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ORIGINAL ARTICLE

Hopelessness correlations with the perception of quality of life in the population affected by the Fundão dam rupture: a cross-sectional study

Correlação entre desesperança e a percepção da qualidade de vida na população atingida pelo rompimento da barragem de Fundão em Minas Gerais: um estudo transversal

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ABSTRACT

Introduction: Hopelessness can be defined as the negative expectation about the future, associated with the lack of expectation of its change. This cognition may be found in the setting of disasters. **Objectives:** Evaluate the prevalence of hopelessness and its correlations with the quality of life and delineate the associated factors with its development in the population affected by the disaster of the Fundão dam at Mariana. **Methods:** 225 adults affected by the disaster were evaluated. The study explored the relationships between hopelessness and depression, quality of life, and its determinants. **Results:** 9% of the population were presented with a mild level of hopelessness. The correlation coefficient (CC) between hopelessness and depression was 0.220 (p=001) and between hopelessness and quality of life was -0.248 (p<0.001). This value remained significant, with the exclusion of individuals diagnosed with depression being -0.204 (p=0.010). Insomnia (OR: 5.92, p=0.002), being 60 years old or older (OR: 4.736, p=0.009) and risk of suicide (OR: 5.468, p=0.005) are predictors of hopelessness, while high resilience was a protective factor (OR: 0.115; p=0.008). **Conclusions:** A high degree of hopelessness was correlated with worsening quality of life even in individuals without depression. Thus, we suggest that interventions focused on reducing hopelessness should be included in assistance plans to minimize the impacts on those affected.

Keywords: Disasters; Quality of life; Mental health; Technological disasters; Depression; Suicide.

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RESUMO

Introdução: A desesperança pode ser definida como a expectativa negativa em relação ao futuro, associada à falta da expectativa de mudança, sendo encontrada em contexto de diferentes desastres. **Objetivo:** Avaliar a prevalência de desesperança e suas correlações com a qualidade de vida e delimitar os fatores associados ao seu desenvolvimento na população atingida pelo desastre pelo rompimento da barragem do Fundão em Mariana/MG. **Métodos:** Foram avaliados 225 adultos atingidos pelo desastre e analisadas as relações de desesperança com depressão, qualidade de vida e seus determinantes. **Resultados:** 9% da população apresentou nível leve de desesperança. A correlação entre desesperança e depressão obteve um coeficiente de correlação (CC) de 0,220 (p=001). Já a correlação entre desesperança e qualidade de vida foi -0,248 (p<0,001) e se manteve significativa com a exclusão dos indivíduos com diagnóstico de depressão sendo de -0,204 (p=0,010). Os preditores de um alto grau de desesperança foram a insônia (OR: 5,92, p=0,002); ter 60 anos ou mais (OR: 4,736, p=0,009); e o risco de suicídio (OR: 5,468, p=0,005). A alta resiliência foi fator protetor de um alto grau de desesperança (OR: 0,115; p=0,008). **Conclusões:** Um alto grau de desesperança correlacionou-se com piora da qualidade de vida mesmo em indivíduos sem depressão. Assim, sugerimos que intervenções focadas em redução de desesperança devem ser incluídas em planos assistenciais para minimizar os impactos nos atingidos.

Palavras-chave: Desastres; Qualidade de vida; Saúde mental; Desastres tecnológicos; Depressão; Suicídio.

Introduction

When exposed to crisis situations, some people maintain positive cognitions, such as the expectation of a better future, favorable prospects, and improvements in their condition. These cognitions constitute coping strategies that allow people to endure adversities. These cognitions end up producing a feeling of hope or positive expectation.

Conversely, some individuals develop negative cognitions when faced with crisis situations, such as hopelessness[1]. Hopelessness has been defined by the American Psychiatric Association as pessimism about the future[2]. Hopelessness usually arises in response to negative events[2], and in psychiatric nosology can be described as a depressive symptom[2]. However, hopelessness is not an exclusive cognitive expression of depression. It can be observed in individuals with other mental disorders and risk factors for these disorders. Neufeld and O'Rourke (2009)[3] identified that hopelessness was more correlated to suicidal ideation than the severity of depressive symptoms (correlation of 0.77 versus 0.68, respectively).

Individuals exposed to disasters can become vulnerable to developing feelings of hopelessness. Disasters can be defined as disruptions in the functioning of a community that causes widespread losses that exceed its coping capacity. Disasters can be classified as natural or technological, the latter occurring when they are man-made and as a result of technological advances[1,2]. As an example, we can cite chemical leaks, fires, nuclear accidents, and dam breaks.

The presence of hopelessness has been described in different disaster contexts, such as prolonged droughts[4], floods[5], earthquakes[6,7], hurricanes, and cyclones[8,9]. These studies point to the existence of a positive correlation between levels of hopelessness and mental distress presented by disaster victims. Ozdemir et al. (2015)[7] point out that high levels of hopelessness are associated with the development of posttraumatic stress disorder (PTSD) in an earthquake survivor population; Kar et al. (2004)[8] reported that hopelessness, depression, and suicidal ideation were present among victims of a cyclone in India. The same phenomenon was observed in survivors of Hurricane Katrina in the United States. In the study by Mortensen et al. (2009)[9], 60% of the evacuated population after the hurricane reported having feelings of hopelessness, nervousness, and fear. Women and the elderly have a higher vulnerability to develop feelings of hopelessness after disasters[3,5,6].

The collapse of the Fundão dam operated by Samarco mining company in the city of Mariana, Minas Gerais, occurred on November 5, 2015. The disaster caused the leak of 62 million cubic meters of mud and mining tailings, nineteen people died, and thousands were left homeless. The mud and tailings from the mining activity polluted the Doce River and its surroundings, dispersing tailings throughout the state of Minas Gerais, Espírito Santo, and Bahia. The affected population was exposed not only to the passage of the tailings but to the shortage of drinking water and food, material losses due to the reduction of trade and tourism in the affected areas, and legal uncertainties[10].

Studies that assess mental health should be conducted whenever a disaster strikes. In 2017, the Nùcleo de Pesquisa em Saúde from Federal University of Minas Gerais (UFMG) conducted the PRISMMA study - Research on the Mental Health of Families Affected by the Fundão Dam in Mariana[10]. Among the 225 adults evaluated, 28.9% were diagnosed with depression, 32% with generalized anxiety, and 12% with PTSD. The present study is a sub-study of the PRISMMA protocol, with the objective of assessing the prevalence of hopelessness, its correlations with quality of life, and sociodemographic characteristics of the population affected by the Mariana disaster.

Based on the literature presented, the present study puts forward the following hypotheses:

There is an inverse correlation between hopelessness and perceived quality of life in this population, even in individuals not diagnosed with depression;

The chances of presenting hopelessness may be associated with sociodemographic characteristics (gender, marital status, education level, and income), clinical characteristics (insomnia), and psychosocial characteristics (social support, history of childhood trauma, discrimination, resilience, degree of exposure to the disaster).

Methods

Study design

This is an ad-hoc analysis of data from the PRISMMA study, an observational, cross-sectional study, conducted in the form of a household survey using structured interviews, whose data collection was carried out two years after the event[10]. The general and mental health of individuals affected by the dam failure in the municipality of Mariana were assessed.

Sample

We included people between the ages of 18 and 90 who, at the time of the disaster, lived in the districts of Mariana directly affected by the mud. People who refused to participate in the study; who had visual or hearing impairments that prevented them from reading the informed consent form or the research materials; who had intellectual or cognitive disabilities; or who showed signs of drunkenness at the time of the interview were excluded from the analysis.

Instruments

We collected sociodemographic data, gender, race, sexual orientation, marital status, education, occupation, income, type of residence, and questions to investigate the impact of the event on the person. Satisfaction with health was evaluated; the occurrence of discrimination for being a person affected by the dam; the level of urgency for evacuation of the site affected by the mud; and the perception of risk for contamination from the presence of toxic components in the mud (Table 1).

Hopelessness was assessed through the culturally adapted and validated version in Brazil of the Beck Scale for Hopelessness (BHS). The BHS is a questionnaire that presents scores ranging from 0 to 20 points. The score is established by summing the values, with higher values indicating greater hopelessness. The scale also divides hopelessness into levels, being none or minimal when the score is in the range 0 to 3, mild in the range 4 to 8, moderate in the range 9 to 14, and severe when the score is 15 points or more. Moderate and severe levels have been associated with greater risk of death in previous research[11].

For the purposes of this research, the sample was divided into individuals "without hopelessness," i.e., those presenting a score of 14 points or less on the BHS, and "with hopelessness," those with a score of 15 points or more on the BHS.

Questions regarding medical history and questions adapted from the Fukushima study questionnaire on the development and exacerbation of cardiovascular symptoms were included[12].

The Questionnaire on Childhood Trauma (QUESI) assessed the presence of childhood trauma. The QUESI is composed of 28 questions that investigate and assess the occurrence of traumatic events during childhood[13]. This research considered as presenting childhood trauma those individuals whom the QUESI classified as presenting moderate or severe/extreme trauma.

For the quality of life, we used the World Health Organization's WHOQOL-BREF instrument. The WHOQOL-BREF instrument is composed of 26 questions, and the final score is obtained by averaging the sum of the scores of the questions. The final score is classified as "needs improvement", "fair", "good", "very good"[14].

The present study uses the WHOQOL-BREF classification "good" or "very good" as having an adequate quality of life.

The Event Impact Scale (IES-R) is a "Likert" questionnaire consisting of 22 questions to measure the influence of daily routine stress, daily trauma, and acute stress[15]. Participants who scored 33 or higher were classified as having a probable PTSD diagnosis.

Resilience was assessed using the 25-item Wagnild and Young Resilience Scale (ERWY). In the end, scores range from 25 to 175, indicating more or less resilience. Scores of 125 points or less indicate low resilience, between 125 points and 145 points indicate medium resilience, and above 145 points indicate high resilience[16].

Table 1. Frequency table of sociodemographic and clinical characteristics of subjects with none or minimal hopelessness and severe hopelessness.

		None or mild hopelessness		Moderate or severe hopelessness			Total	
		n	(%)	n	(%)	*p*-value	n	(%)
Demographic variables								
Biological gender	Female	129	89%	15	10%	0.283	144	64.0%
	Male	76	93%	5	6%		81	36.0%
Age	<60 years	162	93%	11	6%	0.150	173	76.9%
	60 years or more	43	82%	9	17%		52	23.1%
Race/Skin color	Non-white	163	91%	16	9%	0.959	179	79.6%
	White	42	91%	4	9%		46	20.4%
Social variables								
Marital status	Single	82	87%	12	13%	0.830	94	41.8%
	Non-single	123	93%	8	7%		131	58.2%
Years of formal education	<8 years	119	89%	14	11%	0.299	133	59.1%
	≥8 years	86	93%	6	7%		92	40.9%
Income	<3MW	39	100%	0	0%	0.032	39	17.3%
	≥3MW	166	89%	20	11%		186	82.7%
Unemployment		148	89%	18	11%	0.084	166	73.8%
Live accompanied		192	91%	19	9%	0.813	211	93.8%
Discrimination		127	63%	14	70%	0.528	141	62.7%
Needed to leave urgently		148	72%	16	80%	0.473	164	72.9%
Insight of contamination		71	37%	7	44%	0.602	78	34.7%
Clinical variables								
Any clinical disease		167	90%	18	10%	0.341	185	82.2%
Any cardiovascular symptom		131	87%	18	13%	0.020	149	66.2%
Insomnia		56	80%	14	20%	<0.001	70	31.1%
Religiousness		192	91%	19	9%	0.813	211	93.8%
High resilience		89	97.8%	2	2.2%	0.004	91	40.4%
Childhood trauma		67	85%	11	15%	0.045	78	34.7%
Satisfaction with social support		34	17%	8	40%	0.010	42	18.7%
Adequate quality of life		140	68%	7	35%	0.003	147	65.3%
Major depression disorder		52	25%	13	65%	<0.001	65	28.9%
Suicidality		27	13%	10	50%	<0.001	37	16.4%
Generalized anxiety disorder		60	29%	12	60%	0.005	72	32.0%
Posttraumatic stress disorder		19	1%	8	40%	<0.001	27	12.0%
Positive impact event scale		114	57%	14	74%	0.173	128	56.9%
Smoking habit		42	21%	3	15%	0.558	45	20.0%
Substance use disorder		18	9%	0	0%	0.167	18	8.0%

SM = Brazilian Minimum Wage.

Satisfaction with social support was measured by the Social Support Satisfaction Scale (SSSS), which has 15 items. The score ranges from 15 to 75 points; higher scores indicate a perception of better social support[17]. In this study, we used cutoff point scores greater than or equal to 60% of the maximum value of the scale (45) to indicate satisfaction with social support.

The use of psychiatric medications and quality of sleep were evaluated. To diagnose current psychiatric conditions, the Brazilian version of the Mini International Neuropsychiatric Interview (MINI) 5.0.0 was used for depression, suicide, generalized anxiety disorder, posttraumatic stress disorder, and substance use.

Data analysis

Data were tabulated in Microsoft Excel® (Microsoft, WA). Statistical analyses were done using Statistical Package for the Social Sciences (SPSS®) (IBM Corporation, CA). Data were analyzed for duplicate responses without significant results.

To perform the descriptive analysis, we calculated measures of central tendency and dispersion. To evaluate correlation measures, Spearman's correlation test was used, aiming to quantify the impact of hopelessness on quality of life in the general population and after excluding cases diagnosed with depression. The Shapiro-Wilk test ascertained the normality of the data, the univariate analysis of categorical variables was performed using the chi-square test.

By means of multiple logistic regression with stepwise selection, we determined which factors showed an association with moderate or severe hopelessness. Variables with a *p*-value≤0.2 in the univariate analysis were considered fit to enter the regression model. Nagelkerke's of R^2 was used to assess the predictive ability of the logistic model obtained. The odds ratio (OR) calculation considered the 95% confidence interval and significance of $p \leq 0.05$.

Ethical aspects

The project was approved by the Ethics Committee of the Federal University of Minas Gerais under CAAE number 32520314.1.0000.5149. The necessary precautions were taken to ensure the anonymity of the interviewees. Access to the database was limited, and storage was done using secure techniques. All interviewees were briefed about the project and its objectives and signed the informed consent form before the interview.

Results

Sample description

At the end of data collection, 479 individuals were approached. Of these, 193 (40.3%) refused to participate, 6 (1.3%) were afraid of the repercussions of participating, 5 (1.0%) were physically or mentally disabled, or under the influence of drugs, 3 (0.6%) did not consider themselves affected, and 1 (0.2%) was an unaccompanied minor. The flow of inclusion in the survey can be seen in Figure 1.

At the end of the collection, 225 adult individuals answered the questionnaires used for analysis in this study with a mean age between 45.5±17.8 years (minimum 18 years and maximum 90 years); of these, 144 (64%) were women, 173 (76.9%) were under 60 years old. Other sociodemographic data of the study population are described in Table 1.

Among the participants, 166 (73.8%) were unemployed, and 141 (62.7%) had suffered some kind of discrimination because they were considered affected by the disaster, 164 (72.9%) needed to urgently leave the place where they lived at the time of the event, and 34.7% believe that the accident may have caused contamination.

Regarding the clinical variables, 185 (82.7%) of the participants reported the presence of some clinical disease, 149 (66.2%) had some cardiovascular symptom, and 70 (31.1%) had insomnia.

The study population had a mean score of 4.14±3.16 on the Beck Scale of Hopelessness (BHS), with 91% classified as having a mild level of hopelessness.

The prevalence of depression assessed by the MINI was 28.9% in the population assessed, 37 (16.4%) were at risk of suicide, 32% of the sample was diagnosed with generalized anxiety disorder, and 12% with posttraumatic stress disorder.

Psychodynamic and historical characteristics of the affected population that can influence mental health, such as childhood trauma, satisfaction with social support, and resilience, were also evaluated in addition to aspects related to the disaster. These results are described in Table 1.

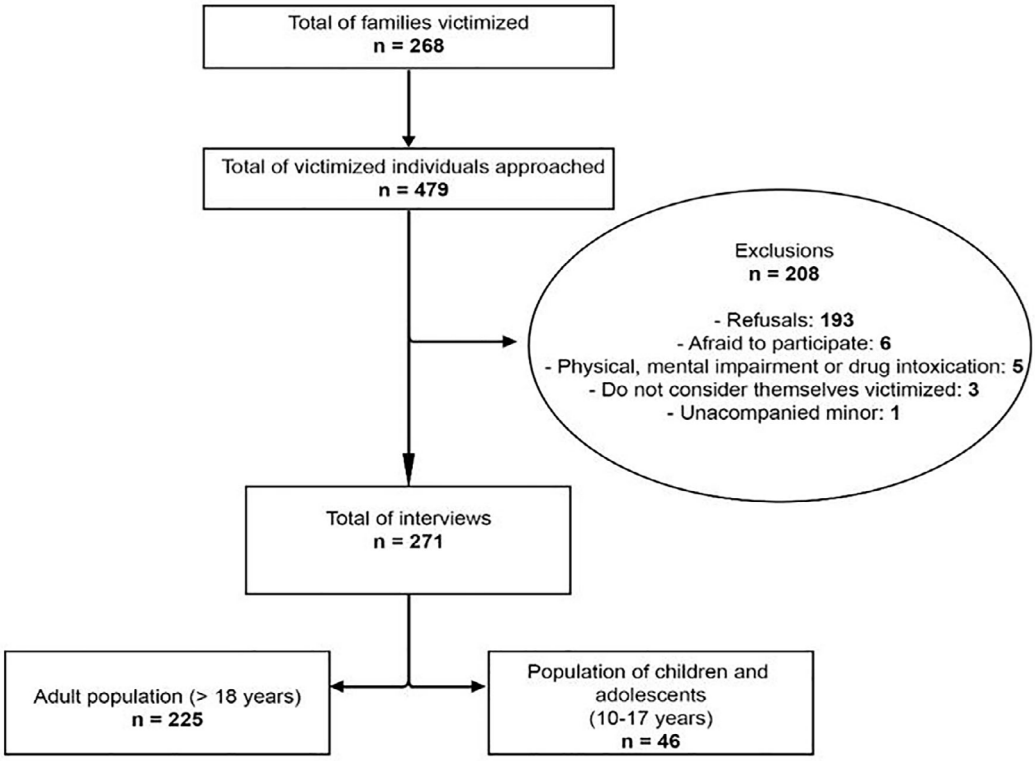

Figure 1. Flow diagram representing the project sample.

Hopelessness and its correlations with quality of life and depression

The correlation between hopelessness and quality of life in the population affected by the Mariana disaster obtained a correlation coefficient (CC) of -0.248, $p<0.001$. The presence of a diagnosis of depression also correlated with the hopelessness score, and the CC is 0.220, $p=0.001$. This correlation remained statistically significant even when we excluded the population with a diagnosis of depression, where the CC is -0.204, $p=0.010$. In other words, the greater the hopelessness, the lower the quality of life even in individuals without a diagnosis of depression (Figure 2).

We also found a negative correlation between depression symptoms and quality of life, with the WC being -0.269, $p<0.001$.

Factors associated with hopelessness in the population affected by the Mariana disaster

The characteristics associated with the presence of hopelessness in the univariate analysis were: age 60 or older ($p=0.015$); income lower than 3 minimum wages ($p=0.032$); presence of some cardiovascular symptom ($p=0.020$); reporting insomnia ($p<0.001$); high resilience ($p=0.004$); childhood trauma ($p=0.045$); satisfaction with social support ($p=0.010$); adequate quality of life ($p=0.003$); depression ($p<0.001$); suicide risk ($p<0.001$); generalized anxiety ($p=0.005$); and post-traumatic stress disorder ($p<0.001$) (Table 1).

Four factors remained statistically associated with hopelessness in the multivariate analysis (Table 2): the presence of insomnia, positivity for suicide risk on the MINI, being 60 years of age or older, and high resilience according to the ERWY scale. Individuals who reported having insomnia ($p=0.002$) were 5.92 (95% confidence interval (95% CI) 1.93-18.18) times more likely to have moderate or severe hopelessness. Individuals with moderate or severe hopelessness are 5.47 (95% CI 1.68-17.81) times more likely to exhibit suicidal behavior ($p=0.005$). Individuals over the age of 60 were 4.74 (95% CI 1.46-15.33) times more likely to report moderate or severe hopelessness ($p=0.009$). Finally, high resilience was the only protective factor for developing hopelessness (odds ratio = 0.115 (0.02-0.57) and $p=0.008$).

The multivariate model was able to explain about 36.2% of the variations recorded in the dependent variable hopelessness (χ^2: 12.969, $p=0.044$, G.L.=6; Nagelkerke's of R^2: 0.362).

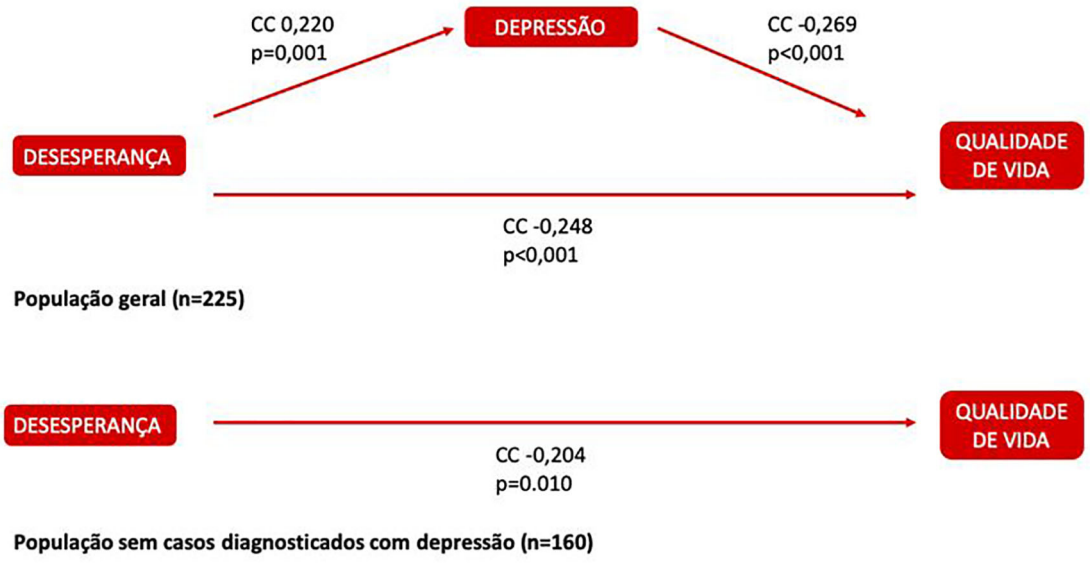

Figure 2. Correlation between hopelessness, depression, quality of life in the general population (n=225) and after the exclusion of the depression diagnoses (n=160)

Table 2. Multivariate analysis between moderate or severe hopelessness and all the variables.

Variables	OR	Std. Err.	*p*	95%CI for OR	
Insomnia	5.920	0.572	0.002	1.928	18.179
Suicidability	5.468	0.603	0.005	1.679	17.810
Age >60 years or more	4.736	0.599	0.009	1.463	15.325
High resilience	0.115	0.814	0.008	0.023	0.566
Constant	0.025	0.568	<0.001		

OOR = *Odds ratio*; Std. Err. = Standard error; CI = Confidence interval.

Discussion

The results obtained from the ad-hoc analysis of the PRISMMA survey database partially confirm the hypotheses of the study. Contrary to what we expected, the prevalence of a high level of hopelessness assessed by the BHS was not found, but rather a percentage of more than 90% of mild levels. Regarding the correlations, our hypotheses were confirmed. We found a positive correlation between hopelessness and depression and a negative correlation between hopelessness and quality of life in the population studied. This negative correlation occurs even among individuals who do not present a diagnosis of depression; that is, the greater the hopelessness, the lower the quality of life. Regarding associated factors, our study found that individuals who reported insomnia, suicidal behavior, and who were older than 60 years had a higher chance of developing hopelessness. Finally, resilience was the only factor capable of protecting and reducing the chances of presenting hopelessness in the studied population.

We found a mean score for hopelessness (4.14±3.16) lower than other studies conducted in populations that have experienced trauma. Ozdemir et al. (2015)[7] found a mean score of 9.49±3.36 on the Turkish version of the BHS in 144 individuals who experienced pathological dissociation following an earthquake in Turkey in 2011. A study conducted in India showed an average of 10.9±3.3 points on the BHS in a population of 540 respondents who suffered from a cyclone that occurred off the coast of the country in 1999[8]. Mortensen et al. (2009)[9] showed that hopelessness was present in 24.5% of individuals who suffered from Hurricane Katrina in New Orleans in 2005, while hopelessness was present in less than 1% of the American population[9]. These findings may be related to methodological aspects such as the long interval between the disaster and the interviews for data collection in this research, which occurred two years after the disaster.

In parallel to what has been seen in other studies, we observed an association between hopelessness, measured by the BHS scale[11], and a lower quality of life, measured by the WHOQL-Bref[14]. Dunn (2005)[1] associated lower quality of life with greater vulnerability to depression, reduced functionality and social support, and with it the possibility of cooperating with each other, a greater willingness to anticipate death (even in the absence of depression), as well as predisposition to coronary heart disease and hypertension. Hopelessness was also independently related to mortality and morbidity[1]. In this sense, it is essential to assess hopelessness in the follow-up of people exposed to disaster situations in order to provide psychological support and thus prevent suicide and the emergence of clinical and psychiatric comorbidities.

Populations subjected to disasters also have a higher prevalence of insomnia. In the present study, 80% of the interviewees reported episodes of insomnia after the dam failure. Insomnia is a worrisome factor if we consider that the quality of sleep can be directly related to depression and hopelessness, as well as the opposite, forming a feedback cycle[18].

The risk of suicide was shown to be related to hopelessness, a result already demonstrated by cross-sectional and longitudinal studies[13,19]. Beck et al. (1974)[11], demonstrated that the risk of suicide is more related to the degree of hopelessness than to the intensity of depressive symptoms. Populations exposed to disasters tend to have higher demands for the use of coping strategies related to the interruption of life plans and personal projects. According to Sugiyama et al. (2020)[20], cognitive-behavioral group therapy has been shown to be effective in increasing resilience and significantly reducing depression, both mild and severe, and may be useful in preventing suicide - commonly associated with depression - and improving the quality of life of those affected by disasters.

Elderly people were more likely to develop hopelessness, in agreement with results found in previous studies, such as the flood victim population studied by Chung et al. (2017)[5,21,22]. In the study by Neufeld and O'Rourke (2009)[3], elderly were noted as a population at higher vulnerability to develop feelings of hopelessness. Reduced levels of hope in the elderly may be related to higher morbidity in this population, loss of functionality, and less social support, as elucidated in the study by Pillay et al. (1999)[23], in which the only protective factor in the development of hopelessness was resilience.

Conceptually, resilience is the ability to deal with negative situations and emotions without suffering the negative impacts of these. Some authors point out that resilience can be considered the key to improving quality of life. Hjemdal et al. (2012)[24] found similar results in a population also subjected to stress, in which resilience was identified as a predictor of hopelessness in cancer patients.

The results presented in this study should be considered within some limitations. The refusal rate to participate in the study is almost 50%, which may have produced some selection bias. Efforts to publicize the project among participants, through the assistance of local associations of those affected, were important in reducing the refusal rate but not preventing it. The time elapsed between the disaster and the interviews increase the risk of recall bias. In addition, the study population is still involved in a long and contentious process for damage repair and relocation, a stressor existing during the time of the interview, which may have contributed to psychopathology among these individuals.

After the occurrence of disasters, it is known that the prior existence of a contingency plan for the treatment of the affected population decreases with the response time of the authorities for the assistance to this population[25]. The medical and psychological assistance to the population seems to be fundamental to minimize the possible impacts of the events on their lives[25]. Psychological assistance must contemplate support measures that focus on stress reduction and habit modification, as well as a focus on reducing hopelessness[25]. There are strategies such as the "Training for Hope Program" held in Turkey[26], which obtained a reduction in the levels of hopelessness in elementary school children, and the "Window to Hope" program held with adults after traumatic[27] brain injury that also obtained results in reducing hopelessness in these patients, using techniques derived from cognitive-behavioral therapy (CBT).

Conclusions

Our data identified a correlation between high hopelessness and worsening quality of life even in individuals without depression. Thus, we emphasize the need to develop assistance plans so that future disaster-affected populations receive the appropriate level of care in order to preserve physical and mental health and quality of life.

Statements

This research project was financed with funds from *Caritas Brasileira*. The funder did not intervene in any stage of the research. The authors declare that they have no other conflicts of interest that might influence the results of this research.

Author Contribution

Marco Antônio Valente Roque: Conceptualization, Investigation, Methodology, Supervision & Writing – Original Draft, Validation & Software, Data curation & Formal Analysis. Nicole Font dos Santos: Conceptualization, Investigation, Methodology, Supervision & Writing – Original Draft/ Review & Editing, Data curation & Formal Analysis. André Augusto Corrêa de Freitas: Conceptualization, Investigation, Methodology, Validation & Software, Data curation & Formal Analysis. Letícia Costa da Silva: Conceptualization, Supervision & Writing – Original Draft. Fernanda Rúbia Batista: Conceptualization, Supervision & Writing – Original Draft. Matheus Gonçalves Flores: Conceptualization, Supervision & Writing – Original Draft. Sarah de Morais Bispo Fidelis: Visualization & Writing – Review & Editing. Frederico Duarte Garcia: Project administration, Resources & Funding acquisition, Visualization & Writing – Review & Editing. Maila de Castro Lourenço das Neves: Project Administration, Resources & Funding Acquisition, Visualization & Writing – Review & Editing.

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