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Analysis of the Risks of Transmission of Ebola Virus Disease within the Population in Beni Health Zone 2025

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Abstract

During the West African epidemic between 2013 and 2016, the largest known to date, chains of transmission reached urban centers for the first time, causing more cases and deaths than in all previous epidemics combined. To prevent such animal to human transmission, current research efforts are focused on identifying animal reservoirs of the virus. This study is of the descriptive correlational type because we evaluated the relationship between the knowledge, attitude and practice of households on the risks of Ebola Virus Disease transmission and the quantitative approach was used. Quantitative data were collected by face-to-face interview based on a questionnaire submitted to households and the supervision of the investigators was continuous to ensure the smooth running of the study in 4 health areas constituting the Ebola Virus Disease foci (Malepe Health Area, Kasabinyole Health Area, Ngongolio Health Area and Kanzulinzuli Health Area). The results of the study specify that the risks of transmission of Ebola Virus Disease by the population in Beni Health Zone are linked to the following socio-demographic and economic factors: the level of education of the respondent and the dangers of eating smoked meat (Kh2=41.239a; dll=3 and pv=0.000<0.05); and prevention and practice against Ebola Virus Disease (OR: 0.485[0.245 ; 0.959] and (pv=: 0.038<0.05). Strict adherence to good prevention practices will help avoid the risks of Ebola Virus Disease transmission in Beni Health Zone.

Keywords: *Analysis, Beni, EVD, Population, Risks, Transmission.*

Introduction

The Ebola virus belongs to the genus Ebolavirus in the family Filoviridae [1]. The Ebolavirus genus includes six species: Zaire ebolavirus, Sudan ebolavirus, Bundi-bugyo ebolavirus, Taï ebolavirus, Reston ebolavirus, and the recently discovered Bombali ebolavirus [2]. All ebolaviruses except Reston ebolavirus and Bombali ebolavirus have been shown to cause disease in humans. Zaire ebolavirus (EBOV) is the most pathogenic of all, with a mortality rate of 70% to 90% [1]. Ebolavirus infection is zoonotic in origin, i.e. caused by infected animals or virus reservoir species (species carrying the virus, where the virus is permanently maintained, which transmit it to humans [3]. The first Ebola epidemics occurred in Sudan and Zaire (now the Democratic Republic of Congo -DRC) in 1976 and were caused by Sudan ebolavirus and Zaire ebolavirus respectively. Since then, there have been several epidemics, most of them caused by

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EBOV in Central Africa [4].

During the West African epidemic between 2013 and 2016, the largest known to date, chains of transmission reached urban centers for the first time, causing more cases and deaths than in all previous epidemics combined [2]. To prevent such animal-to-human transmission, current research efforts are focused on identifying animal reservoirs of the virus.

The Ebola disease is a zoonotic Ebola outbreak that emerged in 1976 and has recently been responsible for major epidemics in Central and West Africa. The outbreak in West Africa between 2013 and 2016 highlights the need to be better prepared to detect and respond to future epidemics [5].

In Beni Health Zone, the response activities encountered difficulties following acts of violence, the throwing of projectiles at vehicles and even the assassination of some members of the response team. The factors that caused the population's resistance to the Ebola Virus Disease epidemic were the lack of confidence in the quality of care in the treatment centers (ETCs), the lack of confidence in the response team and the mistrust of foreigners who came, according to the population, to take advantage of the epidemic, and finally the more economic dimension that this response had taken [6].

The persistence of the EVD and the devastation it causes reflect the weakness of the healthcare systems, which are unable to respond to epidemics of such magnitude [7].

The tireless work to strengthen preparedness capacities in neighboring countries has also limited the risk of the outbreak spreading [8].

Furthermore, the low involvement of health personnel working within the health services in the province of North Kivu, whose capacities needed to be strengthened, was one of the factors that favored the persistence of this epidemic in Beni Health Zone. A study conducted among health providers in the city of Butembo, a neighboring city of Beni, at the start of the epidemic, noted that they were less able to contain an extension of this epidemic in this city [9].

The Ebola Virus Disease is transmitted through direct contact with blood, secretions (stool, urine, saliva, semen) or other bodily fluids of infected individuals, as well as through contact with surfaces or objects (e.g., bedding, clothing, paper towels) contaminated with these fluids. Ebola virus is not transmitted through the air [10].

The Ebola disease is spread only through: (i) direct contact with the bodily fluids of an infected animal or person who is showing symptoms of the disease, contact with semen or breast milk of a person who has recovered from Ebola disease; (ii) person-to-person contact includes contact with bodily fluids or tissues of an infected person showing symptoms of Ebola disease, including: blood, urine, feces, vomit, saliva, sweat, semen, breast milk (this includes: contact with the body or bodily fluids of a person who has died from Ebola disease, sexual contact with a person who has Ebola disease, contact with the semen of a person who has recovered from Ebola disease; during pregnancy, childbirth or breastfeeding, an infected person can transmit Ebola disease to their baby); Contact with contaminated objects includes contact with surfaces, materials (such as bedding), or medical equipment (such as needles) contaminated with an Ebola virus that can cause Ebola disease; (iii) animal-to-human contact may include close contact (such as handling or feeding) with live or dead infected animals or their bodily fluids, including: gorillas, monkeys, chimpanzees, bats, porcupines, woodland antelopes, pigs [11] (Figure 1).

In light of the above, we asked the following questions:

General question

What are the factors associated to the risks of Ebola Virus Disease transmission within the population in Beni Health Zone?

Specific questions

1. What are the sociodemographic and economic characteristics that

significantly influence the risks of Ebola Virus Disease transmission within the population in Beni Health Zone?

2. What are the risks of Ebola Virus Disease transmission related to the level of knowledge, attitudes, and practices of households in Beni Health Zone?
3. What are the best predictors of Ebola Virus Disease transmission risks within the population in the Beni Health Zone?

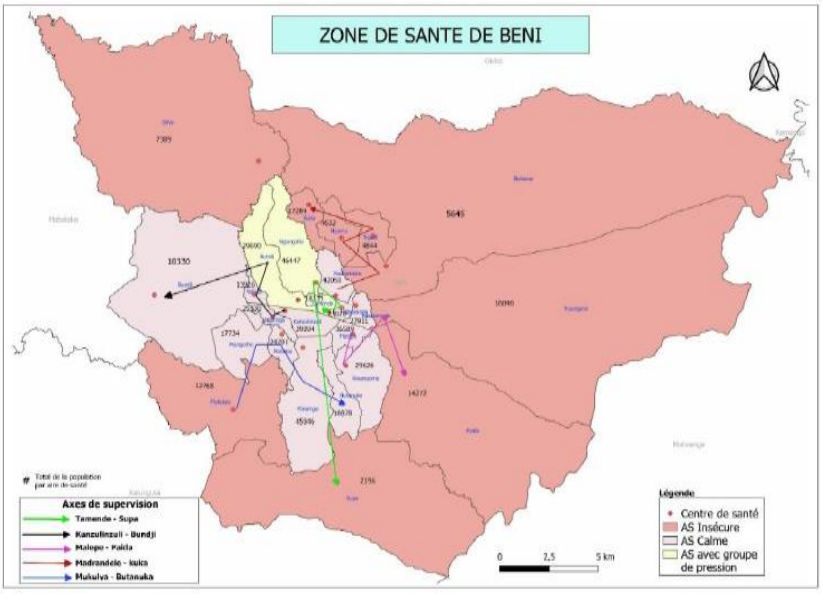

Figure 1. Map of the Beni Health Zone

ZONE DE SANTE DE BENI = BENI HEALTH ZONE [12].

Hypothesis

1. There is a significant relationship between sociodemographic characteristics such as age, sex, education level, religious denomination, and occupation and the risk of Ebola Virus Disease transmission within the population in Beni Health Zone.
2. There is a significant relationship between household knowledge, attitudes, and practices and the risk of Ebola Virus Disease transmission within the population in Beni Health Zone.
3. Among these factors, there are those that are the best predictors of the risk of Ebola Virus Disease transmission within the population in Beni Health Zone.

Objectives

General Objective

The general objective of the research is to identify the risks of transmission of Ebola Virus Disease within the population in Beni Health Zone.

Specific Objectives

The specific objectives of our research are as follows:

1. To establish the link between sociodemographic and economic characteristics such as age, gender, education level, religious denomination, occupation, and the risks of Ebola Virus Disease transmission in Beni Health Zone.
2. To identify the risks of Ebola Virus Disease transmission related to knowledge, attitudes, and practices among the population in Beni Health Zone.
3. To assess the predictive factors of Ebola Virus Disease transmission among the population in the Beni Health Zone

based on household practices regarding the risks and prevention of this disease.

Choice and Significance of the Subject

Scientific Significance

This study will serve as a documentary tool for scientific executives in the field of Public Health.

Community Significance

Knowledge, attitudes, and practices on the prevention of Ebola Virus Disease within the population in Beni Health Zone will help reduce the risks of transmission of this epidemic.

Scope of Work

This study focused on the analysis of the risks of transmission of Ebola Virus Disease within the population in Beni Health Zone and was carried out among households residing in the same Health Zone, during the year 2025.

Materials and Methods

Materials

The materials that will be used for this work are : the heads of households living in the Beni Health Zone, in the same City of Beni, the consultation register of the Health facilities of the Beni Health Zone, the data of the Central Office of the Beni Health Zone, the pen, paper, the computer, the data collection were be done by the Kobo collect software and the processing by Epi Info software.

Types of study

This study is of the descriptive correlational type because we evaluated the relationship between household knowledge, attitude and practice on the risks of Ebola Virus Disease transmission.

Study Population

Regarding this study, the study population consisted of household managers from the targeted Health Areas in Beni Health Zone. Population: is the target of the study or total number of individuals on whom the research focuses [13].

Sampling

It is the process of selecting a group of individuals to be interviewed as part of a study and which symbolizes a reference population; method and process of sample selection [13].

In order to obtain our sample, we used the SHWARTZ formula referring to an infinite population which predicts

$$n = t^2 \frac{pq}{d^2}$$

n = sample size

t = value associated with a 5% risk of error

p = prevalence of EVD is estimated at 27.1% [14].

q = 1 - p, that's to say, the proportion of EVD patients who are positive

d = desired precision, which is equal to 5%.

So, $n = 1{,}96^2 \frac{0{,}27(1-0{,}27)}{(0{,}05)^2} = 303$

In order to resolve the cost risk that should arise during the survey as recommended [15], we reduced the sample size to 33.66% of 303 households to bring the sample down to 102 households, the population of AS in the Beni 2025 Health Zone being 549770 inhabitants [16].

Survey Technique

The collection of these quantitative data was done by face-to-face interviews based on a questionnaire submitted to households and the supervision of the investigators was continuous to ensure the proper conduct of the study.

Ethical Considerations

The Ethical considerations were at the center of this study which had already obtained the approval of Texila American University, the Catholic University of Graben (UCG) under No. PTH.02/25/UCG/CERM and the endorsement of the Central Office of Beni Health Zone [17]. Informed consent was sought from the target population. Any refusal to

participate in the survey was respected by the investigators [18]. Provisions were made to protect the confidentiality of the information provided by respondents. Personal data that could identify the respondent were not collected.

Results

Descriptive Analysis

Sociodemographic Characteristics

Regarding the distribution of gender, there are many female respondents, i.e. 58.8% compared to 41.2% for male respondents (Table 1). And Table 2 shows that the 25 to 34 age group is the most affected with a proportion of 46.1%. 18 à 24 ans = 18 to 24 years old; 25 à 34 = 25 to 34 years old; 35 à 44 ans = 35 to 44 years old; 45 à 55 ans = 45 to 54 years old; 55 à 64 ans = 55 to 64 years; 65 et plus = 65 years old and more. From this graphic, it shows the same that the 25 to 34 age group is the most affected with a proportion of 46.1% (Figure 2)

Table 1. Distribution of Respondents by Gender

Gender of the respondent			
Gender	**Number**	**Percentage (%)**	**Cumulative percentage (%)**
Male	42	41.2	41.2
Female	60	58.8	100.0
Total	102	100.0	

Table 2. Distribution of Respondents by Completed Age

Age group	Number	Percentage (%)	Cumulative percentage (%)
18 to 24 years old	17	16.7	16.7
25 to 34 years old	47	46.1	62.7
35 to 44 years old	26	25.5	88.2
45 to 54 years old	8	7.8	96.1
55 to 64 years old	3	2.9	99.0
65 years old and over	1	1.0	100.0
Total	**102**	**100.0**	

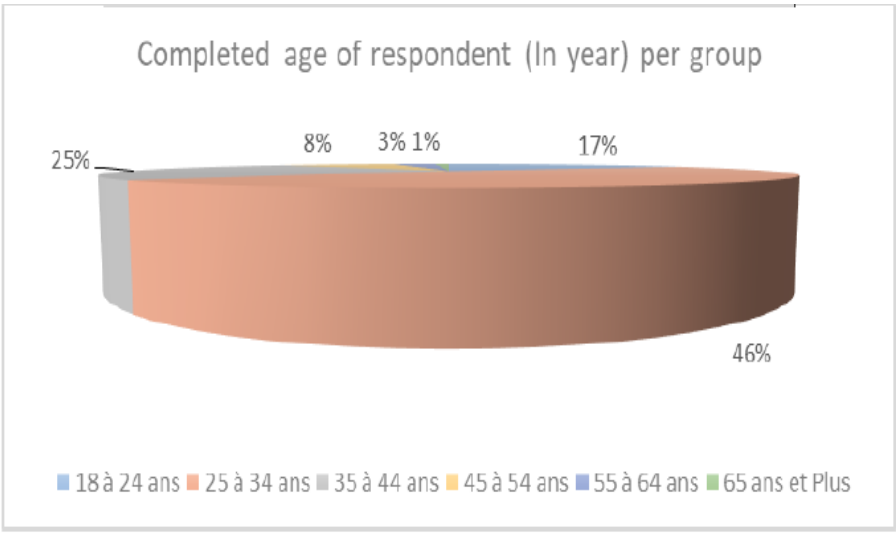

Figure 2. Distribution of respondents by completed age graphic

Table 3. Distribution of Respondents by Level of Education

Level of education of the respondent			
Level of the study	**Number**	**Percentage (%)**	**Cumulative percentage (%)**
None	1	1.0	1.0
Primary	10	9.8	10.8
Secondary	62	60.8	71.6
Higher or university	29	28.4	100.0
Total	102	100.0	

This table 3 reveals that the secondary education level was more affected with a percentage of 60.8% than other education levels.

Socioeconomic Characteristics

Regarding the profession, it appears that 27.5% of the people surveyed are private sector agents (Table 4) and table 5 indicates that 97.1% of respondents have household size of 0 to 5 years.

Table 4. Distribution of Respondents According to their Profession

	Number	**Percentage (%)**	**Cumulative percentage (%)**
Unemployed	25	24.5	24.5
Public sector agent	22	21.6	46.1
Private sector agent	28	27.5	73.5
Farmer	26	25.5	99.0
Other (Please specify)	1	1.0	100.0
Total	**102**	**100.0**	

Table 5. Distribution of Respondents According to the Number of People in the Household

	Number	**Percentage (%)**	**Cumulative percentage (%)**
0 to 5 people	99	97.1	97.1
6 and more	3	2.9	100.0
Total	**102**	**100.0**	

Inferential Analysis

Factors Promoting Knowledge of Ebola Virus Disease

The result of the analysis specifies that at the significance threshold of 5%, there is no link between sex and knowledge of EVD (Kh2=0.0782; ddl=1, pv=0.779), [Table 6].

At the 5% significance level, there is no link between the level of education and knowledge of EVD (Kh2=0.994; ddl=3, pv=0.574), [Table 7].

Table 6. Association Between Respondent's Sex and Knowledge of EVD

Gender								
		Male	Female	Total	kh2	dll	Pv	S
Knowledge	Yes	41	58	99				
	No	1	2	3				
Total		**42**	**60**	**102**	**0.0782**	**1**	**0.779**	**TS**

Table 7. Association Between Level of Education and Knowledge of EVD

Level of education of the respondent										
		None	Primary	Secondary	Higher or University	Total	kh2	dll	Pv	S
Knowledge	Yes	1	10	59	29	99				
	No	0	0	3	0	3				
Total		**1**	**10**	**62**	**29**	**102**	**0.994**	**3**	**0.574**	**TS**

Table 8. Proportion of the Existence of Ebola Virus Disease

Variables in the equation									
		A	E.S.	Forest /Wald	Ddl	Sig.	Exp (B)	CI for Exp (B) 95%	
								Lower	Superior
Step 1[a]	Level of the study of the respondent	-20.891	3139.126	,000	1	,995	,000	0.000	
	Profession of the respondent	-,039	,710	,003	1	,956	,962	,239	3.871
	Gender	-,780	1.619	,232	1	,630	,458	,019	10.950
	Age group	-,649	1,339	,235	1	,628	,523	,038	7.213
	Constant	**45,088**	**6278,254**	**,000**	**1**	**,994**	**0.120**		

In view of the logistic regression analysis table 8 above, the following variables: Level of education, occupation of the respondent, sex and age group are not significant at the 95% confidence interval. Their probabilities are respectively: OR: 0.000[0.000; 0.000] and (p: 0.995); OR: 0.962[0.239; 3.871] and (p: 0.956); OR: 0.458[0.019; 10.950] and (p: 0.630); OR: 0.523[0.038; 7.213] and (p: 0.628). And therefore are not linked to the existence of EVD.

Factors Related to Attitudes and Perceptions towards Ebola Virus Disease

Table 9. Dangers of Eating Smoked Meat

Level of study of the respondent										
		None	Primary	Secondary	Higher or University	Total	Kh2	dll	Pv	S
Do you think there are any dangers in eating smoked meat ?	Yes	0	0	26	29	55				
	No	1	10	36	0	47				
Total		**1**	**10**	**62**	**29**	**102**	**41.239a**	**3**	**0.000**	**TS**

The table 9 above shows the relationship between the level of education of the respondent and the dangers of eating smoked meat. At the 5% significance level, this relationship is significant (Kh2=41.239a; dll=3 and pv=0.000<0.05).

Factors Related to Prevention and Practice

Table 10. Precautions Against Stings

Variables in the equation									
		A	E.S.	Wald	ddl	Sig.	Exp (B)	CI for Exp (B) 95%	
								Lower	Superior
Step 1[a]	Level of the study of the respondent	-,723	,348	4.325	1	,038	,485	,245	,959
	Profession of the respondent	-,112	,195	,328	1	,567	,894	,610	1.311
	Gender	,438	,435	1.014	1	,314	1.549	,661	3.631
	Age group	,085	,220	,151	1	,698	1.089	,708	1.675
	Constant	**1.215**	**1.469**	**,684**	**1**	**,408**	**3.371**		

From this logistic regression analysis table 10 above, only the variable level of study of the respondent which remained significant at the 95% confidence interval; (OR: 0.485 [0.245; 0.959] and (p: 0.038 <0.05) hence this variable is a factor which significantly explains the prevention and practice against Ebola Virus Disease.

Table 11. Hygiene Precautions When Handling Dead Animal Carcasses

Variables in the equation									
		A	E.S.	Forest/ Wald	ddl	Sig.	Exp (B)	CI for Exp (B) 95%	
								Lower	Superior
Step 1[a]	Level of the study of the respondent	-21.267	6098.035	,000	1	,997	,000	0.000	
	Profession of the respondent	-,226	,257	,777	1	,378	,798	,482	1.319
	Gender	-,276	,539	,263	1	,608	,759	,264	2.181
	Age group	,411	,273	2.272	1	,132	1.509	,884	2.576
	Constant	**64.072**	**18294.104**	**,000**	**1**	**,997**	**2.000**		

From the logistic regression analysis table 11 above, it appears that the following variables: Level of education, profession of the respondent, sex and age group are not significant at the 95% confidence interval. Their probabilities are respectively: OR: 0.000[0.000; 0.000] and (p: 0.997); OR: 0.798[0.482; 1.319] and (p: 0.378); OR: 0.759[0.264; 2.181] and (p: 0.608); OR: 1.509[0.884; 2.576] and (p: 0.132).

Table 12. Receipt of Ebola Virus Disease Vaccine

Variables in the equation									
		A	E.S.	Wald	ddl	Sig.	Exp (B)	CI for Exp (B) 95%	
								Lower	Superior
Step 1[a]	Level of the study of the respondent	-21,411	6030,117	0	1	0,997	0	0.000	

	Profession of the respondent	-0,322	0,267	1.450	1	0,229	0,725	0,429	1.224
	Sexe	0,143	0,559	0,066	1	0,798	1.154	0,386	3.451
	Age group	0,63	0,312	4,066	1	0,044	1,877	1,018	3462
	Constant	**63.789**	**18.090.352**	**0**	**1**	**0,997**	**1.000**		

From the logistic regression analysis table 12 above, only the variable age of the respondent remained significant at the 95% confidence interval; (OR: 1.877 [1.018; 3.462] and (p: 0.044 <0.05) hence this variable is a factor which significantly explains the prevention and practice against Ebola Virus Disease.

Discussion

The results of this survey indicate that the main modes of transmission of Ebola Virus Disease are sexual intercourse, consumption of infected wild animals, contact with contaminated blood, injury or contact with a contaminated object, contact with Ebola Virus Disease corpses, simple contact with infected people , and contact with biological fluids (semen, sweat, saliva, vomit, etc.); this was also reported by the Knowledge, Attitudes, and Practices (KAP) survey on Ebola prevention in Ivory Coast [19].

Regarding the attitudes of respondents towards Ebola Virus Disease prevention, respondents are more inclined not to consume bushmeat (85.7%); the results of this study reveal a link between the respondent's level of education and the dangers of eating smoked meat; which is perceived as the best predictor of Ebola Virus Disease transmission. At the 5% significance level, this link is significant, (Kh2=41.239a; dll=3 and pv=0.000<0.05) [Table 9]. This same trend was observed in the study of the resurgence of Ebola Virus Disease in the Nzérékoré region [20].

In relation to precautions against bites, the level of education of the respondent remained significant at the 95% confidence interval. (OR: 0.485 [0.245; 0.959] and (p: 0.038 <0.05) [Table 10] hence this variable is a factor that significantly explains the prevention and practice against Ebola Virus Disease. This is consistent with the study of Perception of healthcare personnel regarding the response to Ebola Virus Disease in the Butembo Health Zone [21].

Regarding physical contact with other people, the study reveals that nearly 83.4% of respondents are willing to avoid contact with other people, including those in their community, to avoid Ebola Virus Disease, which is the same as the study of knowledge, attitudes and practices (KAP) in the context of Ebola prevention in Ivory Coast [19].

Conclusion

The general objective of this study is to better understand the emergence, spread, and consequences of this disease and to define appropriate surveillance and prevention strategies. This study assessed the relationship between household knowledge, attitudes, and practices regarding the risks of Ebola Virus Disease transmission.

In fact, more than half of the population has a satisfactory level of knowledge about Ebola Virus Disease. The same is true for modes of transmission, symptoms, and attitudes; however, problems remain regarding Ebola Virus Disease prevention practices. The results of the analysis confirmed that the best predictors of the risks of transmission of Ebola Virus Disease by the population in Beni Health Zone are linked to the consumption of smoked meat, we also note the level of education of the respondent, the level of education and precautions against bites (OR : 0.485 [0.245; 0.959] and (p : 0.038 <0.05) [Table 9] and finally, the receipt of the Ebola Virus Disease vaccine (OR : 1.877 [1.018; 3.462] and (p: 0.044 <0.05) [Table 10]. Thus, strict

compliance with good prevention practices will prevent the risk of Ebola Virus Disease transmission in Beni Health Zone.

Ethical Approval

The letter and a copy of the research protocol were submitted to the ethics committee of the Catholic University of Graben (UCG) for review of the ethical aspects of the research project in order to obtain authorization. We also contacted the relevant political, administrative, and health authorities to obtain their approval.

Conflicts of Interest

This study was not influenced by any individual, organization, or association to bias the research results for personal gain.

Data Availability

The data will be available in the TEXILA INTERNATIONAL JOURNAL OF PUBLIC HEALTH, https://www.texilajournal.com/.

Author Contributions

We contributed to conduct research to study the factors associated with the resurgence of Ebola virus disease in the population in the Beni Health Zone.

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