural residents of Edo State, Southern Nigeria. The report of this study is below the findings of Morgan *et al* (26). Who reported that 88% of the respondents were able to associate the transmission of LF with eating food contaminated with rats' faeces and urine. Good prevention practices can restrict the spread of infectious diseases from endemic regions to other regions.

Table II. Sources of information about Lassa fever in Iwo and Oluponna, Osun State, Nigeria.

	Iwo (n=254)	Oluponna (n=280)	Total (n=534)	P-value
Media	136 (53.5)	111 (39.6)	247 (46.3)	0.002[b]
Friend/family	55 (21.7)	62 (22.1)	117 (21.9)	0.975
Health worker	47 (18.5)	66 (23.6)	113 (21.2)	0.185
Market	31 (12.2)	17 (6.1)	48 (9.0)	0.020[a]
Religious houses	18 (7.1)	18 (6.4)	36 (6.7)	0.897
Others	13 (5.1)	5 (1.8)	18 (3.4)	0.059

[a]Significant at 5% (P<0.05); [b]significant at 1% (P<0.01).

Table III. Knowledge of Lassa fever among the respondents in Iwo and Oluponna.

Variables	Oluponna (n=280)	Iwo (n=254)	Total (n=534)	P-value
Lassa Fever caused by Lassa virus				
Yes	145 (51.8)	141 (55.5)	286 (53.6)	0.002[b]
Lassa fever is transmitted through				
Mosquito bite	73 (26.1)	34 (13.4)	107 (20.0)	0.000[b]
Dog bite	26 (9.3)	6 (2.4)	32 (6.0)	0.001[b]
Consumption of rat	83 (29.6)	100 (39.4)	183 (34.3)	0.023[a]
Contact with urine/feaces of an infected mouse	57 (20.4)	80 (31.5)	137 (25.7)	0.004[b]
Consumption of food/drink contaminated with urine/feaces of an infected mouse	60 (21.4)	111 (43.7)	171 (32.0)	0.000[b]
Inhalation of aerosol produced	14 (5.0)	16 (6.3)	30 (5.6)	0.643
Direct contact with infected person	22 (7.9)	55 (21.7)	77 (14.4)	0.000[b]
Symptoms of Lassa fever				
Fatigue	133 (47.5)	74 (29.1)	207 (38.8)	0.000[b]
General weakness	43 (15.4)	63 (24.8)	106 (19.9)	0.009[b]
Fever	71 (25.4)	44 (16.1)	112 (21.0)	0.012[a]
Chest pain	6 (2.7)	24 (9.4)	30 (5.6)	0.001[b]
Headache	10 (3.6)	50 (19.7)	60 (11.2)	0.000[b]
Sore throat	5 (1.8)	37 (14.6)	42 (7.9)	0.000[b]
Vomiting	5 (1.8)	52 (20.5)	57 (10.7)	0.000[b]
Diarrhea	4 (1.4)	35 (13.8)	39 (7.3)	0.000[b]
Face swelling	2 (0.7)	20 (7.9)	22 (4.1)	0.000[b]
Low blood pressure	4 (1.4)	23 (9.1)	27 (5.1)	0.000[b]
Nose/Mouth/Gastro bleeding	4 (1.4)	30 (11.8)	34 (6.4)	0.000[b]
Miscarriage	3 (1.1)	10 (3.9)	13 (2.4)	0.062
Cough	0 (0.0)	41 (16.1)	41 (7.7)	0.000[b]
Don't know	22 (7.9)	31 (12.2)	53 (9.9)	0.125
Information about Lassa fever				
All victim show initial symptoms	131 (46.8)	114 (44.9)	245 (45.9)	0.004[b]
Lassa fever can lead to death	133 (47.5)	143 (56.3)	276 (51.7)	0.059
There is Lassa fever vaccination	79 (28.2)	75 (29.5)	154 (28.8)	0.002[b]
Lassa fever can be prevented	120 (42.9)	139 (54.7)	259 (48.5)	0.000[b]
What to do when the symptoms occur				
Go to drug store	33 (11.8)	44 (17.3)	77 (14.4)	0.090
Use local herbs	20 (7.1)	22 (8.7)	42 (7.9)	0.624
Visit herbalists	36 (12.9)	14 (5.5)	50 (9.4)	0.006[b]

Table III. Continued.

Variables	Oluponna (n=280)	Iwo (n=254)	Total (n=534)	P-value
Go to religious house	43 (15.4)	17 (6.7)	60 (11.2)	0.002[b]
Go to hospital	153 (54.6)	173 (68.1)	326 (61.0)	0.002[b]
Do not know	17 (6.1)	4 (1.6)	21 (3.9)	0.014[a]
Lassa fever can be prevented by				
Blocking all rat holes around houses	52 (18.6)	105 (41.3)	157 (29.4)	0.000[b]
Washing of hands	29 (10.4)	73 (28.7)	102 (19.1)	0.000[b]
Avoid touching eye, nose and mouth often	28 (10.0)	51 (20.1)	79 (14.8)	0.002[b]
Keeping food stuff in sealed containers	48 (17.1)	100 (39.4)	148 (27.7)	0.000[b]
Good hygiene and clean environment	109 (38.9)	124 (48.8)	233 (43.6)	0.027[a]
Avoid consumption of rats	42 (15.0)	80 (31.5)	122 (22.8)	0.000[b]
Avoid bush burning	39 (14.0)	36 (14.2)	75 (14.1)	0.000[b]
Dispose garbage away from homes	27 (9.6)	67 (26.4)	94 (17.6)	0.000[b]

[a]Significant at 5%, [b]significant at 1% (P<0.01).

Table IV. Frequency of rats in the house.

	Oluponna (n=372)	Iwo (n=303)	Total (n=675)	P-value
Rats are seen in the house				
Everyday	179 (48.1)	128 (42.2)	307 (45.5)	
<7 days	68 (18.3)	50 (16.5)	118 (17.5)	0.015[a]
<1 month	79 (21.2)	61 (20.1)	140 (20.7)	
<3 months	29 (7.8)	30 (9.9)	59 (8.7)	
<6 months	17 (4.6)	34 (11.2)	51 (7.6)	
Number of rats in the house				
<5	168 (45.2)	112 (37.0)	280 (41.5)	0.099
<10	83 (22.3)	78 (25.7)	161 (23.9)	
Plenty	121 (32.5)	113 (37.3)	234 (34.7)	

[a]Significant at 5% (P<0.05).

It is worth noting that self-medication can prolong illnesses, cause more complications, enhance spread to other people, make diseases more expensive to treat, lengthen hospital stays, and even result to death in some cases (41). Good knowledge of an infectious disease cannot be over-emphasized in curtailing an outbreak. Only 3% of the respondents had good knowledge of LF in a study in Liberia (42), which is similar to what was obtained in this study. Usuwa *et al* (39). and Fatiregun *et al* (43). Reported higher knowledge percentages of 49.7 and 33.6% of LF from respondents in Ebonyi State and Ondo State, Nigeria, respectively, which is contrary to the present finding. A higher level of knowledge of LF recorded in these areas could be as a result of prior sensitization, due to recent outbreaks. Disease outbreaks should not be the only reason for the sensitization of the populace, as their severity could be prevented by prior awareness, adequate knowledge, and good prevention practices. The higher level of knowledge of LF in Iwo as compared to Oluponna in this study can be attributed to the fact that Iwo residents have better access to social media networks.

Bowitt *et al* (14). Reported a high rat frequency rate of 92.4% in houses in rural settlements of Bo District, Sierra Leone, which is similar to the findings of Orji *et al* (44), who reported a household rat prevalence of 82.3% in an endemic region of Ebonyi State, southeast Nigeria. In a field study involving six villages in Guinea, rats were found in 20% of the residential apartments (45). This study showed that 45.5% of the respondents harbour rats in their homes every day, which implies that they do not have effective measures to control rats in their homes. The role of rats in the spread of LF cannot be over-emphasized.

Table V. Association between the demographics of the respondents and awareness of Lassa fever In Iwo and Oluponna (Odd ratios and 95% confidence interval).

Demographic variables	Odd ratios	95% C.I of odd ratios	P-value
Location			
Oluponna	1.00 (reference)	-	-
Iwo	1.62	1.078-2.433	0.020[a]
Age (years)			(0.285)
18-24 yrs	1.00 (reference)	-	-
25-39 yrs	1.523	0.895-2.592	0.121
40-59 yrs	1.472	0.792-2.735	0.222
60 yrs >	0.987	0.490-1.985	0.970
Religion			0.137
Muslim	1.00 (reference)	-	-
Christianity	0.190	0.857-2.169	0.190
Traditional	0.595	0.623-2.284	0.595
Others	0.171	0.253-1.276	0.171
Marital status			0.818
Single	1.00 (reference)	-	-
Married	0.821	0.499-1.352	0.438
Divorced	1.023	0.524-1.997	0.947
Widow	0.710	0.319-1.583	0.403
Widower	0.646	0.142-2.933	0.571
Ethnicity			(0.661)
Yoruba	1.00 (reference)	-	-
Igbo	0.771	0.485-1.225	0.270
Hausa	0.786	0.445-1.387	0.406
Fulani	0.751	0.361-1.562	0.443
Gender			
Male	1.00 (reference)	-	-
Female	0.920	0.623-1.358	0.674
Education			(0.633)
No education	1.00 (reference)	-	-
Less secondary	0.847	0.413-1.738	0.650
Secondary	0.673	0.358-1.267	0.220
Higher college	0.783	0.362-1.692	0.533
University	0.614	0.307-1.227	0.168
Occupation			0.168
Unemployed	1.00 (reference)	-	-
Farming	0.633	0.336-1.192	0.157
Trader	0.986	0.042-1.794	0.964
Transporter/ driving	0.957	0.473-1.938	0.904
Office	1.138	0.619-2.091	0.678
Others	0.586	0.141-2.435	0.462

[a]Significant at 5% (P<0.05).

Some of the factors that could aid the spread of LF in an outbreak include the following: lack of diagnostic facilities in the rural areas; LF symptoms similar to other febrile illnesses, such as malaria and typhoid fever, thus leading to late presentation; un-curtailed rats in homes; inadequate knowledge; and poor prevention practices (1,9,11,24). Although early diagnosis will help reduce spread, diagnostic facilities are difficult to find in many rural communities in Africa, as none could be found in the study areas. Lack of proper barrier, infection prevention, and control practices exposes health workers to infection (22,30). Inter-border communal trade of farm produce within local communities, which is characterised by overcrowding and poor sanitation, could also aid the spread of LF in poorly informed communities. Spreading of semi-processed foods along the walk path to dry is a common practice in rural areas, and this has been observed to invite rodents, thereby enhancing the deposition of rat excreta or urine on such foods (9). Bush burning facilitates the unfettered migration of rodents from the bush to residential apartments. The burning of bush is an unwholesome practice, especially during the dry season (November-April) and this could also be responsible for prevalent outbreaks recorded during the dry season in some parts of Nigeria. Due to poor surveillance in many parts of the country and some of the aforementioned factors, some residents of these local communities would have died as a result of undiagnosed LF infection.

The study of LV and its pathogenicity in the endemic regions of West Africa can be rated as slow. Despite the disease was discovered more than 50 years ago, there has been no approved vaccine yet. This can be attributed to poor funding and its genetic variability, among other factors. Although it is a re-emerging infectious disease, killing thousands at a steady rate, it has been underrecognized (46). However, there have been some advances in the science of LF. Favipiravir, an aniviral agent was recognised as an effective therapeutic against LF in a guinea pig model (47). A vaccine meant for LF and rabies, LASSARAB, was developed in 2018, and was administered with GLA-SE adjuvant into mice and guinea pigs. The results showed the elicitation of antibodies against LF virus in the animal models (48). Also, recombinant vesicular stomatitis virus expressing Ebola virus glycoprotein was also developed by some scientists, and a vaccination trial was conducted in some parts of Guinea and Sierra Leone. The vaccine has been proven to be very effective against the Ebola virus (49). The provision of appropriate diagnostic facilities, efficient case management, and good surveillance systems applied during the COVID-19 epidemic should be applied against LF in the endemic regions of West Africa, so as to save lives and prevent future outbreaks.

Conclusions and recommendations

Although the residents of Iwo are better informed about LF than Oluponna residents, the general knowledge of the disease in both study areas is still inadequate. Accessing information through the health workers was very poor, despite the high level of awareness. The inadequate knowledge of the rural and semirural residents of Osun State, southwest Nigeria, implies that they are not fully prepared against a LF outbreak.

The government should allocate more funds to LF research, increase enlightenment campaigns about LF, especially in rural communities of Nigeria, provide adequate diagnostic facilities across the country, and ensure prompt treatment so as to prevent

Table VI. Association between the demographics on knowledge of causative organism, prevention and treatment of Lassa fever.

Factors	Knowledge of causative organism			Knowledge of prevention			Knowledge of treatment		
	Odd ratio	95% C.I	P-value	Odd ratio	95% C.I	P-value	Odd ratio	95% C.I	P-value
Location									
Oluponna	1.00	-	1.00	-	-	1.00		-	
Iwo	1.019	0.704-1.475	0.920	5.88	2.807-12.317	0.000[b]	1.648	1.122-2.420	0.011[a]
Age (years)			0.235	0.390				0.378	
18-24 yrs	1.00	-	-	1.00	-	-	1.00	-	-
25-39 yrs	0.923	0.564-1.510	0.749	1.786	0.825-3.863	0.141	0.998	0.597-1.670	0.995
40-59 yrs	1.523	0.841-2.760	0.165	1.044	0.357-3.053	0.937	1.355	0.732-2.507	0.334
60 yrs >	1.258	0.601-2.632	0.542	0.672	0.1976-4.5002	0.998	0.754	0.358-1.588	0.458
Religion			(0.405)	0.596				0.287	
Muslim	1.00	-	-	1.00	-	-	1.00	-	-
Christianity	1.253	0.820-1.917	0.297	1.644	0.780-3.465	0.191	1.282	0.824-1.996	0.270
Traditional	0.786	0.427-1.450	0.441	-	-	-	0.762	0.413-1.407	0.385
Others	1.084	0.407-2.885	0.872	2.272	0.196-26.400	0.512	0.826	0.312-2.186	0.700
Marital status			0.080	0.489				0.057	
Single	1.00	-	-	1.00	-	-	1.00	-	-
Married	0.954	0.602-1.513	0.842	0.822	0.384-1.761	0.615	1.044	0.646-1.688	0.860
Divorced	0.684	0.371-1.263	0.225	0.200	0.036-1.116	0.067	0.571	0.307-1.062	0.571
Widow	0.309	0.130-0.734	0.008[b]	0.885	0.071-11.051	0.924	0.389	0.167-0.902	0.028[a]
Widower	0.539	0.090-3.232	0.499	0.237	0.097-3.445	0.819	1.696	0.282-10.218	0.564
Ethnicity			0.308	0.539				0.880	
Yoruba	1.00	-	-	1.00	-	-	1.00	-	-
Igbo	1.280	0.832-1.970	0.261	1.070	0.523-2.192	0.852	0.931	0.595-1.456	0.752
Hausa	1.354	0.798-2.296	0.350	0.447	0.131-1.525	0.199	0.964	0.561-1.654	0.893
Fulani	0.694	0.323-1.492	0.238	1.305	0.313-5.449	0.7150	0.734	0.344-1.567	0.424
Education			0.502	0.440				0.772	
No education	1.00	-	-	1.00	-	-	1.00	-	-
Less secondary	0.967	0.509-1.835	0.776	1.316	0.339-5.120	0.852	0.843	0.442-1.606	0.603
Secondary	1.185	0.666-2.110	0.952	0.699	0.197-2.480	0.199	1.045	0.580-1.882	0.883
Higher college	1.656	0.831-3.300	0.295	0.979	0.263-3.651	0.715	1.037	0.512-2.100	0.919
University	1.774	0.933-3.375	0.307	1.587	0.490-5.145	0.440	1.291	0.665-2.507	0.451
Occupation			0.717	0.016				0.556	
Unemployed	1.00	-	-	1.00	-	-	1.00	-	-
Farming	1.399	0.743-2.635	0.299	0.237	0.048-1.167	0.077	0.964	0.505-1.840	0.911

Table VI. Continued.

	Knowledge of causative organism			Knowledge of prevention			Knowledge of treatment		
Factors	Odd ratio	95% C.I	P-value	Odd ratio	95% C.I	P-value	Odd ratio	95% C.I	P-value
Trader	1.397	0.796-2.451	0.244	0.233	0.081-0.669	0.007[b]	0.702	0.395-1.247	0.227
Transporter	1.030	0.533-1.993	0.929	0.093	0.011-0.773	0.028[a]	1.035	0.525-2.043	0.920
Office	1.451	0.835-2.523	0.187	0.934	0.404-2.162	0.874	1.114	0.625-1.984	0.715
Others	1.508	0.345-6.588	0.585	0.872	0.156-4.858	0.024[a]	2.829	0.331-24.196	0.342
Gender									
Male	1.00	-	-	1.00	-	-	1.00	-	-
Female	1.102	0.766-1.584	0.602	1.228	0.654-2.305	0.523	1.054	0.764-1.455	0.748

[a]Significant at 5%, [b]significant at 1% (P<0.01) (Odd ratios and 95% confidence interval).

LF infection. Health workers should be well informed and provided with appropriate personal protective equipment.

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Ethical approval and consent to participate

The approval for this study was received from the Research and Ethics Committee of Bowen University, Iwo, Nigeria (Reference No: BUREC/02/20). The consent of the respondents was received before the interview, and the responses from this study were kept anonymous and confidential.

Availability of supporting data

The data analyzed for this study are available upon request.

Consent for publication

Not applicable.

Competing interest

The authors declare no conflict of interest.

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References

1. Ogbu O, Ajuluchukwu E and Uneke CJ: Lassa fever in West African Sub-region: An overview. J Vector Borne Dis 44: 1-11, 2007.
2. Khan SH, Goba A, Chu M, Roth C, Healing T, Marx A, Fair J, Guttieri MC, Ferro P, Imes T, *et al*: New opportunities for field research on the pathogenesis and treatment of Lassa fever. Antiviral Res 78: 103-115, 2008.
3. Tobin EA, Asogun DA, Isah EC, Ugege OG and Ebhodaghe P: Assessment of knowledge and attitude towards Lassa fever among primary health care providers in an endemic suburban community of Edo State: implication for control. J Med Med Sci 4: 311-318, 2018.
4. Center for Disease Control and Prevention. Lassa fever. https://www.cdc.gov/vhf/lassa/index.html 2019. Accessed 20 October 2020.
5. Yun NE and Walker DH: Pathogenesis of Lassa fever. Viruses 4: 2031-2048, 2012.
6. Ijarotimi IT, Ilesanmi OS, Aderinwale A, Abiodun-Adewusi O and Okon IM: Knowledge of Lassa fever and use of infection prevention and control facilities among health workers during Lassa fever outbreak in Ondo State, Nigeria. Pan Afri Med J 30: 56, 2018.
7. Gunther S, Emmerich T, Laue T, Kühle O, Asper M, Jung A, Grewing T, Ter Meulen J and Schmitz H: Imported Lassa fever in Germany: Molecular characterization of a new Lassa virus strain. Emerg Infect Dis 6: 466-476, 2000.
8. Atkin S, Anaraki S, Gothard P, Walsh A, Brown D, Gopal R, Hand J and Morgan D: The first case of Lassa fever imported from Mali to the United Kingdom, February 2009. Euro Surveill 14: 19145, 2009.
9. Oladeinde BH, Omoregie R and Odia I: Public awareness of Lassa fever in three rural communities of Nigeria. Int J Health Promot Educ 53: 128-135, 2015.
10. Adebimpe WO: Knowledge and preventive practices against Lassa fever among primary health care workers in Osogbo. Univ Mauritus Res J 21: 579-594, 2015.
11. Akpede GO, Asogun DA, Okogbenin SA, Dawodu SO, Momoh MO, Dongo AE, Ike C, Tobin E, Akpede N, Ogbaini-Emovon E, *et al*: Caseload and case fatality of Lassa fever in Nigeria, 2001-2018: A specialist Center's Experience and its implication. Front Public Health 7: 170-188, 2019.

12. Fichet-Calvet E and Rogers DJ: Risk Maps of Lassa fever in West Africa. PLoS Negl Trop Dis 3: e388, 2009.
13. Kelly JD, Barrie MB, Ross RA, Temple BA, Moses LM and Bausch DG: Housing equity for health equity: A rights-based approach to the control of Lassa fever in post-war Sierra Leone. BMC Int Health Hum Rights 13: 2, 2013.
14. Bonwitt J, Saez AM, Lamin J, Ansumana R, Dawson M, Buanie J, Lamin J, Sondufu D, Borchert M, Sahr F, *et al*: At Home with Mastomys and Rattus: Human-rodent interactions and potential for primary transmission of Lassa virus in domestic spaces. Am J Trop Med Hyg 96: 935-943, 2017.
15. Olayemi A, Oyeyiola A, Obadare A, Igbokwe J, Adesina AS, Onwe F, Ukwaja KN, Ajayi NA, Rieger T, Günther S and Fichet-Calvet E: Widespread arenavirus occurrence and seroprevelence in small mammals, Nigeria. Parasit Vectors 11: 416, 2018.
16. Dan-Nwafo CC, Ipadeola O, Smout E, Ilori E, Adeyemo A, Umeokonkwo C, Nwidi D, Nwachukwu W, Ukponu W, Omabe E, *et al*: A cluster of nosocomial Lassa fever cases in a tertiary health facility in Nigeria: Description and lesson learned, 2018. Int J Infect Dis 83: 88-94, 2019.
17. Center for Disease Control and Prevention. Lassa fever. https://www.cdc.gov/vhf/lassa/transmission/index.html 2014. Accessed 17 October 2020.
18. Stephenson EH, Larson EW and Dominik JW: Effect of environmental factors on aerosol-induced Lassa virus infection. J Med Virol 14: 295-303, 1984.
19. Tambo E, Adetunde OT and Olalubi OA: Re-emerging Lassa fever outbreak in Nigeria: Re-enforcing 'One Health' community surveillance and emerging response practice. Infect Dis Poverty 7: 37-43, 2018.
20. Branco LM, Boisen ML, Anderson KG, Grove JN, Moses LM, Muncy IJ, Henderson LA, Schieffellin JS, Robinson JE, Bangura JJ, *et al*: Lassa hemorrhagic fever in a late term pregnancy from northern Sierra Leone with a positive maternal outcome: A case report. Virol J 8: 404-417, 2011.
21. World Health Organization. Lassa fever. https://www.who.int/news-room/fact-sheets/detail/lassa-fever 2017 Accessed 10 July 2020.
22. World Health Organization. Factors that contribute to undetected spread of Ebola virus and impeded rapid containment. Https://www.who.int/csr/disease/ebola/one-year-report/factors/en/. Accessed 22 October 2020.
23. Balkhy HH, Abolfotouh MA, Al-Hathlool RH and Al-Jumah MA: Awareness, attitude and practices related to the swine influenza pandemic among the Saudi Public. BMC Infect Dis 10: 42-48, 2010.
24. Richmond JK and Baglole DJ: Lassa fever: Epidemiology, clinical features and social consequences. BMJ 327: 1271-1275, 2003.
25. Oboratare O, Chukwuyem A, Emmanuel O and Obekpa AS: Housing factors and transmission of Lassa fever in a rural area of south-south Nigeria. General Health Med Sci 1: 15-20, 2014.
26. Morgan EA, Amos ET, Divine AC, Emaediong E, Mfon IM, Anietie MH, Sylvester UJ and UtibeSamuel A: Knowledge and prevention of Lassa fever among adults in a rural community in southern Nigeria. Saudi Med J 3: 393-399, 2018.
27. Ndu AC, Kassy WC, Ochie CN, Arinze-Onyia SU, Okeke TA, Aguwa EN, Okwor TJ and Chinawa A: Knowledge, misperception and barriers towards Lassa fever control among health care workers in a tertiary institution in Enugu, Nigeria. J Health Care Poor Underserved 30: 1151-1164, 2019.
28. McCormick JB, King IJ, Webb PA, Scribner CL, Craven RB, Johnson KM, Elliott LH and Belmont-Williams R: Lassa fever: Effective therapy with Ribavirin. N Engl J Med 314: 20-26, 1986.
29. Nigeria Center for Disease Control. Lassa fever situation report. https://www.ncdc.gov.ng. Accessed 20 June 2020.
30. National Population Commission of Nigeria (NPC). Population and housing census of the Federal Republic of Nigeria. 2006. Available from: http://www.population.gov.ng. Accessed 20 June 2020.
31. Shaffer JG, Schieffelin JS, Momoh M, Goba A, Kanneh L, Alhasan F, Gbakie M, Engel EJ, Bond NG, Hartnett JN, *et al*: Space-time trends in Lassa fever in Sierra Leone by ELISA Serostatus, 2012-2019. Microorganisms 9: 586, 2021.
32. Jetoh RW, Malik S and Shobayo B: Epidemiology characteristics of Lassa fever cases in Liberia: A retrospective analysisof Surveillance data, 2019-2020. Int J Inf Dis 122: 767-774, 2022.
33. Huhn N: Lassa fever outbreak in Liberia. Outbreak Observatory 2021 www.outbreakobservatory.org. Date Accessed 12/08/2022.
34. Wiley MR, Fakoli L, Letizia AG, Welch SR, Ladner JT, Prieto K, Reyes D, Espy N, Chitty JA, Pratt CB, *et al*: Lassa virus circulating in Liberia: A retrospective genomic characterization. Lancet Infect Dis 19: 1371-1378, 2019.
35. World Health Organization (WHO). Lassa fever-Guinea 2022 www.who.int.org Date Accessed 12/08/2022.
36. Brosh-Nissimov T: Lassa fever: Another threat from West Africa. Disaster Mil Med 2: 8, 2016.
37. Lehmann C, Kochanek M, Abdulla D, Becker S, Böll B, Bunte A, Cadar D, Dormann A, Eickmann M, Emmerich P, *et al*: Control measures following a case of reported Lassa fever from Togo, North Rhine Westphalia, Germany, 2016. Euro Surveill 22: 17-00088, 2017.
38. Asogun DA, Adomeh DI, Ehimuan J, Odia I, Hass M, Gabriel M, Olschläger S, Becker-Ziaja B, Folarin O, Phelan E, *et al*: Molecular diagnostics for Lassa fever at Irrua specialist teaching hospital, Nigeria: Lesson learnt from two years of laboratory operation. PLoS Negl Trop Dis 6: e1839, 2012.
39. Usuwa IS, Akpa CO, Umeokonkwo CD, Umoke M, Oguanuo CS, Olorukooba AA, Bamgboye E and Balogun MS: Knowledge and risk perception towards Lassa fever infection among residents of affected communities in Ebonyi State, Nigeria: Implication for risk communication. BMC Public Health 20: 217, 2020.
40. Rivera-Hernandez M: The role of religious leaders in health promotion for older Mexicans with diabetics. J Relig Health 54: 303-315, 2015.
41. Ateshim Y, Bereket B, Major F, Emun Y, Woldai B, Pasha I, Habte E and Russom M: Prevalence of self-medication with antibiotics and associated factors in the community of Asmara, Eritrea: A descriptive cross sectional survey. BMC Public Health 19: 726, 2019.
42. Dolopei D, Amo-Addae M, Adewuyi P, Wilson H, Shannon F, Lawubah J, Woods O, Gbearr O, Deodeh VK, Sanley A, *et al*: Knowledge, attitude and practices (KAP) regarding Lassa fever disease among adults in endemic and non-endemic countries of Liberia, 2018: A cross-sectional study. J Interventional Epidemiol Public Health 4: 9, 2021.
43. Fatiregun AA, Isere E, Dosumu M, Agunbiade O and Onyibe R: Lassa fever awareness and knowledge among community residents in Ondo State, Nigeria. J Community Med Pry Health Care 31: 26-35, 2019.
44. Orji MLC, Nwaneri DU, Obu DC and Anyanwu OU: Household rat infestation and methods of its control in a Lassa fever endemic community in Southeast Nigeria. Niger J Med 29: 601-606, 2020.
45. Marien J, Lo IG, Rieger T, Magassouba N, Gunther S and Fichet-Calvet E: Households as hotspots of Lassa fever? Assessing the spatial distribution of Lassa virus-infected rodents in rural villages of Guinea. Emerg Microbes Infect 9: 1055-1064, 2020.
46. Fischer WA II and Wohl DA: Moving Lassa fever research and care into the 21st century. J Infect Dis 215: 1779-1781, 2017.
47. Safronetz D, Rosenke K, Westover JB, Martellaro C, Okumura A, Furuta Y, Geisbert J, Saturday G, Komeno T, Geisbert TW, *et al*: The broad-spectrum antiviral favipiravir protects guinea pigs from lethal Lassa virus infection post-disease onset. Sci Rep 5: 14775, 2015.
48. Abreu-Mota T, Hagen KR, Cooper K, Jahrling PB, Tan G, Wirblich C, Johnson RF and Schnell MJ: Non-neutralizing antibodies elicited by recombinant Lassa-Rabies vaccine are critical for protection against Lassa fever. Nat Commun 9: 4223, 2018.
49. Henao-Restrepo AM, Longini IM, Egger M, Dean NE, Edmunds WJ, Camacho A, Carroll MW, Doumbia M, Draguez B, Duraffour S, *et al*: Efficacy and effectiveness of an rVSV-vectored vaccine expressing Ebola surface glycoprotein: Interim results from the Guinea ring vaccination cluster-randomised trial. Lancet 386: 857-866, 2015.