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Risk Perception of Lassa Fever and Rodent Control Practices in a University Campus in South-South Zone of Nigeria.

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Abstract

Lassa fever is a zoonotic disease endemic to Nigeria and the Mano River Union countries in West Africa. This study determined the risk perception and rodent control within the university. Personal and public considerations about safety of agricultural produce and the general living environment were investigated among students and staff within the university community using selected socio-economic variables impacting risks of Lassa fever (LF). Results indicated that higher education was associated with hygiene-related knowledge of LF (73.4%), compared to 37.3% of respondents with basic education who demonstrated poor knowledge of transmission of the disease ($p<0.0001$). High risk awareness was linked to information dissemination on LF in media and campaigns (75.5%), in comparison with native oral transmission of information about the disease (24.5%). Risk perception was significantly associated with measures aimed at rat control amongst respondents ($p<0.02$). The inability of staff (32.4%) and student (46.1%) to recognize Mastomys as LF-virus reservoir as well as contact of rats with human food amongst staff (7.0%) and students (11.3%) demonstrates the persistent public health threat in endemic areas. Cultural practices such as eating of rats (4.4%) and rat hunting practices (6.1%) further corroborates the value of a one-health agenda for LF control.

Keywords: Risk Perception, Lassa fever, Rodent, Control Practices

Introduction

Lassa fever (LF) is an acute and sometimes fatal disease caused by a single-stranded, negative-sensed RNA virus belonging to a diverse group of viruses Arenavirus of the family Arenaviridae. Other arenaviruses known to be pathogenic in humans causing hemorrhagic fevers include Lujo virus in Africa; and Junin, Machupo, Guanarito, Sabia and Chapare viruses in South America. (1,2,3) The disease is zoonotic and endemic in the Lassa fever belt of West Africa that includes Sierra Leone, Guinea, Liberia (the Mano River Union region) and Nigeria. (4,5) Though the natural reservoir of arenaviruses is apparently restricted to single rodent species, *M. natalensis*, the viruses may have adapted to other hosts during their evolution. Arenaviruses has been detected in different African rodents but has not yet been linked to human diseases.

The disease affects an estimated 500,000 individuals annually with a case fatality rate of up to 90% for pregnant women and 15-20% in symptomatic and hospitalized cases. Transmission to man occurs from exposure to secretions and excretions of infected rat (through ingestion of contaminated food or water) or patient.

The order Rodentia comprises more than 40% of all mammalian species. It is the most numerous and evolutionarily diverse taxon of mammals. About one-third of rodent species belong to the super family Muroidea (mice, rats, and hamsters). They are probably the most successful in adaptation to terrestrial competition in comparison to other mammalian orders. Its success gives credence to its remarkable rate of chromosome rearrangements differentiating these extremely close species which is tenfold higher than between human and cat, which are rather distant. The chromosomal differentiation in mouse genome is aided by the possession of unusual chromosomes such as chromosome 17 which combines fragments of many chromosomes.

Apparently one of the most important species of rats in sub-saharan Africa is the multimammate rat *Mastomys natalensis*. *M. natalensis* belong to the super order Euarchontoglires and order Rodentia with some identified 2,277 species. The genus *Mastomys* has a wide distribution in Africa, characterized by inter-and intra-specific karyological variability while exhibiting little morphological and genetic differentiation. (6,7,8,9,10,11,12) It has been described as perhaps, the commonest of all athropophilous rodents in food stores and houses; and the largest in geographic distribution within the genus. (13) Through damages to cultivated fields and transmission of zoonoses, it remains responsible for major agricultural and public health problems. However, its role as the putative reservoir for Lassa fever virus and other diseases of zoonotic importance in West Africa is perhaps more widely known.

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Since the first recorded case of Lassa fever disease in 1969, and despite its epidemicity and high contagious nature in Nigeria and other African countries, elucidation of the disease dynamics and comprehensive responses to contain it has not been well documented in these places. Even worse, it is difficult to learn from these experiences to improve the management of future outbreaks. (14)

Socio-cultural factors such as poverty, low educational level, deficiency in home technologies, high demographic density, and rural living have largely influenced the transmission and persistence of infection. (15) Selected interventions designed to improve any of these situations may fail if they are applied in an isolated manner. The holistic implementation of interventions as compared to selective interventions has proved successful in the control and prevention of infections in several parts of the world. (16) Using Nigeria as a case study, there is little research, if any, looking at macro socio-economic and ecological trends which may drive exposure to the disease at the Local Government, State and National level. Patterns of transmission linked to farming practices and livelihood strategies, old and new, and across gender roles are not known. Even more pertinent is the holistic approach incorporating all possible disease models such as rat-rat and rat-man models in elucidation of transmission pattern of Lassa fever disease. Though rats are widely known to be the carriers of Lassa fever, preventive strategy and communication relying solely on giving biomedical information which overlooks the realities and perspectives of people at risk of the disease will have limited effect.

Objectives of the Study

The objectives of the study are:

1. To assess the risk of transmission of Lassa fever disease posed to students and staff of the University by rat in and around residential dwellings within the University campuses.
2. To assess University of Benin students and staff perception of the risk from exposure to rodent secretions and excretions in transmission of Lassa fever disease.
3. The knowledge and attitude about Lassa Fever by the University of Benin Community in relation to their health risks
4. To assess the level of preponderance of rats around residential dwellings of Staff and student of the University.
5. To assess the effectiveness of rodent control measures.

Materials and Methods

Study location

The study was conducted at the University of Benin (also known as UNIBEN), Benin City, Edo state, Nigeria. University of Benin is located in Edo State (Latitude $6^0$24'N and Longitude $5^0$36'E), Nigeria. It is one of Nigeria's first generation Federal Universities with two campuses, located at Ugbowo and Ekenhuan Road in Benin City. The University offers Postgraduate, Undergraduate, Diploma and Certificate courses.

Study Population

A current profile from the Student Affairs Division of the University reveals that the total student enrolment (full-time and part-time) stands at over 80,000 across various Faculties and staff (academic and non–academic) strength of about 8000. The university has eight (8) hostels at Ugbowo and two (2) hostels in Ekenwan campuses with a total population of about 15,000 resident students. Other students live off-campus.

Sample size

A cross-sectional study design was used, and involved the determination of the sample size using the method described by Cochran (17). A sample size of 255 was obtained and when attrition rate of 10% was adjusted for, an effective sample size of 285 was calculated. However, to account for non-response, A total of 670 questionnaires were administered but 602 responded for students (N=301) and staff (N=301) respectively. Respondents were selected using random sampling technique after obtaining their informed consent. UNIBEN students who were squatters in the halls of residence, staying off campus or in staff quarters during the period of the study were excluded. Contract staff were similarly excluded from the study.

Sampling technique

A stratified random sampling technique was used. Sampling frame for students was the total student population resident in all hostels (10) in both campuses. A sampling fraction was determined by dividing the calculated sample size by the sampling frame. The sampling fraction was applied to population of students resident in each hostel of residence to determine the effective sample size for the stratum. The number of rooms to be sampled was determined by dividing the number of rooms per hostel by the effective sample size. The selection of sampling unit (respondents) was done by balloting.

The sampling frame for staff was the total population of academics and non-academics in all Faculties/Colleges, Schools, Registry, Vice-Chancellor's Office (VCO), Bursary and Library. Effective sample size was determined by application of the sampling fraction on the population. The proportion of the effective sample allocated to the departments was determined by the staff population within that department. The sampling unit was selected by balloting within the departments.

Data Collection

Data (qualitative and quantitative) were collected from respondents with the use of questionnaires. The Questions explored respondent's personal awareness of risk of transmission posed by increased rat population, perception of risk from rodent secretion and excretion and effective rat control measures amongst others.

Data analysis

The questionnaires were screened for appropriate completion and then collated using the Microsoft Excel package (Microsoft Corporation, Redmond, Washington). Collated data were subjected to SPSS (Statistical Package for Social sciences version 22) for descriptive and inferential analyses. Descriptive categorical analysis of data on the demographics, knowledge, awareness, risk perception and methods of rat control was used to design frequency tables while inferential statistics using Chi-Square was used to test significance level of association between variables.

Variable ranking

For the study, income of between less than ₦10,000 and ₦29,999 was categorized as low while income of between ₦30,000 to ₦59,999 and greater ₦60,000 were ranked as moderate and high respectively. Specific questions to assess knowledge of respondents were obtained and a score assigned to each correct response. Similarly, risk awareness and perception was scored as low, moderate or high. The total maximum score of each respondent was obtained and based on this total score; a scale of knowledge was developed as good, fair or poor. Basic education describes respondents who have obtained WASSCE/GCE/NECO while higher education describes respondents who are either degree (Diploma, Bachelor of Science, Master of Science and Doctor of Philosophy) holders or were on course to doing so.

Results

Amongst students, age ranged between 15 and 44 (98.3%). Respondents of the age bracket 15-34 were 96.7% of total student respondents. Male respondents accounted for 46.2% of the total respondents while 53.2% were females. In comparison, the ages of the staff ranged between 25 and 54 which accounted for 92.5% of the total responses amongst staff. The male and female respondents were 43.2% and 50.8% respectively.

A large fraction of sampled staff of the University who responded are high income earners (n=170, 81.1%) with more than 77% of staff earning at least seventy thousand naira monthly (Figure 1). In contrast, 93.4% (n=281) of students were in the low income category, earning less than thirty thousand naira monthly.

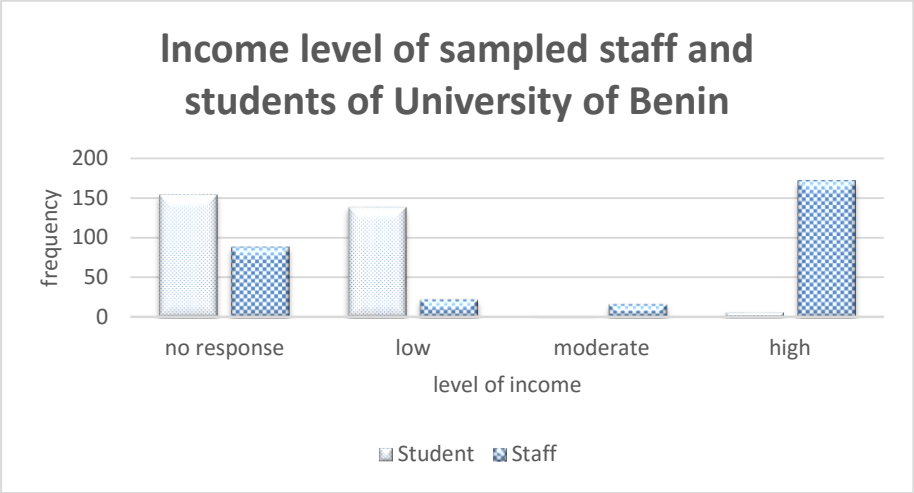

Figure 1: Level of income of sampled staff and students in the University of Benin during the study period

Good knowledge of LF was found in students with higher education (1.5%) and with basic education (7.0%). In contrast, 10.7% of students with higher education and 80.9% with basic education respectively demonstrated poor knowledge. However, this difference was not statistically significant at $p>0.05$. In contrast, a significant proportion of respondents amongst staff (15%) with higher/postgraduate education demonstrated a good knowledge of Lassa fever disease as compared to 53.5% and 18.7% of staff which demonstrated fair and poor knowledge respectively ($p<0.05$). The knowledge of Lassa fever disease was significantly better amongst 10.0% older staff and 35.5% of younger staff ($p<0.05$).

Of 282 responses obtained amongst students of the University of Benin, 12.1% (n=34) admitted to rodent having contact with their food (Table 1). While 87.9% of the students either answered no or were not sure if their food source were accessed by rodents. In contrast, 7.3% of staff indicated that rodents had contact with their food item and 92.7% are either unsure or are unaware of such contact. When asked about what could be done when one discovers that his food was nibbled at by rats, 4.3% of the students would go ahead with consumption of the food item while 30% of them would cut of portion of the food prior to direct consumption.

64.3% stated that they would dispose the food item entirely. However, 72.2% of staff would dispose the entire food item when rats nibble at it. Nonetheless, 25% would cut off the eaten portion and 0.7% would consume the food item.

Table 1 and 2 shows risk of exposure and perception of risk posed by LF amongst staff and students of the University. A high risk of exposure to rats or rat-contaminated materials indicated by the fact that amongst students, 39.8% of the respondents would carry rats with unprotected hands when found dead within the confines of their dwelling while 60.2% said that they would carry the dead rats with gloves. 38.4% of staff carries dead rats with unprotected hands in contrast with 61.6% who protected their hands while disposing of dead rats. Furthermore, 81.9% of the students who responded would throw away the dead rat; while 9.1% each would either burn or bury the dead rats respectively. In comparison, 3.6% of staff burned the rats whereas 10.9% and 85.5% buried or threw away the rats in surroundings respectively. Risk was perceived as high amongst 16.7% of student respondents who revealed that they had direct contact with feces or urine of rats and a further 3.8% admitted to eating rats while 7.3% still engaged in rat hunting and preparation. In comparison, 13.7% of staff observed that rats come in direct contact with their food and 4.8% (14/289) of the staff practice the act of eating rats or engaging in rat hunting and preparation. Also, the reservoir of Lassa fever virus was incorrectly identified by 32.4% of staff and 46.1% of students respectively.

Table 1: Assessment of risk posed by contact with rodent or rodent contaminated food amongst staff and students respectively of the University of Benin

Respondents	**STAFF (%)**	**STUDENT (%)**
What do you do when rat nibbles a portion of your favorite snack?		
No response		
Eat anyway	17 (5.6)	21 (7.0)
Cut off the eaten portion	2 (0.7)	12 (4.0)
Dispose the entire food	71 (23.6)	84 (27.9)
Others	205 (68.1)	180 (59.8)
	6 (2.0)	4 (1.3)
Do rats have contact with your food?		
No response		
no	12 (4.0)	19 (6.3)
yes	211 (70.1)	183 (60.8)
not sure	21 (7.0)	34 (11.3)
	57 (18.9)	65 (21.6)
How do you dispose of dead rats?		
No response		
Burn	26 (8.6)	25 (8.3)
Bury	10 (3.3)	25 (8.3)
Throw away	30 (10.0)	25 (8.3)
	235 (78.1)	226 (75.1)
Do you use gloves or other protective measures when disposing the dead rat?		
No response	25 (8.3)	22 (7.3)
No	106 (35.2)	111 (36.9)
Yes	170 (56.5)	168 (55.8)

Table 2: Risk perception and awareness to Lassa fever amongst staff and students of the University respectively

Respondents	**STAFF N (%)**	**STUDENTS N (%)**
Which age group is at risk?		
children	5 (1.7)	18 (6.4)
adult	6 (2.1)	1 (0.4)
elderly	1 (0.3)	2 (0.7)
all age group	279 (95.9)	261 (92.6)
Are vaccines available for treatment?		
No	86 (29.3)	66 (22.6)
Yes	108 (36.7)	94 (32.2)
Not sure	100 (34.0)	132 (45.2)
Can Lassa fever be cured?		
No	204 (69.7)	140 (48.3)
Yes	28 (9.6)	39 (13.4)
Not sure	60 (20.5)	111 (38.3)
How serious is Lassa fever?		
Very serious	249 (85.3)	230 (78.5)
Slightly serious	27 (9.2)	43 (14.7)
Not very serious	11 (3.8)	12 (4.1)
Not sure	5 (1.7)	8 (2.7)
What is the reservoir of Lassa fever virus?		
All rats	26 (9.4)	49 (18.1)
Long-nosed rat	59 (21.2)	68 (25.1)
House rat	5 (1.8)	8 (3.0)
Mastomys	188 (67.6)	146 (53.9)
Do you have contact with feces or urine of rodents?		
No response		
No	8 (2.7)	20 (6.6)
Yes	253 (84.1)	234 (77.7)
	40 (13.3)	47 (15.6)
Do you eat rat?		
No response	12 (4.0)	17 (5.6)
no	275 (91.4)	273 (90.7)
yes	14 (4.7)	11 (3.7)
Do you engage in rat hunting and preparation?		
No response		
No	9 (3.0)	15 (5.0)
Yes	278 (92.4)	265 (88.0)
	14 (4.7)	21 (7.0)

The preponderance of rats within hostels and other residential quarters (Table 3) was established with 70.6% of students acknowledging that they live with rats and 51.6% of this number sees rats daily, weekly or monthly. Despite the increased frequency with sightings of rats, 19.3% of the students are complacent without active measures to depopulate the rats. However, 50.5% (n = 152) use rat poisons, 29.9% (n = 90) use traps, 1.3% (n = 4) use cats as rat control measures respectively. Further, 2.3% believes that sanitation was a most effective method in the control of rats. 47.1% consistently and diligently applied this rat control measure at least once every month and 90.4% noted that success ranged between very effective to being just effective. In contrast, 71.5% of the staff admitted to having rats in their dwellings while 28.4% indicated that they did not find rats in their surroundings. The reported frequency of encounter with rats were daily (16.1%), weekly (16.8%), monthly (9.8%) and rarely (49.1%). Amongst staff, the two most frequently used rodent control measures were rat poisons (46.2%) and traps (39.9%). Few staff preferred the use of cat (4.3%) and sanitation (1%) respectively in rodent control. Between 41.5% and 54.6% believed the chosen control measures adopted were either very effective or effective while 3.8% did not think that the rodent control measures had any impact on rat population in their houses.

Table 3: Preponderance of rats around dwellings, method of rodent control and effectiveness of control measures of staff and students of the University of Benin respectively

Respondents	STAFF (%)	STUDENTS (%)
Are rats in and around your house?		
No response	17 (5.6)	15 (5.0)
No	81 (26.9)	84 (27.9)
Yes	203 (67.4)	202 (67.1)
How often do you see rat around your dwelling?		
No response		
Daily	16 (5.3)	22 (7.3)
Weekly	46 (15.3)	91 (30.2)
Monthly	48 (15.9)	35 (11.6)
Rarely	28 (9.3)	18 (6.0)
Don't find rats at all	140 (46.5)	119 (39.5)
	23 (7.6)	16 (5.3)
What rat control measure do you use?		
None	40 (13.3)	58 (19.3)
Rat poison		
No	162 (53.8)	149 (49.5)
Yes	139 (46.2)	152 (50.5)
Trap		
No	181 (60.1)	221 (70.1)
Yes	120 (39.9)	90 (29.9)
Cat		
No	285 (94.7)	290 (96.3)
Yes	13 (4.3)	4 (1.3)
Sanitation	3 (1.0)	
		7 (2.3)
How effective is the rat control measure?		
No response	41 (13.6)	47 (15.6)
Very effective	108 (35.9)	93 (30.9)
Effective	142 (47.2)	138 (45.8)
Not effective	10 (3.3)	23 (7.6)
How often do you use this control measure?		
No response	27 (9.0)	40 (13.3)
Daily	32 (10.6)	38 (12.6)
Weekly	33 (11.0)	43 (14.3)
monthly	44 (14.6)	42 (14.0)
As often as I find rat	142 (47.2)	96 (31.9)
Don't use any	23 (7.6)	42 (14.0)

Discussion

Level of income has been reported to influence incidence of Lassa fever. Poverty tends to sustain the transmission of the disease in West Africa. Inferential statistics reveal a significant difference between level of income and level of education and standard of living ($p<0.05$) amongst staff and students of the University sampled for the study. Various authors have proposed the complex interrelationship and dynamics between socioeconomic status and health. According to Helman and Payne (18), Marmot and Wilkinson (19) and Berkman and Kawachi (20); educational attainment, income, and occupational status are indicators of an individual's socioeconomic status. Arguably, the reverse seems plausible. Consequently, socioeconomic status determines an individual's income, housing, clothing and nutrition status which are indicators of poverty level. Poverty influences the health of individuals at different levels either within families or within the neighborhoods in which individuals reside. The socioeconomic status of an individual thus influences his/her behavioural pattern and life style, which in turn affects health. Deaton (21) and Kennedy et al (22) proposed a quantitative measurement of socioeconomic status through determining education, income, occupation, or a composite of these dimensions.

Apparently, awareness of the disease from exposure through various media of dissemination had a higher impact on the knowledge of participants than age as a singular variable. Hence, knowledge did not vary significantly between older or younger staff. This is further supported in this survey which indicates that all the respondents have been exposed to some sort of information on Lassa fever disease and the role of rats in its transmission to man. Radio and television was most acknowledged sources of information amongst staff (51.7%) and students (37.3%). Newspapers, internet and campus campaigns combined contributed 28.5% and 25.5% awareness of the disease amongst students and staff respectively. While 34.2% of students were informed by friends or family members, 22.8% acknowledged that first awareness of the disease was from friends and family.

Therefore, while it could be said that the level of awareness of Lassa fever disease is influenced by accessibility to various sources of information including media, knowledge about the disease is determined by the specific source of information. Sources of information liable to distortion or misinformation such as from inadequately informed individuals may negatively affect the general risk perception of such an individual to Lassa fever disease and the control measures he is willing to take to prevent the disease. Moreover, such misinformation and complacency may be trickled down and sustained in yet others when disseminated. Campus campaigns could be a veritable tool for dissemination of accurate and concise information about Lassa fever disease. However, this could be more effective at increasing the knowledge of the community when it is targeted at transformation of preconceived notion about the disease. Although campus campaigns made only 9.8% contribution to the initial awareness of the disease amongst respondents, it encompassed the young students who are necessary players for future information dissemination and public health promotion in their various interactions.

Knowledge gaps have been reported in various knowledge, attitudes and practices (KAP) studies involving a wide range of respondents including students, health care workers and residents of urban and sub-urban areas. (23,24,25,26,27,28) However, these studies did not assess the association between accessibility of information to risk of awareness and perception of the LF. However, Idris et al (27) opined that the best tools required to address the persistent knowledge gap about the viral hemorrhagic fevers is timely and intense social mobilization and awareness campaigns. This must be coupled with evaluation of the impacts of such campaigns if desired results will be achieved.

Risk of exposure to rats or rat-contaminated materials increases by the fact many of the students would carry rats with unprotected hands when they find any dead rat within the confines of their dwelling while majority said that they would carry the dead rats with gloves. Likewise, many f staff carries dead rats with unprotected hands in contrast with majority who protected their hands while disposing of dead rats. Furthermore, 81.9% of the students who responded would throw away the dead rat; while 9.1% each would either burn or bury the dead rats respectively. In comparison, 3.6% of staff burned the rats whereas 10.9% and 85.5% buried or threw away the rats in surroundings respectively. Moreover, 16.7%of the responses from students revealed that 16.7% have come in direct contact with feces or urine of rats while 3.8% admitted to eating rats. Till the time of the study, 7.3% still engaged in rat hunting and preparation. However, 13.7% of staff observed that rats come in direct contact with their food and 4.8% (14/289) of the staff practice the act of eating rats or engaging in rat hunting and preparation.

Obviously, there are knowledge gaps amongst members of the university community. In a pilot study conducted prior to this survey, respondents acknowledged that there remained grey areas which they desired clarified in their understanding of Lassa fever disease. Foremost among these are anatomical landmarks for precise identification of reservoirs of the Lassa virus, screening of the rat population within the campus to establish the seroprevalence of Lassa fever virus, infectivity of the virus outside its reservoir or in contaminated food items, possible risk of exposure caused by infected dead rat, the best method of disposal of dead rats and how long the virus remains infectious even in infected dead reservoirs. These knowledge gaps may have influenced the risk perception posed by food exposed to rodent excretions. Other secondary factors such as level of income, complacence due to increased presence and persistence of rats in households; and lack of proactive measures in the control of rat population may engender such practice.

Rat infestation is both a health risk and a source of economic loss. Apart from the possibility of destroying properties, the possibility of transmitting zoonotic diseases is a reality. They have been known to cause much damage to household articles and properties such as books, food items, clothing and textiles. Nothing could be more disturbing than to find a live rat within one's room. Rat infestation is a common occurrence in many places especially where hygiene practices are low and in places providing harbourage for the rats. Bamigboye (29) noted that a major cause of rat infestation in the hostels is a multi-faceted one. He advocated that the control of the infestation would also require a comprehensive approach of reducing overcrowding of rooms, prohibiting cooking of food in the rooms and the general maintenance of sanitation all over the campus. Efforts should be made to rat proof the rooms by providing self-closing doors, rat proofing of windows and blocking all other borrows and openings through which rats could enter the rooms

Wilkinson (30) pointed out that *Mastomys*, like all members of the order rodentia, are generally burrowing animals. Dirty floors are common where cement cannot be afforded and foster rat infestation and its increased

population. Hence poverty may be a better indicator of risk. A holistic approach to disease prevention advocating good hygiene and incorporating improved socio-economic conditions holds a more effective strategy against the prevention and control of Lassa fever disease.

Conclusion

Risk perception was significantly associated with measures aimed at control amongst staff and students of the University. Inability of respondents to correctly identify the reservoir of LF virus within residential dwellings and contact of rats with human food demonstrates the persistent public health threat in endemic areas.

Recommendation

The study indicates that level of income and knowledge of Lassa fever disease modifies behaviour and risk perception amongst students and staff and student to rodent control. We recommend filling of knowledge gaps on LF through periodic evaluation, accuracy and adequacy of information dissemination and its impact of reducing risk of exposure to the disease. There is also need for a comprehensive profile of rats within around residential dwellings on campus, and nationally, to assess the actual risk of exposure to the LF disease.

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