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Knowledge, Attitudes, And Practices (kap) About Lassa Fever Prevention And Control: A Survey Of Three Rural Communities In Central Liberia-Epidemiology Of Microbial Diseases

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Knowledge, Attitudes, and Practices (KAP) About Lassa Fever Prevention and Control: a Survey of Three Rural Communities in Central Liberia

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Abstract

Introduction: Since the discovery of Lassa fever in 1969 in Nigeria, the disease has become endemic in many West African countries. An estimated 500,000 cases of Lassa fever virus occur each year, leading to approximately 5,000 deaths annually. Liberia continues to record outbreaks almost every subsequent year in regions once considered non-endemic. With no effective vaccines, many studies have underscored the importance for residents in Lassa-endemic regions to have good knowledge and good prevention practices in place to prevent Lassa fever.

Methods: A cross-sectional data extracted from a longitudinal, observational, cohort study conducted using voluntary participant self-reported and study visits data from the ENABLE study in central Liberia. Generalized Estimating Equation (GEE) model was used to perform a regression analysis to measure the association between 1,700 adult participants' Lassa fever knowledge and Lassa fever infection, and between Lassa fever prevention practices and Lassa fever infection, considering correlations among family members in the same household.

Results: Univariate regression analyses were performed to measure the association between knowledge and infection and between practices and infection. The study found no significant association between response and the outcome (Lassa fever infection), which indicates that people's knowledge and prevention practices of Lassa fever did not have a significant association with their likelihood of acquiring Lassa fever infection. However, formal education and community were found to be significantly associated with the outcome. Significant findings were defined by $p < 0.05$.

Conclusion: The study's findings emphasized the importance of conducting KAP evaluations in rural communities to generate and improve evidence-based knowledge and proper prevention practices to prevent and control Lassa fever outbreaks. Further, the study demonstrates that while good knowledge and prevention practices are integral to preventing Lassa fever in rural communities, KAP studies should seek to understand the impacts of other factors including poverty and socioeconomic status, overcrowding, environmental sanitation, and housing characteristics.

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Introduction

Lassa fever was first discovered in 1969 in the town of Lassa, Nigeria. Since then, Lassa fever has become endemic in the West African countries of Guinea, Liberia, Nigeria, and Sierra Leone [1,2]. In addition, countries such as Mali, Benin, Togo, Ivory Coast, Ghana, and Burkina Faso have sporadically reported Lassa fever cases [2]. Lassa fever is an acute zoonotic disease caused by the Lassa fever virus, one of single-stranded RNA viruses in the arenaviridae family that causes hemorrhagic fever [3]. The animal reservoir for Lassa fever virus is the multimammate rat which is known to be in abundance in West Africa [4]. The virus is transmitted through contact with the saliva and excreta of the natural host [5]. In addition to rodent transmission, there has been evidence of human-to-human transmission and the possibility of human-to-animal transmission of Lassa fever[6].

An estimated 500,000 cases of Lassa fever virus occur each year, leading to approximately 5,000 deaths annually. Among hospitalized patients with Lassa fever, the case fatality rate is as high as 50% [7,8,9,10]. People of all ages are susceptible to Lassa fever, although children may be disproportionately infected. The clinical course of the disease is variable, ranging from mild, non-specific symptoms, to fever and malaise to hemorrhagic fever and death [3].

Liberia recorded its first Lassa fever outbreak in 1972 [11] and has since recorded outbreaks almost every subsequent year [12]. The Northern parts of Liberia have been historically where most cases have been detected [13]. However, Lassa fever outbreaks are now reported in parts of the country that were once considered non-endemic, such as the southward counties of Margibi and Montserrado [14,15].

Because there are no vaccines to protect against Lassa fever infection, studies have underscored the importance for residents in Lassa endemic regions to have good knowledge and good prevention practices to be able to prevent or seek immediate medical care when Lassa fever is suspected. Scientific publications have advocated for sensitization and health education of the general public as effective preventive tools in the absence of an effective Lassa fever vaccine [16,17,18].

In this study, we investigated if possessing good knowledge and prevention practices decreases one's risk of acquiring Lassa fever infection. The overarching aim of this study is to generate evidence to understand and support the claims populated in other studies that good knowledge and prevention practices are protective factors against Lassa fever infection. The objective of this study is to measure Lassa fever knowledge and prevention practices of adult residents in three rural study communities in central Liberia and determine the association between knowledge, practices, and Lassa fever infection. The two main hypotheses driving the conduct of this study are: (1) Good Lassa fever knowledge is associated with a decreased risk for Lassa fever infection among adult residents (ε 18 years), and (2) Good Lassa fever prevention practices are associated with a decreased risk for Lassa fever infection among adult residents (ε 18 years) in the three study communities from central Liberia. Considering that Lassa fever is a disease of poverty and there are no effective vaccines for prevention, by analyzing these two main hypotheses we hope to generate evidence-based findings that support the public health promotion of good knowledge and prevention practices in rural communities to prevent outbreaks and transmission of Lassa fever.

Methods

Study Design, Participants, & Enrollment

A longitudinal, observational, cohort active, and passive surveillance study of symptomatic and asymptomatic Lassa fever was conducted by a collaborative team as part of the ENABLE study within three rural communities with known high rates of confirmed Lassa fever in central Liberia [19]. The team included members from Phebe Hospital, the Institute of Global Health and Infectious Diseases at the University of North Carolina (UNC), and the National Public Health Institute of Liberia (NPHIL). The three participating communities were Phebe Airstrip (PHE), Suakoko (SUA), and Rubber Factory (RUB) - all located in the center of the country and close to the Phebe Hospital, one of the largest hospitals in the country. The ENABLE study collected baseline data which included demographic information and surveys of Lassa fever knowledge,

practices associated with exposure to Lassa fever, household construction, as well as environmental factors associated with acute and prior Lassa fever infection [19]. All participants had their blood drawn at baseline and at subsequent study visits for Lassa fever virus serology and specimen storage. The overarching goal of the survey was to gather data to inform the design of Phase II and III randomized, placebo-controlled Lassa fever vaccine trials. Although the ENABLE study is longitudinal, the sections of the data used in this study are cross-sectional in nature. The blood samples and survey responses used for analysis in this study were collected at a single point in time during the onset of the ENABLE study.

The ENABLE study enrolled a total of 5,005 men, women, and children aged 2 and older living in Phebe Airstrip, Rubber Factory, and Suakoko. Months in advance before the study rolled out, extensive consultation was conducted with relevant stakeholders from the selected communities, NPHIL, and the Ministry of Health (MoH) community health workers (CHWs) system. Participant households were selected at random and visited to solicit interest in participation. Community members were asked to participate during an informed consent process conducted by research nurses who were accompanied by local CHWs. Informed consent was taken from adult residents who agreed to participate in the study. Consent was obtained from minors able to provide assent with parental consent obtained in accordance with accepted procedures in Liberia. Whole households were approached but consent for adults was obtained individually.

Once consent was obtained, entry assessments commenced, and participants completed a social/demographic survey followed by Lassa fever knowledge and practice questionnaires administered by the research nurse and entered on a computer tablet. Blood samples were collected at enrollment from study participants in the field by research nurses for Lassa fever serological testing. GPS coordinates were used to document participant location. Means of follow-up were obtained for all participants (house visit, telephone, text message, etc.). Participants were given ID cards with barcodes, which were used to facilitate the identification of participants during study visits at home or at health facilities. The study ID cards were used to identify the community and household of participants.

Baseline study visits were conducted for 24 months between 2020 and 2023 for 5,005 participants. Of the total 2,731 adult participants (ε 18 years), serology results for Lassa fever

were only available for 1,700 residents from the three study communities combined at the time of this study. To achieve the objectives of the study, the analyses were focused only on those 1,700 adult residents for whom serology results were available.

Inclusionary Criteria

Females and males aged 2 years and older. Must be a resident of the study area, living in the study area at least six (6) months before the beginning of the study, and is expected to stay in the area for the duration of the study. If applicable, approval by the household/family head for participation. For decisionally-impaired individuals, consent will be collected from a legally authorized representative (LAR). Able and willing to provide informed consent or/and assent. For children (<18 years of age), consent will be collected from a parent or legal guardian and children > 6 years of age will have to provide assent in addition to parental/guardian consent. Able to understand Liberian English, local dialects, or have a surrogate who can translate. Able to be contacted for study assessments (e.g., mobile or landline phone).

Exclusionary Criteria

Unwilling to comply with study procedures including blood draws. Unable to provide informed consent/assent including those in the military. Unable, in the opinion of the investigators, to comply with study procedures (e.g., severe mental illness). Study staff or study site staff. Individuals with current Lassa fever acute febrile illness.

Survey Methodology and Data Collection

A survey questionnaire was designed by the research team with significant Liberian inputs from NPHIL, the Phebe Hospital, and CHWs to collect social/demographic information and survey of Lassa fever knowledge, attitudes, and practices (KAP). Additionally, the survey gathered information from participants about housing constructions and environmental factors associated with Lassa fever exposure. The analyses of this study are focused only on the KAP component from the survey. A series of closed ended Yes/No, check all that apply knowledge, and practice questions about Lassa fever were asked to participants. The knowledge-based questions covered participants' familiarity with Lassa fever, Lassa fever symptoms, modes of transmission, the causative agent, and prevention and treatment (see Table 1).

Table 1: Lassa fever knowledge questionnaire

No	Lassa Fever Knowledge Questions	
1	Have you heard about Lassa fever?	☐ Yes / ☐ No
2	What symptoms does a person with Lassa fever have?	☐ Weakness ☐ Headache ☐ Sore Throat ☐ Fever ☐ Vomiting ☐ Runny belly or diarrhea ☐ Bleeding nose, ear, mouth ☐ Seizure ☐ Swelling of face
3	How can a person get Lassa fever?	☐ By eating rat ☐ By eating food contaminated with rat urine ☐ By touching the blood, urine, feces, or sweat of a person infected withLassa fever
4	What animal do you think can give Lassa fever?	☐ Cat ☐ Rat ☐ Bat ☐ Mosquito ☐ Don't know
5	How can a person prevent Lassa fever?	☐ Don't touch sick person with Lassa fever ☐ Properly cover food to prevent rat from touching it ☐ Clean your environment ☐ Wash your hands after touching items in public ☐ Avoiding eating rats
6	Can anybody be infected with Lassa fever?	☐ Yes / ☐ No
7	Can Lassa fever be cured?	☐ Yes / ☐ No
8	How can someone with Lassa fever be cured?	☐ Take the person to the hospital ☐ Home rest without medicine ☐ Take the person to the Lassa fever treatment center
9	Do you think you can get Lassa fever?	☐ Yes / ☐ No

The practice-based questions asked participants about their exposure practices to rats in their areas of dwelling, rat consumption habits as well as hygiene and burial practices associated with Lassa fever infection (see Table 2).

Table 2: Lassa fever practice questionnaire

No	Lassa Fever Practice Questions	
1	Do you ever see rats in your home?	□ Yes / □ No
2	Do you ever see rats close to your home?	□ Yes / □ No
3	Are there rat holes in your homes?	□ Yes / □ No
4	Do you dry food on the floor of your home?	□ Yes / □ No
5	Do you dry food on the ground outside your home?	□ Yes / □ No
6	Do you ever hunt rats?	□ Yes / □ No
7	Do you ever prepare rat meat?	□ Yes / □ No
8	Do you ever hunt other wild animals to eat?	□ Yes / □ No
9	Do you ever prepare other wild animal meat?	□ Yes / □ No
10	Do you often sweep the floor inside or outside your house?	□ Yes / □ No
11	Have you ever been involved in burial practices such as helping to prepare or bathe the body?	□ Yes / □ No

In consultation with the Liberians on the research team, the survey questions were designed in a manner that could be easily understood by Liberian study subjects. Terminology such as “runny belly” was used in addition to diarrhea to denote a symptom of Lassa fever. Research Nurses were partnered with Community Health Workers to administer the survey question to participants. Research nurses verbally read aloud the survey question to participants and then marked down their responses. This was a way of standardizing the data collection process and

maintaining consistency considering the different levels of literacy and fluency in English among research subjects. Field data collection utilized electronic tools with paper forms as backups. At study entry, research staff used tablets to directly enter data collected from participants and other required information (GPS coordinates, contact information, etc.). The Electronic Case Report Form (eCRF) was used as a secure data platform to store directly entered data gathered in the field. Data submitted to the central database underwent an initial data check for missing, inaccurate, or illogical entries. Notices of potential data discrepancies or omissions prompted project staff to investigate and resolve often including follow-up visits with research subjects.

Following the administration of the survey questions, the research nurses drew blood samples from participants to test for the presence of Lassa fever infection and storage. Blood samples collected in the field and at study sites were shipped to the nearby lab at Phebe Hospital for timely testing. Reverse transcription-polymerase chain reaction (RT-PCR) was used to test for the presence of Lassa fever virus infection. The biospecimens collected were tracked upon completion of eCRFs indicating blood drawn, as well as logs maintained by each laboratory of all received specimens. A barcode-based system was used to provide electronic tracking of all drawn specimens. Serology results were entered and saved into the Laboratory Information Management Systems (LDMS). Laboratory data reports were saved without personal identifiers to blind research staff.

Statistical Analysis

All statistical analyses were performed using Statistical Analysis Software (SAS). The Generalized Estimating Equation (GEE) model was used in SAS to perform regression analyses because (1) participants from the same household were correlated, and (2) the outcome variable (infection) was binary.

For the first study's main hypothesis, good Lassa fever knowledge is associated with a decreased risk for Lassa fever infection among adult residents (ε 18 years) in the three study communities in central Liberia, we initially performed univariate analyses to identify important associations between knowledge and infection for inclusion into a multivariate regression analysis. Each of the knowledge-based questions that was asked during the survey was individually run as a covariate to measure the association between Lassa fever knowledge and Lassa fever infection.

For each univariate analysis, the correlation among subjects from the same family or household was considered using the GEE model. We ran a univariate analysis for each knowledge-based question in the hope of identifying significant associations to later build a multivariate regression analysis, which the study did not perform due to a lack of significant association in findings.

For the second main study hypothesis, good Lassa fever prevention practices are associated with a decreased risk for Lassa fever infection among adult residents (ε 18 years) in the three study communities in central Liberia, we performed the same analysis performed for the knowledge-based hypothesis. We initially performed univariate analyses to first identify important associations between each practice-based question and Lassa fever infection to include in a multivariate regression analysis. Each practice-based question was run as a covariate to measure the association between Lassa fever prevention practices and Lassa fever infection. The GEE model was used to control for correlations between the same household subjects. The lack of significant association between practices and Lassa fever limited our ability to further perform a multivariate analysis.

In addition to the study's two main hypotheses, we were interested in exploring the correlation between the outcome and minor variables including gender, community, age, and education. We performed a Chi-Square analysis to measure the association between gender and outcome. Since the community variable has more than 2 levels, we also ran a pairwise comparison to find out which community type is more likely to have Lassa fever infection. We performed an unadjusted regression analysis to see if age plays any significant role in acquiring the infection.

The study also examined the association between educational levels and infection, and the association between occupation and infection. For education, we combined some of the educational groupings in the initial survey to achieve numerical balance. People who reported having no formal education were categorized into a separate group referred to as "none". Participants who acquired some primary education but did not complete were combined into one group with participants who have completed primary education categorized as "primary". Participants who reported having acquired some secondary education but did not complete were combined into one group with participants who have completed secondary education as "secondary". Lastly, post-secondary and tertiary education were combined as one group called

“tertiary”. The same method of regrouping was done for occupations to ensure numerical balance. People who reported as sellers, casual laborers, farmers, health care providers, and traditional healers were combined into one group as “working’. People who reported not doing any forms of work, disabled, and people who reported as being retired were combined into one group as “not working’. Students were considered as one group as “students,” and people who checked themselves as others were considered as a separate group as “others”.

Statistical significance in this study was determined by using a $p < 0.05$.

Results

Of the 1,700 study participants, 519 came from Phebe Airstrip, 405 from Rubber Factory, and 776 from Suakoko. There were 734 males and 966 females. Serology results from blood samples collected during the survey showed that 1,010 (59.41%) participants tested positive for Lassa (see Table 3).

Table 3: Demographics of study subjects

Characteristics	N=1,700 (%)
Age	32.25 ± 14.13
Community	
PHE	519 (30.53)
RUB	405 (23.82)
SUA	776 (45.65)
Gender	
Male	734 (43.18)
Female	966 (56.82)
Education	
None	346 (20.35)
Some primary	356 (20.94)
Completed primary	130 (7.65)
Some secondary	433 (25.47)
Completed secondary	260 (15.29)
Post-secondary/tertiary	175 (10.29)
Occupation	
Nothing	420 (24.71)
Selling goods/small business	273 (16.06)
Casual labor	41 (2.41)
Farming	229 (13.47)
Healthcare provider	40 (2.35)
Traditional healer	5 (0.29)
Student, not working	532 (31.29)
Disabled, not working	3 (0.18)
Retired, not working	9 (0.53)
Other	148 (8.71)
Had Lassa Fever Previously (Self-reported)	
Yes	18 (1.06)
No	1682 (98.94)
Serum Test	
Positive	1010 (59.41)
Negative	690 (40.59)

*PHE=Phebe Airstrip, RUB=Rubber Factory, SUA=Suakoko

Descriptive analyses of our study's Lassa fever knowledge questions found that only 35% (604) of study subjects have heard of Lassa fever, 1.88% (32) have not heard of Lassa fever, and 66.5% (1,064) had missing data. Of the participants who have heard about Lassa fever 64% reported first hearing about Lassa fever from a healthcare worker, and 89% acknowledged that Lassa fever was a serious illness. When asked which animal causes Lassa fever there was wide variability in knowledge, with 50% of participants reporting rats and the other 50% reported bats. Seventy percent of participants who have heard of Lassa fever correctly identified fever as a symptom of Lassa fever while knowledge was below 55% for all other symptoms such as diarrhea (runny belly), bleeding, swelling, weakness, headache, vomiting, seizure, and sore throat. At least 76% of participants believed that eating rats or food contaminated with rat urine can transmit Lassa fever infection while only 50% believe that the blood, urine, or feces of an infected person is capable of transmitting Lassa fever infection. Furthermore, 99% of participants believed that anyone can be infected with Lassa fever, 86% believe Lassa fever can be cured, and 99% would seek medical treatment if they experience any signs or symptoms of Lassa fever, while 98% of participants reported the presence of strong community support for anyone infected with Lassa fever infection.

Descriptive analyses of Lassa fever prevention practice questions found that 92% of participants frequently see rats in their homes, 33% of participants dry food on the floor of their homes, and 44% dry food outside their homes on the ground. Only 5% of participants hunt or consume rats for food and 31% reported being involved in traditional burial practices.

For the first study's main hypothesis, univariate regression analyses found an insignificant association between participants' Lassa fever knowledge and Lassa fever infection as indicated by $p > 0.05$ for each knowledge-based question. These results showed that people's knowledge of Lassa fever did not have a significant association with their likelihood of acquiring Lassa fever infection (see table 4).

Table 4: Univariate analysis results Lassa fever knowledge questions

Lassa Fever Knowledge Questions	Point Estimate	95%-CI OR	Chi-Sq P-value
Have you heard about Lassa fever?	1.301	0.635-2.666	0.473
What symptoms does a person with Lassa fever have?			
☐ Weakness	0.994	0.648-1.526	0. 979
☐ Headache	1.296	0.859-1.956	0.217
☐ Sore Throat	1.874	1.167-3.009	0.390
☐ Fever	0.783	0.541-1.134	0.195
☐ Vomiting	0.879	0.580-1.332	0.544
☐ Runny belly or diarrhea	0.918	0.537-1.567	0.753
☐ Bleeding nose, ear, mouth	1.261	0.823-1.934	0.289
☐ Seizure	0.547	0.290-1.032	0.063
☐ Swelling of face	1.283	0.688-2.402	0.436
How can a person get Lassa fever? ☐ By eating rat	1.738	1.223-2.488	0.964
☐ By eating food contaminated with rat urine	1.735	1.129-2.668	0.912
☐ By touching the blood, urine, feces, or sweat of a person infected withLassa fever	1.385	1.003-1.912	0.827
What animal do you think can give Lassa fever?	1.573	0.871-2.839	0.715
How can a person prevent Lassa fever?			
☐ Don't touch sick person with Lassa fever	1.413	1.024-1.950	0.035*
☐ Properly cover food to prevent rat from touching it	1.867	1.217-2.866	0.947
☐ Clean your environment	1.315	0.887-1.950	0.172
☐ Wash your hands after touching items in public	1.295	0.938-1.787	0.116
☐ Avoiding eating rats	1.297	0.941-1.789	0.113
Can anybody be infected with Lassa fever?	0.475	0.390-1.346	0.965
Can Lassa fever be cured?	2.355	1.473-3.764	0.003*
How can someone with Lassa fever be cured?			
☐ Take the person to the hospital	3.002	1.428-6.319	0.950
☐ Take the person to the Lassa fever treatment center	1.203	0.437-1.031	0.504
Do you think you can get Lassa fever?	1.563	0.920-2.665	0.099

For the study's second main hypothesis, we also found an insignificant association between participants' Lassa fever prevention practices and Lassa fever infection, established by $p > 0.05$ for each practice-based question run as covariates in univariate regression analyses. These findings further illustrate that people's Lassa fever prevention practices did not have a significant association with their likelihood of acquiring Lassa Fever infection (see Table 5).

Table 5: Univariate analysis results Lassa fever practice questions

Lassa Fever Practice Questions	Point Estimate	95%-CI OR	Chi-Sq P-value
Do you ever see rats in your home?	2.282	0.954-5.464	0.701
Do you ever see rats close to your home?	0.656	0.278-1.548	0.510
Are there rat holes in your homes?	0.921	0.580-1.463	0.171
Do you dry food on the floor of your home?	1.176	0.714-1.938	0.961
Do you dry food on the ground outside your home?	0.990	0.617-1.590	0.212
Do you ever hunt rats?	1.145	0.496-2.646	0.222
Do you ever prepare rat meat?	1.386	0.613-3.130	0.361
Do you ever hunt other wild animals to eat?	1.058	0.616-1.816	0.426
Do you ever prepare other wild animal meat?	1.276	0.872-1.866	0.077
Do you often sweep the floor inside or outside your house?	0.946	0.441-2.031	0.321
Have you ever been involved in burial practices such as helping to prepare or bathe the body?	0.587	0.240-1.437	0.555

Univariate regression analysis results from the knowledge and practice-based questions demonstrated that the questions were not good predictors of getting a Lassa fever infection. The lack of important associations between knowledge and practice questions and Lassa fever infection prevented the conduct of further multivariate regression analysis.

However, we found that community played a significant role in one's risk of acquiring Lassa fever infection ($p = .016$) and that people living in Rubber Factory were significantly more likely to have had exposure to Lassa fever virus when compared to people in Phebe Airstrip or

Suakoko (OR=1.32, p = 0.007, 95% CI=0.098-0.283). We also found education to be significantly associated with Lassa fever infection ((p = 0.053). People who were grouped into “none” and “primary” educational groupings were found to be significantly more likely to have had exposure to Lassa fever virus compared to people who were grouped into the “secondary” and "tertiary” categories (OR=1.40, p = 0.003, 95% CI=0.129-0.344) and (OR=1.33, p = 0.058, 95% CI= -0.576-0.010), respectively. Occupation was found to be insignificantly associated with the outcome (p = 0.603). An unadjusted regression analysis found age to have no significant association with the risk of acquiring Lassa fever infection (p = 0.86).

Discussion

Lassa fever continues to be an important public health problem in rural communities in Liberia. In the absence of an effective vaccine, KAP studies should be regularly conducted to generate enough evidence-based knowledge on how to prevent and control Lassa fever outbreaks and transmission through good knowledge and proper prevention practices. Our findings highlight key factors affecting Lassa fever knowledge and prevention practices across rural communities in the Republic of Liberia.

We found that the majority of the study participants who have heard of Lassa fever reported first hearing of Lassa fever from a healthcare worker or provider. This finding underscores the importance of using community healthcare workers as effective means of disseminating accurate Lassa fever information among rural inhabitants.

Our study found a significant inverse association between educational status and the risk of acquiring Lassa fever infection. Individuals with a higher educational status were found less likely to be infected with Lassa fever compared to individuals with lower or no formal education. Our study did not measure SES and as such, it is impossible for us to definitively make assumptions on the impact of education on Lassa fever transmission since education is a

determinant of SES. Further study is needed to investigate the impact of SES including education on diseases of poverty such as Lassa fever.

Community was found to be significantly associated with a higher risk of acquiring Lassa fever infection. People living in Rubber Factory were found to be significantly at a higher risk of acquiring Lassa fever infection compared to people in Phebe Airstrip and Suakoko. This finding emphasized the point that an individual's community of residence matters in acquiring Lassa fever infection. Although the three communities share similar rural characteristics, little is however known about the actual population size, the level of environmental hygiene, rat consumption habits, the abundance of rat reservoirs, and housing characteristics in each of these communities. These factors have been established to increase a person's risk of acquiring Lassa fever infection[16]. Because of our lack of comprehensive knowledge about these factors in each community, it is impossible to decisively conclude why Rubber Factory was shown to be significantly associated with a higher risk of acquiring Lassa fever infection. Further studies are needed to look at these factors separately.

The study found a lack of significant association between individuals' knowledge, prevention practices, and risk of acquiring Lassa fever infection. This finding is consistent with similar findings from other KAP studies. Several factors, as shown in other studies, have established that despite people's knowledge about Lassa fever and its prevention, they might have little control over their risk of infection if they live in overcrowded housing, unhygienic environments with an abundance of rat reservoirs, and poor housing [16, 21]. This finding demonstrates that more is needed than just educating people to prevent Lassa fever.

Our study had several limitations. The first limitation is missing data. Several of the knowledge and practice-based questions had respondents' data missing as high as 62%. Knowledge questions such as "Have you heard about Lassa fever?" had missing data for 1,064 out of 1,700 respondents, which then excluded responses from these participants for other mutually exclusive questions. Secondly, the survey questions were written in English which might have served as a barrier to proper understanding for some non-English speaking respondents. Thirdly, we acknowledge the possible role of information bias during the survey process. KAP surveys are notorious for information bias, and as such, responses from surveys do not necessarily predict

outcomes due to inaccuracies in responses [20]. In the context of our study, research nurses sat with and read aloud the survey questions to participants. Because of this, it is reasonable to believe that some responses might have been subjected to information biases such as social desirability. Lastly, we acknowledge that the way the survey questions were designed could have influenced participants' responses. The closed ended, Yes/No, check all that apply design of the survey questions left no room for subjectivity. Because the questions were Yes/No, participants might have been compelled to respond to questions without critical consideration.to respond to questions without critical consideration.

CONCLUSION

Our study failed to prove its two main hypotheses that good knowledge and prevention practices are associated with a decreased risk for Lassa fever infection among adult residents (≥ 18 years). This lack of findings can be attributed to (1) the external impact of poverty and environmental factors, (2) the general limitation of KAP surveys to predict an outcome, and (3) the limitations in our study design as discussed above. However, our study's findings recognized the limited impact of education and emphasized the importance of conducting KAP studies in rural communities to generate and improve evidence-based knowledge to improve proper education and prevention practices against Lassa fever outbreaks.

Further KAP studies should be conducted to assess and understand the impacts of poverty and socioeconomic status (SES), overcrowding, environmental sanitation, and housing characteristics on the transmissibility of Lassa fever in rural communities.

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