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Research Article

Risk factors and knowledge of ebola virus disease among hunters in Kwara State, Nigeria

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Declarations

Ethical Approval: Ethical approval for this study was obtained from the Kwara State Ministry of Health (Reference number: MOH/KS/EHC/77/98). Written informed consent was obtained from each respondent. The hunters were assured of their voluntary participation, the confidentiality of their responses and the opportunity to withdraw at any time without prejudice.
Availability of data and materials: The raw data generated during the field survey is available on request.

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Abstract: Ebola virus disease (EVD) is a hemorrhagic, severe, often fatal, zoonotic disease transmitted by exposure to body fluids of infected bats and non-human primates. This study assessed the risk factors and knowledge of EVD among hunters in Kwara state. We conducted a cross-sectional survey of 427 hunters using a structured questionnaire that was administered between January and April 2016.

Most of the hunters (99.3 %, n=424/427)) were male and the mean age was 39 years. The mean knowledge score was 4.3±0.9. Most of the hunters (96.2%, n=411/427) were aware of EVD but only 42.6% (n=182/427) of them had good knowledge (GK) of the disease. About one-quarter (22.5%, n=96/427) of the hunters hunted bats and monkeys and 17.1% (n=73/427) of them have consumed raw or undercooked game animals (bush meat). The knowledge of EVD was significantly influenced by the marital status, form of education, occupation, and religion. Hunters who went through conventional western education (OR:4.6; 95% CI: 2.6, 8.1; p<0.001) and those who were married (OR:4.4; 95%CI: 1.4, 11.0; p = 0.051) were more likely to have a GK of EVD respectively than those with no formal education and single hunters. Similarly, hunters who were also professional farmers were more likely (OR = 23.1, 95% C.I.: 7.3, 55.2; p <0.01) to have a GK of EVD. Similarly, the education of hunters (OR = 4.6, 95% CI =2.6-8.1; p = <0.001), their ethnicity (OR = 2.4; 95% CI = 1.4-4.1; p = 0.002), and their religion (OR = 8.7, 95% CI = 2.0-38.9; p = 0.004) had significant impact on their knowledge of EVD.

This study reported high awareness of EVD among hunters in Kwara state. However, mass advocacy on the EVD should be re-instituted with emphasis on the mode of transmission, preventive, and control measures to prevent the re-introduction of EVD into the human population.

Keywords: Hunters, Ebola, Knowledge, Risk factors, Nigeria

1. Introduction

Ebola virus disease (EVD) is a severe, haemorrhagic, highly fatal, and zoonotic infection caused by the Ebolavirus (EBOV) of the Filoviridae family (Osundina F, 2016). The 2014 EVD outbreak in West and Central Africa resulted in 28,616 cases and 11,310 reported deaths in eight reporting countries. Depending on the country, the average case fatality rates (CFR) was 50% (28.8 - 63.20). In Nigeria, the index case was a Liberian-American, who flew from Liberia in July 2014. During the outbreak, only 20 confirmed cases were recorded in Nigeria with a CFR of 40 %.

The virus can be acquired by exposure to body fluids or tissue from infected animals, such as bats and non-human primates (Abubakar A, 2018). Although the natural reservoir and mode of transmission to humans is still poorly understood (Fasina F, 2014), animal-to-human transmission may occur during hunting, processing, and consumption of infected game animals. Several factors such as the poor knowledge of the EVD, poor emergency preparedness and containment measures, poor infection prevention and control measures, and customary beliefs influenced the disease severity across several West African countries (Althaus C, 2015).

The bushmeat industry in West and Central Africa is of great concern for its influence on infectious disease transmission (Subramanian M, 2012) as 900,000 kg of bushmeat was sold annually in the Cross-Sanaga rivers region of Nigeria and Cameroon (Fa J, 2006). There is an increasing human demand for bushmeat which is associated with higher interactions between humans and animals through contact with wildlife habitats, blood, fur, feces, urine, or saliva as well as through crop-raiding, carcass handling, and habitat sharing (Bowen-Jones E, 2002). This exposure increases the probability of disease transmission between animals and humans (9). EBOV is not generally spread through food, but the hunting, butchering, and processing of bush meat brings people into contact with the body fluids of potentially infected animals (Weiss R, 2004). Great apes, several species of forest-dwelling antelope, bats, and other animals may contract Ebola and infect hunters or anyone who processes or eats tainted bush meat (Olival K, 2014; Leroy E, 2005). Similarly, antibodies to the EBOV have been detected in hunting dogs but those dogs never showed any symptoms.

Kwara State, North Central Nigeria has a landmass of 36,825 km2. She has four massive grazing reserves, an international border with the Benin Republic and is a high-risk state for transboundary diseases of humans and animals. There is a paucity of data on risk assessment, public knowledge and perception of EVD in hunters and bush meat processors in Kwara State. Hence, this study assessed the risk factors and knowledge of EVD among hunters in Kwara State.

2. Materials and Methods

2.1 Study area

This study was conducted in the forest reserves during the hunter's roundtable in Kwara State, North Central Nigeria. The state, with a population of about 3.599 million (Oladimeji A, 2015), has 3 agro-ecological zones and 70% of its population are farmers. The hunting season is during the dry season (January to April 2016) in the state.

2.2 Study Design, study population, and sample size

This study was conducted as a cross-sectional survey of hunters in Kwara state between January and April 2016. The survey instrument was administered to hunters based on their proximity to forest reserves, spatial distribution, and ecological diversity as previously. Because this is the first study in Kwara state, we hypothesized that at a 95% confidence interval, 50% of all hunters would have prior knowledge of the EVD. Hence, a total sample size of 384 respondents was needed. We further added a 10% non-response rate. Hence, 427 randomly selected hunters across the state were included in this study.

2.3 Questionnaire design

The study was conducted using a structured questionnaire that was administered using the open data kit (ODK). Where necessary, the questionnaire was administered in the local language of the respondents. This study adapted the structured questionnaire and further validated it. The questionnaire was validated by three independent academic reviewers to ensure face- and content validity. A pre-test of the validated questionnaire was conducted among 20 hunters to ensure that technical errors associated with the ODK were resolved. The questionnaire was divided into three sections. Section A documented the demographic profile of respondents while Section B and C evaluated respondents' knowledge and practices as related to EVD respectively.

2.4 Data Analysis

Data were summarized and analysed using Epi info 7.3.5 software. Qualitative data were presented as frequency and proportions whereas quantitative data were expressed as mean and standard deviation. A numeric scoring system was used to grade the knowledge level of EVD among hunters. The knowledge of EVD was graded based on three domains; mode of spread, symptoms and signs, and preventive measures. One mark was assigned to correct responses mentioned by respondents. Using 50% of the maximum obtainable score as the cut-off, hunters with an EVD knowledge score greater than 4.5 were considered to have a good knowledge (GK) of EVD and vice versa. Univariable logistic regression analysis was used to assess the association between outcome variable (Knowledge of EVD) and independent variables (socio-demographic variables). Furthermore, variables that were significant at $p<0.05$ were subjected to multivariable logistic regression analysis.

3. Results

3.1 Demographic profile of participants

The majority of the participants (99.3 %, n=424/427) were of the male gender. The mean age was 39±9.9 years and most of the hunters (46.4%, n=198/427) were between 30 to 39 years. Because hunting is seasonal, all of the hunters had other occupations and the majority were farmers (61.8%, n=264/427). Two-third of the hunters were Yoruba (66.7%, n=285/427), and 68.4% (n=292/427) either had primary education or less (Table 1).

Table 1. Demographic characteristics of study participants (n=427)

Characteristics	Frequency (%)
Age (years)	
20-29	52 (12.2)
30-39	198 (46.4)
40-49	113 (26.5)
50-59	39 (9.1)
>60	25 (5.9)
Sex	
Female	3 (0.7)
Male	424 (99.3)
Education	
No formal education	124 (29)
Western education	303 (71)
Occupation	
Farmer	264 (61.8)
Artisan	92 (21.6)
Fisherman	20 (4.7)
Civil servant	15 (3.5)
Others	36 (8.4)
Religion	
Islam	330 (77.3)
Christianity	97 (22.7)
Marital status	

Married	377 (88.3)
Single	50 (11.7)

3.2 Knowledge of Ebola Viral Disease

The awareness rate of EVD was very high among hunters (96.2%, n=411/427). The mean EVD knowledge score was 4.3±0.9. Using 50% of the maximum obtainable score as the cut-off for a GK of EVD, only 42.6 % (n= 182/427) of the hunters had a GK of EVD. However, they had poor knowledge of the cause, symptoms, mode of spread and preventive measures. Most of the respondents (74%, n=304/427) thought that EVD cannot be treated (Table 2). Most of the participants (76.6%, n=315/427) do not believe that hunting and consumption of game animals poses risks of EVD.

Table 2 Knowledge of EVD among hunters in Kwara State (n=427).

Variables	Frequency
Have you heard of Ebola?	
Yes	411 (96.2)
No	16 (3.8)
Source of information on EVD	
Radio	181 (44)
TV	179 (43.6)
Others	50 (12.2)
Cause of EVD	
Spiritual attack	143 (34.8)
Sick animals/person	260 (63.3)

Others	8 (1.9)
Prevention of EVD	
Not touching a sick person	120 (28.1)
Hand washing soap and water	28 (6.6)
Drinking and bathing with saltwater	135 (32.9)
Not eating bush meat	44 (10.3)
Spiritual protection	100 (23.4)
Incubation period	
2 days	14 (3.4)
21 days	5 (1.2)
2-21 days	149 (36.3)
Don't know	243 (59.1)
Vaccine for EVD	
No	308 (75)
Yes	103 (25)
Can consumption of bush meat transmit EVD?	
No	315 (76.6)
Yes	96 (23.4)

3.3 Practices associated with risk of exposure to EVD

Only 22.5% (n=96/427) of the hunters affirmed to hunting bats and monkeys and only 17.1% (n=73/427) of them admitted to having consumed raw or undercooked game animals (bushmeat). Based on the practice of picking animals found dead during hunting, 23.9 % (n=102/427) of the hunters were at risk of exposure to EVD. Similarly, some of the hunters (23.9%, n=102/427) (Table 3). About a quarter of the hunters (23.9%, n=102/427) admitted to picking game animals found dead but only 8.4% (n=36/427) ate dead game animals.

Table 3. Practices associated with risk of exposure to EVD (n=427).

Variables	Frequency (%)
Do you hunt bats and monkeys as bush meat?	
No	331 (77.5)
Yes	96 (22.5)
Do you eat raw bush meat?	
No	354 (82.9)
Yes	73 (17.1)
Do you eat dead game animals?	
No	391 (91.6)
Yes	36 (8.4)
Do you pick dead game animals you find on your way?	
No	325 (76.1)
Yes	102 (23.9)
Do you wash your hands after the hunting process?	
No	78 (18.3)
Yes	349 (81.7)

3.4 Analysis of factors associated with knowledge of EVD among hunters in Kwara state.

Knowledge grade n (%)	**Univariable analysis**	Multivariable analysis

Category	Good	Poor	OR (95% CI)	P-value	Adjusted OR (95% CI)	P-value
Marital status						
Single	26 (55.3)	21 (44.7)	1	1	1	1
Married	149 (40.9)	215 (59.1)	1.8 (1.0-3.3)	0.06	4.4 (1.4-11.0)	0.051
Ethnicity						
Other Tribes	70 (53.4)	61 (46.6)				
Yoruba	105 (37.5)	175 (62.5)	1.9 (1.3-2.9)	0.002	2.4 (1.4-4.1)	0.002
Education						
Informal	110 (39.4)	169 (60.6)	1	1	1	1
Formal	65 (49.2)	67 (50.8)	1.5 (1.0-2.3)	0.06	4.6 (2.6-8.1)	< 0.001
Occupation						
Non-Farmer	114 (69.9)	49 (30.1)	1	1	1	1
Farmer	61 (24.6)	187 (75.4)	7.1 (4.6-11.1)	< 0.001	23.1 (7.3-55.2)	<0.001
Religion						
Christianity	49 (52.7)	44 (47.3)	1	1	1	1
Islam	126 (39.6)	192 (60.4)	1.7 (1.1-2.7)	0.02	8.7 (2.0-38.9)	0.004

Results of the multivariable logistic regression analysis showed that socio-demographic factors - ethnicity, marital status, the form of education, occupation, and religion – all statistically influenced the knowledge on EVD among hunters. Hunters who went through conventional western education (OR:4.6; 95% CI: 2.6, 8.1; p<0.001) and those who were married (OR:4.4; 95%CI: 1.0, 19.0; p = 0.051) were more likely to have a GK of EVD respectively (Table 4). Similarly, hunters who were also professional farmers were more likely (OR = 23.1; 95% C.I.: 7.3, 55.2; p <0.01) to have a GK of EVD. However, the age and the geolocation of the hunters did not influence the knowledge of EVD (result not shown).

Table 4. Multivariable logistic regression analysis of factors affecting good knowledge of EVD among hunters in Kwara State.

4. Discussion

The 2021 outbreak of EVD in some African countries necessitates emergency preparedness by other countries. This is especially important during this COVID-19 pandemic which has stretched public health workers, resulted in the loss lives and livelihood, and caused a global health crisis. To the best of our knowledge, this is the first study that evaluated the risk factors and knowledge of EVD among hunters in Kwara State. The EVD awareness rate among the hunters was high. This could be due to the intensified public awareness campaigns on various social media platforms providing health promotion messages that aimed to address public concerns and promote the adoption of EVD preventive/risk reduction behaviour to reduce community transmission. However, relatively lower EVD awareness rates have been previously reported in other parts of Nigeria including Enugu (Glory M. Knowledge, 2016), Bayelsa, Cross River, and Kano, Niger and Lagos.

During the EVD epidemic, hunters held regular meetings and mingled amongst themselves which could have increased their awareness of EVD. However, the high awareness rate has not translated into GK of the EVD. This is evident in that only 42.6% of the hunters had a GK of the cause, symptoms, mode of transmission, and prevention of the EVD. Furthermore, the perception of hunters was characterized by myths and misconceptions. For instance, some of the hunters believed that EVD was a spiritual attack while others believed that bathing with salted water could protect against EVD. Such misconceptions had been earlier reported by (Alhaji, 2017; Shittu, 2015; Nwozichi, C, 2015). To address such misconceptions, public advocacy should be intensified and delivered in the local languages. Also, it is essential to support inter-personal engagements at grassroots levels to improve community response and ownership of the social mobilization efforts.

All respondents have other occupations besides hunting and the majority of the respondents were farmers. Hunting served as a means to earn extra income to support their families. This is similar to the report of (Adefalu, 2021) who reported that bushmeat sales contributed 6–40 % of some rural households' daily income. The majority of hunters

were of the male gender. It was observed that men are generally more involved in hunting and transport of bushmeat, while women are more heavily involved in the sale of bushmeat (Ceppi S, 2014; LeBreton M, 2006). Though several studies might suggest that the male gender is an at-risk group for EVD transmission due to primary contact with wildlife, the female gender is equally at risk because they are involved with handling, processing and trading of game animals. Besides, women were more likely to serve at the higher end of the bushmeat commodity chain, where they buy bush meat from rural hunters and transport it elsewhere for economic gains.

The practices of hunters were however sub-optimal as many of them hunted bats and monkeys; consumed raw or undercooked game animals, and picked dead game animals during hunting. These practices could increase their exposure to EVD. This is similar to the report of to (Le Breton,2006) in which 74% of his respondents in Cameroon perceived a high risk associated with hunting game animals (including contact with blood and bodily fluids) but only 4% of hunters and 2% bush meat processors reported that they took precautionary measures. Similarly, (Subramanian M, 2012) reported that only 24% of bushmeat hunters and traders in Sierra Leone were aware of the danger of zoonotic disease transmission from game animals to humans.

The high frequency of hunting is known to increase the risk of exposure to disease-carrying animals and specifically EVD. Practices of picking dead game animals for personal consumption and sales is highly discouraged. These practices could lead to the introduction of novel emerging or re-merging diseases into the human population. The majority of the hunters in Kwara State said that their awareness of the EVD did not stop them from hunting. This finding is consistent with the findings of (Shittu, 2015) which reported that EVD did not stop people from living their normal lives and businesses. However, 86 % of the hunters said the EVD outbreak affected their game animals' sales and changed the way they hunt and handle game animals. A similar finding was reported by (Odunyemi, 2016).

The knowledge of EVD was significantly influenced by the form of education received by the hunters. Those with conventional western education were more likely to have a GK of EVD. This is similar to the report of (Nwozihi, C, 2015). Generally, the age and the geolocation of the hunters did not influence the knowledge of EVD. This might be due to the widespread community sensitization championed by the national orientation agency during the EVD outbreak. The main limitation of this study is that it did not factor intra cluster variability when estimating the sample size.

5. Conclusion

There is a need to further enlighten hunters on the modes of spread of EBOV and risks associated with hunting and handling of game animals. Further studies should be carried out to determine the seroprevalence of EVD in hunters and wildlife species captured by them in the study area.

Significance for Public Health

EVD is an acute viral hemorrhagic disease with high morbidity and mortality. This study is important as it describes the baseline knowledge of the at-risk group – hunters- in Kwara State. This study described the knowledge gap on EVD among hunters and evaluated the risk assessment. In addition, it will educate the hunters and general public to serve as early warning system to avoid spill-over into human population. We also described socio-demographic factors that were predictors of good knowledge or practices towards EVD.

Supplementary files

Supplementary file 1 – The survey instrument used in this study

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