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Running head: EBOLA VIRUS DISEASE AND SYMPTOMS OF DEPRESSION

Prevalence and risk factors of depression symptoms among populations affected by Ebola virus disease in the Democratic Republic of the Congo

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ABSTRACT

Background. 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.

Methods. The current study was conducted 7 months after the end of the 9th outbreak of EVD in the Democratic Republic of the Congo (DRC). A large population-based sample of 1,614 adults (50% women, mean age = 34.05; *SD* = 12.55) completed questionnaires assessing EVD exposure level, stigmatization related to EVD, and depressive symptoms. The odd ratios associated with sociodemographic data, EVD exposure level, and stigmatization were analyzed through logistic regressions.

Results. Overall 62.03% (95%CI: 59.66-64.40) individuals living in areas affected by EVD were categorized 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 to developing severe depressive symptoms [respectively, OR = 1.94 (95%CI: 1.22-3.09); OR = 2.34 (95%CI: 1.26-4.34)]. Individuals in the two higher categories of stigmatization were two to four times more at risk [respectively, OR = 2.42 (95%CI: 1.53-3.83); OR = 4.73 (95%CI: 2.34-9.56)]. Living in rural areas [OR = .19 (95%CI: 0.09-.38)] and being unemployed [OR = .68 (95%CI: .50-.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 which must be addressed through culturally adapted mental health programs.

Keywords. Infectious disease; Ebola virus disease; Depression; Exposure to EVD; Stigmatization related to EVD; EVD outbreak.

Strengths and limitations

- 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 DRC.
- These results show that depression is a major public health problem in communities affected by EVD.
- Results has important implications suggesting a particular need to implement mental health programs that integrate the medical, anthropological, sociological, cultural, and gender specificities of communities affected by EVD.
- This study shows the importance of health communication strategies during infectious disease epidemics' context to attenuate stigma that is related to mental health outcomes.
- It would have been interesting to assess the history of depression in participants before the EVD outbreak and compare with current symptoms.

Prevalence and risk factors of depression symptoms among populations affected by Ebola virus disease in the Democratic Republic of the Congo

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 Coronavirus disease 2019 (COVID-19), respectively, were categorized 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 categorized as having severe depressive symptoms [4]. Another study led in Guinee 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 exposition and stigmatization 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, stigmatization 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 to evaluate the degree to which depressive symptoms constitute a public health problem which should be prioritize in areas affected by EVD, and if this is the case, to elaborate and implement culturally adapted programs based on empirical data. As the Democratic Republic of the Congo (RDC) has been facing recurrent outbreaks of EVD these three last years, and the current pandemic of COVID-19 [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 Équateur 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 stigmatization related to EVD. Second, this study aims to document the association between exposure to EVD, stigmatization related to EVD, and symptoms of depression.

METHODS

Procedures

This study was conducted 7 months after the declaration of the end of the 9th 2018 outbreak of EVD (March 11th to April 23rd, 2019). Data on mental health problems including depression was 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. The two-stage stratified sampling was used to ensure adequate representation across gender and urban and rural areas in the province of Équateur where most rural areas remain difficult to access and data on mental health

problems are inexistent. Data was collected in the three "health zones" (Bikoro, Iboko, and Wangata) affected by the 9th EVD outbreak in the DRC that are constituted of 18 rural and urban areas in the Province of Équateur in the DRC. Households were selected randomly. When a house was found vacant by investigators, 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. 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. They led a survey door-to-door considering the two-stage stratified sampling method. 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 Équateur 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 dialects and in French. Back-translation methods were used. Translation was done by a team of seven Congolese professors from DRC universities. The psychometric properties of all the measures were explored and found to be reliable, valid and accurate. The ethics committees of the University of Ottawa and the Institut National pour la Recherche Biomedicale (National Institute for Biomedical Research) of DRC approved the study protocol. The University of Kinshasa also approved the study protocol.

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). 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 (x^2 = 18.4, df = 1, p < .001).

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 Ebola virus disease

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 [9]. The score was computed from the sum of the 'Yes' (1) or 'No' (0) statements (e.g., "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 [10,11]. A greater score indicates a higher exposure to Ebola. In our sample, the Cronbach alpha was .92.

Stigmatization related to EVD

We used a 20-item scale that measures 20 possible forms of stigmatization related to EVD, based on the WHO reports and the Social science and behavioral data compilation [12]. This scale has already been used in the DRC with very good internal consistency [10,11]. The measure rated on a 4-point scale ranging from 'Never' (0) to 'Always' (4) (e.g., "Because of the Ebola Virus… You have been subjected to mockeries or other similar attitudes", "Someone insulted you by referring to the Ebola virus disease"). In our sample, Cronbach's alpha was .97.

Depression Symptoms

To measure depression symptoms, we used the *Beck Depression Inventory – Short Form* (BDI-SF) [13]. This scale includes 13 items rated on a 4-point scale ranging from 0 to 3 which differs for each item (e.g., "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 if it; (3) I'm so sad and unhappy I can't support it"). Total scores range from 0 to 39. In the present study, we used the score of 14 and higher to determine if a subject would be classified as severe depression symptoms [14]. The BDI-SF has been widely used in diverse populations and cultures

and appears to have a robust transcultural validity [15,16]. Cronbach's alpha was of .87 in our sample.

Statistical analysis

Using the Statistical Package for Social Science (SPSS – version 26), frequencies were calculated to describe sociodemographic characteristics of the sample, including age, residence are (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 stigmatization related to EVD, scores were classified in 3 categories with respective values below the 50th percentile; between 50th to 75th, and values beyond the 75th percentile. Prevalence of severe depression symptoms was computed for gender, exposure level to EVD, stigmatization related to EVD, and sociodemographic characteristics of the sample (age, residence area, education level, employment, religion and marital status). Bivariate comparisons were performed using Chi-Square tests with 95% Confidence Intervals 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 stigmatization 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 stigmatization 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, 64.4) were categorized as having severe depression symptoms. Bivariate analyses showed that greater scores of exposure level to EVD and stigmatization related to EVD were associated with a higher prevalence of depression symptoms (respectively, $x^2 = 233.9$, $p < .0001$; 254.0, $p < .0001$). Results revealed that participants living in rural areas were more likely to be categorized as having severe depressive symptoms than those living in urban areas [respectively, 76.1%

(95% CI: 74.1-78.2); and 44.0% 95% CI: 41.6-46.4), $x^2 = 174.2$, $p < .0001$]. 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, 39.9% (95% CI: 37.6-42.3), and 48.0%, (95% CI: 45.6-50.5), $x^2 = 4.7$, $p = .03$]. However, in rural areas, men [79.7% (95% CI: 77.7-81.6)] were more likely to be categorized as having severe depressive symptoms than women [95% CI: 72.6% (70.5-74.8)], $x^2 = 6.1$, $p = .01$].

The three categories of exposure level to EVD contained participants who scored 0 to 4 which is below the 50th percentile (790 participants, 49.04%), between the 50th to 75th percentile, scores of 5 to 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 categorized with higher prevalence of severe depression symptoms comparatively to those with lower scores [respectively, 43.3% (95% CI: 40.9-45.7); 75.4% (95% CI: 73.3-77.5), 82.7% (95% CI: (80.8-84.5), $x^2 = 233.9$, $p < .0001$]. For stigmatisation related to EVD, the three categories contained participants who scored 0 to 21 (813 participants, 50.43%), 22 to 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 stigmatization related to EVD were more likely to be categorized with severe depression symptoms [respectively, 43.4% (95% CI: 40.9-55.8); 74.9% (95% CI: 72.8-77.1), 87.1% (95% CI: (85.4-88.7), $x^2 = 254.0$, $p < .0001$] and at higher risk than women (90.6%, 95% CI: 89.2-92.1 vs 83.7%, 95% CI: 81.9-8.5, $x^2 = 4.1$, $p = .04$). 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 = .19 (95% CI: 0.09, .38)] and being unemployed [OR = .68 (95% CI: .50, .93)] increased the likelihood of having symptoms of depression. Compared to participants with no education, those who achieved professional training were more particularly at risk [OR = .36 (95% CI: .14, .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 two-fold higher among those who reported a score from 5 to 8 [OR = 1.94 (95% CI: 1.22, 3.09)] and a score of more than 8 [OR = 2.34 (95% CI: 1.26, 4.34)], respectively. Furthermore, these odds were two to four times higher among participants who reported a score of stigmatization 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, 3.83), and OR = 4.73 (95% CI: 2.34, 9.56)], respectively. Participants in unmarried relationships, compared to single people, were 3.3 times more likely to have depressive symptoms [OR = 3.25 (95% CI: 1.84, 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 stigmatization 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 ($x^2 = 7.41$, $p = .49$).

DISCUSSION

The present 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 which require immediate attention. However, the prevalence of depression symptoms in the present 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 [17]. 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 categorized 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 [18,19]. These factors can increase fear, rumors, 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 stigmatization related to EVD. In fact, people with a higher exposure to EVD had over two-fold higher risk to be categorized 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 hemorrhage, diarrhea, weakness, muscle, abdominal, and stomach pain), 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 [5,20–23]. Stigmatization also constitutes a major risk factor. In fact, those who experienced the higher category of score of stigmatization related to EVD were nearly 5 times more at risk to be categorized as having severe depressive symptoms. Past studies have already shown that stigmatization constitutes a major risk factor for the development of mental health problems among survivors of the 2014-2016 epidemic, in Guinee, in Sierra Leone, and in Nigeria [24–26]. A recent study conducted in DRC, Togo, Rwanda and Haiti also showed the major role of stigmatization in the development of depressive symptoms among populations affected by the COVID-19 pandemic [11]. However, this study is the first of its kind to demonstrate the determinant role of stigmatization related to EVD in the development of depression among a representative sample. The results also showed that unemployment can impact 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 [27]. However, studies

conducted in Africa and in the DRC in the context of Ebola virus disease and COVID-19 corroborated the absence of gender differences in depression symptoms and other mental health problems [10,24,28]. A recent study conducted in DRC, Haiti, Rwanda, and Togo also showed no gender differences in the three African countries, including DRC [11]. 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 to women. This finding corroborates with results generally found in studies on worldwide depression rates [29]. Yet, in rural areas, this relation reverted and men were more numerous than women to be categorized 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 organization and delivery.

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, stigmatization 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 health care 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 is a major public health problem among communities affected by EVD where more than three adults out of five were categorized 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. Stigmatization related to EVD among communities, mainly among less geographically accessible ones, is often related to lack of information as prior studies showed [25]. Moreover, certain communities sustain misconceptions on EVD and attribute it to witchcraft [29]. 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 [30]. Transcultural adaptations of the WHO Mental Health Gap Action Program (mhGAP) and their introduction to the training of doctors, nurses and other healthcare workers are necessary for providing mental health services to these population. Such efforts could allow the diagnosis and the appropriate care for symptoms of depression which have an impact not only on the wellbeing of individuals and of their families, but also on the productivity of the affected countries [31]. 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 and colleagues highlight, to be efficient, first aid has to be inserted in larger programs which involve regular supervision of practicing educators and of community leaders by psychologists or other mental health professionals [32]. 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 [33]. Although the findings highlighted exposition to EVD, stigmatization 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 which consider the capacities of the communities as well as their culture in order 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 to be based on a community approach which takes into account differences between cultures and local differences. It is by putting in place these global mental health programs which rely on community strengths that we will be able to help local populations to develop and to prevent epidemics, and to be equipped to face them when they arise.

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Data availability: Data are available on request from the first author. The data are not publicly available due to ethical restrictions.
Patient and public involvement: Patients and/or the public were not involved in the design, or conduct, or reporting, or dissemination plans of this research.1
Contributors

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References

1 Lowther K, Selman L, Harding R, *et al.* Experience of persistent psychological symptoms and perceived stigma among people with HIV on antiretroviral therapy (ART): A systematic review. Int. J. Nurs. Stud. 2014;**51**:1171–89. doi:10.1016/j.ijnurstu.2014.01.015

2 Cénat JM, Felix N, Blais-Rochette C, *et al.* Prevalence of mental health problems in populations affected by Ebola virus disease: A systematic review and meta-analysis. *Psychiatry Res* 2020;**289**:113033. doi:10.1016/j.psychres.2020.113033

3 Pappa S, Ntella V, Giannakas T, *et al.* Prevalence of depression, anxiety, and insomnia among healthcare workers during the COVID-19 pandemic: A systematic review and meta-analysis. *Brain Behav Immun* Published Online First: 8 May 2020. doi:10.1016/j.bbi.2020.05.026

4 Wilson HW, Amo-Addae M, Kenu E, *et al.* Post-Ebola Syndrome among Ebola Virus Disease Survivors in Montserrado County, Liberia 2016. *Biomed Res Int* 2018;**2018**:1–8. doi:10.1155/2018/1909410

5 Etard J-F, Sow MS, Leroy S, *et al.* Multidisciplinary assessment of post-Ebola sequelae in Guinea (Postebogui): an observational cohort study. *Lancet Infect Dis*

2017;**17**:545–52. doi:10.1016/S1473-3099(16)30516-3

6 Rueda S, Mitra S, Chen S, *et al.* Examining the associations between HIV-related stigma and health outcomes in people living with HIV/AIDS: a series of meta-analyses. *BMJ Open* 2016;**6**:e011453. doi:10.1136/bmjopen-2016-011453

7 James PB, Wardle J, Steel A, *et al.* Post-Ebola psychosocial experiences and coping mechanisms among Ebola survivors: a systematic review. *Trop Med Int Heal* 2019;**24**:671–91. doi:10.1111/tmi.13226

8 John Hopkins University. Coronavirus COVID-19 (2019-nCoV). John Hopkins Univ. 2021.https://gisanddata.maps.arcgis.com/apps/opsdashboard/index.html#/bda7594740fd40299423467b48e9ecf6 (accessed 22 Mar 2021).

9 Cénat JM, Derivois D. Assessment of prevalence and determinants of posttraumatic stress disorder and depression symptoms in adults survivors of earthquake in Haiti after 30 months. *J Affect Disord* 2014;**159**:111–7. doi:10.1016/j.jad.2014.02.025

10 Cénat JM, Dalexis RD, Guerrier M, *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* 2021;**132**:13–7. doi:10.1016/j.jpsychires.2020.09.031

11 Cénat JM, Noorishad PG, Kokou-Kpolou CK, *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. *Psychiatry Res* 2021;**297**:113714. doi:10.1016/j.psychres.2021.113714

12 Bardosh K, Gercama I, Bedford J. Social Science and Behavioural Data Compilation, DRC Ebola Outbreak, June 2019-August 2019. 2019.

13 Beck AT, Steer RA. *Manual for the beck depression inventory*. San Antonio, TX: : The Psychological Corporation 1993.

14 Furlanetto LM, Mendlowicz M V., Romildo Bueno J. The validity of the Beck Depression Inventory-Short Form as a screening and diagnostic instrument for moderate and severe depression in medical inpatients. *J Affect Disord* 2005;**86**:87–91. doi:10.1016/j.jad.2004.12.011

15 Al-Yasiri A-R, Abdkarkosh YS. The Validity of Beck Depression Inventory-Short Version in Depressed Patients Diagnosed According to ICD10. 2013.

16 Jin X, Doukas A, Beiting M, *et al.* Factors Contributing to Intimate Partner

Violence among Men in Kerala, India. *J Fam Violence* 2014;**29**:643–52. doi:10.1007/s10896-014-9623-4

17 Keita MM, Doukouré M, Chantereau I, *et al.* Les survivants de l'épidémie récente de la maladie à virus Ebola au service de psychiatrie de l'hôpital national Donka en Guinée-Conakry : étude psychopathologique et psychothérapeutique. *L'Évolution Psychiatr* 2017;**82**:127–42. doi:10.1016/J.EVOPSY.2016.07.004

18 Ousman K, Kabego L, Talisuna A, *et al.* The impact of Infection Prevention and control (IPC) bundle implementationon IPC compliance during the Ebola virus outbreak in Mbandaka/Democratic Republic of the Congo: a before and after design. *BMJ Open* 2019;**9**:29717. doi:10.1136/bmjopen-2019-029717

19 Jalloh MF, Robinson SJ, Corker J, *et al.* Knowledge, Attitudes, and Practices Related to Ebola Virus Disease at the End of a National Epidemic — Guinea, August 2015. *Morb Mortal Wkly Rep* 2017;**66**:1109–15. doi:10.15585/mmwr.mm6641a4

20 Keita MM, Doukouré M, Chantereau I, *et al.* Survivors of epidemic recent disease Ebola virus in psychiatric hospital service national Donka in Guinea: Psychopathological and psychotherapeutic study. *Evol Psychiatr* Published Online First: 2017. doi:10.1016/j.evopsy.2016.07.004

21 Cénat JM, Balayulu-Makila O, Derivois D, *et al.* The mental health professional at the feet of the Ebola virus: individual treatment and global mental challenges. *Br J Psychiatry* 2019;:1–2. doi:10.1192/bjp.2019.122

22 Kamara S, Walder A, Duncan J, *et al.* Mental health care during the Ebola virus disease outbreak in Sierra Leone. *Bull World Heal Organ* 2017;**95**:842–7. doi:10.2471/BLT.16.190470

23 Mohammed A, Sheikh TL, Gidado S, *et al.* An evaluation of psychological distress and social support of survivors and contacts of Ebola virus disease infection and their relatives in Lagos, Nigeria: a cross sectional study − 2014. *BMC Public Health* 2015;**15**:824. doi:10.1186/s12889-015-2167-6

24 Keita MM, Taverne B, Sy Savané S, *et al.* Depressive symptoms among survivors of Ebola virus disease in Conakry (Guinea): preliminary results of the PostEboGui cohort. *BMC Psychiatry* 2017;**17**:127. doi:10.1186/s12888-017-1280-8

25 Denis-Ramirez E, Sørensen KH, Skovdal M. In the midst of a 'perfect storm': Unpacking the causes and consequences of Ebola-related stigma for children orphaned by Ebola in Sierra Leone. *Child Youth Serv Rev* 2017;**73**:445–53. doi:10.1016/J.CHILDYOUTH.2016.11.025

26 Bakare WA, Ilesanmi OS, Nabena EP, *et al.* Psychosocial stressors and support needs of survivors of Ebola virus disease, Bombali District, Sierra Leone, 2015. *Healthc Low-resource Settings* 2016;**3**:48–51. doi:10.4081/hls.2015.5411

27 Kessler RC, Sampson NA, Berglund P, *et al.* Anxious and non-anxious major depressive disorder in the World Health Organization World Mental Health Surveys. *Epidemiol Psychiatr Sci* 2015;**24**:210–26. doi:10.1017/S2045796015000189

28 Cénat JM, McIntee SE, Guerrier M, *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. *Soc Psychiatry Psychiatr Epidemiol* 2020;:1–6. doi:10.1007/s00127-020-01904-x

29 Adongo PB, Tabong PT-N, Asampong E, *et al.* Beyond Knowledge and Awareness: Addressing Misconceptions in Ghana's Preparation towards an Outbreak of Ebola Virus Disease. *PLoS One* 2016;**11**. doi:10.1371/journal.pone.0149627

30 Cénat JM, Mukunzi JN, Noorishad P-G, *et al.* A systematic review of mental health programs among populations affected by the Ebola virus disease. *J Psychosom Res* 2020;**131**:109966. doi:10.1016/j.jpsychores.2020.109966

31 Lerner D, Adler DA, Chang H, *et al.* Unemployment, job retention, and productivity loss among employees with depression. *Psychiatr Serv* 2004;**55**:1371–8. doi:10.1176/appi.ps.55.12.1371

32 Horn R, O'May F, Esliker R, *et al.* The myth of the 1-day training: the effectiveness of psychosocial support capacity-building during the Ebola outbreak in West Africa – ADDENDUM. *Glob Ment Heal* 2019;**6**. doi:10.1017/gmh.2019.10

33 Cénat JM, Blais-Rochette C, Kokou-Kpolou CK, *et al.* Prevalence of Symptoms of Depression, Anxiety, Insomnia, Posttraumatic Stress Disorder, and Psychological Distress among Populations Affected by the COVID-19 Pandemic: A Systematic Review and Meta-Analysis. *Psychiatry Res* 2021;**295**:113599. doi:https://doi.org/10.1016/j.psychres.2020.113599

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

	Total N (%; CI)	Men N (%; CI)	Women N (%; CI)	x^2; *p*
Total	1614 (100.0; 100-100)	807 (50.0; 46.6-53.5)	807 (50.; 46.6-53.5)	
Residence area				.0, 1.00
Rural	906 (56.1; 52.9-59.4)	453 (50.0; 45.8-54.2)	453 (50.0; 45.8-54.2)	
Urban	708 (43.8; 40.2-47.5)	354 (50.0; 44.8-55.2)	354 (50.0; 44.8-55.2)	
Employment				1.4, .26
Yes	897 (57.65; 54.42-60.88)	457 (50.95; 46.37-55.53)	440 (49.05; 44.38-53.72)	
No	659 (42.35; 38.58-46.12)	316 (47.95; 42.44-53.46)	343 (52.05; 46.76-57.34)	
Education level				18.4, .001
None	62 (3.9; -.91-8.8)	29 (46.8; 28.6-64.9)	33 (53.2; 36.2-70.3)	
Primary school	172 (10.9; 6.2-15.6)	69 (40.1; 28.6-51.7)	103 (59.9; 50.4-69.4)	
High school	898 (56.9; 53.6-60.1)	437 (48.7; 44.0-53.4)	461 (51.3; 46.8-55.9)	
Professional	54 (3.4; -1.4-8.3)	27 (50.0; 31.1-68.9)	27 (50.0; 31.1-68.9)	
University	393 (24.9; 20.6-29.2)	229 (58.3; 51.9-64.7)	164 (41.7; 34.2-49.3)	
Age				3.5, .62
18-24 years	387 (26.2; 21.8-30.6)	183 (47.3; 40.1-54.5)	204 (52.7; 45.9-59.6)	
25-34 years	485 (32.8; 28.7-37.0)	254 (52.4; 46.2-58.5)	231 (47.6; 41.2-54.1)	
35-44 years	303 (20.5; 16.0-25.1)	151 (49.8; 41.9-57.8)	152 (50.2; 42.2-58.1)	
45-54 years	174 (11.8; 7.0-16.6)	95 (54.6; 44.6-64.6)	79 (45.4; 34.4-56.4)	
55-64 years	102 (6.9; 2.0-11.8)	51 (50.0; 36.3-63.7)	51 (50.0; 36.3-63.7)	
65 and more	26 (1.8; -3.3-6.8)	13 (50.0; 22.8-77.2)	13 (50.0; 22.8-77.2)	
Religion				7.2, .21
Catholic	714 (44.6; 40.9-48.2)	341 (47.8; 42.5-53.1)	373 (52.2; 47.2-57.3)	
Protestant	401 (25.0; 20.8-29.3)	205 (51.1; 44.3-58.0)	196 (48.9; 41.9-55.9)	
Animist	30 (1.9; -3.0-6.7)	11 (36.7; 8.2-65.2)	19 (63.3; 41.7-85.0)	
Kimbanguist	73 (4.6; -.2-9.4)	35 (48.0; 31.4-64.5)	38 (52.1; 36.2-67.9)	
Muslim	52 (3.2; -1.6-8.1)	30 (57.7; 40.0-75.4)	22 (42.3; 21.7-63.0)	
Other	332 (20.7; 16.4-25.1)	179 (53.9; 46.6-61.2)	153 (46.1; 38.2-54.0)	
Marital status				14.1, .01
Single	573 (36.4; 32.5-40.3)	292 (51.0; 45.2-56.7)	281 (49.0; 43.2-54.9)	
Married	745 (47.3; 43.7-50.9)	377 (50.6; 45.6-55.7)	368 (49.4; 44.3-54.5)	
Divorced	62 (4.0; -.9-8.8)	23 (37.1; 17.4-56.8)	39 (62.9; 47.7-78.1)	
Separated	33 (2.1; -2.8-8.0)	18 (54.6; 31.6-77.6)	15 (45.5; 20.3-70.7)	
Widowed	42 (2.7; -2.2-7.6)	11 (26.2; -.2-52.2)	31 (73.8; 58.3-89.3)	
In a relationship	119 (7.6; 2.8-12.3)	59 (49.6; 36.8-62.3)	60 (50.4; 37.8-63.1)	

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

	Depression Symptoms				
	Total % (CI)	x^2 (df), *p*	Men % (CI)	Women % (CI)	x^2 (df), *p*
Total	62.0 (59.7-64.4)		62.2 (59.9-64.6)	61.8 (59.46-64.20)	.0, .87
Score of exposure to EVD		233.9, <.0001			
1 to 4	43.3 (40.9-45.7)		41.8 (39.4-44.2)	44.7 (42.26-47.11)	.7, .41
5 to 8	75.4 (73.3-77.5)		72.2 (70.0-74.4)	78.6 (76.56-80.57)	1.7, .20
9 and more	82.7 (80.8-84.5)		84.4 (82.6-86.1)	80.8 (78.63-82.50)	1.2, .28
Stigmatization due to EVD		254.0, <.0001			
0 to 21	43.4 (40.9-55.8)		40.7 (38.3-43.1)	46.0 (43.52-48.38)	2.2, 14
22 to 39	74.9 (72.8-77.1)		77.7 (75.6-79.7)	72.1 (69.89-74.27)	1.7, .20
40 and up	87.1 (85.4-88.7)		90.6 (89.2-92.1)	83.7 (81.94-85-54)	4.1, .04
Residence area		174.2 <.0001			
Rural	76.1 (74.1-78.2)		79.7 (77.7-81.6)	72.6 (70.45-74.81)	6.1, .01
Urban	44.0 (41.6-46.4)		39.9 (37.6-42.3)	48.0 (45.58-50.46)	4.7, .03
Employment		17.1, <.0001			
Yes	55.6 (53.1-58.0)		53.2 (50.8-55.6)	57.7 (55.32-60.14)	1.2, .24
No	65.9 (63.6-68.2)		67.2 (64.9-69.5)	64.6 (62.22-66.88)	.7, .41
Education level		21.4, <.0001			
None	72.6 (70.4-74.8)		75.8 (73.7-77.9)	69.0 (66.71-71.23)	.4, .55
Primary school	65.1 (62.8-67.5)		61.2 (58.8-63.6)	71.0 (68.80-73.22)	1.8, .18
High school	65.2 (62.9-67.5)		64.2 (61.9-66.6)	66.3 (63.97-68.59)	.4, .51
Professional	50.0 (47.7-52.4)		55.6 (53.1-58.0)	44.4 (42.02-46.86)	.7, .41
University	54.1 (51.7-56.5)		54.3 (51.8-56.7)	54.0 (51.52-56.38)	.0, 1.00
Age		16.8, .005			
18-24 years	57.8 (55.1-60.2)		61.5 (59.2-63-9)	54.4 (51.98-56.84)	2.0, .95
25-34 years	57.4 (55.0-59.9)		57.3 (54.9-59.7)	57.6 (55.17-59.99)	.0, 1.00
35-44 years	66.0 (63.7-68.3)		66.9 (64.6-69.2)	65.1 (62.81-67.45)	.1, .75
45-54 years	70.1 (67.8-72.3)		67.4 (65.1-69.7)	73.4 (71.26-75.58)	.8, .39
55-64 years	64.7(62.4-67.0)		68.6 (66.4-70.9)	60.9 (58.40-63.16)	.7, .41
65 and more	76.9 (74.9-78.1)		69.2 (67.0-71.5)	84.6 (82.86-86.38)	.9, .35
Religion		28.2, <.0001			
Catholic	68.1 (65.9-70.4)		70.5 (68.3-72.7)	66.0 (63.64-68.26)	1.7, .20
Protestant	59.6 (57.2-62.0)		60.5 (58.1-62.9)	58.7 (56.27-61.07)	.1, .71
Animist	73.3 (71.2-75.5)		81.8 (79.9-83.7)	68.4 (66.15-70.69)	.6, .42
Kimbanguist	63.0 (60.7-65.4)		57.1 (54.7-59.6)	68.4 (66.15-70.69)	.1, .32
Muslim	57.7 (55.3-60.1)		53.3 (50.9-55.8)	63.6 (61.29-65.99)	.6, .46
Other	52.1 (49.7-54.6)		50.3 (47.8-52.7)	54.3 (51.86-56.72)	.5, .50
Marital status		22.0, .001			
Single	56.9 (54.5-59.3)		57.2 (54.8-59.7)	56.6 (54.16-59.00)	.0, .87
Married	63.8 (61.4-66.1)		66.8 (64.5-69.1)	60.6 (58.22-62.98)	3.1, .08
Divorced	64.5 (62.2-66.9)		52.2 (49.7-54.6)	71.8 (69.59-73.99)	2.4, .12
Separated	57.6 (55.2-60.0)		66.7 (64.4-69.0)	46.7 (44.24-49.10)	1.3, .25
Widowed	73.8 (71.7-76.0)		63.6 (61.3-66.0)	77.4 (75.38-79.46)	.9, .37
In a relationship	77.3 (75.3-79.4)		72.9 (70.7-75.0)	81.7 (79.77-83.55)	1.3, .25

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

	Depression Symptoms $R^2 = .31$; x^2 (8) = 7.41, $p < .001$				
Variables	β	SE	OR	95% CI	
Score of exposure to EVD					
5 to 8	.66**	.24	1.94	1.22	3.09
9 and more	.85**	.32	2.34	1.26	4.34
Stigmatization related to EVD					
22 to 39	.88***	.23	2.42	1.53	3.83
40 and up	1.55***	.36	4.73	2.34	9.56
Gender	.59**	.34	1.80	.94	3.48
Residence area	-1.68***	.37	.19	.09	.38
Employment	-.38**	.16	.68	.50	.93
Education level					
Primary school	-.32	.40	.73	.34	1.59
High school	.09	.36	1.09	.54	2.21
Professional	-1.01*	.49	.36	.14	.96
University	.02	.38	1.02	.48	2.13
Age	.01	.01	1.01	1.00	1.02
Religion					
Protestant	-.19	.16	.83	.61	1.14
Animist	.20	.57	1.22	.40	3.71
Kimbanguist	.19	.33	1.21	.63	2.31
Muslim	-.20	.38	.82	.39	1.71
Other	.07	.19	1.07	.74	1.54
Marital status					
Married	.23	.16	1.26	.92	1.72
Divorced	.07	.36	1.08	.54	2.16
Separated	-.08	.47	.92	.37	2.30
Widowed	.30	.44	1.35	.57	3.19
In a relationship	1.18***	.29	3.25	1.84	5.76
Residence area X Exposure to EVD	.12	.18	1.13	.78	1.62
Residence area X Stigmatization related to EVD	.35	.22	1.42	.93	2.16
Gender X Exposure to EVD	-.06	.18	.95	.67	1.34
Gender X Stigmatization related to EVD	-.35	.20	.70	.47	1.05

Note. *: $p < .05$; **: $p < .01$; ***: $p < .001$. In the table we reported the Nagelkerke R^2. Cox & Snell R^2 = .22. Reference criteria for 'Score of exposure to EVD' was '1 to 4'; Reference criteria for 'Stigmatization related to EVD' was '0 to 21; 'Reference criteria for 'Education level' was 'None'; Reference criteria for 'Marital status' was 'Single'; and reference criteria for 'Religion' was 'Catholic'.

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Running head: EBOLA VIRUS DISEASE AND SYMPTOMS OF DEPRESSION

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 11th to April 23rd, 2019) after the end of the 9th outbreak of EVD in the Province of Equateur in the Democratic Republic of the Congo (DRC).

Participants. A large population-based sample of 1,614 adults (50% women, M_{age} = 34.05; *SD* = 12.55) in health zones affected by the 9th outbreak in DRC.

Primary and secondary outcome measures. Participants completed questionnaires assessing EVD exposure level, stigmatization related to EVD, and depressive symptoms. The odd ratios associated with sociodemographic data, EVD exposure level, and stigmatization were analyzed through logistic regressions.

Results. Overall, 62.03% (95%CI: 59.66-64.40) of individuals living in areas affected by EVD were categorized 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: 1.22-3.09); OR = 2.34 (95%CI: 1.26-4.34)]. Individuals in the two higher categories of stigmatization were two to four times more at risk [respectively, OR = 2.42 (95%CI: 1.53-3.83); OR = 4.73 (95%CI: 2.34-9.56)]. Living in rural areas [OR = .19 (95%CI: 0.09-.38)] and being unemployed [OR = .68 (95%CI: .50-.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 which must be addressed through culturally adapted mental health programs.

Keywords. Infectious disease; Ebola virus disease; Depression; Exposure to EVD; Stigmatization related to EVD; EVD outbreak.

Strengths and limitations

- 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 DRC.
- 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.

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

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 Coronavirus disease 2019 (COVID-19), respectively, were categorized 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 categorized 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 stigmatization 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, stigmatization 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 to evaluate the degree to which depressive symptoms constitute a public health problem which should be prioritize 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 (RDC) 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 Équateur 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 stigmatization related to EVD. Second, this study aims to document the association between exposure to EVD, stigmatization 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 enrollment 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 9th 2018 outbreak of EVD (March 11th to April 23rd, 2019). Data on mental health problems including depression was 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 was collected during door-to-door surveys in the three "health zones" (Bikoro, Iboko, and Wangata) affected by the 9th 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. 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; (4) have no mental health disorder that interferes with functioning t. 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 dialects and in French. Back-translation methods were used. Translation was done by a team of seven Congolese professors from DRC

universities. The ethics committees of the University of Ottawa and the Institut National pour la Recherche Biomedicale (National Institute for Biomedical Research) of DRC approved the study protocol. The University of Kinshasa also approved the study protocol.

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 18–85. 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 (x^2 = 18.4, $df = 1$, $p < .001$).

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 Ebola virus disease

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 [11]. The score was computed from the sum of the 'Yes' (1) or 'No' (0) statements (e.g., "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 [12,13]. A greater score indicates a higher exposure to Ebola. In our sample, the Cronbach alpha was .92.

Stigmatization related to EVD

We used a 20-item scale that measures 20 possible forms of stigmatization related to EVD, based on the WHO reports and the Social science and behavioral data compilation [14]. This scale has already been used in the DRC with very good internal consistency [12,13]. The measure rated on a 4-point scale ranging from 'Never' (0) to 'Always' (4) (e.g., "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 .97.

Depression Symptoms

To measure depression symptoms, we used the *Beck Depression Inventory – Short Form* (BDI-SF) [15]. This scale includes 13 items rated on a 4-point scale ranging from 0 to 3 which differs for each item (e.g., "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 if it; (3) I'm so sad and unhappy I can't support it"). Total scores range from 0 to 39. In the present study, we used the score of 14 and higher to determine if a subject would be classified as severe depression symptoms [16]. The BDI-SF has been widely used in diverse populations and cultures and appears to have a robust transcultural validity [17,18]. Cronbach's alpha was of .87 in our sample.

Statistical analysis

Using the Statistical Package for Social Science (SPSS – version 26), frequencies were calculated to describe sociodemographic characteristics of the sample, including age, residence are (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 stigmatization related to EVD, scores were classified in 3 categories with respective values below the 50th percentile; between 50th to 75th, and values beyond the 75th percentile. Prevalence of severe depression symptoms was computed for gender,

exposure level to EVD, stigmatization related to EVD, and sociodemographic characteristics of the sample (age, residence area, education level, employment, religion and marital status). Bivariate comparisons were performed using Chi-Square tests with 95% Confidence Intervals 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 stigmatization 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 stigmatization 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, 64.4) were categorized as having severe depression symptoms. Bivariate analyses showed that greater scores of exposure level to EVD and stigmatization related to EVD were associated with a higher prevalence of depression symptoms (respectively, $x^2 = 233.9$, $p < .0001$; 254.0, $p < .0001$). Results revealed that participants living in rural areas were more likely to be categorized as having severe depressive symptoms than those living in urban areas [respectively, 76.1% (95% CI: 74.1-78.2); and 44.0% 95% CI: 41.6-46.4), $x^2 = 174.2$, $p < .0001$]. 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: 45.6-50.5) and 39.9% (95% CI: 37.6-42.3), $x^2 = 4.7$, $p = .03$]. However, in rural areas, men [79.7% (95% CI: 77.7-81.6)] were more likely to be categorized as having severe depressive symptoms than women [95% CI: 72.6% (70.5-74.8)], $x^2 = 6.1$, $p = .01$].

The three categories of exposure level to EVD contained participants who scored 0 to 4 which is below the 50th percentile (790 participants, 49.04%), between the 50th to 75th percentile, scores of 5 to 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 categorized with higher prevalence of severe depression symptoms comparatively to those with lower scores [respectively, 43.3% (95% CI: 40.9-45.7); 75.4% (95% CI: 73.3-77.5), 82.7% (95% CI: (80.8-84.5), $x^2 = 233.9$, $p < .0001$]. For stigmatisation related to EVD, the three categories contained participants who scored 0 to 21 (813 participants, 50.43%), 22 to 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 stigmatization related to EVD were more likely to be categorized with severe depression symptoms [respectively, 43.4% (95% CI: 40.9-55.8); 74.9% (95% CI: 72.8-77.1), 87.1% (95% CI: (85.4-88.7), $x^2 = 254.0$, $p < .0001$] and at higher risk than women (90.6%, 95% CI: 89.2-92.1 vs 83.7%, 95% CI: 81.9-8.5, $x^2 = 4.1$, $p = .04$). 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 = .19 (95% CI: 0.09, .38)] and being unemployed [OR = .68 (95% CI: .50, .93)] increased the likelihood of having symptoms of depression. Compared to participants with no education, those who achieved professional training were more particularly at risk [OR = .36 (95% CI: .14, .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 two-fold higher among those who reported a score from 5 to 8 [OR = 1.94 (95% CI: 1.22, 3.09)] and a score of more than 8 [OR = 2.34 (95% CI: 1.26, 4.34)], respectively. Furthermore, these odds were two to four times higher among participants who reported a score of stigmatization 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, 3.83), and OR = 4.73 (95% CI: 2.34, 9.56)], respectively. Participants in unmarried relationships, compared to single people, were 3.3 times more likely to have depressive symptoms [OR = 3.25 (95% CI: 1.84, 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 stigmatization 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 ($x^2 = 7.41$, $p = .49$).

DISCUSSION

The present 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 which require immediate attention. However, the prevalence of depression symptoms in the present 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 [19]. 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 categorized 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 [20,21]. These factors can increase fear, rumors, 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 stigmatization related to EVD. In fact, people with a higher exposure to EVD had over two-fold higher risk to be categorized 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 hemorrhage, diarrhea, weakness, muscle, abdominal, and stomach pain), 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 [5,22–25]. Stigmatization also constitutes a major risk factor. In fact, those who experienced the higher category of score of stigmatization related to EVD were nearly 5 times more at risk to be categorized as having severe depressive symptoms. Past studies have already shown that stigmatization constitutes a major risk factor for the development of mental health problems among survivors of the 2014-2016 epidemic, in Guinee, in Sierra Leone, and in Nigeria [26–28]. A recent study conducted in DRC, Togo, Rwanda and Haiti also showed the major role of stigmatization in the development of depressive symptoms among populations affected by the COVID-19 pandemic [13]. However, this study is the first of its kind to demonstrate the determinant role of stigmatization related to EVD in the development of depression among a representative sample. The results also showed that unemployment can impact 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 [29]. However, studies conducted in Africa and in the DRC in the context of Ebola virus disease and COVID-19 corroborated the absence of gender differences in depression symptoms and other mental health problems [12,26,30]. A recent study conducted in DRC, Haiti, Rwanda, and Togo also showed no gender differences in the three African countries, including DRC [13]. 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 to women. This finding corroborates with results generally found in studies on worldwide depression rates [31]. Yet, in rural areas, this relation reverted and men were more numerous than women to be categorized 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 organization 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 [32]. 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 [33]. In addition, different results were observed for psychological distress and posttraumatic stress disorder [34,35]. 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, stigmatization 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 health care 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 is a major public health problem among communities affected by EVD where more than three adults out of five were categorized 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. Stigmatization related to EVD among communities, mainly among less geographically accessible ones, is often related to lack of information as prior studies showed [27,36]. Moreover, certain communities sustain misconceptions on EVD and attribute it to witchcraft [31]. 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 [37]. 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 [38]. Transcultural adaptations of the WHO Mental Health Gap Action Program (mhGAP) 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 wellbeing of individuals and of their families, but also on the productivity of the affected countries [39]. 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 and colleagues highlight, to be efficient, first aid must be inserted in larger programs that involve regular supervision of practicing educators and of community leaders by psychologists or other mental health professionals [40]. 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 [41]. Although the findings highlighted exposure to EVD, stigmatization 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 which consider the capacities of the communities as well as their culture in order 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 to be based on a community approach which takes into account differences between cultures and local differences. It is by putting in place these global mental health programs which rely on community strengths that we will be able to help local populations to develop and to prevent epidemics, and to be equipped to face them when they arise.

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Data availability: Data are available on request from the first author. The data are not publicly available due to ethical restrictions.

Contributors

Jude Mary Cénat: Conceptualization, Investigation, Methodology, Software, Formal analysis, Writing - original draft. **Pari-Gole Noorishad**: Writing - original draft. **Rose Darly Dalexis**: Writing – original draft, Methodology, Data curation, Writing - review & editing. **Cécile Rousseau**: Methodology, Data curation, Review & editing, Validation, Visualization. **Daniel Derivois**: Review & editing, Validation, Visualization, Supervision. **Cyrille Kossigan Kokou-Kpolou**: Conceptualization and Writing. **Jacqueline Bukaka**: Conceptualization, Investigation, Methodology, Data curation. **Oléa Balayulu-Makila**: Research coordination, Investigation, Methodology, Data curation. **Mireille Guerrier**: Methodology, Software, Formal analysis, Writing - original draft.

References

1 Lowther K, Selman L, Harding R, *et al.* Experience of persistent psychological symptoms and perceived stigma among people with HIV on antiretroviral therapy (ART): A systematic review. Int. J. Nurs. Stud. 2014;**51**:1171–89. doi:10.1016/j.ijnurstu.2014.01.015

2 Cénat JM, Felix N, Blais-Rochette C, *et al.* Prevalence of mental health problems in populations affected by Ebola virus disease: A systematic review and meta-analysis. *Psychiatry Res* 2020;**289**:113033. doi:10.1016/j.psychres.2020.113033

3 Pappa S, Ntella V, Giannakas T, *et al.* Prevalence of depression, anxiety, and insomnia among healthcare workers during the COVID-19 pandemic: A systematic review and meta-analysis. *Brain Behav Immun* Published Online First: 8 May 2020. doi:10.1016/j.bbi.2020.05.026

4 Wilson HW, Amo-Addae M, Kenu E, *et al.* Post-Ebola Syndrome among Ebola Virus Disease Survivors in Montserrado County, Liberia 2016. *Biomed Res Int* 2018;**2018**:1–8. doi:10.1155/2018/1909410

5 Etard J-F, Sow MS, Leroy S, *et al.* Multidisciplinary assessment of post-Ebola

sequelae in Guinea (Postebogui): an observational cohort study. *Lancet Infect Dis* 2017;**17**:545–52. doi:10.1016/S1473-3099(16)30516-3

6 Rueda S, Mitra S, Chen S, *et al.* Examining the associations between HIV-related stigma and health outcomes in people living with HIV/AIDS: a series of meta-analyses. *BMJ Open* 2016;**6**:e011453. doi:10.1136/bmjopen-2016-011453

7 James PB, Wardle J, Steel A, *et al.* Post-Ebola psychosocial experiences and coping mechanisms among Ebola survivors: a systematic review. *Trop Med Int Heal* 2019;**24**:671–91. doi:10.1111/tmi.13226

8 John Hopkins University. Coronavirus COVID-19 (2019-nCoV). John Hopkins Univ. 2021.https://gisanddata.maps.arcgis.com/apps/opsdashboard/index.html#/bda7594740fd40299423467b48e9ecf6 (accessed 22 Mar 2021).

9 Nanivazo M. UNU-WIDER : Blog : Multidimensional Poverty in the Democratic Republic of Congo. 2014.https://www.wider.unu.edu/publication/multidimensional-poverty-democratic-republic-congo (accessed 5 Oct 2021).

10 Mahrt K, Nanivazo M. Growth and Poverty in the Democratic Republic of Congo. *Growth and Poverty in Sub-Saharan Africa* 2016;:421–46. doi:10.1093/ACPROF:OSO/9780198744795.003.0018

11 Cénat JM, Derivois D. Assessment of prevalence and determinants of posttraumatic stress disorder and depression symptoms in adults survivors of earthquake in Haiti after 30 months. *J Affect Disord* 2014;**159**:111–7. doi:10.1016/j.jad.2014.02.025

12 Cénat JM, Dalexis RD, Guerrier M, *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* 2021;**132**:13–7. doi:10.1016/j.jpsychires.2020.09.031

13 Cénat JM, Noorishad PG, Kokou-Kpolou CK, *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. *Psychiatry Res* 2021;**297**:113714. doi:10.1016/j.psychres.2021.113714

14 Bardosh K, Gercama I, Bedford J. Social Science and Behavioural Data Compilation, DRC Ebola Outbreak, June 2019-August 2019. 2019.

15 Beck AT, Steer RA. *Manual for the beck depression inventory*. San Antonio, TX: : The Psychological Corporation 1993.

16 Furlanetto LM, Mendlowicz M V., Romildo Bueno J. The validity of the Beck Depression Inventory-Short Form as a screening and diagnostic instrument for moderate and severe depression in medical inpatients. *J Affect Disord* Published Online First: 2005. doi:10.1016/j.jad.2004.12.011

17 Al-Yasiri A-R, Abdkarkosh YS. The Validity of Beck Depression Inventory-Short Version in Depressed Patients Diagnosed According to ICD10. 2013.

18 Jin X, Doukas A, Beiting M, *et al.* Factors Contributing to Intimate Partner Violence among Men in Kerala, India. *J Fam Violence* 2014;**29**:643–52. doi:10.1007/s10896-014-9623-4

19 Keita MM, Doukouré M, Chantereau I, *et al.* Les survivants de l'épidémie récente de la maladie à virus Ebola au service de psychiatrie de l'hôpital national Donka en Guinée-Conakry : étude psychopathologique et psychothérapeutique. *L'Évolution Psychiatr* 2017;**82**:127–42. doi:10.1016/J.EVOPSY.2016.07.004

20 Ousman K, Kabego L, Talisuna A, *et al.* The impact of Infection Prevention and control (IPC) bundle implementationon IPC compliance during the Ebola virus outbreak in Mbandaka/Democratic Republic of the Congo: a before and after design. *BMJ Open* 2019;**9**:29717. doi:10.1136/bmjopen-2019-029717

21 Jalloh MF, Robinson SJ, Corker J, *et al.* Knowledge, Attitudes, and Practices Related to Ebola Virus Disease at the End of a National Epidemic — Guinea, August 2015. *Morb Mortal Wkly Rep* 2017;**66**:1109–15. doi:10.15585/mmwr.mm6641a4

22 Keita MM, Doukouré M, Chantereau I, *et al.* Survivors of epidemic recent disease Ebola virus in psychiatric hospital service national Donka in Guinea: Psychopathological and psychotherapeutic study. *Evol Psychiatr* 2017;**82**:127–42. doi:10.1016/j.evopsy.2016.07.004

23 Cénat JM, Balayulu-Makila O, Derivois D, *et al.* The mental health professional at the feet of the Ebola virus: individual treatment and global mental challenges. *Br J Psychiatry* 2019;:1–2. doi:10.1192/bjp.2019.122

24 Kamara S, Walder A, Duncan J, *et al.* Mental health care during the Ebola virus disease outbreak in Sierra Leone. *Bull World Health Organ* 2017;**95**:842–7. doi:10.2471/blt.16.190470

25 Mohammed A, Sheikh TL, Gidado S, *et al.* An evaluation of psychological distress and social support of survivors and contacts of Ebola virus disease infection and their relatives in Lagos, Nigeria: a cross sectional study − 2014. *BMC Public Health* 2015;**15**:824. doi:10.1186/s12889-015-2167-6

26 Keita MM, Taverne B, Sy Savané S, *et al.* Depressive symptoms among survivors of Ebola virus disease in Conakry (Guinea): preliminary results of the PostEboGui cohort. *BMC Psychiatry* 2017;**17**:127. doi:10.1186/s12888-017-1280-8

27 Denis-Ramirez E, Sørensen KH, Skovdal M. In the midst of a 'perfect storm': Unpacking the causes and consequences of Ebola-related stigma for children orphaned by Ebola in Sierra Leone. *Child Youth Serv Rev* 2017;**73**:445–53. doi:10.1016/J.CHILDYOUTH.2016.11.025

28 Bakare WA, Ilesanmi OS, Nabena EP, *et al.* Psychosocial stressors and support needs of survivors of Ebola virus disease, Bombali District, Sierra Leone, 2015. *Healthc Low-resource Settings* 2016;**3**. doi:10.4081/hls.2015.5411

29 Kessler RC, Sampson NA, Berglund P, *et al.* Anxious and non-anxious major depressive disorder in the World Health Organization World Mental Health Surveys. *Epidemiol Psychiatr Sci* 2015;**24**:210–26. doi:10.1017/S2045796015000189

30 Cénat JM, McIntee SE, Guerrier M, *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. *Soc Psychiatry Psychiatr Epidemiol* 2021;**56**:57–62. doi:10.1007/s00127-020-01904-x

31 Adongo PB, Tabong PT-N, Asampong E, *et al.* Beyond Knowledge and Awareness: Addressing Misconceptions in Ghana's Preparation towards an Outbreak of Ebola Virus Disease. *PLoS One* 2016;**11**. doi:10.1371/journal.pone.0149627

32 Béné C, Merten S. Women and Fish-for-Sex: Transactional Sex, HIV/AIDS and Gender in African Fisheries. *World Dev* 2008;**36**:875–99. doi:10.1016/J.WORLDDEV.2007.05.010

33 Kaputu-Kalala-Malu C, Musalu EM, Walker T, *et al.* PTSD, depression and anxiety in Ebola virus disease survivors in Beni town, Democratic Republic of the Congo. *BMC Psychiatry 2021 211* 2021;**21**:1–8. doi:10.1186/S12888-021-03343-7

34 Cénat JM, Kokou-Kpolou CK, Mukunzi JN, *et al.* Ebola virus disease, stigmatization, peritraumatic distress, and posttraumatic stress disorder in the Democratic Republic of the Congo: A moderated mediation model. *J Affect Disord* 2021;**293**:214–21. doi:10.1016/j.jad.2021.06.047

35 Cénat JM, McIntee SE, Guerrier M, *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. *Soc Psychiatry Psychiatr Epidemiol* 2020;:1–

6. doi:10.1007/s00127-020-01904-x

36 Cénat JM, Rousseau C, Dalexis RD, *et al.* 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. *Public Heal Pract* 2021;**2**:100178. doi:10.1016/J.PUHIP.2021.100178

37 Cénat JM, Mukunzi JN, Noorishad P-G, *et al.* A systematic review of mental health programs among populations affected by the Ebola virus disease. *J Psychosom Res* 2020;**131**:109966. doi:10.1016/j.jpsychores.2020.109966

38 Alcayna-Stevens L. Planning for Post-Ebola: Lessons learned from DR Congo's 9th epidemic. New York: 2018.

39 Lerner D, Adler DA, Chang H, *et al.* Unemployment, job retention, and productivity loss among employees with depression. *Psychiatr Serv* 2004;**55**:1371–8. doi:10.1176/appi.ps.55.12.1371

40 Horn R, O'May F, Esliker R, *et al.* The myth of the 1-day training: the effectiveness of psychosocial support capacity-building during the Ebola outbreak in West Africa – ADDENDUM. *Glob Ment Heal* 2019;**6**. doi:10.1017/gmh.2019.10

41 Cénat JM, Blais-Rochette C, Kokou-Kpolou CK, *et al.* Prevalence of Symptoms of Depression, Anxiety, Insomnia, Posttraumatic Stress Disorder, and Psychological Distress among Populations Affected by the COVID-19 Pandemic: A Systematic Review and Meta-Analysis. *Psychiatry Res* 2021;**295**:113599. doi:https://doi.org/10.1016/j.psychres.2020.113599

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

	Total N (%; CI)	Men N (%; CI)	Women N (%; CI)	x^2; *p*
Total	1614 (100.0; 100-100)	807 (50.0; 46.6-53.5)	807 (50.; 46.6-53.5)	
Residence area				.0, 1.00
Rural	906 (56.1; 52.9-59.4)	453 (50.0; 45.8-54.2)	453 (50.0; 45.8-54.2)	
Urban	708 (43.8; 40.2-47.5)	354 (50.0; 44.8-55.2)	354 (50.0; 44.8-55.2)	
Employment				1.4, .26
Yes	897 (57.65; 54.42-60.88)	457 (50.95; 46.37-55.53)	440 (49.05; 44.38-53.72)	
No	659 (42.35; 38.58-46.12)	316 (47.95; 42.44-53.46)	343 (52.05; 46.76-57.34)	
Education level				18.4, .001
None	62 (3.9; -.91-8.8)	29 (46.8; 28.6-64.9)	33 (53.2; 36.2-70.3)	
Primary school	172 (10.9; 6.2-15.6)	69 (40.1; 28.6-51.7)	103 (59.9; 50.4-69.4)	
High school	898 (56.9; 53.6-60.1)	437 (48.7; 44.0-53.4)	461 (51.3; 46.8-55.9)	
Professional	54 (3.4; -1.4-8.3)	27 (50.0; 31.1-68.9)	27 (50.0; 31.1-68.9)	
University	393 (24.9; 20.6-29.2)	229 (58.3; 51.9-64.7)	164 (41.7; 34.2-49.3)	
Age				3.5, .62
18-24 years	387 (26.2; 21.8-30.6)	183 (47.3; 40.1-54.5)	204 (52.7; 45.9-59.6)	
25-34 years	485 (32.8; 28.7-37.0)	254 (52.4; 46.2-58.5)	231 (47.6; 41.2-54.1)	
35-44 years	303 (20.5; 16.0-25.1)	151 (49.8; 41.9-57.8)	152 (50.2; 42.2-58.1)	
45-54 years	174 (11.8; 7.0-16.6)	95 (54.6; 44.6-64.6)	79 (45.4; 34.4-56.4)	
55-64 years	102 (6.9; 2.0-11.8)	51 (50.0; 36.3-63.7)	51 (50.0; 36.3-63.7)	
65 and more	26 (1.8; -3.3-6.8)	13 (50.0; 22.8-77.2)	13 (50.0; 22.8-77.2)	
Religion				7.2, .21
Catholic	714 (44.6; 40.9-48.2)	341 (47.8; 42.5-53.1)	373 (52.2; 47.2-57.3)	
Protestant	401 (25.0; 20.8-29.3)	205 (51.1; 44.3-58.0)	196 (48.9; 41.9-55.9)	
Animist	30 (1.9; -3.0-6.7)	11 (36.7; 8.2-65.2)	19 (63.3; 41.7-85.0)	
Kimbanguist	73 (4.6; -.2-9.4)	35 (48.0; 31.4-64.5)	38 (52.1; 36.2-67.9)	
Muslim	52 (3.2; -1.6-8.1)	30 (57.7; 40.0-75.4)	22 (42.3; 21.7-63.0)	
Other	332 (20.7; 16.4-25.1)	179 (53.9; 46.6-61.2)	153 (46.1; 38.2-54.0)	
Marital status				14.1, .01
Single	573 (36.4; 32.5-40.3)	292 (51.0; 45.2-56.7)	281 (49.0; 43.2-54.9)	
Married	745 (47.3; 43.7-50.9)	377 (50.6; 45.6-55.7)	368 (49.4; 44.3-54.5)	
Divorced	62 (4.0; -.9-8.8)	23 (37.1; 17.4-56.8)	39 (62.9; 47.7-78.1)	
Separated	33 (2.1; -2.8-8.0)	18 (54.6; 31.6-77.6)	15 (45.5; 20.3-70.7)	
Widowed	42 (2.7; -2.2-7.6)	11 (26.2; -.2-52.2)	31 (73.8; 58.3-89.3)	
In a relationship	119 (7.6; 2.8-12.3)	59 (49.6; 36.8-62.3)	60 (50.4; 37.8-63.1)	

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

	Depression Symptoms				
	Total % (CI)	x^2 (df), p	Men % (CI)	Women % (CI)	x^2 (df), p
Total	62.0 (59.7-64.4)		62.2 (59.9-64.6)	61.8 (59.46-64.20)	.0, .87
Score of exposure to EVD		233.9, <.0001			
1 to 4	43.3 (40.9-45.7)		41.8 (39.4-44.2)	44.7 (42.26-47.11)	.7, .41
5 to 8	75.4 (73.3-77.5)		72.2 (70.0-74.4)	78.6 (76.56-80.57)	1.7, .20
9 and more	82.7 (80.8-84.5)		84.4 (82.6-86.1)	80.8 (78.63-82.50)	1.2, .28
Stigmatization due to EVD		254.0, <.0001			
0 to 21	43.4 (40.9-55.8)		40.7 (38.3-43.1)	46.0 (43.52-48.38)	2.2, 14
22 to 39	74.9 (72.8-77.1)		77.7 (75.6-79.7)	72.1 (69.89-74.27)	1.7, .20
40 and up	87.1 (85.4-88.7)		90.6 (89.2-92.1)	83.7 (81.94-85-54)	4.1, .04
Residence area		174.2 <.0001			
Rural	76.1 (74.1-78.2)		79.7 (77.7-81.6)	72.6 (70.45-74.81)	6.1, .01
Urban	44.0 (41.6-46.4)		39.9 (37.6-42.3)	48.0 (45.58-50.46)	4.7, .03
Employment		17.1, <.0001			
Yes	55.6 (53.1-58.0)		53.2 (50.8-55.6)	57.7 (55.32-60.14)	1.2, .24
No	65.9 (63.6-68.2)		67.2 (64.9-69.5)	64.6 (62.22-66.88)	.7, .41
Education level		21.4, <.0001			
None	72.6 (70.4-74.8)		75.8 (73.7-77.9)	69.0 (66.71-71.23)	.4, .55
Primary school	65.1 (62.8-67.5)		61.2 (58.8-63.6)	71.0 (68.80-73.22)	1.8, .18
High school	65.2 (62.9-67.5)		64.2 (61.9-66.6)	66.3 (63.97-68.59)	.4, .51
Professional	50.0 (47.7-52.4)		55.6 (53.1-58.0)	44.4 (42.02-46.86)	.7, .41
University	54.1 (51.7-56.5)		54.3 (51.8-56.7)	54.0 (51.52-56.38)	.0, 1.00
Age		16.8, .005			
18-24 years	57.8 (55.1-60.2)		61.5 (59.2-63-9)	54.4 (51.98-56.84)	2.0, .95
25-34 years	57.4 (55.0-59.9)		57.3 (54.9-59.7)	57.6 (55.17-59.99)	.0, 1.00
35-44 years	66.0 (63.7-68.3)		66.9 (64.6-69.2)	65.1 (62.81-67.45)	.1, .75
45-54 years	70.1 (67.8-72.3)		67.4 (65.1-69.7)	73.4 (71.26-75.58)	.8, .39
55-64 years	64.7(62.4-67.0)		68.6 (66.4-70.9)	60.9 (58.40-63.16)	.7, .41
65 and more	76.9 (74.9-78.1)		69.2 (67.0-71.5)	84.6 (82.86-86.38)	.9, .35
Religion		28.2, <.0001			
Catholic	68.1 (65.9-70.4)		70.5 (68.3-72.7)	66.0 (63.64-68.26)	1.7, .20
Protestant	59.6 (57.2-62.0)		60.5 (58.1-62.9)	58.7 (56.27-61.07)	.1, .71
Animist	73.3 (71.2-75.5)		81.8 (79.9-83.7)	68.4 (66.15-70.69)	.6, .42
Kimbanguist	63.0 (60.7-65.4)		57.1 (54.7-59.6)	68.4 (66.15-70.69)	.1, .32
Muslim	57.7 (55.3-60.1)		53.3 (50.9-55.8)	63.6 (61.29-65.99)	.6, .46
Other	52.1 (49.7-54.6)		50.3 (47.8-52.7)	54.3 (51.86-56.72)	.5, .50
Marital status		22.0, .001			
Single	56.9 (54.5-59.3)		57.2 (54.8-59.7)	56.6 (54.16-59.00)	.0, .87
Married	63.8 (61.4-66.1)		66.8 (64.5-69.1)	60.6 (58.22-62.98)	3.1, .08
Divorced	64.5 (62.2-66.9)		52.2 (49.7-54.6)	71.8 (69.59-73.99)	2.4, .12
Separated	57.6 (55.2-60.0)		66.7 (64.4-69.0)	46.7 (44.24-49.10)	1.3, .25
Widowed	73.8 (71.7-76.0)		63.6 (61.3-66.0)	77.4 (75.38-79.46)	.9, .37
In a relationship	77.3 (75.3-79.4)		72.9 (70.7-75.0)	81.7 (79.77-83.55)	1.3, .25

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

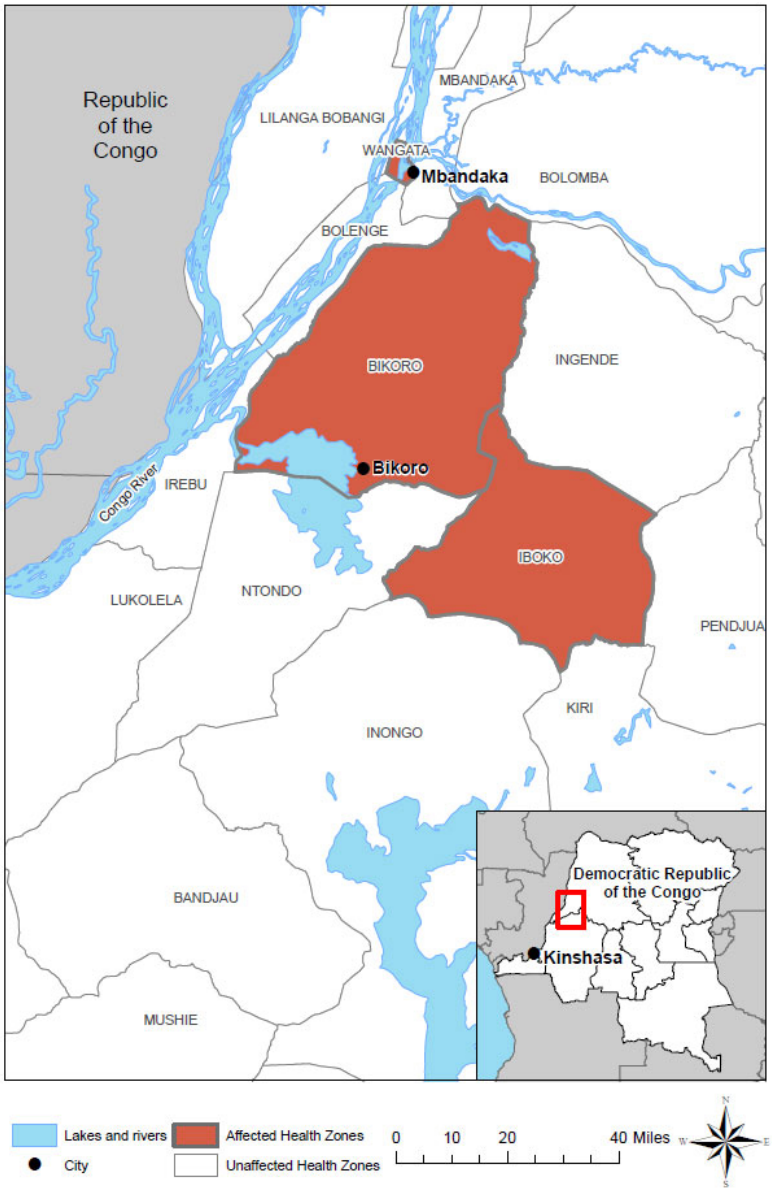
Depression Symptoms

	$R^2 = .31$; x^2 (8) = 7.41, $p < .001$				
Variables	β	SE	OR	95% CI	
Score of exposure to EVD					
1 to 4 (Reference criterion)					
5 to 8	.66**	.24	1.94	1.22	3.09
9 and more	.85**	.32	2.34	1.26	4.34
Stigmatization related to EVD					
0 to 21 (Reference criterion)					
22 to 39	.88***	.23	2.42	1.53	3.83
40 and up	1.55***	.36	4.73	2.34	9.56
Gender	.59**	.34	1.80	.94	3.48
Residence area	-1.68***	.37	.19	.09	.38
Employment	-.38**	.16	.68	.50	.93
Education level					
None (Reference criterion)					
Primary school	-.32	.40	.73	.34	1.59
High school	.09	.36	1.09	.54	2.21
Professional	-1.01*	.49	.36	.14	.96
University	.02	.38	1.02	.48	2.13
Age	.01	.01	1.01	1.00	1.02
Religion					
Catholic (Reference criterion)					
Protestant	-.19	.16	.83	.61	1.14
Animist	.20	.57	1.22	.40	3.71
Kimbanguist	.19	.33	1.21	.63	2.31
Muslim	-.20	.38	.82	.39	1.71
Other	.07	.19	1.07	.74	1.54
Marital status					
Single (Reference criterion)					
Married	.23	.16	1.26	.92	1.72
Divorced	.07	.36	1.08	.54	2.16
Separated	-.08	.47	.92	.37	2.30
Widowed	.30	.44	1.35	.57	3.19
In a relationship	1.18***	.29	3.25	1.84	5.76
Residence area X Exposure to EVD	.12	.18	1.13	.78	1.62
Residence area X Stigmatization related to EVD	.35	.22	1.42	.93	2.16
Gender X Exposure to EVD	-.06	.18	.95	.67	1.34
Gender X Stigmatization related to EVD	-.35	.20	.70	.47	1.05

Note. *: $p < .05$; **: $p < .01$; ***: $p < .001$. In the table we reported the Nagelkerke R^2. Cox & Snell $R^2 = .22$.

Figure 1. Map of Ebola-Affected Health Zones in 2018 Equateur Province Outbreak in the Democratic Republic of the Congo (DRC)

Source : Centers for Disease Control and Prevention (CDC): https://www.cdc.gov/vhf/ebola/outbreaks/drc/2018-may.html



Map of Ebola-Affected Health Zones in 2018 Equateur Province Outbreak in the Democratic Republic of the Congo (DRC)

210x325mm (72 x 72 DPI)

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Page number	Recommendation
Title and abstract	1	2, line 12	(*a*) Indicate the study's design with a commonly used term in the title or the abstract
		3	(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found
Introduction			
Background/rationale	2	5, lines 12-56 and 6, lines 3-23	Explain the scientific background and rationale for the investigation being reported
Objectives	3	6, lines 25-36	State specific objectives, including any prespecified hypotheses
Methods			
Study design	4	7-10	Present key elements of study design early in the paper
Setting	5	7, lines 7-35	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection
Participants	6	7, lines 35-55	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants
Variables	7	8-10	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable
Data sources/ measurement	8*	8, lines 34-54 and 9, lines 3-39	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group
Bias	9	6-7	Describe any efforts to address potential sources of bias
Study size	10	8, lines 14-17	Explain how the study size was arrived at
Quantitative variables	11	9, lines 42-55 and 10, lines 3-7	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why
Statistical methods	12	9, lines 42-55 and 10, lines 3-21	(*a*) Describe all statistical methods, including those used to control for confounding
		10, lines 16-21	(*b*) Describe any methods used to examine subgroups and interactions
		8, lines 14-17	(*c*) Explain how missing data were addressed
		9, lines 45-50	(*d*) If applicable, describe analytical methods taking account of sampling strategy
		9-10	(*e*) Describe any sensitivity analyses
Results			
Participants	13*	8, lines 14-17	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed
		8, lines 14-17	(b) Give reasons for non-participation at each stage
		N. A.	(c) Consider use of a flow diagram
Descriptive data	14*	47	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders

		22-24	(b) Indicate number of participants with missing data for each variable of interest
Outcome data	15*	22-24	Report numbers of outcome events or summary measures
Main results	16	22-24	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included
		22 and 24	(*b*) Report category boundaries when continuous variables were categorized
		N. A.	(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses	17	9-10 and 22-24	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses
Discussion			
Key results	18	12-, lines 5-23	Summarise key results with reference to study objectives
Limitations	19	14, lines 28-56	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias
Interpretation	20	12-14	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence
Generalisability	21	16, lines 8-32	Discuss the generalisability (external validity) of the study results
Other information			
Funding	22	17, lines 37-55	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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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Running head: EBOLA VIRUS DISEASE AND SYMPTOMS OF DEPRESSION

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 11th to April 23rd, 2019) after the end of the 9th outbreak of EVD in the Province of Equateur in the Democratic Republic of the Congo (DRC).

Participants. A large population-based sample of 1,614 adults (50% women, M_{age} = 34.05; *SD* = 12.55) in health zones affected by the 9th outbreak in DRC.

Primary and secondary outcome measures. Participants completed questionnaires assessing EVD exposure level, stigmatization related to EVD, and depressive symptoms. The odd ratios associated with sociodemographic data, EVD exposure level, and stigmatization were analyzed through logistic regressions.

Results. Overall, 62.03% (95%CI: 59.66-64.40) of individuals living in areas affected by EVD were categorized 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: 1.22-3.09); OR = 2.34 (95%CI: 1.26-4.34)]. Individuals in the two higher categories of stigmatization were two to four times more at risk [respectively, OR = 2.42 (95%CI: 1.53-3.83); OR = 4.73 (95%CI: 2.34-9.56)]. Living in rural areas [OR = .19 (95%CI: 0.09-.38)] and being unemployed [OR = .68 (95%CI: .50-.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 which must be addressed through culturally adapted mental health programs.

Keywords. Infectious disease; Ebola virus disease; Depression; Exposure to EVD; Stigmatization related to EVD; EVD outbreak.

Strengths and limitations

- 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 DRC.
- 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.

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

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 Coronavirus disease 2019 (COVID-19), respectively, were categorized 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 categorized 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 stigmatization 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, stigmatization 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 to evaluate the degree to which depressive symptoms constitute a public health problem which should be prioritize 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 (RDC) 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.

Analyzing data collected among a two-stage stratified sample of rural and urban populations affected by the EVD epidemic of 2018 in the province of Équateur 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 stigmatization related to EVD. Second, this study aims to document the association between exposure to EVD, stigmatization 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 enrollment 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 9th 2018 outbreak of EVD (March 11th to April 23rd, 2019). Data on mental health problems including depression was 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 was collected during door-to-door surveys in the three "health zones" (Bikoro, Iboko, and Wangata) affected by the 9th 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; (4) have no mental health disorder that interferes with functioning t. 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 dialects and in French. Back-translation methods were used. Translation was done by a team of seven Congolese professors from DRC universities. The ethics committees of the University of Ottawa and the Institut National pour la Recherche Biomedicale (National Institute for Biomedical Research) of DRC approved the study protocol. The University of Kinshasa also approved the study protocol.

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 18–85. 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 (x^2 = 18.4, $df = 1$, $p < .001$).

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 Ebola virus disease

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 (e.g., "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 .92.

Stigmatization related to EVD

We used a 20-item scale that measures 20 possible forms of stigmatization related to EVD, based on the WHO reports and the Social science and behavioral 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) (e.g., "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 .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 (e.g., "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 if it; (3) I'm so sad and unhappy I can't support it"). Total scores range from 0 to 39. In the present 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 .87 in our sample.

Statistical analysis

Using SPSS – version 26, frequencies were calculated to describe sociodemographic characteristics of the sample, including age, residence are (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 stigmatization related to EVD, scores were classified in 3 categories with respective

values below the 50th percentile; between 50th to 75th, and values beyond the 75th percentile. Prevalence of severe depression symptoms was computed for gender, exposure level to EVD, stigmatization related to EVD, and sociodemographic characteristics of the sample (age, residence area, education level, employment, religion and marital status). Bivariate comparisons were performed using Chi-Square tests with 95% Confidence Intervals 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 stigmatization 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 stigmatization 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, 64.4) were categorized as having severe depression symptoms. Bivariate analyses showed that greater scores of exposure level to EVD and stigmatization related to EVD were associated with a higher prevalence of depression symptoms (respectively, $x^2 = 233.9$, $p < .0001$; 254.0, $p < .0001$). Results revealed that participants living in rural areas were more likely to be categorized as having severe depressive symptoms than those living in urban areas [respectively, 76.1% (95% CI: 74.1-78.2); and 44.0% 95% CI: 41.6-46.4), $x^2 = 174.2$, $p < .0001$]. 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: 45.6-50.5) and 39.9% (95% CI: 37.6-42.3), $x^2 = 4.7$, $p = .03$]. However, in rural areas, men [79.7% (95% CI: 77.7-81.6)] were more likely to be categorized as having severe depressive symptoms than women [95% CI: 72.6% (70.5-74.8)], $x^2 = 6.1$, $p = .01$].

The three categories of exposure level to EVD contained participants who scored 0 to 4 which is below the 50th percentile (790 participants, 49.04%), between the 50th to 75th percentile, scores of 5 to 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 categorized with higher prevalence of severe depression symptoms comparatively to those with lower scores [respectively, 43.3% (95% CI: 40.9-45.7); 75.4% (95% CI: 73.3-77.5), 82.7% (95% CI: (80.8-84.5), $x^2 = 233.9$, $p < .0001$]. For stigmatisation related to EVD, the three categories contained participants who scored 0 to 21 (813 participants, 50.43%), 22 to 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 stigmatization related to EVD were more likely to be categorized with severe depression symptoms [respectively, 43.4% (95% CI: 40.9-55.8); 74.9% (95% CI: 72.8-77.1), 87.1% (95% CI: (85.4-88.7), $x^2 = 254.0$, $p < .0001$] and at higher risk than women (90.6%, 95% CI: 89.2-92.1 vs 83.7%, 95% CI: 81.9-8.5, $x^2 = 4.1$, $p = .04$). 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 = .19 (95% CI: 0.09, .38)] and being unemployed [OR = .68 (95% CI: .50, .93)] increased the likelihood of having symptoms of depression. Compared to participants with no education, those who achieved professional training were more particularly at risk [OR = .36 (95% CI: .14, .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 two-fold higher among those who reported a score from 5 to 8 [OR = 1.94 (95% CI: 1.22, 3.09)] and a score of more than 8 [OR = 2.34 (95% CI: 1.26, 4.34)], respectively. Furthermore, these odds were two to four times higher among participants who reported a score of stigmatization 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, 3.83), and OR = 4.73 (95% CI: 2.34, 9.56)], respectively. Participants in unmarried relationships, compared to single people, were 3.3 times more likely to have depressive symptoms [OR = 3.25 (95% CI: 1.84, 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 stigmatization 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 ($x^2 = 7.41$, $p = .49$).

DISCUSSION

The present 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 which require immediate attention. However, the prevalence of depression symptoms in the present 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 categorized 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, rumors, 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 stigmatization related to EVD. In fact, people with a higher exposure to EVD had over two-fold higher risk to be categorized 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 hemorrhage, diarrhea, weakness, muscle, abdominal, and stomach pain), 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]. Stigmatization also constitutes a major risk factor. In fact, those who experienced the higher category of score of stigmatization related to EVD were nearly 5 times more at risk to be categorized as having severe depressive symptoms. Past studies have already shown that stigmatization constitutes a major risk factor for the development of mental health problems among survivors of the 2014-2016 epidemic, in Guinee, in Sierra Leone, and in Nigeria [27–29]. A recent study conducted in DRC, Togo, Rwanda and Haiti also showed the major role of stigmatization 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 stigmatization related to EVD in the development of depression among a representative sample. The results also showed that unemployment can impact 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 Ebola virus disease 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 to 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 categorized 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 organization 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 posttraumatic 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, stigmatization 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 health care 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 is a major public health problem among communities affected by EVD where more than three adults out of five were categorized 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. Stigmatization 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]. Transcultural adaptations of the WHO Mental Health Gap Action Program (mhGAP) 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 wellbeing 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 and colleagues highlight, to be efficient, first aid must be inserted

in larger programs that involve regular supervision of practicing 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, stigmatization 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 which consider the capacities of the communities as well as their culture in order 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 to be based on a community approach which takes into account differences between cultures and local differences. It is by putting in place these global mental health programs which rely on community strengths that we will be able to help local populations to develop and to prevent epidemics, and to be equipped to face them when they arise.

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Data availability: Data are available on request from the first author. The data are not publicly available due to ethical restrictions.
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References

1 Lowther K, Selman L, Harding R, *et al.* Experience of persistent psychological symptoms and perceived stigma among people with HIV on antiretroviral therapy (ART): A systematic review. Int. J. Nurs. Stud. 2014;**51**:1171–89. doi:10.1016/j.ijnurstu.2014.01.015

2 Cénat JM, Felix N, Blais-Rochette C, *et al.* Prevalence of mental health problems in populations affected by Ebola virus disease: A systematic review and meta-analysis. *Psychiatry Res* 2020;**289**:113033. doi:10.1016/j.psychres.2020.113033

3 Pappa S, Ntella V, Giannakas T, *et al.* Prevalence of depression, anxiety, and insomnia among healthcare workers during the COVID-19 pandemic: A systematic review and meta-analysis. *Brain Behav Immun* Published Online First: 8 May 2020. doi:10.1016/j.bbi.2020.05.026

4 Wilson HW, Amo-Addae M, Kenu E, *et al.* Post-Ebola Syndrome among Ebola Virus Disease Survivors in Montserrado County, Liberia 2016. *Biomed Res Int*

2018;**2018**:1–8. doi:10.1155/2018/1909410

5 Etard J-F, Sow MS, Leroy S, *et al.* Multidisciplinary assessment of post-Ebola sequelae in Guinea (Postebogui): an observational cohort study. *Lancet Infect Dis* 2017;**17**:545–52. doi:10.1016/S1473-3099(16)30516-3

6 Rueda S, Mitra S, Chen S, *et al.* Examining the associations between HIV-related stigma and health outcomes in people living with HIV/AIDS: a series of meta-analyses. *BMJ Open* 2016;**6**:e011453. doi:10.1136/bmjopen-2016-011453

7 James PB, Wardle J, Steel A, *et al.* Post-Ebola psychosocial experiences and coping mechanisms among Ebola survivors: a systematic review. *Trop Med Int Heal* 2019;**24**:671–91. doi:10.1111/tmi.13226

8 John Hopkins University. Coronavirus COVID-19 (2019-nCoV). John Hopkins Univ. 2021.https://gisanddata.maps.arcgis.com/apps/opsdashboard/index.html#/bda7594740fd40299423467b48e9ecf6 (accessed 22 Mar 2021).

9 Nanivazo M. UNU-WIDER : Blog : Multidimensional Poverty in the Democratic Republic of Congo. 2014.https://www.wider.unu.edu/publication/multidimensional-poverty-democratic-republic-congo (accessed 5 Oct 2021).

10 Mahrt K, Nanivazo M. Growth and Poverty in the Democratic Republic of Congo. *Growth and Poverty in Sub-Saharan Africa* 2016;:421–46. doi:10.1093/ACPROF:OSO/9780198744795.003.0018

11 Ministère du Plan et Suivi de la Mise en œuvre de la Révolution de la Modernité (MPSMRM), Ministère de la Santé Publique (MSP), ICF InternationaL. Enquête Démographique et de Santé en République Démocratique du Congo 2013-2014. Rockville, Maryland: 2014. www.DHSprogram.com. (accessed 20 Nov 2021).

12 Cénat JM, Derivois D. Assessment of prevalence and determinants of posttraumatic stress disorder and depression symptoms in adults survivors of earthquake in Haiti after 30 months. *J Affect Disord* 2014;**159**:111–7. doi:10.1016/j.jad.2014.02.025

13 Cénat JM, Dalexis RD, Guerrier M, *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* 2021;**132**:13–7. doi:10.1016/j.jpsychires.2020.09.031

14 Cénat JM, Noorishad PG, Kokou-Kpolou CK, *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. *Psychiatry Res* 2021;**297**:113714. doi:10.1016/j.psychres.2021.113714

15 Bardosh K, Gercama I, Bedford J. Social Science and Behavioural Data Compilation, DRC Ebola Outbreak, June 2019-August 2019. 2019.

16 Beck AT, Steer RA. *Manual for the beck depression inventory*. San Antonio, TX: : The Psychological Corporation 1993.

17 Furlanetto LM, Mendlowicz M V., Romildo Bueno J. The validity of the Beck Depression Inventory-Short Form as a screening and diagnostic instrument for moderate and severe depression in medical inpatients. *J Affect Disord* Published Online First: 2005. doi:10.1016/j.jad.2004.12.011

18 Al-Yasiri A-R, Abdkarkosh YS. The Validity of Beck Depression Inventory-Short Version in Depressed Patients Diagnosed According to ICD10. 2013.

19 Jin X, Doukas A, Beiting M, *et al.* Factors Contributing to Intimate Partner Violence among Men in Kerala, India. *J Fam Violence* 2014;**29**:643–52. doi:10.1007/s10896-014-9623-4

20 Keita MM, Doukouré M, Chantereau I, *et al.* Les survivants de l'épidémie récente de la maladie à virus Ebola au service de psychiatrie de l'hôpital national Donka en Guinée-Conakry : étude psychopathologique et psychothérapeutique. *L'Évolution Psychiatr* 2017;**82**:127–42. doi:10.1016/J.EVOPSY.2016.07.004

21 Ousman K, Kabego L, Talisuna A, *et al.* The impact of Infection Prevention and control (IPC) bundle implementationon IPC compliance during the Ebola virus outbreak in Mbandaka/Democratic Republic of the Congo: a before and after design. *BMJ Open* 2019;**9**:29717. doi:10.1136/bmjopen-2019-029717

22 Jalloh MF, Robinson SJ, Corker J, *et al.* Knowledge, Attitudes, and Practices Related to Ebola Virus Disease at the End of a National Epidemic — Guinea, August 2015. *Morb Mortal Wkly Rep* 2017;**66**:1109–15. doi:10.15585/mmwr.mm6641a4

23 Keita MM, Doukouré M, Chantereau I, *et al.* Survivors of epidemic recent disease Ebola virus in psychiatric hospital service national Donka in Guinea: Psychopathological and psychotherapeutic study. *Evol Psychiatr* 2017;**82**:127–42. doi:10.1016/j.evopsy.2016.07.004

24 Cénat JM, Balayulu-Makila O, Derivois D, *et al.* The mental health professional at the feet of the Ebola virus: individual treatment and global mental challenges. *Br J Psychiatry* 2019;:1–2. doi:10.1192/bjp.2019.122

25 Kamara S, Walder A, Duncan J, *et al.* Mental health care during the Ebola virus disease outbreak in Sierra Leone. *Bull World Health Organ* 2017;**95**:842–7. doi:10.2471/blt.16.190470

26 Mohammed A, Sheikh TL, Gidado S, *et al.* An evaluation of psychological distress and social support of survivors and contacts of Ebola virus disease infection and their relatives in Lagos, Nigeria: a cross sectional study − 2014. *BMC Public Health* 2015;**15**:824. doi:10.1186/s12889-015-2167-6

27 Keita MM, Taverne B, Sy Savané S, *et al.* Depressive symptoms among survivors of Ebola virus disease in Conakry (Guinea): preliminary results of the PostEboGui cohort. *BMC Psychiatry* 2017;**17**:127. doi:10.1186/s12888-017-1280-8

28 Denis-Ramirez E, Sørensen KH, Skovdal M. In the midst of a 'perfect storm': Unpacking the causes and consequences of Ebola-related stigma for children orphaned by Ebola in Sierra Leone. *Child Youth Serv Rev* 2017;**73**:445–53. doi:10.1016/J.CHILDYOUTH.2016.11.025

29 Bakare WA, Ilesanmi OS, Nabena EP, *et al.* Psychosocial stressors and support needs of survivors of Ebola virus disease, Bombali District, Sierra Leone, 2015. *Healthc Low-resource Settings* 2016;**3**. doi:10.4081/hls.2015.5411

30 Kessler RC, Sampson NA, Berglund P, *et al.* Anxious and non-anxious major depressive disorder in the World Health Organization World Mental Health Surveys. *Epidemiol Psychiatr Sci* 2015;**24**:210–26. doi:10.1017/S2045796015000189

31 Cénat JM, McIntee SE, Guerrier M, *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. *Soc Psychiatry Psychiatr Epidemiol* 2021;**56**:57–62. doi:10.1007/s00127-020-01904-x

32 Adongo PB, Tabong PT-N, Asampong E, *et al.* Beyond Knowledge and Awareness: Addressing Misconceptions in Ghana's Preparation towards an Outbreak of Ebola Virus Disease. *PLoS One* 2016;**11**. doi:10.1371/journal.pone.0149627

33 Béné C, Merten S. Women and Fish-for-Sex: Transactional Sex, HIV/AIDS and Gender in African Fisheries. *World Dev* 2008;**36**:875–99. doi:10.1016/J.WORLDDEV.2007.05.010

34 Kaputu-Kalala-Malu C, Musalu EM, Walker T, *et al.* PTSD, depression and anxiety in Ebola virus disease survivors in Beni town, Democratic Republic of the Congo. *BMC Psychiatry 2021 211* 2021;**21**:1–8. doi:10.1186/S12888-021-03343-7

35 Cénat JM, Kokou-Kpolou CK, Mukunzi JN, *et al.* Ebola virus disease, stigmatization, peritraumatic distress, and posttraumatic stress disorder in the Democratic Republic of the Congo: A moderated mediation model. *J Affect Disord* 2021;**293**:214–21. doi:10.1016/j.jad.2021.06.047

36 Cénat JM, McIntee SE, Guerrier M, *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. *Soc Psychiatry Psychiatr Epidemiol* 2020;:1–6. doi:10.1007/s00127-020-01904-x

37 Cénat JM, Rousseau C, Dalexis RD, *et al.* 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. *Public Heal Pract* 2021;**2**:100178. doi:10.1016/J.PUHIP.2021.100178

38 Cénat JM, Mukunzi JN, Noorishad P-G, *et al.* A systematic review of mental health programs among populations affected by the Ebola virus disease. *J Psychosom Res* 2020;**131**:109966. doi:10.1016/j.jpsychores.2020.109966

39 Alcayna-Stevens L. Planning for Post-Ebola: Lessons learned from DR Congo's 9th epidemic. New York: 2018.

40 Lerner D, Adler DA, Chang H, *et al.* Unemployment, job retention, and productivity loss among employees with depression. *Psychiatr Serv* 2004;**55**:1371–8. doi:10.1176/appi.ps.55.12.1371

41 Horn R, O'May F, Esliker R, *et al.* The myth of the 1-day training: the effectiveness of psychosocial support capacity-building during the Ebola outbreak in West Africa – ADDENDUM. *Glob Ment Heal* 2019;**6**. doi:10.1017/gmh.2019.10

42 Cénat JM, Blais-Rochette C, Kokou-Kpolou CK, *et al.* Prevalence of Symptoms of Depression, Anxiety, Insomnia, Posttraumatic Stress Disorder, and Psychological Distress among Populations Affected by the COVID-19 Pandemic: A Systematic Review and Meta-Analysis. *Psychiatry Res* 2021;**295**:113599. doi:https://doi.org/10.1016/j.psychres.2020.113599

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

	Total N (%; CI)	Men N (%; CI)	Women N (%; CI)	x^2; *p*
Total	1614 (100.0; 100-100)	807 (50.0; 46.6-53.5)	807 (50.; 46.6-53.5)	
Residence area				.0, 1.00
Rural	906 (56.1; 52.9-59.4)	453 (50.0; 45.8-54.2)	453 (50.0; 45.8-54.2)	
Urban	708 (43.8; 40.2-47.5)	354 (50.0; 44.8-55.2)	354 (50.0; 44.8-55.2)	
Employment				1.4, .26
Yes	897 (57.65; 54.42-60.88)	457 (50.95; 46.37-55.53)	440 (49.05; 44.38-53.72)	
No	659 (42.35; 38.58-46.12)	316 (47.95; 42.44-53.46)	343 (52.05; 46.76-57.34)	
Education level				18.4, .001
None	62 (3.9; -.91-8.8)	29 (46.8; 28.6-64.9)	33 (53.2; 36.2-70.3)	
Primary school	172 (10.9; 6.2-15.6)	69 (40.1; 28.6-51.7)	103 (59.9; 50.4-69.4)	
High school	898 (56.9; 53.6-60.1)	437 (48.7; 44.0-53.4)	461 (51.3; 46.8-55.9)	
Professional	54 (3.4; -1.4-8.3)	27 (50.0; 31.1-68.9)	27 (50.0; 31.1-68.9)	
University	393 (24.9; 20.6-29.2)	229 (58.3; 51.9-64.7)	164 (41.7; 34.2-49.3)	
Age				3.5, .62
18-24 years	387 (26.2; 21.8-30.6)	183 (47.3; 40.1-54.5)	204 (52.7; 45.9-59.6)	
25-34 years	485 (32.8; 28.7-37.0)	254 (52.4; 46.2-58.5)	231 (47.6; 41.2-54.1)	
35-44 years	303 (20.5; 16.0-25.1)	151 (49.8; 41.9-57.8)	152 (50.2; 42.2-58.1)	
45-54 years	174 (11.8; 7.0-16.6)	95 (54.6; 44.6-64.6)	79 (45.4; 34.4-56.4)	
55-64 years	102 (6.9; 2.0-11.8)	51 (50.0; 36.3-63.7)	51 (50.0; 36.3-63.7)	
65 and more	26 (1.8; -3.3-6.8)	13 (50.0; 22.8-77.2)	13 (50.0; 22.8-77.2)	
Religion				7.2, .21
Catholic	714 (44.6; 40.9-48.2)	341 (47.8; 42.5-53.1)	373 (52.2; 47.2-57.3)	
Protestant	401 (25.0; 20.8-29.3)	205 (51.1; 44.3-58.0)	196 (48.9; 41.9-55.9)	
Animist	30 (1.9; -3.0-6.7)	11 (36.7; 8.2-65.2)	19 (63.3; 41.7-85.0)	
Kimbanguist	73 (4.6; -.2-9.4)	35 (48.0; 31.4-64.5)	38 (52.1; 36.2-67.9)	
Muslim	52 (3.2; -1.6-8.1)	30 (57.7; 40.0-75.4)	22 (42.3; 21.7-63.0)	
Other	332 (20.7; 16.4-25.1)	179 (53.9; 46.6-61.2)	153 (46.1; 38.2-54.0)	
Marital status				14.1, .01
Single	573 (36.4; 32.5-40.3)	292 (51.0; 45.2-56.7)	281 (49.0; 43.2-54.9)	
Married	745 (47.3; 43.7-50.9)	377 (50.6; 45.6-55.7)	368 (49.4; 44.3-54.5)	
Divorced	62 (4.0; -.9-8.8)	23 (37.1; 17.4-56.8)	39 (62.9; 47.7-78.1)	
Separated	33 (2.1; -2.8-8.0)	18 (54.6; 31.6-77.6)	15 (45.5; 20.3-70.7)	
Widowed	42 (2.7; -2.2-7.6)	11 (26.2; -.2-52.2)	31 (73.8; 58.3-89.3)	
In a relationship	119 (7.6; 2.8-12.3)	59 (49.6; 36.8-62.3)	60 (50.4; 37.8-63.1)	

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

	Depression Symptoms				
	Total % (CI)	x^2 (df), p	Men % (CI)	Women % (CI)	x^2 (df), p
Total	62.0 (59.7-64.4)		62.2 (59.9-64.6)	61.8 (59.46-64.20)	.0, .87
Score of exposure to EVD		233.9, <.0001			
1 to 4	43.3 (40.9-45.7)		41.8 (39.4-44.2)	44.7 (42.26-47.11)	.7, .41
5 to 8	75.4 (73.3-77.5)		72.2 (70.0-74.4)	78.6 (76.56-80.57)	1.7, .20
9 and more	82.7 (80.8-84.5)		84.4 (82.6-86.1)	80.8 (78.63-82.50)	1.2, .28
Stigmatization due to EVD		254.0, <.0001			
0 to 21	43.4 (40.9-55.8)		40.7 (38.3-43.1)	46.0 (43.52-48.38)	2.2, 14
22 to 39	74.9 (72.8-77.1)		77.7 (75.6-79.7)	72.1 (69.89-74.27)	1.7, .20
40 and up	87.1 (85.4-88.7)		90.6 (89.2-92.1)	83.7 (81.94-85-54)	4.1, .04
Residence area		174.2 <.0001			
Rural	76.1 (74.1-78.2)		79.7 (77.7-81.6)	72.6 (70.45-74.81)	6.1, .01
Urban	44.0 (41.6-46.4)		39.9 (37.6-42.3)	48.0 (45.58-50.46)	4.7, .03
Employment		17.1, <.0001			
Yes	55.6 (53.1-58.0)		53.2 (50.8-55.6)	57.7 (55.32-60.14)	1.2, .24
No	65.9 (63.6-68.2)		67.2 (64.9-69.5)	64.6 (62.22-66.88)	.7, .41
Education level		21.4, <.0001			
None	72.6 (70.4-74.8)		75.8 (73.7-77.9)	69.0 (66.71-71.23)	.4, .55
Primary school	65.1 (62.8-67.5)		61.2 (58.8-63.6)	71.0 (68.80-73.22)	1.8, .18
High school	65.2 (62.9-67.5)		64.2 (61.9-66.6)	66.3 (63.97-68.59)	.4, .51
Professional	50.0 (47.7-52.4)		55.6 (53.1-58.0)	44.4 (42.02-46.86)	.7, .41
University	54.1 (51.7-56.5)		54.3 (51.8-56.7)	54.0 (51.52-56.38)	.0, 1.00
Age		16.8, .005			
18-24 years	57.8 (55.1-60.2)		61.5 (59.2-63-9)	54.4 (51.98-56.84)	2.0, .95
25-34 years	57.4 (55.0-59.9)		57.3 (54.9-59.7)	57.6 (55.17-59.99)	.0, 1.00
35-44 years	66.0 (63.7-68.3)		66.9 (64.6-69.2)	65.1 (62.81-67.45)	.1, .75
45-54 years	70.1 (67.8-72.3)		67.4 (65.1-69.7)	73.4 (71.26-75.58)	.8, .39
55-64 years	64.7(62.4-67.0)		68.6 (66.4-70.9)	60.9 (58.40-63.16)	.7, .41
65 and more	76.9 (74.9-78.1)		69.2 (67.0-71.5)	84.6 (82.86-86.38)	.9, .35
Religion		28.2, <.0001			
Catholic	68.1 (65.9-70.4)		70.5 (68.3-72.7)	66.0 (63.64-68.26)	1.7, .20
Protestant	59.6 (57.2-62.0)		60.5 (58.1-62.9)	58.7 (56.27-61.07)	.1, .71
Animist	73.3 (71.2-75.5)		81.8 (79.9-83.7)	68.4 (66.15-70.69)	.6, .42
Kimbanguist	63.0 (60.7-65.4)		57.1 (54.7-59.6)	68.4 (66.15-70.69)	.1, .32
Muslim	57.7 (55.3-60.1)		53.3 (50.9-55.8)	63.6 (61.29-65.99)	.6, .46
Other	52.1 (49.7-54.6)		50.3 (47.8-52.7)	54.3 (51.86-56.72)	.5, .50
Marital status		22.0, .001			
Single	56.9 (54.5-59.3)		57.2 (54.8-59.7)	56.6 (54.16-59.00)	.0, .87
Married	63.8 (61.4-66.1)		66.8 (64.5-69.1)	60.6 (58.22-62.98)	3.1, .08
Divorced	64.5 (62.2-66.9)		52.2 (49.7-54.6)	71.8 (69.59-73.99)	2.4, .12
Separated	57.6 (55.2-60.0)		66.7 (64.4-69.0)	46.7 (44.24-49.10)	1.3, .25
Widowed	73.8 (71.7-76.0)		63.6 (61.3-66.0)	77.4 (75.38-79.46)	.9, .37
In a relationship	77.3 (75.3-79.4)		72.9 (70.7-75.0)	81.7 (79.77-83.55)	1.3, .25

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

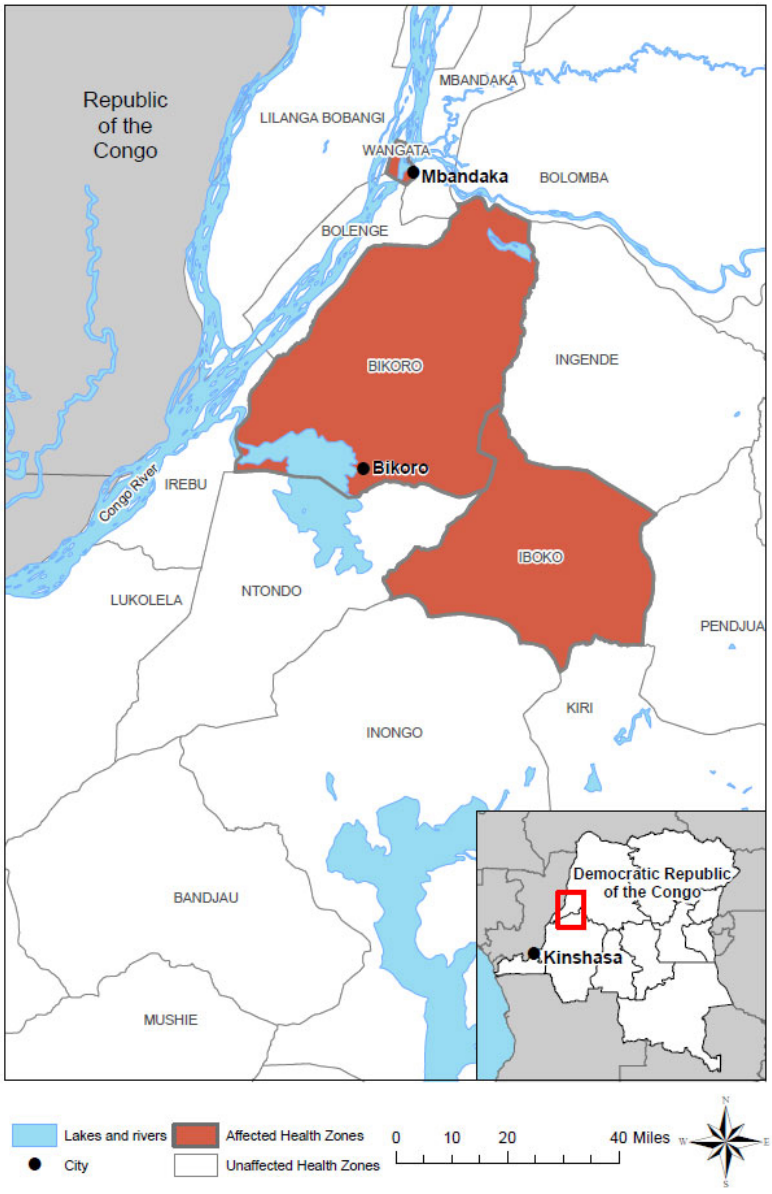
Depression Symptoms

	$R^2 = .31$; x^2 (8) = 7.41, $p < .001$				
Variables	β	SE	OR	95% CI	
Score of exposure to EVD					
1 to 4 (Reference criterion)					
5 to 8	.66**	.24	1.94	1.22	3.09
9 and more	.85**	.32	2.34	1.26	4.34
Stigmatization related to EVD					
0 to 21 (Reference criterion)					
22 to 39	.88***	.23	2.42	1.53	3.83
40 and up	1.55***	.36	4.73	2.34	9.56
Gender	.59**	.34	1.80	.94	3.48
Residence area	-1.68***	.37	.19	.09	.38
Employment	-.38**	.16	.68	.50	.93
Education level					
None (Reference criterion)					
Primary school	-.32	.40	.73	.34	1.59
High school	.09	.36	1.09	.54	2.21
Professional	-1.01*	.49	.36	.14	.96
University	.02	.38	1.02	.48	2.13
Age	.01	.01	1.01	1.00	1.02
Religion					
Catholic (Reference criterion)					
Protestant	-.19	.16	.83	.61	1.14
Animist	.20	.57	1.22	.40	3.71
Kimbanguist	.19	.33	1.21	.63	2.31
Muslim	-.20	.38	.82	.39	1.71
Other	.07	.19	1.07	.74	1.54
Marital status					
Single (Reference criterion)					
Married	.23	.16	1.26	.92	1.72
Divorced	.07	.36	1.08	.54	2.16
Separated	-.08	.47	.92	.37	2.30
Widowed	.30	.44	1.35	.57	3.19
In a relationship	1.18***	.29	3.25	1.84	5.76
Residence area X Exposure to EVD	.12	.18	1.13	.78	1.62
Residence area X Stigmatization related to EVD	.35	.22	1.42	.93	2.16
Gender X Exposure to EVD	-.06	.18	.95	.67	1.34
Gender X Stigmatization related to EVD	-.35	.20	.70	.47	1.05

Note. *: $p < .05$; **: $p < .01$; ***: $p < .001$. In the table we reported the Nagelkerke R^2. Cox & Snell $R^2 = .22$.

Figure 1. Map of Ebola-Affected Health Zones in 2018 Equateur Province Outbreak in the Democratic Republic of the Congo (DRC)

Source : Centers for Disease Control and Prevention (CDC): https://www.cdc.gov/vhf/ebola/outbreaks/drc/2018-may.html



Map of Ebola-Affected Health Zones in 2018 Equateur Province Outbreak in the Democratic Republic of the Congo (DRC)

210x325mm (72 x 72 DPI)

STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Page number	Recommendation
Title and abstract	1	2, line 12	(*a*) Indicate the study's design with a commonly used term in the title or the abstract
		3	(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found
Introduction			
Background/rationale	2	5, lines 12-56 and 6, lines 3-23	Explain the scientific background and rationale for the investigation being reported
Objectives	3	6, lines 25-36	State specific objectives, including any prespecified hypotheses
Methods			
Study design	4	7-10	Present key elements of study design early in the paper
Setting	5	7, lines 7-35	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection
Participants	6	7, lines 35-55	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants
Variables	7	8-10	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable
Data sources/ measurement	8*	8, lines 34-54 and 9, lines 3-39	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group
Bias	9	6-7	Describe any efforts to address potential sources of bias
Study size	10	8, lines 14-17	Explain how the study size was arrived at
Quantitative variables	11	9, lines 42-55 and 10, lines 3-7	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why
Statistical methods	12	9, lines 42-55 and 10, lines 3-21	(*a*) Describe all statistical methods, including those used to control for confounding
		10, lines 16-21	(*b*) Describe any methods used to examine subgroups and interactions
		8, lines 14-17	(*c*) Explain how missing data were addressed
		9, lines 45-50	(*d*) If applicable, describe analytical methods taking account of sampling strategy
		9-10	(*e*) Describe any sensitivity analyses
Results			
Participants	13*	8, lines 14-17	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed
		8, lines 14-17	(b) Give reasons for non-participation at each stage
		N. A.	(c) Consider use of a flow diagram
Descriptive data	14*	47	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders

		22-24	(b) Indicate number of participants with missing data for each variable of interest
Outcome data	15*	22-24	Report numbers of outcome events or summary measures
Main results	16	22-24	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included
		22 and 24	(*b*) Report category boundaries when continuous variables were categorized
		N. A.	(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses	17	9-10 and 22-24	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses
Discussion			
Key results	18	12-, lines 5-23	Summarise key results with reference to study objectives
Limitations	19	14, lines 28-56	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias
Interpretation	20	12-14	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence
Generalisability	21	16, lines 8-32	Discuss the generalisability (external validity) of the study results
Other information			
Funding	22	17, lines 37-55	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.