Knowledge and practices of foodstuff traders on Lassa fever and rodent control in Izzi Local Government Area, Ebonyi State, Nigeria

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ABSTRACT

Introduction: Lassa fever (LF) could be transmitted through food contamination with excreta or body fluids of infected *Mastomys natalensis*. Foodstuff markets in rural areas are usually rodent infested with possibility of foodstuff contamination with Lassa virus. We assessed the knowledge and practices of foodstuff traders on LF and rodent control in rural markets. **Methods:** A cross-sectional study was carried out in three rural markets in Ebonyi State in 2017. We administered questionnaire on 111 respondents selected via multi-stage sampling. Knowledge of LF and rodent control practices were assessed using cut-off of 75% and their relationship with socio-demographic characteristics were explored using crude odds ratio and logistic regression. **Results:** Mean age of respondents was 33.6±9.2 years, majority were females 67/111 (60.4%), married 81/111 (73.0%) and had secondary education 45/111 (40.5%). Although all respondents had heard of LF, 34/111 (30.6%) knew any symptom of LF, 51/111 (46.0%) knew any route of transmission, 24/111 (21.6%) knew any practices exposing one to LF infection, and 40/111 (36.0%) knew any preventive measures against LF infection. Fifty-two percent of respondents covered their wares, 57/111 (51.4%) blocked rodent access into their shops, while 16/111 (14.4%) used chemical agents to control rats. None used traps/cats for rodent control. Overall, 32/111 (28.8%) respondents had good knowledge of LF and 15/111 (13.5%) had good practice of rodent control. **Conclusion:** Many foodstuff traders had poor knowledge of LF and poor practices of rodent control. These traders should be targeted for sensitization on LF and rodent control to minimize contamination of foodstuff.

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Introduction

In recent times, more cases of Lassa fever (LF) have been reported in West Africa. Annually, Lassa fever virus (LASV) infects approximately 300,000 people and causes about 3,000 deaths in affected Africa countries [1]. LF is endemic in Nigeria with annual peak of its cases observed in the dry season (December-April), and its incidence decreases around May [2,3]. In the last few years, the incidence of the disease has been on the increase in Nigeria [4,5]. Disease seasonality may be linked to the increasing temperature and decreasing relative humidity of the dry season in which there could be stability of LASV [6,7]. This season is also the period of harvest when bags of grains are stored in homes and rodent numbers increase rapidly in communities [8].

Infection with the virus is largely under-diagnosed as early symptoms are mild and similar to those of other diseases such as malaria or typhoid fever in endemic areas [9]. The existence of very few diagnostic facilities for LF in Nigeria is also contributory to the problem of under-diagnosis [3]. Delay in diagnosis may arise due to late presentation to treatment facility which could lead to severity of disease and possibly death [10,11]. Case fatality rate of LF in Nigeria has remained between 20% and 25% in the past two years of increasing epidemics [12]. Ebonyi State has recorded cases of LF since 2005 with the event of the disease among healthcare workers also [10,13]. It is one of the three states with high endemicity for LF in Nigeria. There is no known documentation for the reason(s) for its high endemicity. During the 2018 LASV outbreak, about 15% of confirmed cases were detected in this state [14].

Mastomys natalensis, the reservoir host for the virus are prolific and are distributed throughout West, Central and East African countries [15]. These rodents are predominantly found in houses in rural areas during the dry season when there is scarcity of food in farms. They then disperse into surrounding fields again in the rainy season to feed on cultivated crops [7]. Other common rodent species have also been implicated in LASV transmission [16]. Some Nigerian studies on small mammals identified rodents (*Mastomys natalensis, M. erythroleucus* and *Hylomyscus pamfi*) known as reservoirs of LASV and LASV-like arenaviruses which were present in all ecological zones sampled and both in areas endemic and non-endemic for Lassa fever [17,18]. *M. erythroleucus* was IgG-positive for LASV in Ndubia, a community in Izzi Local Government Area (LGA) of Ebonyi State [18]. There are ongoing rodent studies in the state to identify the rodents that harbour LASV. Infected rodents remain carriers throughout life and are asymptomatic, they shed the virus through their urine, faeces, saliva, respiratory secretion and exposed blood vessels through micro- or macro-trauma [19].

Humans presumably become infected when these rodent excreta or body fluids make contact with breached skin or mucous membranes or by ingestion of contaminated food or drink. The virus is also transmitted by inhalation of aerosols produced by infected rodents [2,20]. Some sources have mentioned that transmission of LASV through food items as fomites occurs [21-23]. The virus achieves some stability with increasing temperature and decreasing relative humidity [6,7]. Hunting and consumption of peri-domestic rodents is another known route of LASV transmission to humans [24]. The virus also spreads between humans via contact with body fluids of infected persons or contaminated medical equipment [25].

Persons living in rural areas, especially with poor sanitation, where rodents thrive are at greater risk of infection. In rural areas of Nigeria, foodstuff markets are usually dirty and congested and thus creating opportunity for rodent infestation [26]. Activities of rodents in these markets increase the possibility of contaminating human food with infected excreta and other body fluids. This increases the chance of human infection both in the markets and at home after purchase of contaminated foodstuffs.

There have been several cases of food-borne illnesses and poisonings in Nigeria, with a strong need for regulation and legislation [27]. At the level of food production/ trading, use of chemicals have been reported while at food consumption level, poor hygiene and ineffective food storage could contribute to food-borne illnesses [27]. One of the goals of Nigeria´s National Policy on Food Safety and Its Implementation Strategy is to minimise the incidence of risks associated with physical, chemical and biological hazards in foods and water [28]. However, the issue of food safety in Nigeria is exacerbated by public ignorance on the subject,

uncoordinated approach to food control, lack of technical expertise, poorly equipped laboratories, poor enforcement of legislation and regulatory limits [29]. In Nigeria, the LGAs are responsible for traditional markets and inspection activities are carried out by Environmental Health Officers [29]. Ingestion of contaminated food items is one of the documented routes of LF transmission. We aimed to assess knowledge of foodstuff traders in rural markets of Izzi LGA on LF and their practices towards protection of their foodstuff from rodents.

Methods

Study area/setting

The study was carried out in Izzi LGA in Ebonyi State located in south-eastern Nigeria. Izzi LGA is one of the areas that have repeatedly recorded cases of the disease in the state. As obtained from the Ministry of Health, the projected population of Izzi LGA as at 2016 was 313,200. The LGA is predominantly inhabited by Izzi-speaking people, a subgroup of the Igbo ethnic group. It is entirely rural and majorly agrarian. The major market days in Izzi communities are every five days. However, daily trading also goes in small scale in these markets. Commonly, food items are displayed in the shops and stored in shops at the close of daily trading with possibility of rodent contamination at night. Typically, the shops have doors and without windows. An LGA is an administrative division of Nigeria that a local government (the smallest of the three tiers of government) is responsible for. In Ebonyi State, there are thirteen LGAs. It has a diagnostic and treatment centre for LF located in Alex Ekwueme Federal University Teaching Hospital, Abakaliki. The state has reported outbreaks of LF since 2005.

Study design and population

A cross-sectional study was carried out between June and December 2017 among foodstuff traders in three rural markets, namely Nwezenyi, Iboko and Iziogo markets out of 8 major markets in Izzi LGA, Ebonyi State, Nigeria.

Sampling/sample size considerations Sample size was determined using the formula for estimating minimum sample size for cross-sectional studies;

$$n = \frac{Z^2\, p(1-p)}{d^2}$$

Z = standard normal deviate set at 1.96 which corresponds to 95% confidence limit; p = 0.074 as proportion of respondents with good knowledge of LF in a similar rural-based study in Nigeria(30); d = desired level of precision set at 0.05. Based on the calculation, the minimum sample size was 106. We used multi-stage sampling to recruit 111 foodstuff traders. In the first stage, 3 markets were selected through simple random sampling out of the list of 8 major markets in Izzi LGA. The second stage involved approaching all foodstuff traders who were available on the days of data collection to be recruited into the study. Those who gave written consent were recruited to participate in the study.

Data collection

Data were collected between June and December 2017 using pre-tested, structured interviewer-administered questionnaire. Participants' information on socio-demographics, knowledge of LF (symptoms, prevention, transmission and bad practices) and rodent control practices were obtained by trained research assistants who could speak the local dialect so as to translate the content of the questionnaire for those who could not communicate in English. They were trained by the primary author on data collection for two days. Only foodstuff traders available on the days of the survey were interviewed.

Statistical analysis

The independent variables were socio-demographic characteristics (age, gender, religion, educational and marital status). Dependent variables were knowledge of LF and rodent control practices. A

total of 5 questions (Yes/No) and each of the 4 questions specifically to assess knowledge was scored 2 points for appropriate answer and 0 point for inappropriate answer. Knowledge was categorised into ***poor knowledge*** (< 75% of the percentage score) and ***good knowledge*** (≥ 75% of the percentage score). Four questions (Yes/No) assessed rodent control practices and each was scored 2 points for appropriate answer and 0 point for inappropriate answer. A score of 75% and above was taken as ***good practice*** while less than 75% was interpreted as ***poor practice***.

Data were entered and analysed with SPSS version 20.0. Frequencies and proportions were generated and presented using tables. Crude odds ratios (COR) were used for bivariate analysis. We used a p-value of 0.1 as a cut-off in selecting variables from the bivariate analysis to be modelled into logistic regression. Adjusted odds ratios (AOR) were calculated with 95% confidence interval (CI) used to determine statistical significance. P-value < 0.05 was considered statistically significant.

Ethical considerations

Ethical approval was obtained from Ebonyi State Ethical Review Committee. Respondents were informed of their voluntariness to participate in the study, and confidentiality and anonymity of data collected were maintained by avoiding inclusion of possible identifiers, such as names and contact details.

Results

In total, 111 foodstuff traders were interviewed from three rural markets. Majority of the respondents were females 67/111 (60.4%). Respondents´ mean age was 33.6 (±9.2) years. Majority of the participants were Christians (92.8%). Over one-third of the traders had secondary education 45/111 (40.5%) and most of them were married 81/111 (73.0%) (**Table 1**).

All the respondents (100.0%) were aware of LF. However, only 34/111 (30.6%) had knowledge of any of its symptoms and 51/111 (46.0%) knew about any of its possible routes of transmission. Twenty-four (21.6%) of them had knowledge of any bad practices that could contribute to contracting the disease, while 40/111 (36.0%) were knowledgeable of any preventive measures against it (**Table 2**). Table 3 shows the association between participants´ socio-demographic characteristics and poor knowledge of LF. Gender and marital status were statistically significant predictors of knowledge of LF among study participants. Female participants had 0.223 odds of having poor knowledge compared to their male counterparts (95% CI = 0.087-0.571). Similarly, married participants had 0.292 odds of having poor knowledge compared to those that were not currently married (95% CI = 0.106-0.806) (**Table 3**).

Fifty-eight (52.3%) of the foodstuff traders made effort to prevent rats from accessing food stuff by covering bowls used for storage or obliterating openings on sacks containing foodstuff. Access/holes through which rats could get into their shops were blocked by 57/111 (51.4%) respondents. Only 16/111 (14.4%) used rat poisons in their shops but none of the respondents put traps against rats in shops and none of them kept cats as a biological control agent against rats in the market (**Table 4**).

Table 5 shows the association between participants´ socio-demographic characteristics and good practice of rodent control in their shops. Only gender was a statistically significant predictor of rodent control practices. Female participants had 0.269 odds of having poor rodent control practices compared to the males (95% CI = 0.083-0.867) (**Table 5**). Overall, 32/111 (28.8%) respondents had good knowledge of LF whereas only 15/111 (13.5%) of them had good practice on rodent control (**Table 6**).

Discussion

In this study, all the participants had heard about LF. This was higher than an earlier finding in a market in Izzi LGA reporting about three-quarter being aware of the disease, although the participants were traders generally and not only foodstuff traders [31]. In some other Nigerian studies, awareness was far less [30,32]. Lower awareness of LF may be because the study areas are non-endemic for the disease. Furthermore, the knowledge of LF among foodstuff traders in selected rural markets in Izzi LGA was generally poor with only about one-fourth having good knowledge. This may be connected with low level of education observed in this group as over half

of the respondents had primary or no formal education. But in this study, education was not a statistically significant predictor of knowledge of LF, however, other studies in Nigeria have shown that attainment of higher level of education is associated with having good knowledge of LASV [31,32].

The poor knowledge of LF despite annual epidemics of LF in the state is disturbing considering the fact that LASV is endemic in Ebonyi State [10,31]. The state had reported LF epidemics since 2005 and lately the disease is seen all year round. Poor knowledge among these key stakeholders involved in handling foodstuff is therefore worrisome. The efforts in recent years to identify the source of annual outbreaks and effectively stop the needless deaths mean that every important stakeholder needs to be reached with the appropriate message and behaviour change. The educational level of this segment of the population may require methods of communication like the radio jingle and information and educational communication materials like pictures and diagrams. These methods should contain more details about LF to improve knowledge beyond being aware of the disease. Also, being female and married were significant predictors of knowledge of LF whereas in some other studies these did not predict knowledge of the disease [31,32].

Despite the low proportion of good knowledge of LF, rodent control practices were majorly poor with about one-seventh with good practices. Only being female was a significant predictor of rodent control practices. About half of the traders have adopted methods of reducing rat infestation in their shops by blocking rats′ access/holes and storing food items in covered bowls or tied sacks. Assessment of Bodija market in Ibadan Nigeria identified access through doors that were not rat-proof and holes on the floors and roofs of foodstuff stores [33]. Many of the respondents may have been motivated to cover food items they sell to reduce damage and loss of their goods. If knowledge of the disease is raised, they may be further motivated to continue the practice considering the extra benefit of disease control this will offer. However, in a study in Sierra Leone where flour bags (similar to sacks used for storage in this study) and covered buckets were used to store food items, it was common to see container bags eaten through by rodents with possibility of damage of food items [34]. Therefore, use of bowls/buckets made of materials that cannot be easily destroyed by rodents may be more protective while sacks (when used) should be hanged off the floor or kept on raised surfaces/platforms.

Notably, some respondents used poisons against rats in their shops. While this approach may reduce rat population in foodstuff shops, there is possibility of chemical contamination of food items from their usage. Use of poisons is not recommended for control of rodents in storage facilities for food items [33]. Although, a study showed that poisons are commonly used for rodent control in households [34]. Among the methods recommended to control rodents against food items is use of rat traps [33], however, in this study no respondent used them in their shops. Furthermore, despite the fact that presence of cats has been reported to result in fewer rodents in some houses [34-36], none of the respondents had cats in their shops in the market. A study in some communities noted that use of cats as predators were discouraged as cats were associated with witchcraft [26]. On use of rat traps, a study on its acceptability noted that most respondents not willing to pay for actual cost of these traps as they are more expensive compared to poisons [37]. The authors did not find out reasons for non-use of cats or rat traps for rodent control, but there is need for further studies on perception of the people about their use in controlling rodents in Ebonyi State.

Conclusion

The high level of awareness of LF is commendable in an endemic state. It may have been due to increase in media campaigns about the disease in the state. However, results of this study showed that most foodstuff traders had poor knowledge of LF, hence the need to improve the content of information about LF disseminated among foodstuff traders in markets especially rural markets so as to increase the knowledge of the disease. Also, most foodstuff traders had poor practices of rodent control; hence, in order to achieve better control of LF, it is important to improve rodent control in markets so as to reduce contamination of food items. This could be achieved through engagement of the foodstuff traders on rodent control measures that is acceptable to them and also effective. Environmental Health Officers may also be instrumental through the LGA structure in carrying out market inspections and sanitation sensitisations/campaigns to make the

markets neater and ensure safe storage of food items. These might contribute to reduction of spread of LF through food contamination.

What is known about this topic

- In recent times, more cases of Lassa fever (LF) have been reported in West Africa
- LF is endemic in Nigeria with annual peak of its cases observed in the dry season (December–April), and its incidence decreases around May
- In rural areas of Nigeria, foodstuff markets are usually dirty and congested and thus creating opportunity for rodent infestation

What this study adds

- The high level of awareness of LF is commendable in an endemic state
- There is poor knowledge of LF among foodstuff traders in Izzi LGA of Ebonyi State
- There is poor practice of rodent control measures among foodstuff traders in Izzi LGA of Ebonyi State

Competing interests

The authors declare that they have no competing interests.

Ethical approval: Ethical approval was obtained from Ebonyi State Ethical Review Committee. Respondents were informed of their voluntariness to participate in the study, and confidentiality and anonymity of data collected were maintained by avoiding inclusion of possible identifiers, such as names and contact details.

Authors' contributions

ASA and AVO are first authors and equally contributed to the work

ASA and AVO conceived and designed the study. ASA and AVO performed data collection. ASA, INO and AVO performed data analysis. ASA, AVO, CDU, INO, ABU and MBS contributed to the interpretation of the data. ASA, AVO, CDU, INO, ABU and MBS were involved in writing the manuscript at draft and revision stages. All authors have read and approved the final version.

Tables and figures

Table 1: Socio-demographic characteristics of foodstuff traders in rural markets of Ebonyi State, Nigeria, 2017 (N=111)

Table 2: Knowledge of Lassa fever among foodstuff traders in rural markets of Ebonyi State, Nigeria, 2017 (N=111)

Table 3: Factors associated with knowledge of Lassa fever among foodstuff traders in rural markets of Ebonyi State, Nigeria, 2017 (N=111)

Table 4: Practice of rodent control among foodstuff traders in rural markets of Ebonyi State, Nigeria, 2017 (N=111)

Table 5: Factors associated with rodent control practices among foodstuff traders in rural markets of Ebonyi State, Nigeria, 2017 (N=111)

Table 6: Proportion of respondents with good knowledge of Lassa fever and rodent control practices (N=111)

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Table 1: Socio-demographic characteristics of foodstuff traders in rural markets of Ebonyi State, Nigeria, 2017		
Variable	**Frequency (N=111)**	**Percent (%)**
Age group (Years)		
11 – 20	6	5.4
21 – 30	36	32.4
31 – 40	47	42.4
41 – 50	17	15.3
51 – 60	5	4.5
Gender		
Male	44	39.6
Female	67	60.4
Religion		
Christian	103	92.8
Traditional	6	5.4
Islam	2	1.8
Educational Status		
No formal education	29	26.1
Primary	33	29.8
Secondary	45	40.5
Tertiary	4	3.6
Marital Status		
Single	23	20.7
Married	81	73.0
Separated	7	6.3

Table 2: Knowledge of Lassa fever among foodstuff traders in rural markets of Ebonyi State, Nigeria, 2017		
Knowledge Variable	**Frequency (N=111)**	**Percent (%)**
Knowledge of any symptoms of LF	34	30.6
Knowledge of any route of LF transmission	51	46.0
Knowledge of any practices that contribute to acquiring LF	24	21.6
Knowledge of any preventive measures against LF	40	36.0

Table 3: Factors associated with knowledge of Lassa fever among foodstuff traders in rural markets of Ebonyi State, Nigeria, 2017					
Variable	**Knowledge status (N=111)**		**COR (95% CI)**	**P-value**	**AOR (95% CI)**
	Poor knowledge (%)	**Good knowledge (%)**			
Age					
≤30 years	31 (73.8)	11 (26.2)	1.233 (0.523-2.908)	0.632	
>30 years	48 (69.6)	21 (30.4)	Ref		
Gender					
Female	55 (82.1)	12 (17.9)	3.819 (1.614-9.039)	0.002	0.223 (0.087-0.571)
Male	24 (54.5)	20 (45.5)	Ref		
Educational status					
≤ Primary	50 (80.6)	12 (19.4)	Ref		
≥ Secondary	29 (59.2)	20 (40.8)	0.348 (0.149-0.814)	0.013	2.247 (0.864-5.846)
Marital status					
Married	64 (79.0)	17 (21.0)	3.765 (1.541-9.199)	0.003	0.292 (0.106-0.806)
Single/others	15 (50.0)	15 (50.0)	Ref		

Table 4: Practice of rodent control among foodstuff traders in rural markets of Ebonyi State, Nigeria, 2017		
Practices	**Frequency (N=111)**	**Percent (%)**
Foodstuff stored in covered bowls or tied sacks	58	52.3
Block rats' access/holes in the shops	57	51.4
Use of poisons against rats in the shops	16	14.4
Use of traps/cats against rats in the shops	0	0.0

Table 5: Factors associated with rodent control practices among foodstuff traders in rural markets of Ebonyi State, Nigeria, 2017					
Variable	**Practice status (N=111)**		**COR (95% CI)**	**P-value**	**AOR (95% CI)**
	Poor practice (%)	**Good practice (%)**			
Age					
≤30 years	38 (90.5)	4 (9.5)	1.802 (0.534-6.074)	0.337	
>30 years	58 (84.1)	11 (15.9)	Ref		
Gender					
Female	62 (92.5)	5 (7.5)	3.647 (1.152-11.543)	0.021	0.269 (0.083-0.867)
Male	34 (77.3)	10 (22.7)	Ref		
Educational status					
≤ Primary	57 (91.9)	5 (8.1)	Ref		
≥ Secondary	39 (79.6)	10 (20.4)	0.342 (0.109-1.079)	0.059	2.997 (0.924-9.722)
Marital status					
Married	70 (86.4)	11 (13.6)	0.979 (0.286-3.349)	1.000	
Single/others	26 (86.7)	4 (13.3)	Ref		

Table 6: Proportion of respondents with good knowledge of Lassa fever and rodent control practices		
Variable	**Frequency (N=111)**	**Percent (%)**
Knowledge status		
Good knowledge	32	28.8
Poor knowledge	79	71.2
Practice status		
Good practice	15	13.5
Poor practice	96	86.5