Public Health in Practice 2 (2021) 100178

Contents lists available at ScienceDirect

Public Health in Practice

journal homepage: www.sciencedirect.com/journal/public-health-in-practice

Original Research

Knowledge and misconceptions related to the Ebola Virus Disease among adults in the Democratic Republic of the Congo: The venomous snake under the table of prevention

Jude Mary Cénat [a,*], Cécile Rousseau [b], Rose Darly Dalexis [c], Jacqueline Bukaka [d], Daniel Derivois [e], Oléa Balayulu-Makila [d,e], Jean-Pierre Birangui [f]

[a] School of Psychology, University of Ottawa, Ontario, Canada
[b] Division of Social and Transcultural Psychiatry, McGill University, Montreal, Canada
[c] Interdisciplinary School of Health Sciences, University of Ottawa, Canada
[d] Department of Psychology, University of Kinshasa, Kinshasa, Democratic Republic of the Congo
[e] Laboratory of Psychology Psy-DREPI (EA 7458), Université Bourgogne Franche Comté, Dijon, France
[f] Department of Psychology, University of Lubumbashi, Democratic Republic of the Congo

ARTICLE INFO

Keywords:
Ebola virus disease
Knowledge
Practices and misconceptions
Prevention

ABSTRACT

Objectives: On July 24, the Ministry of Health of the Democratic Republic of the Congo declared the end of the 2018 Ebola Virus Disease (EVD) outbreak in the Equateur Province. Conducted seven months after, this study aimed to examine knowledge and misconceptions related to EVD in a representative sample of affected communities in order to develop evidence-based prevention programs.
Study design: Cross-sectional study with a two-stratified representative sample.
Methods: A sample of 1,614 participants (50% of women) was recruited between March and April 2019 in the three affected health zones. Participants completed a questionnaire assessing knowledge, perception, practices and misconceptions related to EVD.
Results: One-third of the 1,614 participants did not know that EVD is transmitted through bodily fluids of infected people. Only 39.85% and 45.99% were aware that EVD cannot be transmitted through air and mosquitoes. Only 44.93% declared a salty and hot bath cannot prevent EVD; and only 43.78% answered that spiritual or traditional healers cannot cure EVD. Results also indicated that although participants with high levels of education had more knowledge of EVD, they did not differ significantly from less educated ones for misconceptions. Hierarchical linear regression models showed interactions of sociodemographic characteristics that predicted EVD knowledge.
Conclusions: The pervasive lack of knowledge, misconceptions and attitudes related to EVD constitute a major concern for prevention. Instead of basing awareness programs on the fear of EVD, health authorities, World Health Organization and NGOs should co-develop culturally sensitive and inclusive community evidence-based programs to educate the populations.

1. Introduction

On May 3, 2018, the Equateur Provincial Health Division reported 17 deaths following the infection of 21 people with an undiagnosed disease. Two days after, the Ministry of Health of the Democratic Republic of Congo sent a team on-site with the support of Doctors without Borders and the World Health Organization [1]. Out of five patients identified in Ikoko-Impenge, two were tested positive for Zaire ebolavirus species, which triggered the Ebola outbreak on May 8, 2018 in the Equateur Province. During this outbreak, three health zones were affected: Bikoro, Iboko and Wangata. Of these three health zones, 18 rural and urban areas were affected, some with reduced access due to the virtual absence of roads. At the end of the outbreak in July 2018, 33 of the 54 infected individuals died, for a fatality rate of 61.11% [1]. Although DRC is the most affected country by EVD over the years since its discovery in 1976 [2], the country has always shown an ability to respond quickly and to contain outbreaks in space and time. However, the recurrence of outbreaks, including the 11th outbreak in the east regions

* Corresponding author. School of Psychology (Clinical), University of Ottawa, 136 Jean-Jacques-Lussier, 4017, Vanier Hall Ottawa, Ontario, K1N 6N5, Canada.
E-mail address: jcenat@uottawa.ca (J.M. Cénat).

https://doi.org/10.1016/j.puhip.2021.100178
Received 21 January 2021; Received in revised form 4 July 2021; Accepted 30 July 2021
Available online 30 August 2021

and the 12th in the Equateur region, raises important questions about the country's ability to prevent them, especially considering the vulnerability of low and middle income countries to infectious diseases [3]. Studies among affected populations during the 2014–2016 outbreak showed that education is the key to raising awareness and preventing EVD [4–7]. These studies and others particularly showed that knowledge of the means of transmission and prevention, signs and symptoms of EVD can prevent the infection transmission in communities [8]. Other studies also showed that EVD is associated to rumors and misconceptions that put populations at risk [9]. Misconceptions lead people to ignore the health authorities' instructions, to adopt inappropriate attitudes towards hypothetical cases, to take risks and to rely on traditional and spiritual healers instead of healthcare workers [10,11].

Studies conducted in the context of EVD have shown that local communities do not always have the necessary knowledge to understand how to protect themselves [9] [–] [12]. These studies and others have also shown that when epidemics are over and the associated anxiety and fear disappear, populations generally retain the misconceptions associated with EVD and continue to live according to them [10,13]. Among the misconceptions identified in local populations, some are related to the modes of transmission of EVD, while others are related to treatment. For those related to EVD transmission, studies have identified transmission by air, mosquito and housefly bites, and hot and salty baths [10–12]. For those related to treatment, the studies identified salt and hot baths; prayer healing, traditional and spiritual healers, that effectiveness of traditional and spiritual healers compared to physicians [9–12].

In the last three years, the province of Équateur has faced two Ebola outbreaks. First, the outbreak in May 2018 and a second in 2020, in the midst of the COVID-19 pandemic [14]. In addition to being a very expansive province (103,902 km2), a lot of regions are very difficult to access and some of them can only be reached by unsafe boat transportation [15]. The geographic situation of the province of Équateur requires significant resources that neither regional nor central public health authorities dispose to access local populations and implement necessary programs to educate and raise awareness about the risks associated with EVD. Often, programs are based on fear and are limited to the duration of outbreaks. However, implementation of these programs is crucial and relevant to prevent recurrent outbreaks of EVD, as the province, and especially rural areas, face major infrastructure deficiencies. With a net secondary school enrollment rate of 16.6% in 2009, the level of education of the population is below the national rate (25.7%) and great are the needs to implement long-term culturally adapted education programs to provide EVD knowledge to the communities [15].

Using data from the EVD and Mental Health project (EboMH), this article aimed first, to examine basic knowledge of EVD, means of transmission, prevention and treatment and analyze misconceptions, practices and attitudes associated to EVD among adults in the 18 rural and urban areas (of the three Health Zones) affected by the 2018 Ebola outbreak in the Equateur Province of the DRC seven months after the end, according to the sociodemographic characteristics of the participants. Secondly, this article aimed to determine predictors associated to EVD knowledge.

2. Methods

2.1. Study design and sample

We used data from the EboMH [16,17]. The study was conducted from March 11 to April 7, 2019, seven months after the declaration of the end of the ninth outbreak of EVD in the DRC. It was conducted in the 18 rural and urban areas that reported at least one case of EVD in the three health zones (Bikoro, Iboko and Wangata) affected by the 2018 outbreak in Equateur Province. Adults aged 18 and over were selected from a two-stage stratified sample: 1) the affected rural and urban areas, according to their demographic weight, with reference to estimates from the National Statistics Institute; and 2) the proportion of women in affected rural and urban areas. A door-to-door survey was conducted by 26 investigators (including 12 women) who were trained for a day and a half on how to complete the questionnaire and ethical issues. To prevent misunderstandings and because there is a high illiteracy rate and it is culturally inappropriate to ask a person if he/she knows how to read, the interviewers themselves read the items for the participants and completed the questionnaire in their local Lingala language. A total of 23 people refused to participate in the study (including 12 men). Therefore, 1,637 people were solicited and 1,614 agreed to participate, for a response rate of 98.59%. All participants signed an informed consent form. The study protocol was approved by the ethics committees of the University of Ottawa, the Institut National de Recherche Biomédicale, and the University of Kinshasa.

The sample included 1,614 adults (50% women) aged 18–85 years, with an average age of 34.05 years (SD = 12.55). This low average age can be explained by the youthfulness of the Congolese population and particularly in Equateur province where in 2009, the average age was 21 years and 57.2% of the population under 20 years old.

2.2. Measures

The *Ebola Virus Disease Knowledge, Perception and Attitudes Scale* (EboKPAS) consists of 18 items. Participants completed the EboKPAS which includes 4 sub-scales (see Table 1) assessing *i. Basic knowledge related to Ebola prevention and treatment* (5 items)*; ii. Misconceptions related to the transmission, prevention and treatment of Ebola* (4 items)*; iii. Knowledge of prevention measures* (5 items) *iv. Knowledge of dignified and safe burial practices* (4 items). The EboKPAS was developed based, first, on documents from the Centers for Disease Control and Prevention (CDC) and the World Health Organization on the means of transmission and prevention, as well as the signs and symptoms of EVD [1,18]. It is also based on interviews with physical and mental health professionals (doctors, nurses, psychologists, epidemiologists, social workers, psychosocial counsellors) who intervened in the response in Equateur and North Kivu province on the most widespread misconceptions related to EVD.

Respondents quoted both on a 3-point-scale: *No* (0), *Yes* (1) and *Don't know* (2). To calculate the scores for the scale and subscale, we created a dichotomized score for each item according to the answers: *No* and *Don't know* (0), and *Yes* (1). To calculate the total score of the scale, the scores of the "*Misconceptions related to the transmission, prevention and treatment of Ebola"* subscale were reversed. The score was also reversed for item 5 of the *Knowledge of prevention measures* subscale and for item 1 of the *Knowledge of dignified and safe burial practices* subscale.

The entire scale showed a very good internal consistency with a construct reliability coefficient (coefficient H) of.92 [19]. The subscale also presented very good internal consistence with respective coefficient H of 0.86; 0.90; 0.85; 0.83.

2.3. Statistical analyses

All the statistical analyses were performed using the Statistical Package for Social Sciences (SPSS), version 25 for windows. First, percentages were computed to assess the distribution (Yes; No; I don't know) of the knowledge of the participants for each item. Then, chi-square tests were performed to assess the difference of prevalence between men and women for each item. Next, the difference of proportions test (*z-test*) were used to evaluate the difference between Yes and No answers for each item. We also conducted *t*-test analyses to evaluate difference of scores between participants according to gender. Finally, one-way Analyses of Variance were conducted to assess differences of scores between participants according to education level, religion and age group. To investigate predictors of EVD knowledge, we conducted a two-step hierarchical linear regression analysis. First, these analyses

Table 1
Prevalence of knowledge and misconceptions related to the Ebola virus disease (N = 1614).

Basic knowledge related to Ebola Virus Disease					
Items		Total %	Men %	Women %	*x* [2]
1. It can be avoided by abstaining from contact with the bodily fluids of infected people (such as sweat, blood, urine, poop, saliva, spit …)	Yes	64.88	65.29	64.47	1.36
	No	27.32	27.69	26.96	
	I don't know	7.80	7.02	8.57	
	z-test	21.33***	15.06***	15.11***	
2. It can be avoided by abstaining from contact with the bodies of people who have died from Ebola virus disease	Yes	69.75	69.04	70.10	1.97
	No	22.65	23.85	21.46	
	I don't know	7.78	7.12	8.44	
	z-test	26.68***	18.14***	19.60***	
3. Immediate treatment in an Ebola Treatment Centre increases the chances of survival	Yes	71.73	74.94	68.51	9.56**
	No	16.81	14.11	19.52	
	I don't know	11.46	10.96	11.96	
	z-test	31.15***	24.39***	19.67***	
4. Immediate treatment in an Ebola Treatment Centre reduces the risk of spreading Ebola	Yes	68.60	70.40	66.79	3.77
	No	19.42	17.51	21.34	
	I don't know	11.98	12.09	11.87	
	z-test	27.90***	21.24***	18.22***	
5. It can be avoided by not touching an animal found dead in the forest	Yes	71.21	72.32	70.10	2.02
	No	18.22	16.84	19.59	
	I don't know	10.57	10.84	10.31	
	z-test	29.86***	22.10***	20.13***	
Misconceptions related to the transmission, prevention and treatment of Ebola					
1. It can be transmitted through the air	Yes	44.88	45.51	44.25	7.86*
	No	39.85	37.18	42.48	
	I don't know	15.21	17.18	13.27	
	z-test	3.34**	0.71	2.85*	
2. You can protect yourself against the Ebola virus by avoiding mosquito bites	Yes	39.75	41.01	38.49	3.72
	No	45.99	43.92	48.05	
	I don't know	14.20	14.94	13.46	
	z-test	3.55**	1.17	3.85**	
3. It can be avoided by bathing with salt and hot water	Yes	43.61	44.84	42.39	6.40*
	No	44.93	42.19	47.67	
	I don't know	11.45	12.97	9.94	
	z-test	0.75	1.06	2.12*	
4. It can be successfully treated by spiritual or traditional healers	Yes	40.75	43.04	38.46	3.57
	No	43.78	41.77	45.78	
	I don't know	15.48	15.19	15.76	
	z-test	1.73	0.51	2.95**	
Knowledge of prevention measures					
1. Wash hands with soap and water more often	Yes	69.87	71.37	68.39	1.97
	No	20.92	19.51	22.29	
	I don't know	9.22	9.11	9.32	
	z-test	27.57***	20.56***	18.45***	
2. Avoid physical contact with people suspected of having the Ebola virus disease	Yes	71.34	72.94	69.76	2.80
	No	15.97	14.49	17.44	
	I don't know	12.69	12.58	12.80	
	z-test	31.42***	23.38***	21.06	
3. Avoid crowds	Yes	69.34	71.21	67.47	2.62
	No	18.80	17.68	19.92	
	I don't know	11.86	11.11	12.61	
	z-test	30.19***	21.44***	19.09***	
4. Send a family member to an Ebola treatment centre if he/she shows Ebola virus disease symptoms or signs	Yes	69.52	72.28	66.75	6.86*
	No	19.58	17.09	22.08	
	I don't know	10.90	10.63	11.17	
	z-test	28.22***	22.06***	17.84***	
5. Hide a family member from neighbours and health authorities if they show Ebola virus disease symptoms or signs	Yes	57.25	59.77	54.77	4.13
	No	29.58	27.59	31.53	
	I don't know	13.17	12.64	13.69	
	z-test	15.69***	12.84***	9.36***	
Knowledge of dignified and safe burial practices					
1. Would wash or touch the body if a family member died from suspected Ebola virus disease.	Yes	47.95	49.94	45.99	6.98*
	No	41.00	41.02	40.98	
	I don't know	11.05	9.04	13.03	
	z-test	3.94**	3.55**	2.03*	
2. Would accept a burial team to take care of the body if a family member died from suspected Ebola virus disease.	Yes	51.54	52.99	50.13	2.92
	No	36.60	36.49	36.71	
	I don't know	11.86	10.52	13.16	
	z-test	8.40***	6.51***	5.38***	
3. Would accept alternatives to traditional burials that do not involve physical contact with a corpse if a family member died from suspected Ebola virus disease	Yes	44.75	45.58	43.91	2.77
	No	44.49	44.95	44.04	
	I don't know	10.76	9.47	12.05	
	z-test	0.14	0.25	0.05	
4. Would agree to observe the funeral from a safe distance	Yes	56.41	59.24	53.60	5.55
	No	32.30	30.70	33.88	
	I don't know	11.29	10.06	12.52	
	z-test	13.62***	11.36	7.91	

z-test: Difference of proportions test between Yes and No. *x* [2]*: Chi-square* between men and women for "Yes" answers. *: $p < .05$; **: $p < .01$; **: $p < .001$.

determined whether age, sex, education level, employment status, religious practices, residence area (urban or rural) are associated with EVD knowledge. In the second model, we tested two interactions: education level X employment status and education level X employment status X living area.

3. Results

The results revealed that among the 1,614 participants, in general, one-third lacked basic knowledge of the EVD (Table 1). A total of 35.12% (27.32% for "No" and 7.80% for "I don't know") of participants do not know that the virus is prevented by avoiding contact with the bodily fluids of infected people. However, the results particularly showed that participants had Misconceptions related to the transmission, prevention and treatment of EVD. Indeed, less than half of the participants were aware that the virus is not transmitted by ambient air (39.85%), or by mosquitoes (45.99%). Similarly, less than half of the participants were aware that a salt-and-hot bath does not prevent the virus (44.93%). Regarding the treatment of EVD, 40.75% of participants declared that spiritual or traditional healers can cure it, while 43.78% answered "No" and 15.78% did not know. The results are presented item by item in Table 1 to observe the distribution of scores and therefore the participants' knowledge, perception and attitudes of the EVD. The results also showed significant gender differences for only 5 items. In all these five cases, men had a better knowledge of Ebola disease than women.

The *t*-test and ANOVA analyses presented in Table 2 showed that there are significant differences between men and women only for the *Misconceptions related to the transmission, prevention and treatment of Ebola* subscale where men have a higher score of misconception than

Table 2
Comparisons of means for the different EboKPAS subscales by socio-demographic characteristics (N = 1614).

	Basic knowledge related to Ebola Virus Disease $\bar{x}$ (SD)	Misconceptions related to the transmission, prevention and treatment of Ebola$\bar{x}$ (SD)	Knowledge of prevention measures$\bar{x}$ (SD)	Knowledge of dignified and safe burial practices$\bar{x}$ (SD)	The whole measure$\bar{x}$ (SD)
Total	3.91 (1.48)	2.22 (1.62)	3.48 (1.10)	2.24 (.99)	11.34 2.76)
Gender	$t(1606) = 1.30, p = .20$	$t(1604) = 2.32, p < .05$	$t(1606) = .1.40, p = .16$	$t(1602) = .10, p = .92$	$t(1606) = .08, p = .94$
Men	3.96 (1.43)	2.63 (1.60)	3.52 (1.04)	2.24 (.98)	11.34 (2.59)
Women	3.86 (1.52)	2.13 (1.63)	3.44 (1.16)	2.23 (1.01)	11.35 (2.91)
Residence area	$t(1606) = 3.45, p <. 001$	$t(1606) = .52, p = .61$	$t(1606) = 1.18, p = .24$	$t(1606) = .51, p = .61$	$t(1606) = 1.82, p = .07$
City	4.06	2.20	3.45	2.24	11.48
Rural village	3.80	2.24	3.51	2.23	11.23
Education level	$F(5, 1571) = 5.55, p < .0001$	$F(5, 1571) = .42, p = .83$	$F(5, 1569) = 1.65, p = .68$	$F(5, 1571) = 5.47, p < .0001$	$F(5, 1567) = 2.97, p < .05$
None	3.23 (1.82)	2.16 (1.57)	3.05 (1.26)	2.15 (1.05)	10.20 (3.16)
Primary school	3.89 (1.45)	2.12 (1.64)	3.34 (1.14)	2.06 (1.06)	11.10 (2.86)
High school	4.00 (1.39)	2.26 (1.65)	3.57 (1.04)	2.31 (.97)	11.56 (2.68)
Professional	3.09 (1.78)	2.15 (1.58)	3.04 (1.35)	2.24 (1.08)	10.19 (3.03)
University	3.91 (1.54)	2.16 (1.56)	3.46 (1.14)	2.14 (.98)	11.30 (2.74)
Age	$F(5, 1465) = 5.38, p < .001$	$F(5, 1463) = 4.00, p < .001$	$F(5, 1465) = 2.21, p = .10$	$F(5, 1461) = 2.67, p < .05$	$F(5, 1465) = 2.94, p < .05$
18–24 years	3.70 (1.70)	2.23 (1.70)	3.41 (1.24)	2.25 (.96)	11.09 (2.94)
25–34 years	4.00 (1.44)	2.36 (1,61)	3.57 (1.04)	2.32 (.98)	11.46 (2.71)
35–44 years	4.02 (1.16)	2.29 (1.56)	3.50 (1.00	2.20 (.97)	11.35 (2.59)
45–54 years	4.13 (1.28)	1.94 (1.63)	3.52 (1.02	2.19 (1.07)	11.83 (2.67)
55–64 years	4.17 (1.32)	1.76 (1.53)	3.65 (1.09	1.96 (1.09)	11.97 (3.00)
65 and more	3.38 (1.64)	1.63 (1.53)	3.17 (.82)	2.00 (.93)	10.79 (2.36)
Religion	$F(6, 1592) = 1.86, p = .09$	$F(6, 1590) = 2.65, p < .05$	$F(6, 1592) = 3.09, p = .01$	$F(6, 1588) = 2.70, p < .05$	$F(6, 1592) = 3.54, p < .01$
Catholic	3.86 (1.50)	2.14 (1.62)	3.43 (1.14)	2.16 (1.02)	11.24 (2.76)
Protestant	3.92 (1.40)	2.11 (1.58)	3.55 (1.11)	2.21 (1.00)	11.52 (2.88)
Animist	3.50 (1.63)	2.63 (1.54)	3.40 (.81)	2.37 (1.10)	10.63 (2.61)
Kimbanguist	3.78 (1.46)	2.74 (1.43)	3.42 (1.07)	2.49 (.93)	10.89 (2.46)
Muslim	3.63 (1.80)	2.54 (1.54)	2.98 (1.24)	2.13 (1.05)	10.17 (2.60)
Other	4.10 (1.44)	2.31 (1.69)	3.60 (1.00)	2.37 (.90)	11.69 (2.61)
No religion	4.00 (1.44)	0.33 (0.58)	3.00 (1.73)	1.67 (1.53)	11.33 (4.73)

women. The results showed significant differences according to education level, except for the *Knowledge of prevention measures* subscale [$F(5, 1571) = 5.55$, $p < .0001$ for *Basic knowledge related to Ebola Virus;* $F(5, 1571) = 5.47$, $p < .0001$ for *Knowledge of dignified and safe burial practices*; $F(5, 1567) = 2.97$, $p < .05$ for the entire scale]. The multiple comparison test of means score for the entire scale showed that participants with a secondary level of education had better knowledge of EVD than those with no level and those who reported having a professional level of education (respectively *Ms = .77, p < .01; Ms=.91, p <.001*). The same observation was made for participants who attended university (respectively, *Ms= .68, p < .05; Ms= .82, p<.01*). However, results presented in Table 2 showed no significant differences for education level in *misconceptions related to the transmission, prevention and treatment of Ebola* subscale.

The results showed significant differences according to the age of the participants (Table 2). Participants aged 25 to 34 and 45 to 54 had better knowledge than those aged 18 to 24 (respectively $Ms = .30$, $p < .05$; $Ms = .43$, $p < .01$). The results also showed that people aged 45 and more have further misconceptions than younger people. Results of ANOVA for age, education and religion for each subscale score are presented in Table 2.

As shown in Table 3, in the first model of the hierarchical linear regression analysis that explained 12% of the variance, only age and education level predicted EVD knowledge (respectively $\beta = .099, p < .001; \beta = .063, p < .05$). In the second model, age remained significant ($\beta = 0.086$, $p <.01$), but not education level ($\beta = -.012, p = .77$). However, living area, employment status, interactions between education level and employment status (being employed); and between education level, employment status (being employed) and living area (living in rural area) predicted EVD knowledge (respectively, $\beta = -.087, p < .05; \beta = .169, p < .01; \beta = .342, p < .001; \beta = -.187, p < .05$).

Table 3
Results of hierarchical regression analyses predicting factors related to Ebola virus disease knowledge.

Predictors variables	β	T	p
Model 1	$F(6, 1349) = 2.67, p < .05$ R [2] = .12		
Sex	.002	.089	.93
Age	.099	3.400	<.001
Education level	.063	2.173	<.05
Living area (Village)	-.044	−1.476	.14
Employment status	.024	.794	.43
Religious practices	-.014	-.498	.62
Model 2	$F(2, 1347) = 6.58, p < .001$ R [2] = .22; ΔR [2] = .10		
Sex	.001	.012	.99
Age	.086	2.936	<.01
Education level	-.012	-.291	.77
Living area (Village)	-.087	−2.439	<.05
Employment status	.169	2.574	<.01
Religious practices	-.005	-.195	.85
Education X Employment status	.342	3.609	<.001
Education X Employment status X Living area	-.187	−2.229	<.05

β: Standardized coefficients.

4. Discussion

The aim of this study was to examine basic knowledge of EDV, means of transmission, prevention and treatment and to analyze misconceptions, safety practices and attitudes of adults in the 18 cities and villages affected by the 2018 EVD outbreak in the Equateur Province in the DRC, according to the sociodemographic characteristics of the participants. A second objective was to examine predictors associated to

EVD knowledge.

The results first showed that, despite the recent outbreak of EVD in their city or village, many people living in the three affected health zones lack basic knowledge (means of transmission and prevention) about the disease. These worrisome results indicate that it may be very difficult for communities to protect themselves when their members are not sufficiently knowledgeable about EVD, in spite of being aware of its dangerousness (9-15). Indeed, because of the high contagiousness of EVD, the infection of a single person can induce a rapid spread when community members have not acquired the appropriate practices. In fact, as the data from this study indicate, more than a half of the people living in communities recently affected by the 9th outbreak in the DRC still do not know the appropriate attitudes to have when it comes to deal with probable cases of EVD and even less about dealing with death cases [8,20]. As the results revealed, less than one in three people say they would not hide the dead bodies of people who have probably died from EVD. Previous studies have been documented that keeping patients at home and traditional funerals are major risk factors for the spread of EVD [21,22]. In addition, these results showed few significant differences both between gender and between urban and rural residents.

The results of this study also showed that members of the communities affected during the 2018 outbreak have misconceptions about the EVD. Indeed, the results of this study showed that as a major concern because more than about a half of the participants believes that hot and salty baths and spiritual and traditional healers can heal the EVD. Previous studies have shown that misconceptions are a real challenge for the prevention of EVD in communities during the 2014–2016 outbreak in West Africa [8–11,23]. In addition, these studies also showed that awareness of EVD is not necessarily associated with knowledge of the disease [10]. In such cases, instead of having good prevention practices, members of affected communities often engage in stigmatization of those suspected of being infected with EVD [12]. By revealing that only two out of five participants know that EVD is not an airborne disease, the results of this study also indicate that people can avoid, isolate and stigmatize anyone suspected of being affected by EVD and even after their recovery because of the lack of knowledge. Also, although these rural and urban areas have been directly affected by EVD recently, they have higher rates of misconceptions than those observed in many communities in West Africa during the 2014–2016 outbreak [9,10,23].

The results of this study also showed important insights into the association between participants' level of education and their knowledge of the EVD and associated misconceptions. Those who have reached high school and university have a better knowledge of the EVD and less misconceptions than others. Results from previous studies are mixed. For example, studies conducted in Nigeria during the 2014 epidemic did not show significant differences according to the educational level of participants in their knowledge of the MVE and associated misconceptions [10], while those conducted in Guinea showed the opposite [9]. However, the final model of the hierarchical regression analysis demonstrates very interesting interactions between sociodemographic characteristics of the population. First, it shows that being highly educated with employment predicted EVD knowledge. Second, it reveals that being highly educated with employment, but living in a village predicted less EVD knowledge. These results suggest that education and traditionalism and maybe geographical distance from urban centers are separate dimensions which may have distinct effects on attitudes and knowledge and need all to be considered when developing prevention programs.

Finally, the results also show that participants in the so-called traditional religions, i.e. Animism and Kimbanguism and Muslims, are those with less knowledge of EVD. Qualitative studies could better explain these results, and the relationship of traditional religions with the deaths and their use of traditional medicine could be explored in this perspective.

4.1. Limitations

Although this study is important to understand the level of knowledge of Ebola populations and the misconceptions associated with EVD in order to better plan prevention programs, it has some limitations. First, there is a lack of studies conducted before the May 2018 outbreak on this issue in the DRC. Indeed, previous studies could have allowed us to compare and analyze the evolution in the knowledge of people living in the affected communities since the outbreak. Then, a longitudinal design would have allowed us to examine the curve of the change in the knowledge and perception of EVD, as well as associated misconceptions and attitudes. A qualitative part would have made it possible to collect a narrative perspective of the representations of EVD from community members, types of rumors circulated within the affected areas in order to better analyze the eventual cultural beliefs associated with misconceptions and better understand certain aspects related to religion, age and education. It would be also interesting to assess how participants obtain information related to EVD (e.g., community radios, public health authorities, religious leaders) and how this source could impact their knowledge of the disease. Finally, although it is known that few effective long-term education programs have been implemented and that outreach campaigns are frequently limited to the duration of outbreaks, an assessment of people's access to these programs would have helped to better contextualize the results of this study.

4.2. Implications for prevention

At a time when the DRC is facing a major EVD outbreak, these results highlight the urgent need for a comprehensive prevention program based on education for urban and even more importantly for rural communities and for men and women. This is a prerequisite for the prevention of EVD outbreak. Indeed, the prevention of EVD depends primarily on providing information and education to communities. Instead of basing community awareness programs on the fear of EVD, they should be built by empowering communities, by educating them, and by answering their specific questions.

This study also identifies groups for whom education programs should be intensified, such as less educated people, young adults aged 18 to 24, older people and remote villages. The observed interactions between these categories of factors suggest that these programs, in order to be effective, must also integrate cultural factors (e.g., religious practices, funeral rites, cultural beliefs associated to misconception) and be co-developed with the beneficiaries. It is by integrating these factors, utilizing the best media, methods for educating and sensitizing, that preventing new outbreaks can be identified. Implementing programs that address educational aspects are relevant because research among communities affected by Ebola and COVID-19 has shown the major role of stigmatization related to these diseases in the mental health of populations [17,24–26].

5. Conclusions

The results showed that although recently affected by an outbreak, communities still do not know enough about EVD. Most importantly, results showed that misconceptions about EVD persist in the affected communities. This study shows the important role of research in planning prevention campaigns with a special focus on remote villages and less educated people. Indeed, to better prevent EVD, campaigns should help communities to acquire the necessary knowledge in a climate of trust. To do this, it is important to rely on local resources such as health professionals, teachers, community and religious leaders, psychosocial workers, while integrating the cultural factors and taboos surrounding EVD, including religious practices, funeral rites, cultural beliefs related to misconceptions. Finally, a massive investment should be made in education about EVD. In addition to adults, it should also focus on youth and children who can be important agents of change in communities.

Without education programs, misconceptions and lack of knowledge related to the Ebola Virus Disease will remain a venomous snake under the table of prevention.

Financial disclosure

This article was supported by the Ebola and Mental Health project (EboMH) grant # 108968 from the International Development Research Centre (IDRC).

Ethical approval statement

The study protocol was approved by the ethics committees of the University of Ottawa and the Institut National de Recherche Biomédicale.

Declaration of competing interest

No conflict of interest for any author.

Acknowledgments

This article was supported by the grant # 108968 from the International Development Research Centre (IDRC), in collaboration with the Social Sciences and Humanities Research Council (SSHRC) and the Canadian Institutes of Health Research (CHIR), and the Faculty of Social Sciences of the University of Ottawa.

References

[1] World Health Organization, Ebola Virus Disease [Internet], World Health Organization, 2018 [cited 2018 Oct 21]. Available from: https://www.who.int/en/news-room/fact-sheets/detail/ebola-virus-disease.

[2] K.M. Johnson, J.V. Lange, P.A. Webb, F.A. Murphy, Isolation and partial characterisation of a new virus causing acute haemorrhagic fever in Zaire, London, England) [Internet], Lancet 1 (8011) (1977 Mar 12) [cited 2019 Jun 16], http://www.ncbi.nlm.nih.gov/pubmed/65661, 569–71. Available from:.

[3] J.M. Cénat, The vulnerability of low-and middle-income countries facing the COVID-19 pandemic: the case of Haiti [Internet], [cited 2020 Apr 23], Trav. Med. Infect. Dis. (2020 Apr), 101684, https://linkinghub.elsevier.com/retrieve/pii/S1477893920301526. Available from:.

[4] T. Stehling-Ariza, A. Rosewell, S.A. Moiba, B.B. Yorpie, K.D. Ndomaina, K. S. Jimissa, et al., The Impact of Active Surveillance and Health Education on an Ebola Virus Disease Cluster — Kono District, Sierra Leone, 2014–2015 [Internet], BMC Infect Dis 16 (1) (2016 Dec 27) 611 [cited 2019 Jun 17], http://bmcinfectdis.biomedcentral.com/articles/10.1186/s12879-016-1941-0. Available from:.

[5] R.N. Ngewa, J. Kuriansky, Awareness and education about Ebola through public health campaigns, in: J. Kuriansky (Ed.), The Psychosocial Aspects of a Deadly Epidemic: what Ebola Has Taught Us about Holistic Healing: what Ebola Has Taught Us about Holistic Healing, ABC-CLIO, Santa Barbara, 2016, p. 335.

[6] J.M. Cénat, N. Felix, C. Blais-Rochette, C. Rousseau, J. Bukaka, D. Derivois, et al., Prevalence of mental health problems in populations affected by Ebola virus disease: a systematic review and meta-analysis [Internet], Psychiatr. Res. 289 (2020 Jul 1), 113033 [cited 2020 May 3], https://linkinghub.elsevier.com/retrieve/pii/S0165178119325272. Available from:.

[7] J.M. Cénat, J.N. Mukunzi, P.-G. Noorishad, C. Rousseau, D. Derivois, J. Bukaka, A systematic review of mental health programs among populations affected by the Ebola virus disease, J. Psychosom. Res. 131 (2020 Feb 1), 109966.

[8] J.A. Wilken, P. Pordell, B. Goode, R. Jarteh, Z. Miller, B.G. Saygar, et al., Liberia: February-March 2015. Prehosp Disaster Med [Internet], Knowledge, Attitudes, and Practices Among Members of Households Actively Monitored or Quarantined to Prevent Transmission of Ebola Virus Disease — Margibi County, vol. 32, 2017 Dec 27 [cited 2019 Jun 17], https://www.cambridge.org/core/product/identifier/S1049023X17006720/type/journal_article (6):673–8. Available from:.

[9] B.G. Buli, L.N. Mayigane, J.F. Oketta, A. Soumouk, T.E. Sandouno, B. Camara, et al., Misconceptions about Ebola seriously affect the prevention efforts: KAP related to Ebola prevention and treatment in Kouroussa Prefecture, Guinea [Internet], Pan Afr Med J 22 (2015) 1–11 [cited 2019 Jun 17], http://www.panafrican-med-journal.com/content/series/22/1/11/full. Available from:.

[10] O.R. Shittu, A.M. Sanni, O.L. Odeigah, A.A. II, G.A. Sule, S. Isiaka-Lawal, et al., Awareness, knowledge and misconceptions about Ebola virus disease (EVD) in a family practice setting in Nigeria, West Africa [Internet], J. Antivir. Antiretrovir. (2015) [cited 2019 Jun 17];7(1):10–4. Available from: https://www.longdom.org/open-access/awareness-knowledge-and-misconceptions-about-ebola-virus-disease-evd-in-a-family-practice-setting-in-nigeria-west-africa-1948-5964.1000114.pdf.

[11] P.B. Adongo, P.T.-N. Tabong, E. Asampong, J. Ansong, M. Robalo, R.M. Adanu, Beyond knowledge and awareness: addressing misconceptions in Ghana's preparation towards an outbreak of Ebola virus disease [Internet], in: M.F. Boni (Ed.), PLoS One, 2016 Feb 18 [cited 2019 Jun 17];vol. 11(2). Available from: https://dx.plos.org/10.1371/journal.pone.0149627.

[12] L. Kpanake, K. Gossou, P.C. Sorum, E. Mullet, Misconceptions about Ebola virus disease among lay people in Guinea: lessons for community education [Internet], J. Publ. Health Pol. 37 (2) (2016 May 11) [cited 2019 Jun 18], http://link.springer.com/10.1057/jphp.2016.1, 160–72. Available from:.

[13] D. Pedi, A. Gillespie, J. Bedson, M.F. Jalloh, M.B. Jalloh, A. Kamara, et al., The development of standard operating procedures for social mobilization and community engagement in Sierra Leone during the West Africa Ebola outbreak of 2014–2015 [Internet], J. Health Commun. 22 (sup1) (2017 Mar 30) 39–50 [cited 2020 Jan 16], https://www.tandfonline.com/doi/full/10.1080/10810730.2016.1212130. Available from:.

[14] Centers for Disease Control and Prevention, Democratic Republic of the Congo, 2020. Equateur Province | Democratic Republic of Congo | Outbreaks | Ebola (Ebola Virus Disease) | CDC [Internet], 2020, [cited 2021 Jul 4]. Available from: https://www.cdc.gov/vhf/ebola/outbreaks/drc/2020-june.html.

[15] PNUD, Unité de lutte contre la pauvreté. Province de l'Équateur: Pauvreté et conditions de vie des ménages, Profil résumé. Kinshasa, 2009.

[16] J.M. Cénat, S.E. McIntee, M. Guerrier, D. Derivois, C. Rousseau, R.D. Dalexis, et al., Psychological distress among adults from the urban and rural areas affected by the Ebola virus disease in the Democratic Republic of the Congo [Internet], Soc. Psychiatr. Psychiatr. Epidemiol. (2020 Jun 14) 1–6 [cited 2020 Jun 22], https://link.springer.com/article/10.1007/s00127-020-01904-x. Available from:.

[17] J.M. Cénat, C.K. Kokou-Kpolou, J.N. Mukunzi, R.D. Dalexis, P.-G. Noorishad, C. Rousseau, et al., Ebola virus disease, stigmatization, peritraumatic distress, and posttraumatic stress disorder in the Democratic Republic of the Congo: a moderated mediation model [Internet], J. Affect. Disord. 293 (2021 Oct 1) [cited 2021 Jul 4], https://linkinghub.elsevier.com/retrieve/pii/S0165032721006339, 214–21. Available from:.

[18] Centers for Disease Control and Prevention (CDC), Ebola (Ebola Virus Disease) [Internet], Centers for Disease Control and Prevention (CDC), 2018 [cited 2018 Oct 21]. Available from: https://www.cdc.gov/vhf/ebola/index.html.

[19] M. Brunner, H.-M. SÜβ, Analyzing the reliability of multidimensional measures: an example from intelligence research [Internet], Educ. Psychol. Meas. 65 (2) (2005 Apr 2) [cited 2019 Jun 13], http://journals.sagepub.com/doi/10.1177/0013164404268669, 227–40. Available from:.

[20] H. Jiang, G.-Q. Shi, W.-X. Tu, C.-J. Zheng, X.-H. Lai, X.-X. Li, et al., Rapid assessment of knowledge, attitudes, practices, and risk perception related to the prevention and control of Ebola virus disease in three communities of Sierra Leone [Internet], Infect Dis Poverty 5 (1) (2016 Dec 6) 53 [cited 2019 Jun 17], http://idpjournal.biomedcentral.com/articles/10.1186/s40249-016-0142-9. Available from:.

[21] J. Brainard, L. Hooper, K. Pond, K. Edmunds, P.R. Hunter, Risk factors for transmission of Ebola or Marburg virus disease: a systematic review and meta-analysis [Internet], Int. J. Epidemiol. 45 (1) (2016 Feb 1) [cited 2019 Jun 18], https://academic.oup.com/ije/article-lookup/doi/10.1093/ije/dyv307, 102–16. Available from:.

[22] S.H. Lee-Kwan, N. DeLuca, R. Bunnell, H.B. Clayton, A.S. Turay, Y. Mansaray, Facilitators and barriers to community acceptance of safe, dignified medical burials in the context of an Ebola epidemic, Sierra Leone, 2014 [Internet], J. Health Commun. 22 (sup1) (2017 Mar 30) 24–30 [cited 2019 Jun 18], https://www.tandfonline.com/doi/full/10.1080/10810730.2016.1209601. Available from:.

[23] M.F. Jalloh, S.J. Robinson, J. Corker, W. Li, K. Irwin, A.M. Barry, et al., Knowledge, attitudes, and practices related to Ebola virus disease at the end of a national epidemic — Guinea, august 2015 [Internet], Morb. Mortal. Wkly. Rep. 66 (41) (2017 Oct 20) [cited 2019 Jun 20], http://www.ncbi.nlm.nih.gov/pubmed/29049279, 1109–15. Available from:.

[24] D. Miconi, Z.Y. Li, R.L. Frounfelker, T. Santavicca, J.M. Cénat, V. Venkatesh, et al., Ethno-cultural disparities in mental health during the COVID-19 pandemic: a cross-sectional study on the impact of exposure to the virus and COVID-19-related discrimination and stigma on mental health across ethno-cultural groups in Quebec (Canada), BJPsych Open 7 (2021) 1–10, e14.

[25] J.M. Cénat, R.D. Dalexis, M. Guerrier, P.G. Noorishad, D. Derivois, J. Bukaka, et al., Frequency and correlates of anxiety symptoms during the COVID-19 pandemic in low- and middle-income countries: a multinational study, J. Psychiatr. Res. 132 (2021) 13–17.

[26] J.M. Cénat, P.G. Noorishad, C.K. Kokou-Kpolou, R.D. Dalexis, S. Hajizadeh, M. Guerrier, et al., Prevalence and correlates of depression during the COVID-19 pandemic and the major role of stigmatization in low- and middle-income countries: a multinational cross-sectional study, Psychiatr. Res. 297 (2021 Mar 1), 113714.