

BMJ Open Prevalence and risk factors of depression symptoms among rural and urban populations affected by Ebola virus disease in the Democratic Republic of the Congo: a representative cross-sectional study

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ABSTRACT

Objectives High mortality rates, anxiety and distress associated with Ebola virus disease (EVD) are risk factors for mood disorders in affected communities. This study aims to document the prevalence and risk factors associated with depressive symptoms among a representative sample of individuals affected by EVD.

Design Cross-sectional study.

Setting The current study was conducted 7 months (March 11, 2019 to April 23, 2019) after the end of the ninth outbreak of EVD in the province of Equateur in the Democratic Republic of the Congo (DRC).

Participants A large population-based sample of 1614 adults (50% women, $M_{age}=34.05$; $SD=12.55$) in health zones affected by the ninth outbreak in DRC.

Primary and secondary outcome measures Participants completed questionnaires assessing EVD exposure level, stigmatisation related to EVD and depressive symptoms. The ORs associated with sociodemographic data, EVD exposure level and stigmatisation were analysed through logistic regressions.

Results Overall, 62.03% (95% CI 59.66% to 64.40%) of individuals living in areas affected by EVD were categorised as having severe depressive symptoms. The multivariable logistic regression analyses showed that adults in the two higher score categories of exposure to EVD were at two times higher risk of developing severe depressive symptoms (respectively, OR 1.94 (95% CI 1.22 to 3.09); OR 2.34 (95% CI 1.26 to 4.34)). Individuals in the two higher categories of stigmatisation were two to four times more at risk (respectively, OR 2.42 (95% CI 1.53 to 3.83); OR 4.73 (95% CI 2.34 to 9.56)). Living in rural areas (OR 0.19 (95% CI 0.09 to 0.38)) and being unemployed (OR 0.68 (95% CI 0.50 to 0.93)) increased the likelihood of having severe depressive symptoms.

Conclusions Results indicate that depressive symptoms in EVD affected populations is a major public health problem that must be addressed through culturally adapted mental health programs.

Strengths and limitations of this study

- This is the first study on depressive symptoms among a representative sample of health zones affected by Ebola virus disease (EVD) in the Equateur province in Democratic Republic of the Congo.
- The two-stratified sampling ensures adequate representation across gender and urban and rural areas.
- A limitation of the study is that we did not have information about the history of depression among individuals before the EVD outbreak.
- The lack of studies on this topic limited the possibility to discuss the results of the present research.

INTRODUCTION

Depression is one of the most reported mental health disorders among populations affected by infectious disease outbreaks.^{1–3} Two recent meta-analyses revealed that 22.8% and 19.9% of populations affected by Ebola virus disease (EVD) and the COVID-19, respectively, were categorised as having severe depressive symptoms.^{2,3} Indeed, from 12% to 75% of populations affected by EVD presented significant depressive symptoms.² A study conducted after the 2014–2016 EVD epidemic in Liberia showed that a significantly higher number of survivors (75%) were categorised as having severe depressive symptoms.⁴ Another study led in Guinea found that 17% of survivors presented severe depressive symptoms and that a low socioeconomic status constituted a risk factor for the development of depressive symptoms.⁵

Previous research in the context of the AIDS epidemic revealed the critical role of



exposure and stigmatisation related to HIV in the onset and development of negative mental health outcomes among infected patients and affected populations.⁶ This study found significant associations between HIV-related stigma and higher rates of depression, but weaker statistical associations with anxiety. Pertaining to EVD, a recent systematic review outlined that the majority of EVD survivors experienced stigma and discrimination when they returned to their communities; some reported lower levels of reintegration with friends and at the workplace, including with the general public.⁷ However, research remains scarce on the association between the level of exposure to EVD, stigmatisation related to EVD and the development of depressive symptoms. Additionally, there is a lack of research on mental health problems in geographically remote rural communities affected by EVD.

Moreover, a dearth of studies has thus far examined differences according to sociodemographic factors such as the area of residence (urban vs rural) and employment status.⁵ Therefore, more studies are necessary to evaluate the consequences of EVD on the mental health of affected populations and to grasp factors related to the development of depressive symptoms. Such studies would allow the evaluation of the extent to which depressive symptoms constitute a public health problem that should be prioritized in areas affected by EVD, and if this is the case, to elaborate and implement culturally adapted programs based on empirical data. In addition, between 2017 and 2020, the Democratic Republic of the Congo (DRC) has been facing recurrent outbreaks of EVD and the COVID-19 pandemic.⁸ Studies are important to document the prevalence of mental health problems among populations affected by infectious disease epidemics, as well as associated risk factors. Such studies are valuable to capture mental health problems among populations affected by EVD and to provide mental health services based on empirical data.

Analysing data collected among a two-stage stratified sample of rural and urban populations affected by the EVD epidemic of 2018 in the province of Equateur in DRC, this study aims, first, to document the prevalence of depression symptoms according to sociodemographic characteristics of participants (gender, age, marital status, education level, religion, employment status and residency area), level of exposure to EVD and stigmatisation related to EVD. Second, this study aims to document the association between exposure to EVD, stigmatisation related to EVD and symptoms of depression.

METHODS

Procedures

The province of Equateur is among the three poorest provinces in the DRC, a country where more than 50% of the population lives above the poverty line.⁹ For example, a report has shown that the proportion of non-poor children is zero.¹⁰ In total, 77.3% of the population of the

province of Equateur lives below the poverty line.¹⁰ The province faces significant shortages in potable water, food, sanitation, access to road infrastructures and information. Although the province's population is very young, it has the lowest national school enrolment rate in the country. The province has a fragile health system with few material and human resources. From 2018 to 2020, Equateur has been affected by two outbreaks of EVD (May–July 2018 and June–November 2020).

This study was conducted 7 months after the declaration of the end of the ninth 2018 outbreak of EVD (11 March 2019–23 April 2019). Data on mental health problems including depression were collected through a two-stage stratified and random sample: (1) the demographic weight of the affected rural and urban areas was considered by relying on estimates from the National Statistics Institute and (2) the proportion of women in affected rural and urban areas according to estimates of an equal gender split by the National Statistics Institute was considered. The two-stage stratified sampling was used to ensure adequate representation across gender and urban and rural areas in the province of Equateur where most rural areas remain difficult to access and data on mental health problems are inexistent. Data were collected during door-to-door surveys in the three 'health zones' (Bikoro, Iboko and Wangata) affected by the ninth EVD outbreak in the DRC. These 'health zones' include 18 rural and urban areas in the province of Equateur (see [figure 1](#)). Households in the 18 affected areas were selected randomly using the same sampling frame as the Demographic Health Survey of 2013–2014 and the Multiple Indicator Surveys conducted by National Institute of Statistics.¹¹ The sample was selected randomly from the most recent household list using a computer-based random number generator for each affected health zone separately. When a house was found vacant by investigators or when a person wanted to participate but did not meet inclusion criteria, the next house was selected. To access certain remote rural areas, because of the absence of transport infrastructures, the research team spent many days in unsecure boats. The inclusion criteria were: (1) be at least 18 years of age; (2) live in one of the 18 villages and cities affected by EVD since the beginning of the outbreak; (3) speak French or Lingala and (4) have no mental health disorder that interferes with their judgment. Participants in the study did not receive any monetary compensation. [Table 1](#) largely describes the sociodemographic characteristics of the study sample. The research team included 26 regional Lingala speaking investigators (14 men, 12 women). They are junior psychologists, educators and psychiatric nurses. All the 26 investigators followed a day and a half-day training on ethical issues and on ways to administer the questionnaire. Due to a high illiteracy rate in Equateur and due to the fact that asking a person if he/she knows how to read is culturally inappropriate, the interviewers read the items for the participants and completed the questionnaire. The questionnaire was available in three different Lingala

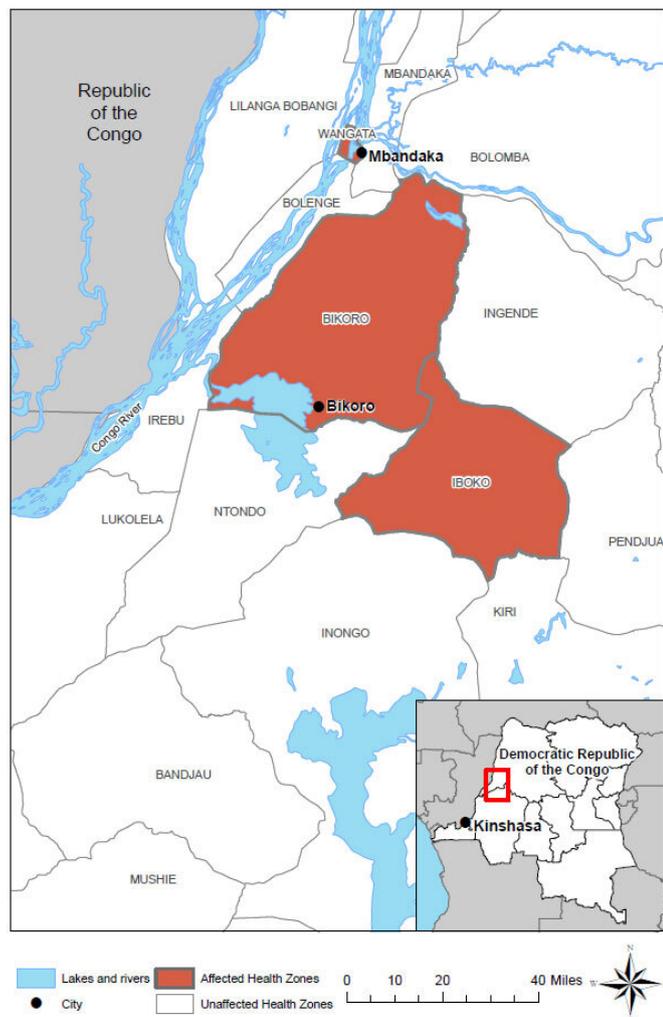


Figure 1 Map of Ebola-Affected Health Zones in 2018 Equateur Province Outbreak in the Democratic Republic of the Congo. Source: Centers for Disease Control and Prevention: <https://www.cdc.gov/vhf/ebola/outbreaks/drc/2018-may.html>.

dialects and in French. Backtranslation methods were used. Translation was done by a team of seven Congolese professors from DRC universities.

Participants

From the 1637 people solicited, 23 people refused participation (12 men, 11 women). The sample includes 1614 individuals (50% women), which corresponds to a response rate of 98.6%. All participants signed an informed consent form. The total sample's mean age was of 34.1 (SD=12.6), with ages ranging between 18 and 85. As shown in [table 1](#), there were no gender differences depending on age, education, residence area and religious affiliation. However, men attending university outnumbered women ($\chi^2=18.4$, $df=1$, $p<0.001$).

Patient and public involvement

Participants were not involved in the design, or conduct, or reporting plans of this research. However, community leaders were included in the knowledge transfer plan.

Measures

Sociodemographic data

The sociodemographic questionnaire collected information on gender, age, residency area (rural vs urban), employment status, education level, religion and marital status. See [table 1](#) one for sociodemographic data.

Exposure to the EVD

Participants completed a 17-item measure that assesses level of exposure to EVD. This dichotomous 'yes' or 'no' scale is inspired by the Trauma Exposure Scale.¹² The score was computed from the sum of the 'yes' (1) or 'no' (0) statements (eg, 'Has a member of your family fallen ill because of the Ebola virus?', 'Have you participated in the funeral of a person deceased because of the Ebola virus?'). The same measure was used during the COVID-19 pandemic with acceptable internal consistency in different countries.^{13 14} A greater score indicates a higher exposure to Ebola. In our sample, the Cronbach alpha was 0.92.

Stigmatisation related to EVD

We used a 20-item scale that measures 20 possible forms of stigmatisation related to EVD, based on the WHO reports and the Social science and behavioural data compilation.¹⁵ This scale has already been used in the DRC with very good internal consistency.^{13 14} The measure rated on a 4-point scale ranging from 'never' (0) to 'always' (4) (eg, 'Because of the Ebola Virus... You have been subjected to mockeries or other similar attitudes', 'Someone has insulted you by referring to the Ebola virus disease'). In our sample, Cronbach's alpha was 0.97.

Depression symptoms

To measure depression symptoms, we used the Beck Depression Inventory-Short Form (BDI-SF).¹⁶ This scale includes 13 items rated on a 4-point scale ranging from 0 to 3 which differs for each item (eg, 'item 1: (0) I don't feel sad; (1) I feel gloomy or sad; (2) I always feel gloomy or sad, and I can't get out of it; (3) I'm so sad and unhappy I can't support it'). Total scores range from 0 to 39. In this study, we used the score of 14 and higher to determine if a subject would be classified as severe depression symptoms.¹⁷ The BDI-SF has been widely used in diverse populations and cultures and appears to have a robust transcultural validity.^{18 19} Cronbach's alpha was of 0.87 in our sample.

Statistical analysis

Using SPSS V.26, frequencies were calculated to describe sociodemographic characteristics of the sample, including age, residence area (rural vs urban), education level, employment, religion and marital status with respect to participants' gender. To better capture the severity of both exposure level to EVD and stigmatisation related to EVD, scores were classified in three categories with respective values below the 50th percentile; between 50th and 75th, and values beyond the 75th percentile. Prevalence of severe depression symptoms was computed for

Table 1 Sociodemographic characteristics of the sample (N=1614)

	Total N (%; 95% CI)	Men N (%; 95% CI)	Women N (%; 95% CI)	χ^2; p value
Total	1614 (100.0; 100 to 100)	807 (50.0; 46.6 to 53.5)	807 (50.; 46.6 to 53.5)	
Residence area				0, 1.00
Rural	906 (56.1; 52.9 to 59.4)	453 (50.0; 45.8 to 54.2)	453 (50.0; 45.8 to 54.2)	
Urban	708 (43.8; 40.2 to 47.5)	354 (50.0; 44.8 to 55.2)	354 (50.0; 44.8 to 55.2)	
Employment				1.4, 0.26
Yes	897 (57.65; 54.42 to 60.88)	457 (50.95; 46.37 to 55.53)	440 (49.05; 44.38 to 53.72)	
No	659 (42.35; 38.58 to 46.12)	316 (47.95; 42.44 to 53.46)	343 (52.05; 46.76 to 57.34)	
Education level				18.4, 0.001
None	62 (3.9; -0.91 to 8.8)	29 (46.8; 28.6 to 64.9)	33 (53.2; 36.2 to 70.3)	
Primary school	172 (10.9; 6.2 to 15.6)	69 (40.1; 28.6 to 51.7)	103 (59.9; 50.4 to 69.4)	
High school	898 (56.9; 53.6 to 60.1)	437 (48.7; 44.0 to 53.4)	461 (51.3; 46.8 to 55.9)	
Professional	54 (3.4; -1.4 to 8.3)	27 (50.0; 31.1 to 68.9)	27 (50.0; 31.1 to 68.9)	
University	393 (24.9; 20.6 to 29.2)	229 (58.3; 51.9 to 64.7)	164 (41.7; 34.2 to 49.3)	
Age				3.5, 0.62
18–24 years	387 (26.2; 21.8 to 30.6)	183 (47.3; 40.1 to 54.5)	204 (52.7; 45.9 to 59.6)	
25–34 years	485 (32.8; 28.7 to 37.0)	254 (52.4; 46.2 to 58.5)	231 (47.6; 41.2 to 54.1)	
35–44 years	303 (20.5; 16.0 to 25.1)	151 (49.8; 41.9 to 57.8)	152 (50.2; 42.2 to 58.1)	
45–54 years	174 (11.8; 7.0 to 16.6)	95 (54.6; 44.6 to 64.6)	79 (45.4; 34.4 to 56.4)	
55–64 years	102 (6.9; 2.0 to 11.8)	51 (50.0; 36.3 to 63.7)	51 (50.0; 36.3 to 63.7)	
65 and more	26 (1.8; -3.3 to 6.8)	13 (50.0; 22.8 to 77.2)	13 (50.0; 22.8 to 77.2)	
Religion				7.2, 0.21
Catholic	714 (44.6; 40.9 to 48.2)	341 (47.8; 42.5 to 53.1)	373 (52.2; 47.2 to 57.3)	
Protestant	401 (25.0; 20.8 to 29.3)	205 (51.1; 44.3 to 58.0)	196 (48.9; 41.9 to 55.9)	
Animist	30 (1.9; -3.0 to 6.7)	11 (36.7; 8.2 to 65.2)	19 (63.3; 41.7 to 85.0)	
Kimbanguist	73 (4.6; -0.2 to 9.4)	35 (48.0; 31.4 to 64.5)	38 (52.1; 36.2 to 67.9)	
Muslim	52 (3.2; -1.6 to 8.1)	30 (57.7; 40.0 to 75.4)	22 (42.3; 21.7 to 63.0)	
Other	332 (20.7; 16.4 to 25.1)	179 (53.9; 46.6 to 61.2)	153 (46.1; 38.2 to 54.0)	
Marital status				14.1, 0.01
Single	573 (36.4; 32.5 to 40.3)	292 (51.0; 45.2 to 56.7)	281 (49.0; 43.2 to 54.9)	
Married	745 (47.3; 43.7 to 50.9)	377 (50.6; 45.6 to 55.7)	368 (49.4; 44.3 to 54.5)	
Divorced	62 (4.0; -0.9 to 8.8)	23 (37.1; 17.4 to 56.8)	39 (62.9; 47.7 to 78.1)	
Separated	33 (2.1; -2.8 to 8.0)	18 (54.6; 31.6 to 77.6)	15 (45.5; 20.3 to 70.7)	
Widowed	42 (2.7; -2.2 to 7.6)	11 (26.2; -0.2 to 52.2)	31 (73.8; 58.3 to 89.3)	
In a relationship	119 (7.6; 2.8 to 12.3)	59 (49.6; 36.8 to 62.3)	60 (50.4; 37.8 to 63.1)	

gender, exposure level to EVD, stigmatisation related to EVD and sociodemographic characteristics of the sample (age, residence area, education level, employment, religion and marital status). Bivariate comparisons were performed using χ^2 tests with 95% CIs for the different categories of the sociodemographic characteristics with respect to gender. To further investigate the association between depression and both exposure level to EVD and stigmatisation related to EVD, multivariable logistic regression was carried out using both factors controlling for sociodemographic characteristics. In a subsequent stage, four interaction terms were added to test whether

the relationship between the main effects (exposure level to EVD and stigmatisation related to EVD) and depression symptoms was influenced by residence area or gender. Results are reported for the final model.

RESULTS

Table 2 presents the prevalence rates of depression symptoms across the study variables. Overall, 62.0% (95% CI 59.7% to 64.4%) were categorised as having severe depression symptoms. Bivariate analyses showed that greater scores of exposure level to EVD and stigmatisation

Table 2 Prevalence of depression symptoms by sociodemographic characteristic of the sample (N=1614)

Depression symptoms

	Total % (95% CI)	χ^2 (df), p value	Men % (95% CI)	Women % (95% CI)	χ^2 (df), p value
Total	62.0 (59.7 to 64.4)		62.2 (59.9 to 64.6)	61.8 (59.46 to 64.20)	0, 0.87
Score of exposure to EVD		233.9, <0.0001			
1–4	43.3 (40.9 to 45.7)		41.8 (39.4 to 44.2)	44.7 (42.26 to 47.11)	0.7, 0.41
5–8	75.4 (73.3 to 77.5)		72.2 (70.0 to 74.4)	78.6 (76.56 to 80.57)	1.7, 0.20
9 and more	82.7 (80.8 to 84.5)		84.4 (82.6 to 86.1)	80.8 (78.63 to 82.50)	1.2, 0.28
Stigmatisation due to EVD		254.0, <0.0001			
0–21	43.4 (40.9 to 55.8)		40.7 (38.3 to 43.1)	46.0 (43.52 to 48.38)	2.2, 1.4
22–39	74.9 (72.8 to 77.1)		77.7 (75.6 to 79.7)	72.1 (69.89 to 74.27)	1.7, 0.20
40 and up	87.1 (85.4 to 88.7)		90.6 (89.2 to 92.1)	83.7 (81.94–85–54)	4.1, 0.04
Residence area		174.2, <0.0001			
Rural	76.1 (74.1 to 78.2)		79.7 (77.7 to 81.6)	72.6 (70.45 to 74.81)	6.1, 0.01
Urban	44.0 (41.6 to 46.4)		39.9 (37.6 to 42.3)	48.0 (45.58 to 50.46)	4.7, 0.03
Employment		17.1, <0.0001			
Yes	55.6 (53.1 to 58.0)		53.2 (50.8 to 55.6)	57.7 (55.32 to 60.14)	1.2, 0.24
No	65.9 (63.6 to 68.2)		67.2 (64.9 to 69.5)	64.6 (62.22 to 66.88)	0.7, 0.41
Education level		21.4, <0.0001			
None	72.6 (70.4 to 74.8)		75.8 (73.7 to 77.9)	69.0 (66.71 to 71.23)	0.4, 0.55
Primary school	65.1 (62.8 to 67.5)		61.2 (58.8 to 63.6)	71.0 (68.80 to 73.22)	1.8, 0.18
High school	65.2 (62.9 to 67.5)		64.2 (61.9 to 66.6)	66.3 (63.97 to 68.59)	0.4, 0.51
Professional	50.0 (47.7 to 52.4)		55.6 (53.1 to 58.0)	44.4 (42.02 to 46.86)	0.7, 0.41
University	54.1 (51.7 to 56.5)		54.3 (51.8 to 56.7)	54.0 (51.52 to 56.38)	0, 1.00
Age		16.8, 0.005			
18–24 years	57.8 (55.1 to 60.2)		61.5 (59.2–63–9)	54.4 (51.98 to 56.84)	2.0, 0.95
25–34 years	57.4 (55.0 to 59.9)		57.3 (54.9 to 59.7)	57.6 (55.17 to 59.99)	0, 1.00
35–44 years	66.0 (63.7 to 68.3)		66.9 (64.6 to 69.2)	65.1 (62.81 to 67.45)	0.1, 0.75
45–54 years	70.1 (67.8 to 72.3)		67.4 (65.1 to 69.7)	73.4 (71.26 to 75.58)	0.8, 0.39
55–64 years	64.7 (62.4 to 67.0)		68.6 (66.4 to 70.9)	60.9 (58.40 to 63.16)	0.7, 0.41
65 and more	76.9 (74.9 to 78.1)		69.2 (67.0 to 71.5)	84.6 (82.86 to 86.38)	0.9, 0.35
Religion		28.2, <0.0001			
Catholic	68.1 (65.9 to 70.4)		70.5 (68.3 to 72.7)	66.0 (63.64 to 68.26)	1.7, 0.20
Protestant	59.6 (57.2 to 62.0)		60.5 (58.1 to 62.9)	58.7 (56.27 to 61.07)	0.1, 0.71
Animist	73.3 (71.2 to 75.5)		81.8 (79.9 to 83.7)	68.4 (66.15 to 70.69)	0.6, 0.42
Kimbanguist	63.0 (60.7 to 65.4)		57.1 (54.7 to 59.6)	68.4 (66.15 to 70.69)	0.1, .32
Muslim	57.7 (55.3 to 60.1)		53.3 (50.9 to 55.8)	63.6 (61.29 to 65.99)	0.6, 0.46
Other	52.1 (49.7 to 54.6)		50.3 (47.8 to 52.7)	54.3 (51.86 to 56.72)	0.5, 0.50
Marital status		22.0, 0.001			
Single	56.9 (54.5 to 59.3)		57.2 (54.8 to 59.7)	56.6 (54.16 to 59.00)	0.0, 0.87
Married	63.8 (61.4 to 66.1)		66.8 (64.5 to 69.1)	60.6 (58.22 to 62.98)	3.1, 0.08
Divorced	64.5 (62.2 to 66.9)		52.2 (49.7 to 54.6)	71.8 (69.59 to 73.99)	2.4, 0.12
Separated	57.6 (55.2 to 60.0)		66.7 (64.4 to 69.0)	46.7 (44.24 to 49.10)	1.3, 0.25
Widowed	73.8 (71.7 to 76.0)		63.6 (61.3 to 66.0)	77.4 (75.38 to 79.46)	0.9, 0.37
In a relationship	77.3 (75.3 to 79.4)		72.9 (70.7 to 75.0)	81.7 (79.77 to 83.55)	1.3, 0.25

EVD, Ebola virus disease.

related to EVD were associated with a higher prevalence of depression symptoms (respectively, $\chi^2=233.9$, $p<0.0001$; 254.0, $p<0.0001$). Results revealed that participants living in rural areas were more likely to be categorised as having severe depressive symptoms than those living in urban areas (respectively, 76.1% (95% CI 74.1% to 78.2%); and 44.0%, 95% CI 41.6% to 46.4%), $\chi^2=174.2$, $p<0.0001$). **Table 2** shows no significant differences between men and women for depressive symptoms. Furthermore, the results of gender interaction effects on rates of depression symptoms revealed that women living in urban areas presented greater risk than men (respectively, 48.0% (95% CI 45.6% to 50.5%) and 39.9% (95% CI 37.6% to 42.3%), $\chi^2=4.7$, $p=0.03$). However, in rural areas, men (79.7% (95% CI 77.7% to 81.6%)) were more likely to be categorised as having severe depressive symptoms than women (72.6% (95% CI 70.5% to 74.8%)), $\chi^2=6.1$, $p=0.01$).

The three categories of exposure level to EVD contained participants who scored 0–4 which is below the 50th percentile (790 participants, 49.04%), between the 50th and 75th percentile, scores of 5–8 (306 participants, 18.99%) and values beyond the 75th percentile, scores of 9 and more (515, 31.98%). Participants in the two highest categories were more likely to be categorised with higher prevalence of severe depression symptoms comparatively to those with lower scores (respectively, 43.3% (95% CI 40.9% to 45.7%); 75.4% (95% CI 73.3% to 77.5%), 82.7% (95% CI 80.8% to 84.5%), $\chi^2=233.9$, $p<0.0001$). For stigmatisation related to EVD, the three categories contained participants who scored 0–21 (813 participants, 50.43%), 22–39 (403 participants, 25%), and 40 and up (396 participants, 24.57%). Results also indicated that participants within the two highest categories of scores of stigmatisation related to EVD were more likely to be categorised with severe depression symptoms (respectively, 43.4% (95% CI 40.9% to 55.8%); 74.9% (95% CI 72.8% to 77.1%), 87.1% (95% CI 85.4% to 88.7%), $\chi^2=254.0$, $p<0.0001$) and at higher risk than women (90.6%, 95% CI 89.2% to 92.1% vs 83.7%, 95% CI 81.9% to 85.5%, $\chi^2=4.1$, $p=0.04$). All the results are presented in **table 2**.

These results, except for age and religion, are confirmed by the multivariable logistic regression analysis (see **table 3**). Regarding sociodemographic-related risk factors, results showed that living in a rural area (OR 0.19 (95% CI 0.09 to 0.38)) and being unemployed (OR 0.68 (95% CI 0.50 to 0.93)) increased the likelihood of having symptoms of depression. Compared with participants with no education, those who achieved professional training were more particularly at risk (OR 0.36 (95% CI 0.14 to 0.96)). The results showed that, comparatively to those who reported a score of exposure to EVD from 1 to 4, the odds of meeting criteria for depressive symptoms were twofold higher among those who reported a score from 5 to 8 (OR 1.94 (95% CI 1.22 to 3.09)) and a score of more than 8 (OR 2.34 (95% CI 1.26 to 4.34)), respectively. Furthermore, these odds were two to four times higher among participants who reported a score of stigmatisation related to EVD from 22 to 39 and 40

and up, comparatively to those who reported a score of 21 and less (OR 2.42 (95% CI 1.53 to 3.83), and OR 4.73 (95% CI 2.34 to 9.56)), respectively. Participants in unmarried relationships, compared with single people, were 3.3 times more likely to have depressive symptoms (OR 3.25 (95% CI 1.84 to 5.76)). Considering the results presented in **table 1**, we examined interactions between gender and area of residence with levels of exposure to EVD and stigmatisation related to EVD, but there were no significant interactions. The Hosmer-Lemeshow test was non-significant, indicating that the fit of the model was good ($\chi^2=7.41$, $p=0.49$).

DISCUSSION

This study aimed to document prevalence and factors associated with depression symptoms among populations affected by the latest EVD outbreak in the province of Équateur in the DRC. The results showed that more than three individuals out of five presented symptoms within the clinical range of depression. This very high prevalence indicates that in EVD affected areas depressive symptoms are a major public health problem that require immediate attention. However, the prevalence of depression symptoms in this study is higher compared to the results observed in Guinea where participants have been received in psychiatric services and have received free care and medication.²⁰ Research conducted with representative samples of affected communities in Guinea, however, could have provided us with more accurate observations in a comparative perspective.

In terms of risk and protective factors, findings demonstrated that residents of rural areas were significantly more likely to be categorised as having severe depressive symptoms compared to those living in urban areas. In addition to having a lower education than those living in urban areas, individuals living in rural areas also have less access to information and healthcare facilities.^{21 22} These factors can increase fear, rumours and affect individuals' mood in rural areas. As stated in the methods section, to access certain rural areas, the research team had to spend many days in unsecure boats. However, the findings indicating that the rural areas are at higher risk justify the risk taken to access a large sample among this too often forgotten and vulnerable group.

In addition to the area of residency, the results indicated two major risk factors for depression symptoms after an EVD outbreak: degree of exposure to EVD and stigmatisation related to EVD. In fact, people with a higher exposure to EVD had over two-fold higher risk to be categorised as having severe depressive symptoms. The more people were close to someone infected by EVD, the more they were exposed to EVD, the more they were at risk of developing severe depressive symptoms. These individuals, in addition to having observed their relatives with physical symptoms associated to EVD (severe headache, vomiting, fever, fatigue, unexplained haemorrhage, diarrhoea, weakness, muscle, abdominal and stomach pain),

Table 3 Logistic regression model of study variables and depression symptoms (N=1614)

Variables	Depression symptoms			
	β	SE	OR	95% CI
Score of exposure to EVD				
1–4 (Reference criterion)				
5–8	0.66**	0.24	1.94	1.22 to 3.09
9 and more	0.85**	0.32	2.34	1.26 to 4.34
Stigmatisation related to EVD				
0–21 (Reference criterion)				
22–39	0.88***	0.23	2.42	1.53 to 3.83
40 and up	1.55***	0.36	4.73	2.34 to 9.56
Gender	0.59**	0.34	1.80	0.94 to 3.48
Residence area	–1.68***	0.37	0.19	0.09 to 0.38
Employment	–0.38**	0.16	0.68	0.50 to 0.93
Education level				
None (reference criterion)				
Primary school	–0.32	0.40	0.73	0.34 to 1.59
High school	0.09	0.36	1.09	0.54 to 2.21
Professional	–1.01*	0.49	0.36	0.14 to 0.96
University	0.02	0.38	1.02	0.48 to 2.13
Age	0.01	0.01	1.01	1.00 to 1.02
Religion				
Catholic (Reference criterion)				
Protestant	–0.19	0.16	0.83	0.61 to 1.14
Animist	0.20	0.57	1.22	0.40 to 3.71
Kimbanguist	0.19	0.33	1.21	0.63 to 2.31
Muslim	–0.20	0.38	0.82	0.39 to 1.71
Other	0.07	0.19	1.07	0.74 to 1.54
Marital status				
Single (reference criterion)				
Married	0.23	0.16	1.26	0.92 to 1.72
Divorced	0.07	0.36	1.08	0.54 to 2.16
Separated	–0.08	0.47	0.92	0.37 to 2.30
Widowed	0.30	0.44	1.35	0.57 to 3.19
In a relationship	1.18***	0.29	3.25	1.84 to 5.76
Residence area×exposure to EVD	0.12	0.18	1.13	0.78 to 1.62
Residence area×stigmatisation related to EVD	0.35	0.22	1.42	0.93 to 2.16
Gender×exposure to EVD	–0.06	0.18	0.95	0.67 to 1.34
Gender×stigmatisation related to EVD	–0.35	0.20	0.70	0.47 to 1.05

In the table, we reported the Nagelkerke R^2 . Cox and Snell $R^2=0.22$.

* $P<0.05$, ** $p<0.01$, *** $p<0.001$.

EVD, Ebola virus disease.

also experienced anxiety from being themselves infected by EVD, being afraid of dying, being faced with the death of loved ones, often losing their material goods and in certain cases, their homes.^{5,23–26} Stigmatisation also constitutes a major risk factor. In fact, those who experienced

the most stigmatization related to EVD were nearly five times more at risk to be categorised as having severe depressive symptoms. Past studies have already shown that stigmatisation constitutes a major risk factor for the development of mental health problems among survivors of



the 2014–2016 epidemic, in Guinea, in Sierra Leone and in Nigeria.^{27–29} A recent study conducted in DRC, Togo, Rwanda and Haiti also showed the major role of stigmatisation in the development of depressive symptoms among populations affected by the COVID-19 pandemic.¹⁴ However, this study is the first of its kind to demonstrate the determinant role of stigmatisation related to EVD in the development of depression among a representative sample. The results also showed that unemployment has an impact on depressive symptoms. Former studies also highlighted the role of socioeconomic status in the development of depressive symptoms among EVD survivors.⁵ These findings indicate the fact that in zones where services are scarce, socioeconomic status not only plays an important role in access to care, but also in the quality of services received and in the persistence of symptoms. The fact that the results show no significant gender difference is noteworthy. In the general scientific literature on depression, gender (being a woman) is a significant risk factor.³⁰ However, studies conducted in Africa and in the DRC in the context of EVD and COVID-19 corroborated the absence of gender differences in depression symptoms and other mental health problems.^{13 27 31} A recent study conducted in DRC, Haiti, Rwanda, and Togo also showed no gender differences in the three African countries, including DRC.¹⁴ Beyond the overall absence in gender differences, results indicate gender differences according to area of residency: in urban areas, men presented less prevalence of depression symptoms compared with women. This finding corroborates with results generally found in studies on worldwide depression rates.³² Yet, in rural areas, this relation reverted and men were more numerous than women to be categorised as having severe depressive symptoms. Unfortunately, anthropologic, psychological and sociological studies are inexistent on the roles of gender in these rural areas; the roles of women in these often-inaccessible rural areas could have helped us better understand such results, which may have key implication in terms of service organisation and delivery.

Results also showed that participants in an unmarried relationship are at higher risk of developing symptoms of depression. There are no studies in the Equateur region to compare our findings to. However, research in the DRC has shown that women who co-habit with men in unmarried relationships are more vulnerable to experience different forms of vulnerabilities.³³ In addition, they are particularly at risk of being rejected by their partners, leaving them with no social and financial security for themselves and their children. Moreover, studies conducted on EVD and depression are very limited in DRC. However, a study of 144 survivors in the East showed opposite results for education level.³⁴ In addition, different results were observed for psychological distress and post-traumatic stress disorder.^{35 36} Both qualitative and quantitative research is needed to better explain these findings.

Limitations

Although this study is the first to have examined depression among a large population-based sample affected by EVD, it also contains its limitations.

The cross-sectional design used did not allow us to explore causal associations between the risk factors and the depression symptoms and temporal relations between the explored variables. Longitudinal studies among populations affected by EVD could assess causal relationships between key factors such as the degree of exposure to EVD, stigmatisation related to EVD, unemployment, gender and area of residency with the development of depressive symptoms, but also include possible confounders. Additionally, there is a lack of research in less geographically accessible populations. Yet, past studies among these communities would have enriched the discussion and helped us to compare results, such as the impacts of gender differences between urban and rural areas. Finally, it would have been interesting to assess the history of depression in participants before the EVD outbreak, as well as in their families. But as the Congolese researchers on the team and mental health workers in Équateur Province advised, very few people are aware of mental healthcare and even fewer know their mental health status. This design could have been a significant bias for the study, so we preferred to avoid it.

Research and clinical implications

The current study revealed that symptoms of depression are a major public health problem among communities affected by EVD where more than three adults out of five were categorised as having severe depressive symptoms. It also shows important risk factors related to the development of depressive symptoms among communities affected by EVD. It also raises implications for research and for clinical practice. Stigmatisation related to EVD among communities, mainly among less geographically accessible ones, is often related to lack of information as prior studies showed.^{28 37} Moreover, certain communities sustain misconceptions on EVD and attribute it to witchcraft.³² In addition to vast information campaigns at a national level on EVD in a non-epidemic context, new studies should examine the relationship between the levels and types of information available in the populations and mental health problems. Furthermore, interventions differentiated by gender, whether led in urban or in rural areas are important. Likewise, mixed-methods studies (quantitative and qualitative) that could provide a better understanding of gender differences between rural and urban EVD affected populations are essential. This study also raises the importance of providing mental health services to less geographically accessible regions.³⁸ This is a public health emergency considering that mental health services are almost non-existent in the province of Equateur and completely absent in rural areas.³⁹ Trans-cultural adaptations of the WHO Mental Health Gap Action Programme and their introduction to the training of doctors, nurses and other healthcare workers are

necessary for providing mental health services to these populations. Such efforts could allow the diagnosis and the appropriate care for symptoms of depression which have an impact not only on the well-being of individuals and of their families, but also on the productivity of the affected countries.⁴⁰ Additionally, the training of educators and of community leaders for psychological first aid can be a good start to providing mental health services to these populations. As Horn *et al* highlight, to be efficient, first aid must be inserted in larger programmes that involve regular supervision of practising educators and of community leaders by psychologists or other mental health professionals.⁴¹ Finally, the results of this study shed light on the importance of acting and of intervening among survivors, families affected by EVD, and those who are the most exposed such as healthcare workers, by offering them psychological support in the prevention of mental health problems.

CONCLUSIONS

In this time of COVID-19 pandemic, this study demonstrated the importance of producing research on psychosocial risk factors of mental health among populations affected by infectious disease outbreaks.⁴² Although the findings highlighted exposure to EVD, stigmatisation related to EVD, area of residency and unemployment as risk factors, more studies are necessary to better understand the experiences of affected populations. Such studies should also allow us to better prepare ourselves in cases of outbreaks with high mortality rates. This study also underscored the need to find strategies that consider the capacities of the communities as well as their culture to develop mental health programs and to evaluate their impacts at medium and long terms. Finally, this study raised the importance of global mental health being based on a community approach that takes into account differences between cultures and local differences. It is by implementing these global mental health programs that rely on the strengths of the community that we can help local populations develop and prevent epidemics, and be equipped to deal with them when they occur.

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