The Psychological Impact of the Ebola epidemic among Survivors in Liberia: a retrospective cohort study

Simmie Segbe Nyanfor, Jr

Central South University Xiangya School of Public Health <https://orcid.org/0000-0002-5140-2910>

Shuiyuan Xiao (✉ xiaosy@csu.edu.cn)

Research article

Keywords: Ebola, infectious diseases, survivors, quality of life

Posted Date: March 23rd, 2020

DOI: <https://doi.org/10.21203/rs.3.rs-18672/v1>

License: © ⓘ This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

Abstract

Background The 2013- 2016 West Africa Ebola epidemic resulted in an unprecedented number of survivors. The outbreak has contributed to many survivors, who have shown to have suffered from physical and mental sequelae – stigma, physical violence, diminished quality of life, ostracism, and isolation. The goal of this study was to evaluate the relationship between Ebola virus disease and long-term psychological problems among Ebola survivors in Liberia.

Method In January 2019, quantitative data from 232 respondents (EVD survivors, n = 116; non-survivors, n = 116) were gathered by structured face-to-face interviews. We used Davidson Trauma Scale for PTSD (DTS), the Generalized Anxiety Disorder Scale (GAD-7) to assess anxiety, the Patient Health Questionnaire (PHQ-9) to assess depression, and the Suicide Behavior Questionnaire-Revised (SBQ-R) to assess suicidality of both the survivors and their controls. Data were analyzed by linear regression analyses, chi-square, or t-tests to determine the prevalence, Ebola virus infection, and factors associated with long term psychological problems among EVD survivors and non-survivors.

Results We have identified 116 survivors of EVD and 116 non-Ebola survivors. Of the 116 people who survived, 76 (66%) recorded posttraumatic stress disorder, 61 (53%) depression, 43 (37%) anxiety, and 39 (34%) attempted suicide. Relative to EVD survivors, the non-survivors had very significantly lower levels of posttraumatic stress disorder, 7(6%), depression, 5 (4%), anxiety, 5 (4%), and 2 (2%) attempted suicide reported three years after the outbreak. In a logistic regression analysis, EVD survivors had higher odds of observing posttraumatic stress disorder ($\beta = 3.39$, OR, 29.59 [95% CI 2.53, 4.24]; $p < .001$), depression ($\beta = 3.20$ OR, 24.62 [95% CI 2.24, 4.17]; $p < .001$); anxiety ($\beta = 2.57$, OR, 13.08 [95% CI 1.60, 3.54]; $p < .001$), and suicidality ($\beta = 3.36$, OR, 28.87 [95% CI 1.91, 4.81], $p < .001$) three years after the outbreak.

Conclusion Three years after the outbreak, EVD survivors still had persistently high levels of posttraumatic stress disorder, depression, anxiety, and suicide attempt. The long-term psychological implications of infectious diseases should not be ignored. The results underscore the need for Mental Health services on a national scale for the EVD survivors.

Background

Ebola Virus Disease (EVD) is a rare but deadly disease that causes fever, body aches, and vomiting, which in and out of the skin often bleeds. It damages the immune system and organs as the virus spreads through the body [1].

The epidemic of the West African Ebola virus disease (EVD) in 2013–2016 was an unprecedented large-scale crisis in public health that caused significant human deaths and suffering [1]. Current estimates indicate that the EVD infected 28,646 persons and caused 11,323 deaths as of May 11, 2016 [1]. The epidemic resulted in more than 17,323 EVD survivors in history. In Liberia, there were more than 5000 survivors [2]. The West African outbreak has contributed to many survivors who have shown to have suffered from physical and mental sequelae – stigma, physical violence, diminished quality of life, social

exclusion, and isolation [3]. It is known that the prejudice and discrimination encounter by the survivors receive less attention [3].

As in most epidemics, Ebola virus disease control strategies are directed at managing the transmission, but issues related to the disease's mental/psychological impact on patients have gained less focus [3]. The EVD has resulted in many victims of Ebola who need psychological support. The EVD-related stigma impacts the survivors' social and psychological aspects. A stigma has been described in several ways, but with regard to EVD, it refers to negative actions, attitudes, and activities aimed at people living with and accused of being infected [3]. A research study conducted among survivors of the 1995 Ebola epidemic in Kikwit, Democratic Republic of Congo, described the feelings and experiences of survivors of the Ebola epidemic [4]. They described survivors' psychological consequences to include fear of serious illness, denial, fear of being blamed by neighbors, and guilt. Others included public condemnation, thinking the disease was a divine punishment, income loss, and deep sorrow for colleagues who did not survive the outbreak [4, 5].

The Ebola outbreak's psychosocial consequences mirror those of other disasters, particularly epidemics, where populations and health workers were subjected to infection and psychological stressors, exacerbating existing challenges [6–11]. The previous study that evaluated the psychological impact and depressive symptoms of the 2003 epidemic of the severe acute respiratory syndrome on hospital employees showed that about 10% of the participants had a high level of depressive symptoms and three years later had a high level of depressive symptoms [8, 11]. SARS patients still had high levels of anxiety and alarming levels of psychological distress one year after the epidemic [7].

Survivors have also reported the mental health effects of other disasters, such as bioterrorism [12]. Psychological distress, fear, depression, and post-traumatic stress disorder (PTSD) have been recorded in communities subject to mass violence and relocation, including those affected by Sierra Leone and Liberia civil conflict between 1992 and 2002 [13].

Given the magnitude of the epidemic, adverse mental health outcomes could be expected in the general population. Among Ebola survivors in Guinea, Sierra Leone, and Liberia [14, 15], and health workers in the three countries affected, high levels of psychological distress have been documented [16]. The risk of long-term psychological problems associated with Ebola virus disease has not been assessed in Liberia; moreover, most studies have excluded the general population despite people have been faced with civil wars, constant human rights violations and have already dealt with numerous other deadly diseases such as malaria, diarrhea, and HIV / AIDS [17].

Our primary goal was to investigate the association between the Ebola virus infection and long-term psychological problems among survivors of the Ebola Virus Disease in Liberia. Our secondary goal was to describe the types and prevalence of psychological problems experienced by survivors three years after the outbreak. We hypothesized that the Ebola virus is a risk factor for long-term psychological problems. If true, this would suggest the need to develop and reinforce national diagnostic and care systems for mental health in the post-epidemic context.

Methods

Study design

We did a retrospective cohort study of EVD survivors of the 2013–2016 Ebola virus disease outbreak in Liberia. The study ran from January to March 2019. Our main goal was to evaluate the association between the Ebola virus infection and long-term psychological problems among survivors of the Ebola Virus Disease in Liberia. The secondary goal was to describe the types and prevalence of psychological problems experienced by survivors three years after the outbreak. The study was conducted in Monrovia, the capital city of Liberia, with a population of 1,010,970 inhabitants as of 2008 National Census.

The sample size of the cohort of 232 participants included in this study have been included in previous research studies: A sample of 150 participants in the Ebola Treatment Unit survivors study[18]; 112 survivors in a study of persistent viral excretion[19]; 151 survivors in a study of long term mortality[20], and 123 survivors in a series of household transmission studies [21–23].

Participants

The study sample was EVD survivors recorded in Monrovia from the beginning of the epidemic, May 2014 – September 3, 2015. All qualified survivors' names and contacts were identified from the database of Ebola virus disease handled by the Liberian Ministry of Health and collaborators. This database contains complete epidemiological information available to the Ministry of Health and information on the disease of all suspected, probable, and confirmed cases of Ebola virus disease in Liberia. Inclusion for cases selection were as follows: (1) Persons confirmed as a case of EVD in the present outbreak response and had been managed, cured, and discharged by the case management team (2) EVD survivors ≥ 18 years of age (3) EVD survivors should be a resident of Monrovia. Exclusion criteria included the following: (1) EVD survivors without an original discharge certificate or copy. (2) EVD survivors with no membership card of the Survivors Network, Liberia. (3) EVD survivors refuse consent from being part of the study. Individuals who had no prior history of Ebola infection and unrelated to cases were included as controls. The cases and controls were matched 1:1 by age (± 5 yrs) and sex.

Procedure

We randomly selected the cases using the contact tracing list of all survivors living in Monrovia from the National Ebola Survivor Network and randomized controls from the 2008 National Census of Liberia. Participants were tracked using their telephone number. A team of 10 local health volunteers carried out a structured face-to-face interview with the participants. The interviewers randomly selected intersections; from there, they selected the households according to the protocol defined by Hoffmeyer-Zlotnik [24]. Each interview took about an hour. Only a person per household was interviewed. The interviewers attended a three-day intensive training program prior to the data collection, during which they learned about the methodology of the study, its objectives, and the conceptual background of the study questionnaire. Also, they learned how to fill the questionnaire and practiced the translation of questions into local languages. The study procedure and instruments were approved by the Xiangya School of

Public Health Institutional Review Board and obtained approval from the Mental Health Bureau, Ministry of Health – Liberia. The meeting was conducted with the Ebola Survivor Network to explain the objectives of the study before the participation of the survivors. After signing the consent form by each participant to ensure the willingness, privacy, and confidentiality of information, after which, each participant was asked to complete a face-to-face interview.

Questionnaire and measures

Data was collected through interviews with participants using a socio-demographic questionnaire that was designed to collect information on the respondents' age, gender, marital status, employment status, religion, and educational level. A semi-structured self-assessment questionnaire was comprising of Davidson's Trauma Scale, GAD-7, PHQ-9, and SBQ-R to collect information on the respondent's psychological health.

Davidson Trauma Scale – is designed to evaluate symptoms of PTSD in individuals with a history of trauma [25]. The 17 item scale measuring each DSM-IV symptom of PTSD on a 5-point frequency and severity scale [25]. The DTS consists of 17 items that relate to each of the 17 symptoms of DSM-IV. For each item, the subject rates both frequency and severity during the previous week on a 5-point (0 to 4) scale for a total possible score of 136 points [25]. A participant with a DTS score of 40 or more was considered to have PTSD [25].

Generalized Anxiety Disorder (GAD-7) - used for screening and severity measuring of a generalized anxiety disorder (GAD)[26]. GAD-7 has seven items, which check measure the severity of various signs of GAD according to reported response categories with assigned points. The evaluation is shown by the total score, which consists of adding the scores for the scale of all seven items [27]. The threshold selected as an indicator of anxiety was 11 or more [26, 27].

The Patient Health Questionnaire (PHQ-9) is a self-administered version of the PRIME-MD diagnostic instrument for common mental disorders. The PHQ-9 is the depression test, scoring each of the nine DSM-IV criteria from "0" (not at all) to "3" (nearly every day) [28]; PHQ-9 is a reliable and valid measure of depression severity, that is, a score of 11 or more was used; [28] higher scores correspond to more severe depression.

The Suicide Behavior Questionnaire-Revised (SBQ-R) – a validated questionnaire to identify patients at risk of attempted suicide.[29] In this research, we use a cutoff point of 8 or more to be considered a high symptom of suicide attempt [29].

All questionnaires in this study have previously been validated [25–29].

It is established that study participants are different from the general population. The self-selection bias will exist. A randomized sampling was conducted to eliminate selection bias. Those who were not involved in the study may have quite different results; therefore, the generalizability of the study is limited.

Statistical analysis

Data were entered, cleaned, coded, and analyzed with SPSS version 25. Descriptive statistics explained the characteristics of the study participants and presented continuous variables as mean and range. Categorical variables were presented in tables showing frequencies and percent distributions. Characteristics among EVD survivors and non-survivors were assessed for differences using Fischer exact or t-tests. We assessed the association between EVD survivorship (EVD survivors vs. non-survivors) and health outcomes and used linear regression models in bivariate and multivariate analyses adjusting for potential confounders of age, sex, educational level, marital status, employment status, region and being a health care worker. We calculated ORs with 95% confidence intervals for association with Ebola virus disease and PTSD, depression, anxiety, and suicidality. Our threshold for the statistically significant finding was $p < 0.05$. The Chi-square test was also used to compare the cases and controls' categorical demographic characteristics. There were no missing data.

Results

One hundred twenty-five EVD survivors were identified. One twenty (96%) agreed to participate, were deemed eligible, and enrolled. Five survivors (4%) refused or were unreachable, ineligible after screening, or incapacitated. Among these 120 survivors, four (4) were disqualified because the interviews were not completed. Compared to the 116 non-survivors (controls) enrolled. No significant difference was seen between the cases and controls enrolled ($p > 0.05$).

Characteristics of the sample

One hundred EVD survivors and 116 non-survivors were enrolled. Among these 116 EVD survivors, 66 (57%) were women, and 50 (43) were men. Age range from 18–60 years, whereas 24–29 years reported the most frequently observed. The majority, 74 (64%), were single, and 13 (11%) were health care workers during the outbreak. Christianity was the largest religion, 89 (77%). Comparing these characteristics among EVD survivors and non-survivors, there was no significant difference for age, gender, marital status, religion, and being a health care worker (Table 1). However, there was a trend of significant differences in educational level and employment status (Table 1). Most of the survivors had an educational level of secondary education, 37 (32%) or above, and were unemployed, 39 (34%).

Table 1

Sociodemographic characteristics of EVD survivors (N = 116) and Non-survivors (N = 116) in Monrovia, Liberia

Characteristics		EVD Survivors (n%)	Non-survivors (n%)	X ² p-value
Age in years	18–23	29 (25%)	29 (25%)	1.000
	50–54	5 (4%)	5 (4%)	
	24–29	35 (30%)	35 (30%)	
	30–34	14 (12%)	14 (12%)	
	45–49	3 (3%)	3 (3%)	
	55–60	7 (6%)	7 (6%)	
	35–39	16 (14%)	16 (14%)	
	40–45	7 (6%)	7 (6%)	
Gender	Female	66 (57%)	66 (57%)	1.000
	Male	50 (43%)	50 (43%)	
Marital Status	Single	74 (64%)	76 (66%)	0.921
	Divorced	6 (5%)	5 (4%)	
	Living as married	13 (11%)	11 (9%)	
	Married	17 (15%)	20 (17%)	
	Separated	6 (5%)	4 (3%)	
Education	Secondary School	37 (32%)	47 (41%)	0.001
	Tertiary School	34 (29%)	57 (49%)	
	Primary School	15 (13%)	10 (9%)	
	None	30 (26%)	2 (2%)	
Employment Status	Unemployed	39 (34%)	14 (12%)	0.001
	Self-employed	30 (26%)	15 (13%)	
	Employed	20 (17%)	46 (40%)	
	Student	20 (17%)	39 (34%)	
	Unable to Work	6 (5%)	1 (1%)	
	Retired	1 (1%)	1 (1%)	

Characteristics		EVD Survivors (n%)	Non-survivors (n%)	X ² p-value
Religion	Muslim	27 (23%)	18 (16%)	0.135
	Christian	89 (77%)	98 (84%)	
Health care worker	Yes	103 (89%)	102 (88%)	0.838
	No	13 (11%)	14 (12%)	

About 66% (n = 76) of the EVD survivors reported having high levels of PTSD symptoms (that is, a DTS score of 40 or more) at some time during the three years following their exposure to the Ebola outbreak. The DTS scores in this sample ranged from 0–17, with a mean of 38.83, and the standard deviation was 14.68. It was found that among the EVD survivors, 61 (53%) had high symptoms of depression (that is a score of 11 or more). This scale had a range from 0–9; the mean was 9.76, with 5.89 standard deviations. It was further observed among the EVD survivors, nearly half had anxiety 43 (37%) (that is, a GAD-7 score of 11 or more), and score ranged from 0–7 (mean was 7.67 and Standard Deviation was 5.41). Also, the suicide attempt was 39 (34%) reported among the survivors with SBQ-R scores ranged from 0–4 with a mean of 6.30, and the standard deviation was 4.02. In this research, we use a cutoff point of 8 or more to be considered a high symptom level of a suicide attempt. In comparison, the non-survivors, 7 (6%) had low posttraumatic stress disorder symptoms, 5 (4%) reported to have depressive symptoms, and 5 (4%) had anxiety with just 2 (2%) had suicide attempts. Tables 2 and 3 summarize the results.

Table 2
The prevalence of psychological problems among the survivors and the controls

Variable	Cases (n %)	Controls (n %)	χ^2 value	df	P-value
PTSD			89.3	1	< .001
Yes	76 (66%)	7 (6%)			
No	40 (34%)	109 (94%)			
Depression			66.4	1	< .001
Yes	61 (53%)	5 (4%)			
No	55 (47%)	111 (96%)			
Anxiety			37.9	1	< .001
Yes	43 (37%)	5 (4%)			
No	73 (63%)	111 (96%)			
Suicidality			40.5	1	< .001
Yes	39 (34%)	2 (2%)			
No	77 (66%)	114 (98%)			

Table 3
Two-Tailed Independent Samples t-Test for the Difference Between the Psychological Health scores of the Survivors and Non-victims of Ebola

Scales	EVD Survivors Mean (SD)	Non-survivors Mean (SD)	df	F	P
DTS scores	38.8 (14.7)	8.36 (13.3)	2,30	10.5	< .001
PHQ-9 scores	9.76 (5.9)	1.92 (3.1)	2,30	74.639	< .001
GAD-7 scores	7.67 (5.4)	1.82 (3.4)	2,30	61.379	< .001
SBQ-R scores	6.30 (4.0)	3.20 (1.0)	2,30	72.327	< .001

Factors Related to PTSD, Depression, Anxiety and Suicidal Symptom Levels

The result of the multinomial regression analysis (Table 4) indicate that, among the sociodemographic factors, high PTSD symptom levels since the 2014 Ebola outbreak were associated with marital status – separated (OR 5.55, 95% CI 0.15 to 3.28, $p = 0.32$), and with no formal education (OR 10.45, 95% CI 1.27

to 3.42, $p < 0.001$) more likely to have high PTSD symptom level. The overall model was significantly based on alpha 0.05. For depression, anxiety, suicidality, the overall model (multinomial regression analysis) was not significant; therefore, we did not observe a statistically significant difference in depressive, anxiety, and suicidal symptom levels with sociodemographic factors.

Table 4
Logistic Regression Results in the Final Model showing significant effects with associated factors Predicting PTSD (Final Model included only significant variables at 0.05 level)

Variable	B	SE	95.0% CI	χ^2	p	OR
Marital Status - Separated	1.71	0.80	[0.15, 3.28]	4.62	.032	5.55
Age - 30–34	-1.42	0.61	[-2.61, -0.22]	5.42	.020	0.24
Age - 35–39	-1.28	0.62	[-2.50, -0.06]	4.21	.040	0.28
Education - None	2.35	0.55	[1.27, 3.42]	18.26	< .001	10.45
Note. $\chi^2(20) = 53.27$, $p < .001$, McFadden $R^2 = 0.18$.						

EVD Association with PTSD, Depression, Anxiety, and Suicidality

To further elucidate the relation among the outbreak psychological impact, logistic regression analyses were conducted. In Model 1, the EVD survivors reported to have significantly higher odds of observing posttraumatic stress disorder, $B = 3.39$, $OR = 29.59$, [95% CI 2.53–4.24], $p < .001$. The overall model was significant, $\chi^2(1) = 100.26$, $p < .001$, indicating that for a one-unit increase in the survivors, the odds of observing post-traumatic stress disorder would increase by approximately 29.59% (Table 5). In Model 2, when depression was added to the equation, EVD survivors had significantly higher odds of observing depression, $B = 3.20$, $OR = 24.62$, [95% CI 2.24–4.17], $p < .001$. The result suggests that for a one-unit increase in EVD survivors, the odds of observing depression would increase by approximately 24.62% (Table 5). In Model 3, anxiety, $B = 2.57$, $OR = 13.08$, [95% CI 1.60–3.54], $p < .001$, and suicidality was observed, $B = 3.36$, $OR = 28.87$, [95% CI [1.91, 4.81], $p < .001$, also showed higher odds among the EVD survivors. All retained a statistically significant association with the Ebola virus disease. Tables 5 summarizes the results of the regression model.

Table 5
Logistic Regression Results in the Final Model Showing Significant
Effects with EVD Survivors Predicting PTSD, Depression, Anxiety, and
Suicidality

Variable	B	SE	95% CI	χ^2	p	OR
PTSD	3.39	0.44	[2.53, 4.24]	60.33	< .001	29.59
Depression	3.20	0.49	[2.24, 4.17]	42.15	< .001	24.62
Anxiety	2.57	0.50	[1.60, 3.54]	26.88	< .001	13.08
Suicidality	3.36	0.74	[1.91, 4.81]	20.66	< .001	28.87

Discussion

The survivability of the Ebola Virus Disease is such a traumatic condition due to unfavorable physical and psychological consequences a person with EVD may endure during infection, treatment, and recovery. Several studies have shown that patients right after infection or after hospital discharge have compromised psychological health [4, 6, 9, 14, 30]. However, little is known, however, about the long term mental health implications of the EVD exposure. Our study is the first to investigate the psychological problem in Ebola survivors three years after the outbreak to address the question of whether exposure to EVD a risk factor for long term psychological problems in survivors.

Earlier studies on catastrophe survivors have shown that about one year after more than three-fourths of those with psychological problems shortly after the tragedy still have it [31, 32]. This study provides data on the psychological problems in EVD survivors, showing that they have higher odds of developing PTSD, depression, anxiety, and suicidality three years after recovery in comparison to non-survivors. Our results show a prevalence of PTSD (66%), depression (53%), anxiety (37%), and suicidality (34%) among EVD survivors three years after the outbreak. Such findings contribute to our understanding of Ebola survivors' experience of persistent psychological symptoms. It is established that psychological symptoms that persist after an incident for more than six months are likely to persist over the long term [33, 34].

Our research findings indicate that most participants scored above the critical threshold with DTS, GAD-7, PHQ-7, and SBQ-R scores. In addition, the mean difference of depression, PTSD, anxiety, and suicidality scores were significantly higher in EVD survivors as compared to controls. The psychological consequences of EVD are often ignored in the acute setting but would be likely to persist into convalescing and may compound physical disabilities.

Earlier studies identified specific instances of major depression with suicide attempts after the EVD outbreak [35, 36]. Due to the shortage of therapists and social workers in the region, most survivors are still unable to receive adequate psychiatric care [17]. In order to offer medical and psychological services and the provision of appropriate medications, it is vital to have adequate skilled health professionals

available. Currently, this is a significant limitation in Liberia. The availability of psychiatrists is rare in Liberia with just one psychiatrist [17]. Counseling of the Ebola survivors was performed by aid organizations and was done slowly [17].

Females account for most of our study participants. Other research studies have also reported more female survivors [37, 38]. It is due to the proportion of females admitted was more than males.

As in many traumatic events [6, 9], our study shows that psychological problems among Ebola survivors are common. Persons that have experienced severe trauma are at risk of increased psychological disorders [39]. The 1995 Kikwit, DR Congo Ebola outbreak, reported that 61% of the study participants presented issues related to mental/psychological consequences from the disease [4]. In Sierra Leone, a study of 74 survivors in Moyamba District, 2015 revealed that 48% of survivors show symptoms of psychological problems a few weeks after discharge from the ETC, placing them at risk of developing diverse levels of psychological disorders [40]. Similarly, 81 participants of another study in Kenema District, Sierra Leone, recorded around 35% had depression four months after discharge from the Ebola Treatment Unit [41]. Whereas in Liberia, the initial results of the ongoing research on neurological sequelae undertaken by Prevail III project showed a 49% prevalence of depression, for a cohort of 82 persons released from the treatment facility about six months earlier [36]. Another study performed by a Médecins Sans Frontières (MSF) team in Monrovia, reports a 40% prevalence of depression rate for a cohort of 136 persons discharged out of an Ebola Treatment Center for more than three months earlier and 12% for major PTSD-related depression [42]. The survivors of EVD are plagued by disease-related traumatic memories and associated death of relatives [43]. Our study also showed the survivors are struggling with extreme anxiety. This is due to fear of discrimination, as described by Reardon S. [43].

Contrary to assumptions, after three years of post-outbreak, psychological health levels did not subside, and depressed, nervous, suicidal, and posttraumatic symptoms are prevalent. It appears that instead of improving over time, EVD survivors' psychological health in terms of PTSD, depression, anxiety, and suicidal symptoms is elevated; this may have been attributed to civil wars, constant human rights violations, economic hardships and fight against deadly diseases such as malaria, HIV/AIDS and diarrhea [44]. Another logical rationale was that many of the volunteers recruited by aid programs were students, social workers, and others without specialized psychology experience or advanced psychological counseling expertise. The following years also saw the rise of several economic hardships, unemployment, social shifts, health inequality, education, making it difficult for survivors and supporters to engage in long-term psychotherapy. Therefore, survivors who only once received the support for mental health remembered painful thoughts and re-experienced horrific scenarios without adequate assistance to relieve and resolve the negative feelings that may have contributed to secondary psychological issues. A significant contribution to the prevention and treatment of EVD survivors is the availability of long-lasting and effective mental health support after an epidemic.

The study revealed a significant association between EVD and later diagnosis of PTSD, depression, anxiety, and suicidality. The other relationship studied included marital status, age, region, education,

gender, being a health care worker. In the secondary analysis, the variables of significance for the association predicting PTSD were marital status (separated), ages 30–34, and 35–39, low educational level, and religion – Christian. Our findings showed that the higher the level of education received, the less the psychological symptoms. It is necessary to combine local knowledge and understanding of the illness with a psychosocial approach, so, to help decrease the mental burdens surrounding the EVD epidemic. Training sessions can be structured classes regarding constructive mental health promotion or informal conversations between survivors and community members, peer support, education, and mental care services can be some methods shaping EVD survivors' policy initiatives. Training sessions can be structured classes regarding constructive mental health promotion or informal conversations between survivors and community members, peer support, education, and mental care services can be some methods shaping EVD survivors' policy initiatives [45]. The integration of local knowledge and understanding of the disease with psychosocial intervention is vital. Also, a marriage spilled is associated with poor mental health. A possible reason is due to the changes that occur after separation such as, poor sleep and appetite. The determinants of PTSD among Wenchuan earthquake survivors were also discussed by some recent articles [46–48]. During the post-earthquake period of the following the earthquake, Guo J. et al. [47] demonstrated that female gender, married, and low educational status were significantly associated with PTSD; and depression was significantly associated with PTSD 44 months after the earthquake. Additionally, Zhou X. et al. [48] further discovered that risk factors for PTSD were old age, female gender, and lonely living. While some of the causes as mentioned above are factors similar to our results, it is not fair to equate our findings with those of the above articles is not rational since our study was conducted three years after the outbreak and this is an epidemic of Ebola rather than an earthquake; all the above papers are cross-sectional studies, whereas this study was a retrospective cohort study.

Our research findings and that of other published reports have shown that many of the survivors have experienced psychological symptoms during and after the outbreak. It is, therefore, evident that a sensitive psychological trauma-informed care model is needed to meet the needs of the Ebola survivors, thus maximizing their mental and psychological health outcomes [49]. Such an approach enables health care providers, social workers, and policymakers to become aware of trauma, enhance screening and evaluation procedures, and implement evidence-based interventions that are tailored to the needs of EVD survivors [49].

We should also recognize existing efforts addressing the outbreak's psychological effects, as evidenced by the award of approximately US\$3 million in psychological assistance from the World Bank and Japan to address the necessities of physical and psychological and social care of EVD survivors [43]. Nonetheless, significant gaps exist in resolving the survivors' psychological care, as shown by the findings of our study. Mental Health care has been inadequate due to the absence of proper planning, lack of resources, staff shortages, and weak health systems, and insufficient knowledge of policymakers that support mental health needs [43].

A significant limitation of the research is exploring psychological symptoms linked to different types of Ebola virus disease-related event exposures. Some other limitations existed in the interview and data collection process before analysis. Most of the survivors (cases) were illiterate; therefore, we have to explain the questions into simple English/ dialect for him/her to understand. Thus, the responses were subject to information bias. The self-reports of the study subjects, describing the effects encountered over the three years, were also subject to recall bias. The final major limitation in our study was the potential for participation bias. It is possible that, as with any cohort study, either cases or controls were differentially more likely to participate than the other if they somehow included in the results of the research.

Nevertheless, the results provide vital information about the psychological impact of an infectious disease epidemic for policymakers and mental health professionals globally, which can help brace the development of health systems and strategies to respond to possible future outbreaks of Ebola.

Conclusion

The present study show provides insight into the potential long-term adverse psychological effects of infectious diseases. As a group, the EVD survivors showed increased levels of psychological problems after three years, as evidenced by alarmingly high odds of depression, anxiety, suicidal and posttraumatic symptoms, as well as high prevalence of potential psychiatric morbidity cases.

The long-term psychological implications of infectious diseases should not be ignored. The results underscore the need for Mental Health services on a national scale for the EVD survivors.

An intervention in line with the IASC guidelines on mental health and psychosocial support for emergency settings and used with the unique characteristics of the Ebola virus outbreak is essential for the Ministry of Health, Liberia and its partners to implement and maintain rapidly throughout the recovery process. The IASC guidelines are structured around a 4-tiered pyramid of intervention: (1) restoring essential services and protection to the affected population; (2) strengthening family and community networks; (3) providing psychosocial assistance to those in distress; and (4) providing specialized mental health treatment to severely affected survivors.

Given the need for further research with a more extensive study to validate our findings, we are optimistic that a potential intervention to reduce the rate of PTSD, depression, anxiety, and suicidality will help the survivors of EVD. Poor policy-making will not help; instead, ground-level implementation. Soon, the best solutions for minimizing the mental health problems associated with the EVD will be awareness, prevention, and therapeutic vaccination.

Abbreviations

Abbreviations	Full name
---------------	-----------

EVD	Ebola Virus Disease
WHO	World Health Organization
IFRC	International Federation of the Red Cross
ETC	Ebola Treatment Center
PTSD	Post – Traumatic Stress Disorder
ETU	Ebola Treatment Unit
PHQ	Patient Health Questionnaire
DTS	Davidson’s Trauma Scale
DSW-VI	Diagnosis and Statistical Manual of Mental Disorder, 4 th Edition
NPHIL	National Public Health Institute of Liberia
MOH	Ministry of Health
SPSS	Statistical Package for Social Sciences
SBQ-R	Suicide Behaviors Questionnaire-Revised
GAD	Generalized Anxiety Disorder

Declarations

Competing interest

The authors declare that they have no competing interest

Authors’ contributions

Conceptualization: Simmie Nyanfor, Jr, Shuiyuan Xiao

Data curation: Simmie Nyanfor, Jr, Shuiyuan Xiao

Formal analysis: Simmie Nyanfor, Jr, Shuiyuan Xiao

Funding acquisition: Shuiyuan Xiao

All authors read and approved the final manuscript.

Acknowledgments

We gratefully thank the study participants and their communities for their engagement in this study, the National Ebola Survivor Network staff, the volunteers that facilitated the collection of data used in this study, including Princess Jaylee Sarsih (Mental Care Liberia), Princess N. Karnaga, Martha K. Slon, Sianneh M. Johnson, and all members of our research review committee and technical team that contributed to this research.

Funding

This work was funded by CMB-Collaborating Program in Mental Health Policy, CMB 14-188

Availability of data and materials

The datasets generated and analyzed during the current research study are not publicly available due to confidentiality reasons but are available from the corresponding author request.

Consent for publication

Not applicable

Ethics approval and consent to participate

The Institutional Review Committee approved the protocol of the Xiangya School of Public Health, Central South University. Ethical clearance for the survey was provided by the Ethics Committee of the Ministry of Health – Liberia and the National Survivors Network of Liberia. All study participants provided their written, informed consent.

References

1. Organization WH. Ebola situation report 16 March 2016. Geneva: World Health Organization, 2016. 2018.
2. Rabelo I, Lee V, Fallah MP, Massaquoi M, Evlampidou I, Crestani R, et al. Psychological Distress among Ebola Survivors Discharged from an Ebola Treatment Unit in Monrovia, Liberia - A Qualitative Study. *Frontiers in public health*. 2016;4:142-.
3. Davtyan M, Brown B, Folayan MO. Addressing Ebola-related stigma: lessons learned from HIV/AIDS. *Global health action*. 2014;7:26058.
4. De Roo A, Ado B, Rose B, Guimard Y, Fonck K, Colebunders R. Survey among survivors of the 1995 Ebola epidemic in Kikwit, Democratic Republic of Congo: their feelings and experiences. *Tropical medicine & international health : TM & IH*. 1998;3(11):883-5.
5. Yadav S, Rawal G. The Current Mental Health Status of Ebola Survivors in Western Africa. *Journal of clinical and diagnostic research : JCDR*. 2015;9(10):La01-2.

6. Chua SE, Cheung V, McAlonan GM, Cheung C, Wong JW, Cheung EP, et al. Stress and psychological impact on SARS patients during the outbreak. *Canadian journal of psychiatry Revue canadienne de psychiatrie*. 2004;49(6):385-90.
7. Lee AM, Wong JG, McAlonan GM, Cheung V, Cheung C, Sham PC, et al. Stress and psychological distress among SARS survivors 1 year after the outbreak. *Canadian journal of psychiatry Revue canadienne de psychiatrie*. 2007;52(4):233-40.
8. Liu X, Kakade M, Fuller CJ, Fan B, Fang Y, Kong J, et al. Depression after exposure to stressful events: lessons learned from the severe acute respiratory syndrome epidemic. *Comprehensive psychiatry*. 2012;53(1):15-23.
9. Maunder R, Hunter J, Vincent L, Bennett J, Peladeau N, Leszcz M, et al. The immediate psychological and occupational impact of the 2003 SARS outbreak in a teaching hospital. *CMAJ : Canadian Medical Association journal = journal de l'Association medicale canadienne*. 2003;168(10):1245-51.
10. Styra R, Hawryluck L, Robinson S, Kasapinovic S, Fones C, Gold WL. Impact on health care workers employed in high-risk areas during the Toronto SARS outbreak. *Journal of psychosomatic research*. 2008;64(2):177-83.
11. Wu P, Fang Y, Guan Z, Fan B, Kong J, Yao Z, et al. The psychological impact of the SARS epidemic on hospital employees in China: exposure, risk perception, and altruistic acceptance of risk. *Canadian journal of psychiatry Revue canadienne de psychiatrie*. 2009;54(5):302-11.
12. Stein BD, Tanielian TL, Eisenman DP, Keyser DJ, Burnam MA, Pincus HA. Emotional and behavioral consequences of bioterrorism: planning a public health response. *The Milbank quarterly*. 2004;82(3):413-55.
13. Silove D, Ventevogel P, Rees S. The contemporary refugee crisis: an overview of mental health challenges. *World psychiatry : official journal of the World Psychiatric Association (WPA)*. 2017;16(2):130-9.
14. Keita MM, Taverne B, Sy Savane S, March L, Doukoure M, Sow MS, et al. Depressive symptoms among survivors of Ebola virus disease in Conakry (Guinea): preliminary results of the PostEboGui cohort. *BMC psychiatry*. 2017;17(1):127.
15. Ji D, Ji YJ, Duan XZ, Li WG, Sun ZQ, Song XA, et al. Prevalence of psychological symptoms among Ebola survivors and healthcare workers during the 2014-2015 Ebola outbreak in Sierra Leone: a cross-sectional study. *Oncotarget*. 2017;8(8):12784-91.
16. Gershon R, Dernehl LA, Nwankwo E, Zhi Q, Qureshi KJPc. Experiences and psychosocial impact of West Africa Ebola deployment on US health care volunteers. 2016;8.
17. Reardon S. Ebola's mental-health wounds linger in Africa. *Nature*. 2015;519(7541):13-4.
18. Hunt L, Gupta-Wright A, Simms V, Tamba F, Knott V, Tamba K, et al. Clinical presentation, biochemical, and haematological parameters and their association with outcome in patients with Ebola virus disease: an observational cohort study. *The Lancet Infectious Diseases*. 2015;15(11):1292-9.

19. Green E, Hunt L, Ross JCG, Nissen NM, Curran T, Badhan A, et al. Viraemia and Ebola virus secretion in survivors of Ebola virus disease in Sierra Leone: a cross-sectional cohort study. *The Lancet Infectious Diseases*. 2016;16(9):1052-6.
20. Bower H, Smout E, Bangura MS, Kamara O, Turay C, Johnson S, et al. Deaths, late deaths, and role of infecting dose in Ebola virus disease in Sierra Leone: retrospective cohort study. 2016;353:i2403.
21. Glynn JR, Bower H, Johnson S, Houlihan CF, Montesano C, Scott JT, et al. Asymptomatic infection and unrecognised Ebola virus disease in Ebola-affected households in Sierra Leone: a cross-sectional study using a new non-invasive assay for antibodies to Ebola virus. 2017;17(6):645-53.
22. Bower H, Johnson S, Bangura MS, Kamara AJ, Kamara O, Mansaray SH, et al. Effects of mother's illness and breastfeeding on risk of Ebola virus disease in a cohort of very young children. 2016;10(4):e0004622.
23. Bower H, Johnson S, Bangura MS, Kamara AJ, Kamara O, Mansaray SH, et al. Exposure-specific and age-specific attack rates for Ebola virus disease in Ebola-affected households, Sierra Leone. 2016;22(8):1403.
24. Hoffmeyer-Zlotnik JHJDias. New sampling designs and the quality of data. 2003;19:205-17.
25. Davidson JR, Book SW, Colket JT, Tupler LA, Roth S, David D, et al. Assessment of a new self-rating scale for post-traumatic stress disorder. *Psychological medicine*. 1997;27(1):153-60.
26. Jordan P, Shedden-Mora MC, Löwe B. Psychometric analysis of the Generalized Anxiety Disorder scale (GAD-7) in primary care using modern item response theory. *PloS one*. 2017;12(8):e0182162-e.
27. Mossman SA, Luft MJ, Schroeder HK, Varney ST, Fleck DE, Barzman DH, et al. The Generalized Anxiety Disorder 7-item scale in adolescents with generalized anxiety disorder: Signal detection and validation. *Annals of clinical psychiatry : official journal of the American Academy of Clinical Psychiatrists*. 2017;29(4):227-34a.
28. Kroenke K, Spitzer RL, Williams JB. The PHQ-9: validity of a brief depression severity measure. *J Gen Intern Med*. 2001;16(9):606-13.
29. Osman A, Bagge CL, Gutierrez PM, Konick LC, Kopper BA, Barrios FX. The Suicidal Behaviors Questionnaire-Revised (SBQ-R): validation with clinical and nonclinical samples. *Assessment*. 2001;8(4):443-54.
30. Sow S, Desclaux A, Taverne B. [Ebola in Guinea: experience of stigma among health professional survivors]. *Bulletin de la Societe de pathologie exotique (1990)*. 2016;109(4):309-13.
31. North CS, Kawasaki A, Spitznagel EL, Hong BAJTJon, disease m. The course of PTSD, major depression, substance abuse, and somatization after a natural disaster. 2004;192(12):823-9.
32. North CS, Pfefferbaum B, Tivis L, Aya K, Reddy C, Spitznagel ELJAoCP. The course of posttraumatic stress disorder in a follow-up study of survivors of the Oklahoma City bombing. 2004;16(4):209-15.
33. Kessler RC, Sonnega A, Bromet E, Hughes M, Nelson CBJAogp. Posttraumatic stress disorder in the National Comorbidity Survey. 1995;52(12):1048-60.

34. Sprang GJPr. Vicarious stress: patterns of disturbance and use of mental health services by those indirectly affected by the Oklahoma City bombing. 2001;89(2):331-8.
35. Hewlett BS, Amola RPJEid. Cultural contexts of Ebola in northern Uganda. 2003;9(10):1242.
36. Bowen L, Smith B, Steinbach S, Billioux B, Summers A, Azodi S, et al. Survivors of Ebola virus disease have persistent neurological deficits (S53. 003). AAN Enterprises; 2016.
37. Nabena EP, Bakare WA, Ilesanmi OS, Anyanwu R, Akuechiama JC, EJ Inyang S, et al. Health problems of Ebola virus disease survivors in Sierra Leone, 2015: making a case for follow-up care after discharge from Ebola treatment centres. 2015;2(1).
38. Qureshi AI, Chughtai M, Loua TO, Pe Kolie J, Camara HFS, Ishfaq MF, et al. Study of Ebola virus disease survivors in Guinea. 2015;61(7):1035-42.
39. Goldmann E, Galea S. Mental health consequences of disasters. Annual review of public health. 2014;35:169-83.
40. Colom L, Grasmuck MJMD, Sierra Leone, may. EVD survivors' comprehensive assessment. 2015.
41. Nanyonga M, Saidu J, Ramsay A, Shindo N, Bausch DGJCID. Sequelae of Ebola Virus Disease, Kenema District, Sierra Leone. 2015;62(1):125-6.
42. Rabelo I, Evlampidou I, Cox P, Lee V, Fallah MP, Massaquoi M, et al. Psychological suffering among Ebola Virus Disease survivors in Monrovia, Liberia.
43. Reardon SJN. Ebola's mental-health wounds linger in Africa: health-care workers struggle to help people who have been traumatized by the epidemic. 2015;519(7541):13-5.
44. Yadav S, Rawal GJJoc, JCDR dr. The current mental health status of Ebola survivors in Western Africa. 2015;9(10):LA01.
45. Mulinge I, Soyemi KJPAMJ. End of the Ebola virus outbreak: time to reinforce the African health system and improve preparedness capacity. 2016;23(1).
46. Guo J, Wu P, Tian D, Wang X, Zhang W, Zhang X, et al. Post-traumatic Stress Disorder among adult survivors of the Wenchuan Earthquake in China: A repeated cross-sectional study. 2014;28(1):75-82.
47. Kun P, Tong X, Liu Y, Pei X, Luo HJPh. What are the determinants of post-traumatic stress disorder: age, gender, ethnicity or other? Evidence from 2008 Wenchuan earthquake. 2013;127(7):644-52.
48. Zhou X, Kang L, Sun X, Song H, Mao W, Huang X, et al. Prevalence and risk factors of post-traumatic stress disorder among adult survivors six months after the Wenchuan earthquake. 2013;54(5):493-9.
49. Reeves E. A synthesis of the literature on trauma-informed care. Issues in mental health nursing. 2015;36(9):698-709.